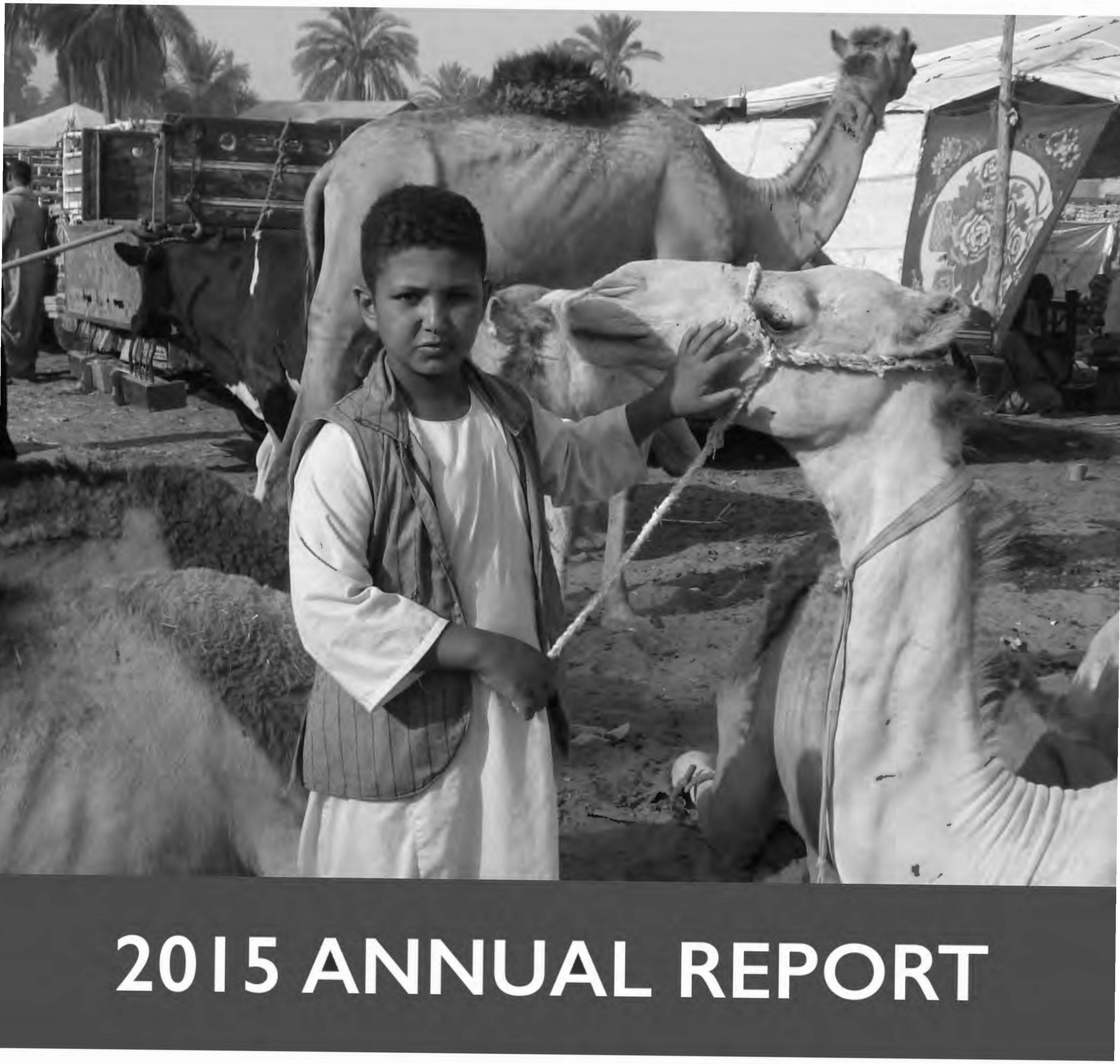
USAID
FROM THE AMERICAN PEOPLE
| PREDICT



2015 ANNUAL REPORT

USAID FROM THE AMERICAN PEOPLE
UC DAVIS VETERINARY MEDICINE One Health Institute
WILDLIFE CONSERVATION SOCIETY
EcoHealth Alliance
METABIOTA
Smithsonian Institution

REDUCING PANDEMIC RISK, PROMOTING GLOBAL HEALTH

USAID | PREDICT

FROM THE AMERICAN PEOPLE

PREDICT 2015 ANNUAL REPORT

This publication was prepared by the PREDICT Consortium headquartered at the One Health Institute (OHI), School of Veterinary Medicine, University of California, Davis.

www.predict.global
1089 Veterinary Medicine Drive
Davis, CA 95616
(530) 752-7526
predict@ucdavis.edu

Cover: *A boy with camels at a market in Egypt. PREDICT is investigating the camel value chain and camel, bat, and human interactions as part of targeted surveillance for Middle East Respiratory Syndrome (MERS) and MERS-like Coronaviruses that could pose a threat to people* (Source: Maureen Miller, EcoHealth Alliance).

TABLE OF CONTENTS

USAID | PREDICT
FROM THE AMERICAN PEOPLE

REDUCING PANDEMIC RISK, PROMOTING GLOBAL HEALTH

PREDICT, a project of USAID's Emerging Pandemic Threats (EPT) program, was initiated in 2009 to strengthen global capacity for detection and discovery of zoonotic viruses with pandemic potential. Those include coronaviruses, the family to which SARS and MERS belong; paramyxoviruses, like Nipah virus; influenza viruses; and filoviruses, like the ebolavirus.

PREDICT has made significant contributions to strengthening global surveillance and laboratory diagnostic capabilities for new and known viruses.

Now working with partners in 31 countries, PREDICT is continuing to build platforms for disease surveillance and for identifying and monitoring pathogens that can be shared between animals and people. Using the One Health approach, the project is investigating the behaviors, practices, and ecological and biological factors driving disease emergence, transmission, and spread. Through these efforts, PREDICT will improve global disease recognition and begin to develop strategies and policy recommendations to minimize pandemic risk.

SURVEILLANCE

PREDICT's surveillance for emerging pathogens focuses on areas of the world at the highest risk for zoonotic disease emergence. The goal is to move countries away from a reactive post-outbreak response to a proactive approach in which pathogens of pandemic potential are discovered at their source before large-scale epidemics occur in people.

PREDICT's disease surveillance strategy is based on the inextricable link between animals, humans, and the environment. Rather than prescribing an across-the-board surveillance plan, PREDICT works in each focus country to cultivate targeted, measurable, adaptive, and responsive approaches that are integrated across health and environmental sectors.

CAPACITY STRENGTHENING

Preparing for emerging disease threats requires investments in infrastructure, institutions, and human resources across a broad array of health and social systems to operationalize One Health platforms. In collaboration with country governments and EPT partners, PREDICT is committed to developing the infrastructure and core skills and capabilities required by tomorrow's One Health workforce.

Through PREDICT, more than 2,500 people (and counting) have been trained in biosafety, field epidemiology and surveillance, laboratory diagnostics, social sciences and behavioral risk investigations, and modeling and analytics, creating an extensive network of global One Health professionals to support long-term zoonotic disease surveillance.

PATHOGEN DISCOVERY & DIAGNOSTICS

PREDICT's diagnostic success lies in the use of broadly reactive consensus (genus/family level) PCR supplemented with high throughput sequencing. These powerful tools produce specific, high-resolution data allowing for rapid detection of known and new potential pathogens. To date, PREDICT has developed and optimized detection protocols and capacities in laboratories in all of the countries in which we have engaged, ensuring regional capacity to detect pandemic threats.

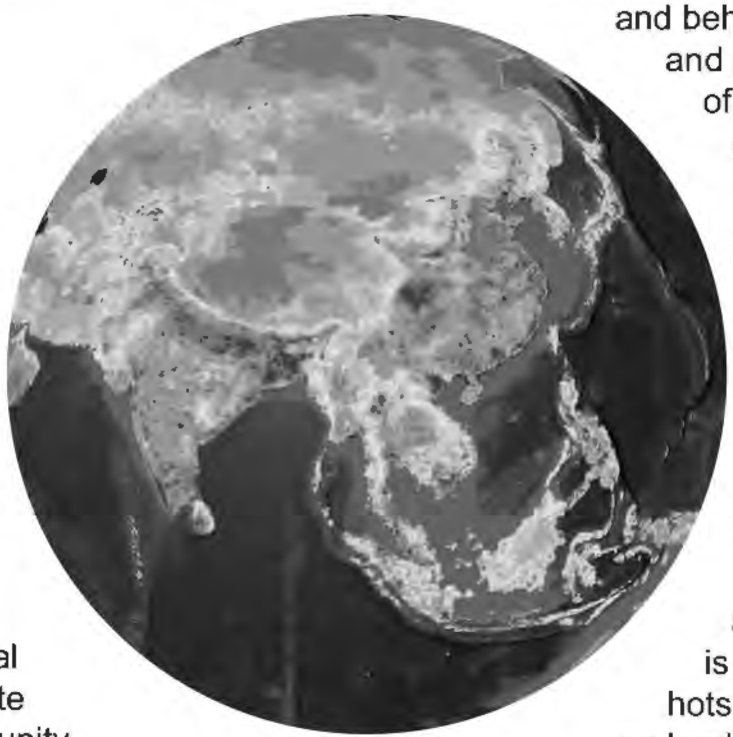
The PREDICT approach is especially important for the diagnosis of mystery illnesses in medical hospitals and veterinary labs where testing options are often limited. By testing targeted samples based on the circumstances that promote disease transmission and the route of exposure, PREDICT can detect known and novel pathogens in tandem, rather than sequentially.

BEHAVIORAL RISK

PREDICT uses a multidisciplinary approach to identify groups of populations at highest risk of exposure to emerging pathogens, and the 'how' and the 'why' of risk.

Our teams assess community perceptions of animal exposure and disease risk and evaluate widely held assumptions of community practices (e.g., high risks from bushmeat hunting). PREDICT is identifying and monitoring the risk factors for zoonotic diseases with pandemic threat potential.

Our methods will lead to well-rounded understanding of disease spillover and transmission dynamics, essential to the design and evaluation of mitigating interventions, and to informing policy by identifying barriers to change and acceptable alternatives.



MODELING & ANALYTICS

PREDICT will use state-of-the-art modeling and analytic approaches to guide surveillance and help countries develop disease control and prevention strategies. PREDICT is producing next-generation, fine-scale hotspots maps, combining in-country data on land use, socioeconomic, and agricultural changes with surveys of human behavior, market value chains, and livestock production to identify where zoonoses will spillover, where they will amplify, and who is at risk.

By using data direct from PREDICT viral testing and conducting outbreak scenario modeling, PREDICT will provide information on which pathogens are most likely to become pandemic and which control and mitigation strategies can be most effective.

INFORMATION MANAGEMENT

PREDICT works closely with host governments and partners to interpret and share information through systems designed to protect and ensure data quality and accuracy. PREDICT data are managed in a purposefully-designed internal information management system, in which all data undergo a rigorous quality control process. Diagnostic test results are interpreted in light of all available scientific literature by PREDICT virologists.

After interpretation, results are provided to host governments for examination, to inform policy, and for approval for public release through the PREDICT data site powered by HealthMap. This open access platform allows users to visualize PREDICT data along with disease events worldwide (http://data.predict.global).

ONE HEALTH PARTNERSHIPS

PREDICT at its core is built upon One Health partnerships. Cross-disciplinary collaborations are critical for gaining a more full understanding of the integral links between human, animal, and environmental health that can provide opportunities for prevention or early detection and control of disease threats. By working across sectors and including a diverse range of stakeholders and expertise, PREDICT helps operationalize efforts that promote public health, effective natural resource management, and development.

On a country basis and at a global level, PREDICT enables and supports implementation of One Health practices. Toward this goal, PREDICT has worked closely with a wide range of government ministries, scientific institutions, local organizations, and other stakeholders to further One Health initiatives. These have taken the form of inter-ministerial data sharing and interpretation, interdisciplinary capacity building and surveillance, and coordinated outbreak response activities. Building on these best practices, PREDICT is working with Emerging Pandemic Threats program partners to develop an evidence base to demonstrate the value of the One Health approach.

Bangladesh

A new Adenovirus, PREDICT_AdV-11, was found in 2 Indian flying fox (Pteropus giganteus). The samples were collected in Aug 2007.

There is no evidence at this time to suggest this virus poses a threat to human health

Click here to access this virus in Genbank

A new Astrovirus within the genus Mamastrovirus, PREDICT MAstV-1 was found in 1 Indian flying fox (Pteropus giganteus). The samples were collected in Aug 2007

Map Layers

☑ PREDICT Countries
☑ Hotspot Layer

Global distribution of relative risk of an emerging infectious disease event as adapted from Jones, Patel, et al. Global trends in emerging infectious diseases. Nature 451, 990-993. 21 February 2008

Data Layer

**actual location of sampling may be scaled to the District level for conservation and privacy reasons*

○ PREDICT Animal Sampling Data
● PREDICT Preliminary Test Results
○ HealthMap Alerts for PREDICT regions

Website: http://predict.global | Email: predict@ucdavis.edu

I. SUCCESS STORIES

USAID-02080

SECTION 1. SUCCESS STORIES

Throughout 2014-2015, PREDICT focused on planning to operationalize surveillance under the new EPT-2 program and to establish One Health platforms in new countries and areas of engagement. In the midst of planning and coordination with continuing and new EPT-2 and Global Health Security Agenda (GHSA) partners from US agencies, the World Health Organization (WHO), the Food and Agricultural Organization (FAO), Preparedness and Response (P&R), One Health Workforce (OHW), along with regional and national partners and networks, PREDICT made significant strides towards strengthening One Health capacity from field to lab, in supporting disease outbreak investigations and national capacity and policy for outbreak preparedness, and towards developing and integrating social science expertise to improve understanding of the human behaviors associated with viral spillover and transmission. Select Success Stories from this year are highlighted here. Additional information is available throughout the Annual Report and is noted where applicable for reference.

Members of the PREDICT Cameroon team with PREDICT's Deputy Behavioral Risk Coordinator, Dr. Karen Saylors. (Source: Metabiota, Inc.)

EBOLA VIRUS DISEASE PREPAREDNESS AND SURVEILLANCE

PREDICT provided expert guidance and support in Ebola control and outbreak response over the course of Year 1: In the **Democratic Republic of Congo** (DRC), PREDICT actively participated in the Boende Ebola Outbreak Laboratory and Research Commission and was engaged in the development of training manuals and national Standard Operating Procedures (SOPs) for EVD outbreak response. In **Uganda**, the PREDICT team participated in a workshop with the Ministry of Health and partners in Entebbe to review and develop SOPs and guidelines for Ebola and Marburg virus disease management from detection and initiation of effective response to effective implementation of outbreak control measures, taking lessons from the West Africa Ebola outbreak; additionally the Uganda team assisted with the review of the structure and composition of the National Task Force. In **Cameroon**, PREDICT successfully tested an Ebola real-time PCR assay using a synthesized positive control, led or contributed to workshops and presentations on Ebola preparedness, and provided key counsel in the development of an Ebola readiness assessment and a draft document detailing roles of Ebola rapid intervention teams. The PREDICT **Indonesia** team contributed to the national disaster agency's workshop on Ebola outbreak contingency planning. Finally, in **Thailand**, government officials began screening arrivals to Thailand for suspected Ebola infections using PREDICT protocols, and PREDICT Thailand team members presented on EVD at multiple national meetings.

Pigs in a culvert, Salone, Sierra Leone. PREDICT initiated plans to identify reservoir, transient, and spillover hosts of ebolavirus in three key West African countries. (Source: Metabiota, Inc.)

In **DRC**, the PREDICT team prepared three genome sequences of the ebolavirus detected during the Boende Ebola Outbreak in DRC (2014) in collaboration with University of California San Francisco (UCSF) lab and submitted the sequences to GenBank (KP271018-KP271019-KP271020). At the time of the outbreak, it was not clear if the Boende outbreak was related to the outbreak in West Africa. By releasing these sequences publicly, PREDICT was able to demonstrate that they were separate outbreaks of ebolavirus. Further, upon request from the DRC Ministry of Health (MoH), the PREDICT DRC team organized a trip to Boende in the aftermath of the Ebola Virus Disease (EVD) outbreak to collect wildlife specimens for filovirus testing. During the visit the team collected a total of 255 samples (from 41 bats and two rodents).

The DRC team prepares a canoe in Boende with bat capture and sampling gear in the aftermath of the Ebola Virus Disease outbreak. (Source: Metabiota, Inc.)

This year, the PREDICT modeling team conducted a statistical analysis of demographic factors (e.g., number of cases at detection, regional population density) for historical ebolavirus outbreaks to identify any unique factors that may have contributed to the unique spread of the West Africa outbreak. Further, the team examined changes in global airline travel volume and international connectivity when travel sanctions are put in place using the West Africa ebolavirus outbreak as case study. An economic analysis was also conducted on specific intervention strategies enacted or proposed for the West Africa outbreak.

In the West Africa region, the PREDICT team developed a strategy to evaluate multiple potential hosts of Ebola in the three most affected West African countries as reservoirs or transient spillover hosts to help shed more light on the disease dynamics.

SUPPORTING NATIONAL OUTBREAK RESPONSE CAPACITY

PREDICT's **DRC** Country Coordinator Prime Mulembakani received a nomination from the DRC Minister of Health to be a member of the national team of first responders in case of chemical, biological, radiological and nuclear (CBRN) hazard and contributed to the preparation of the national action plan for CBRN threats. PREDICT's DRC team was also designated by the North Kivu Provincial Division of Health as a standing invitee to its bi-weekly epidemio-surveillance meetings in Goma, where all human disease cases in the Province are reported and discussed. Further, the DRC team received the express support of the North Kivu Provincial Inspector of Human Health to work in two health zones around Virunga National Park (Bunagana and Rwanguba), enabling Virunga National Park (PNVi) to assign its head nurse to visit 14 community health centres surrounding the Mikeno Sector of PNVi (Bunagana, Bugusa, Kabonero, Shangi, Rutsiro, Kabaya, Kabindi, Tanda, Kazuba, Rugari , Kakomero, Kingarama Gasizi and Kibumba), to identify centres for collaboration and to assess their capacity to store samples and participate in human health surveillance.

The DRC team, led by Ipos Ngay and Placide Mbala, working with community members in Boende after the Ebola Virus Disease outbreak. (Source: Metabiota Inc.)

In **Cameroon**, PREDICT, together with representatives of the Food and Agriculture Organization of the United Nations (FAO), Preparedness & Response (P&R), One Health Workforce (OHW), and USAID, was received by the Prime Minister of Cameroon to discuss the Emerging Pandemic Threats-2 (EPT-2) program and disease emergence in Cameroon.

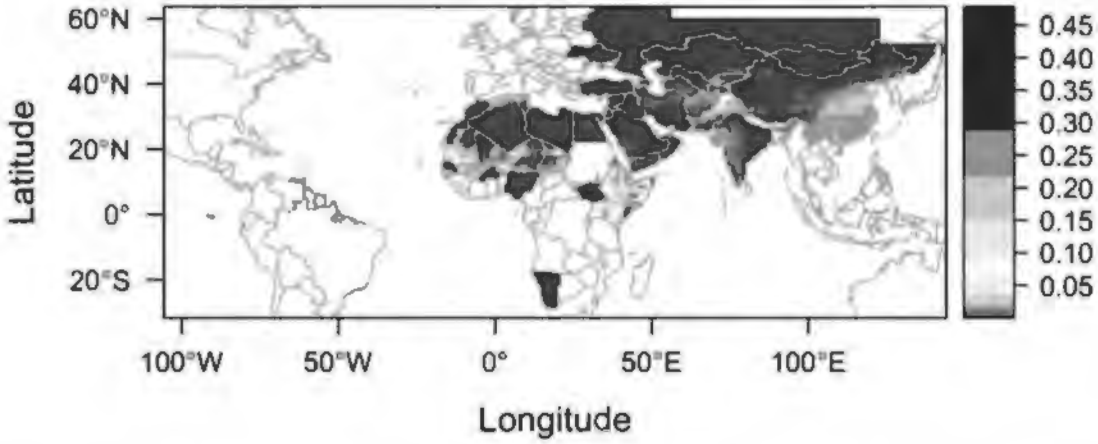
In **Rwanda**, PREDICT was invited to participate in the drafting of a One Health work plan under the Government of Rwanda's One Health Strategic Plan 2014-2018, and the team identified activities for which PREDICT will aim to provide technical support. Further, the Rwanda team was alerted by the Rwanda Development Board (RDB) to the first ever report of respiratory disease affecting wild human-habituated chimpanzees in Nyungwe National Park, a priority surveillance area, and upon invitation by RDB, the team opportunistically collected fecal samples and forage material from sick chimpanzees in support of Rwanda's expanding response capacity for outbreaks among wildlife populations, especially those that could be hosts or susceptibles of ebolavirus.

PREDICT's Rwanda team led by Country Coordinator Julius Nziza (second from left) preparing traps for disease surveillance activities. (Source: Gorilla Doctors)

In **Uganda**, the PREDICT team, led by Country Coordinator Benard Ssebide, briefed the Government of Uganda's State House in Entebbe in March during a government-led primate capture and sampling exercise on State House grounds. The team also presented on the public health risks posed by human-primate contact and the purpose and objectives of the PREDICT-2 project to the President's office.

MERS AND OTHER CORONAVIRUS (COV) SURVEILLANCE

The PREDICT Modeling team finalized "Outbreak Scenario" models and developed two-page summaries for MERS-like coronavirus (spread from slaughtering imported camels – Section 6.4) and MERS-like Coronavirus from bat guano (Thailand). Further, the team completed a MERS-epizone spatial spillover risk model, combining geographic range of potential bat reservoir host and national data on dromedary camel densities and developed a preliminary SIR model for circulation of MERS-CoV within camel populations based on herd size, connectivity, and market structure to guide surveillance of camel populations and to forecast the potential effect of livestock intensification on changes in MERS disease dynamics in Africa and the Middle East.



Hotspot map for risk of MERS-like virus spillover from bats to camels (See Section 6.4 for more information).

In **Thailand**, the PREDICT team detected the first human MERS-CoV case in-country. The MERS-CoV infection was first confirmed at the PREDICT lab at Chulalongkorn University, and viral family protocols were used to compare to the sensitivity of the WHO protocol. The result was reported to MOPH within eight hours, with sequence confirmation following within 24 hours after receiving the specimen. The nasopharyngeal swab specimen collected on the same day and tested by the other two Thai laboratories showed an inconclusive/negative result.

In **Bangladesh**, the PREDICT team assisted with the first MERS-CoV surveillance activity in-country by collecting samples from 60 dromedary camels from a live animal market in Dhaka. The camels were imported for an annual festival and sampled to screen for MERS coronavirus. These samples will be tested for coronavirus RNA and antibodies against MERS CoV at icddr,b. Lab reagents for testing were provided to the PREDICT partner lab by NIH NIAID Rocky Mountain Labs.

A technician practices camel sampling techniques during a training workshop. PREDICT has been targeting camel and bat populations to learn more about the epidemiology and disease transmission risks of Middle East Respiratory Syndrome (MERS) and other MERS-like Coronaviruses that might represent a public health risk. (Source: EcoHealth Alliance)

In **China**, PREDICT detected a novel coronavirus clustering with the SARS-like coronaviruses in *Rhinolophus* bats from Guangdong. Further characterization of this Beta Coronavirus is underway, including sequencing of the spike protein, to determine if it has the potential to infect other hosts.

UNDERSTANDING HUMAN BEHAVIORS AND RISKS FOR DISEASE EMERGENCE AND SPREAD

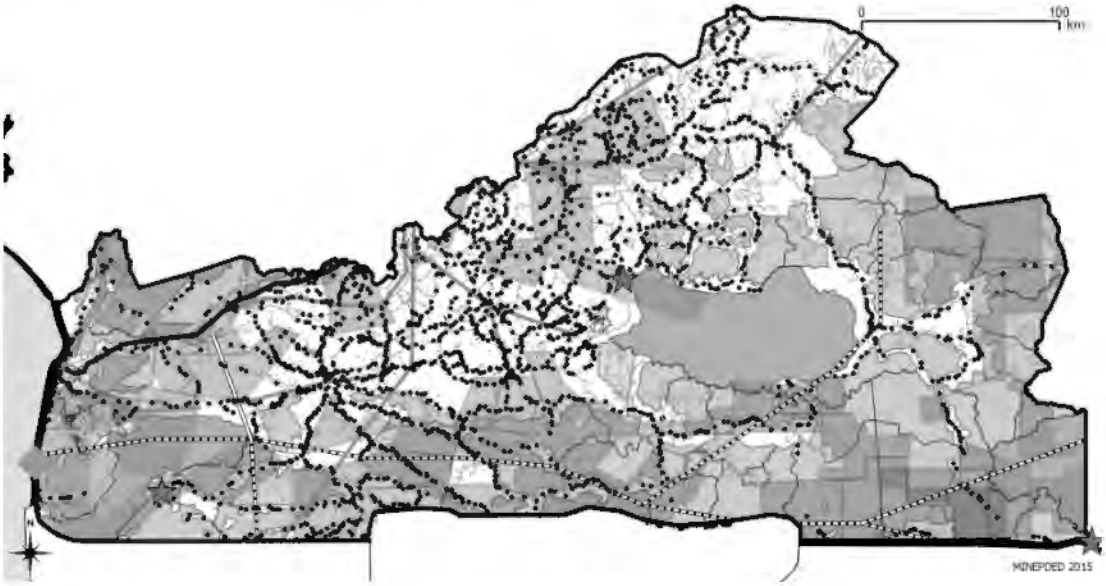
This year PREDICT conducted trainings in five priority countries targeted for behavioral risk research (**China**, **Bangladesh**, **Uganda**, **Cameroon**, and **DRC**). Notably, 88% (15/17), 88% (28/32) and 86% (12/14) of individuals trained in China, Bangladesh, and DRC, respectively, were not PREDICT staff or were new to the project, demonstrating PREDICT's contributions to developing local capacity in critical, but often overlooked, disease surveillance methodologies. Following local IRB approval for qualitative research activities, PREDICT initiated data collection in Bangladesh, China, and DRC.

In Bangladesh, a man feeds a macaque. This common behavior often results in bites, scratches, and injuries that pose risks for disease spillover between macaques and people. PREDICT has been investigating interactions like these with a new cadre of trained behavioral scientists through qualitative research methods to help better understand human-animal interactions and help identify potential intervention strategies to prevent disease transmission. (Source: EcoHealth Alliance)

PREDICT expanded the core capabilities of the **China** team to include skills and expertise in behavioral risk investigations through trainings in human behavioral data collection in Yunnan, Guangxi, and Guangdong. All materials, guides, and data collection tools for behavioral risk activities (Behavioral Research: "Qualitative Research for Behavioral Risk Surveillance and Characterization") were translated into Chinese and provided to teams including the ethnographic interview guides, focus group guides, and observational protocols (see Section 6.3). In total, 17 individuals received training with the teams implementing new skills as activities were initiated in Yunnan, Guangxi, and Guangdong. Following the training, the team conducted approximately 65 ethnographic interviews and four focus groups in Yunnan, Guangxi, and Guangdong. Preliminary findings suggest that there is a consistent perception that wildlife is dwindling, though bats continue to be opportunistically hunted and eaten. One intervention implication is potential conservation readiness, since communities express distress at the change in wildlife abundance due to overhunting and environmental degradation.

EXTRACTIVE INDUSTRIES AND PUBLIC-PRIVATE PARTNERSHIPS

In recognition of the potential for disease emergence and transmission associated with the extractive industries, PREDICT worked this year to plan surveillance around areas impacted by extractive industry operations. In Cameroon, the team liaised with officials from Sud Cameroun Hevea SA (SUDCAM), an agroindustrial and rubber-producing company currently expanding plantations in-country, to discuss opportunities for operational alignment and to assess the rubber expansion zone as a possible surveillance site. In the **Republic of Congo (RoC)**, PREDICT obtained country maps indicating areas of extractive industry activity, identified key regions at high risk for disease transmission along human-wildlife interfaces, and produced a table detailing the location and importance of biodiversity and the presence or absence of extractive industries to facilitate site selection.



Map showing a segment of Cameroon with overlapping land use types, including the extractive industries. PREDICT is investigating relationships among the extractive industries, human and animal contact, and viral emergence in areas undergoing land-use change. (Source: Cameroon Ministry of Environment, Nature Protection and Sustainable Development - MINEPDED)

STRENGTHENING THE ONE HEALTH WORKFORCE

In **Cambodia**, PREDICT engaged government partners from the Cambodia CDC, Ministry of Agriculture and the Forestry Administration to develop a coordinated One Health field approach to establish a multi-sectoral field team with animal, human health, and forestry government counterparts and successfully went into the field as a One Health team to complete pilot sampling of rodents and bats in areas where the cross-border rodent trade occurs.

Preparing for field sampling in Kandal with the Department of Animal Health and Production and the Forestry Administration. PREDICT is helping to develop and deploy One Health teams for disease surveillance in Cambodia. (Source: UC Davis)

Over the course of two weeks in **Indonesia**, PREDICT successfully trained lab staff (11 individuals, four of them women) from the Ministry of Agriculture Laboratories and Disease Investigation Centers (DICs) Maros and Banjarbaru in laboratory safety and intensive hands-on laboratory investigations from sample extraction to final sequencing of positive specimens. In addition, follow-up trainings were organized in collaboration with FAO on bioinformatic analysis of sequence results from domestic animal screening. During the trainings, mammal and avian domestic animal specimens from DICs at Maros and Banjarbaru were screened for three viral families (Coronaviridae, Paramyxoviridae, Herpesviridae) and two additional viral pathogens (Influenza A, and Encephalomyocarditis virus) using PREDICT protocols. Results were sent by DICs to MoA Director of Animal Health. As a result, MoA and DIC lab staff are well equipped with the knowledge and technical skills to complete viral detection and discovery activities.

In **Malaysia**, PREDICT contributed to the training of PREDICT implementing partners and the development of Malaysia's One Health workforce by training 35 wildlife staff from Sabah Wildlife Department, Lok Kawi Wildlife Park, and Sepilok Orangutan Rehabilitation Centre in zoonoses, biosafety, PPE (with respirator fit testing), safe animal capture and handling, risk assessment, and lab safety. In addition, conducted multiple trainings with Wildlife Health Unit and DGFC staff, including field and lab first aid trainings for three PREDICT, three WHU, and six DGFC staff and biosafety, PPE use, safe animal handling, sampling of bats and non-human primates, cold chain maintenance, and safe transport of samples for 15 individuals from WHU DGFC, Borneo Sun Bear Conservation Centre, University Putra Malaysia, and British Columbia Institute (See Training Summary below for details). As a result, WHU, DGFC, and other wildlife professionals in Sabah are equipped with more knowledge and technical skills required for field surveillance and safe handling and sampling of wildlife and are sensitized to animal mortality events that may represent a risk for viral spillover or disease emergence.

PREDICT Malaysia Country Coordinator Tom Hughes poses with the Wildlife Health Unit in Sabah comprised of partners from the Sabah Wildlife Department and Danau Girang Field Centre. PREDICT has been training WHU and DGFC personnel in biosafety, personal protective equipment, and safe handling and sampling of animals and working to develop their capacity for conducting disease investigations in animal populations. (Source: EcoHealth Alliance).

ASSESSING PANDEMIC THREAT IN THE WAKE OF A NATURAL DISASTER

In **Nepal**, the PREDICT team worked to identify areas for support of infectious disease control in disaster relief efforts following the 2015 earthquake. Contributions to the disaster response included producing and distributing informational disease outbreak prevention and risk communication materials (posters and brochures – Section 6.5), and working with PREDICT partners at HealthMap to develop a digital disease detection and monitoring platform of health alerts and events to improve situational awareness of potential infectious disease threats (the site is publicly available at http://www.healthmap.org/nepal/).

A macaque perched on rubble in the aftermath of the earthquakes that devastated the Nepal and the Kathmandu Valley, chews a dental rope used by the PREDICT Nepal team to collect samples without causing harm to the animal or field technician. (Source: UC Davis)

REGIONAL NETWORKING AND COORDINATION

Over the past year, PREDICT contributed to a number of regional (multi-national) training and coordination meetings for zoonotic disease surveillance: In **Cameroon**, PREDICT joined the FAO-led Regional Network of National Epidemiosurveillance Systems for HPAI and Other Priority Animal Diseases in West Africa (RESEPI) and the West and Central Africa Veterinary Laboratory Network for Avian Influenza and other Transboundary Diseases (RESOLAB) meetings. In **Tanzania**, PREDICT trained 15 international veterinary students and one human medical student in One Health and PREDICT's approach to disease surveillance. Further, a number of PREDICT in-country teams have presented at international symposia on One Health and infectious diseases, including the International One Health Congress (Amsterdam, Netherlands), Readiness, Prevention and Resolution of Emerging Infectious Diseases (Bangkok, Thailand), and the International Congress on Pathogens at the Human-Animal Interface (Chiang Mai, Thailand).

With the support from PREDICT **Cameroon** and a member of the Department of Forest Economy, the PREDICT **RoC** team participated in trainings in safe animal sampling methods and information management, with sessions in Brazzaville and the Sibiti region of the Lékoumou Department, 300 km to the northeast. The training included hands-on and in-service instruction in capture and sampling methods, and during the session 558 samples were collected from bats and small rodents. PREDICT teams in the Central Africa region are increasingly engaged in cross-country collaborations like these trainings, which are supporting the development of a broader African cadre for disease response, including Ebola.

The PREDICT team in Republic of Congo processing samples from rodents and small mammals. (Source: Global Viral)

II. GLOBAL REPORT

PREDICT YEAR 1 ANNUAL GLOBAL REPORT
(October 2014-September 2015)

Objective 1. Managing and Coordinating Operations

Establish and maintain collaborative and adaptive management of program operations and ensure compliance with agency policies and procedures.

- Generated, submitted, and obtained approval for EPT-2 workplans and budgets.
- Fully executed subawards with consortium and international partners in continuing PREDICT countries and initiated subaward approval processes with partners in new countries.
- Established financial and technical monitoring and reporting procedures and responded to all requests for information and reports from EPT and GHSA partners.
- Provided guidance on administration and compliance questions with subawardees.
- Created and maintained staff travel log and migrated travel log content to shared calendars for EPT partner coordination.
- Developed and implemented Environmental Management and Monitoring Plans and reporting with all consortium and implementing partners.
- Operationalized communications with Management Team and Executive Board and information flows with operational teams and implementing partners.
- Renewed and amended IACUC protocols to include new countries and sampling targets for continuation of animal sampling activities under revised scope of work.
- Convened a consortium-wide human subjects research working group, held meetings with the Director of the UC Davis IRB administration, and established reliance agreements with all consortium partners to extend UCD coverage for human subjects research across all sites (EcoHealth Alliance and Metabiota completed; WCS and Smithsonian Institution in progress).
- Submitted a Master IRB protocol to the UCD IRB for approval of all human subjects research and established procedures to ensure compliance among all sites engaged in human subjects research at global and local levels; responded to all levels of concerns; anticipating IRB approval in January 2016.
- Developed global and in-country staff contact information spreadsheet to facilitate communication and coordination among EPT partners at all levels.
- Introduced project to all new countries, coordinating with Missions and country governments.
- Considered and responded to all coordination concerns from USAID, FAO, WHO, and other partners and stakeholders; adapted workplans as appropriate.

Objective 2: Characterizing Biological and Ecological Risk

Identify the biological and ecological drivers and host-pathogen dynamics at high-risk interfaces within three critical pathways of disease emergence and spread in Asia and Africa.

Activity 2.1. Targeted monitoring for zoonotic viruses with pandemic potential at specific high-risk interfaces

- Held biweekly surveillance calls with operational leads and regional surveillance leads to provide direction and support for standardized surveillance operations across Asia and Africa.
- Developed surveillance data collection tools for 1) site and event characterization with data on animal-human contact, landscape change, and animal and human host ecology; 2) animal information with data on animal contact with people and condition at sampling; 3) sample data including sample type and condition; and 3) human data including data on occupations, travel, medical history, and animal contact. Resulting data collection tools (Objective 4 below and Section 6.1 and 6.2) for sites, animals, and humans have standardized terms and modules that link across high-risk interfaces and disease emergence pathways to allow implementation of the first ever data collection system standardized across animal, human, and ecological risk.
- Identified high priority disease emergence pathways, target sites for concurrent sampling, and high-risk taxa for focused surveillance activities in 31 countries.
- Engaged with FAO on livestock sampling coordination, both broadly in EPT partner meetings and via regional and in-country meetings, to prioritize site and animal targets along high priority disease emergence pathways.
- Explored opportunities for collaboration and coordination at the country level with local Ministries of Health and WHO regarding involvement in surveillance activities and reporting frameworks for surveillance data and policy development (globally and locally).
- Engaged WHO at EPT partner meetings and involved in-country WHO counterparts in selection of clinic and hospital partners for syndromic surveillance of undiagnosed severe acute respiratory illness (SARI), influenza-like illness (ILI), acute encephalitis, and hemorrhagic diseases in humans.
- Developed and shared detailed surveillance plans for 31 countries with EPT partners to facilitate alignment of in-country plans for concurrent surveillance specifically with regard to surveillance locations, target animal taxa, data collection, diagnostic testing plans, and laboratories.
- Implemented plans for longitudinal and concurrent surveillance at high priority sites in which wildlife sampling is being initiated, livestock sampling is coordinated with FAO, and human surveillance activities are prioritized in sequence with syndromic surveillance at collaborating clinics/hospitals implemented first and significant findings used to direct

occupational/community surveillance at wildlife/livestock sampling sites in high-risk populations to subsequently assess viral sharing and develop targets for mitigating interventions to disrupt exposure, amplification, and spread.

- As a proof-of-concept for longitudinal surveillance of influenza viruses and the integration of pathogens beyond influenza into existing human and animal surveillance systems, coordinated with WHO and FAO to develop a pilot project in Viet Nam (pending local approvals and support) at existing SARI site(s) and areas with intensive animal production and animal value chain, including wildlife farms.
- Analyzed data from PREDICT-1 to estimate sample sizes needed to detect shedding of target viruses to guide planning and budgeting for surveillance activities.
- Conducted epidemiologic and ecological analyses of host species-level datasets on past viral spillover risk and species occurrence in value chains to prioritize wildlife and livestock host taxa for surveillance and presented data for integration into surveillance plans at partner-wide meetings.
- Refined all field sample collection protocols for targeted hosts and taxonomic groups to optimize RNA virus detection and sample transport, and worked with global and in country field and lab teams to implement changes.
- Established uniform guidelines for best practices on geographic precision of sample location data for sharing of information in public databases (e.g., HealthMap and GenBank), reports, and publications.
- Developed master protocol for human subjects research involved in biological sampling and surveys and submitted to UC Davis Internal Review Board to ensure best practices, protection of privacy for consenting individuals, and minimal risk for all activities.
- Obtained or renewed national and local permits for animal sampling in 13 countries including Bangladesh, Cambodia, China, Nepal, Malaysia, Thailand, Viet Nam, Cameroon, Democratic Republic of Congo, Republic of Congo, Rwanda, Tanzania, and Uganda.
- Began animal sampling activities targeting high-risk wildlife taxa in 12 countries including Bangladesh, Cambodia, China, Nepal, Malaysia, Thailand, Viet Nam, Cameroon, Democratic Republic of Congo, Republic of Congo, Rwanda, and Uganda.

Activity 2.2. Characterizing Risk

- Conducted Modeling and Analytics (M&A) team planning meetings and developed workplan to prioritize activities and overarching goals.
- Finalized "Outbreak Scenario" models and developed 2-page summaries for: GB virus (Bangladesh); MERS-like coronavirus (spread from slaughtering imported camels – Section 6.4); Hantavirus (Yunnan, China); Simian Foamy Virus (Cameroon); Novel bat Paramyxovirus (Indonesia); MERS-like Coronavirus from bat guano (Thailand).

- Completed MERS-epizone spatial spillover risk model, combining geographic range of potential bat reservoir host and national data on dromedary camel densities.
- Developed a preliminary SIR model for circulation of MERS-CoV within camel populations based on herd size, connectivity, and market structure to guide surveillance of camel populations and forecast the potential effect of livestock intensification on changes in MERS disease dynamics in Africa and the Middle East.
- Conducted statistical analysis of demographic factors (e.g., number of cases at detection, regional population density) for historical Ebola virus outbreaks to identify any unique factors that may have contributed to unique spread of West Africa outbreak.
- Conducted spatial analysis of PREDICT-1 global site data (including spatial extent of named sites, pairwise distances between sites per country, and frequency of sampling at each site) to refine strategy for site definitions under PREDICT-2.
- To inform site and interface sampling targets within epizones, conducted epidemiologic analysis of test results to date to evaluate high-risk wildlife hosts and common animal-human interfaces along with sample types and animal conditions yielding positive samples for viral families tested.
- Identified zoonotic viruses reported in wildlife and domestic animal species to date and evaluated the relationship between species abundance and species propensity for hosting a higher number of zoonotic viruses, while adjusting for data deficient animal species.
- Examined changes in global airline travel volume and international connectivity when travel sanctions are put in place using West Africa Ebola virus outbreak as case study.
- Conducted economic analyses of specific intervention strategies enacted or proposed for West Africa Ebola outbreak.
- Developed natural language processing tool (PubCrawler) to map fine-scale research effort globally (bias measure) for EID risk analyses.
- Finalized and published new method that ranks high-risk interfaces and key ecological and epidemiological processes influencing the evolution, spillover, amplification, and spread of viral threats (Section 5: Johnson et al., 2015).
- Modeled and mapped the predicted vs. observed number of zoonotic viruses for all mammals globally to identify areas and mammalian communities of greatest value for zoonotic virus discovery (manuscript in preparation).
- Revised global analyses for characterizing ecological risk factors and areas for zoonotic EID spillover risk (Hotspots II); manuscript drafted and publication pending.
- Initiated stand-alone Hotspots II in order to identify the specific drivers of emerging infectious diseases in Africa and to define the role of livestock intensification (cattle, pigs and chickens) for the project Africa Livestock 2050.

- Initiated collaboration with FAO (Africa Livestock 2050) to share data and develop SIR and spatial models to analyze different agricultural intensification scenarios for Africa.

Activity 2.3. Viral detection and discovery, and longitudinal monitoring of viruses to track changes in geographic and host distribution, genetic sequences, transmissibility, infectivity, and viral evolution

- Refined laboratory methods for RNA extraction to align with PREDICT focus on RNA viruses.
- Completed development and optimization of new cPCR protocols for improved detection of Filo, Flavi, and Bunya viruses; cPCR assays for Hepaci, Pegi, and Parvo viruses still in development.
- Developed guidelines for prioritization of sample selection for PREDICT-2 testing.
- Initiated pilot testing of cPCR assays for bacterial detection.
- Completed full genome sequence of a MERS-like coronavirus found in Uganda; performed 3-D structural analysis of the spike protein and noted changes that have consequences for host species range.
- Completed full genome sequence of three bat influenza viruses from Bolivia and Brazil; genetic analysis suggests one of these may be a new subtype.
- Identified PREDICT Influenza and Corona viruses for deep sequencing in order to develop primer sets for PCR characterization of genomes in country.
- Initiated high throughput sequencing of select coronavirus (five out of 18) for genome completion, sequencing completed and data analysis in progress.
- Established a project-wide Laboratory Implementation Team as a forum to resolve problems to ensure consistency for sample handling, testing, and viral detection, as well as to provide feedback and information to labs.
- Published a study examining the global diversity and mutation rates of Influenza A viruses to identify re-combination hotspots and inform on surveillance (Section 5: Rejmanek et al., 2015).
- Published a study examining the viral diversity in macaques in Bangladesh; discovered 184 viruses and conducted ecological analyses to show that viral communities are structured in largely predictable ways (Section 5: Anthony et al., 2015).

Activity 2.4 Advancing pathogen characterization through refinement and development of new diagnostic tools and mainstreaming testing protocols

- In Bangladesh, introduced Virome Capture Sequencing (VirCapSeq-VERT) for pathogen discovery in human samples from cases with acute encephalitis and respiratory illness.
- Initiated comparison of viral detection technologies used for testing samples from humans with traditional PCR for specific pathogens with PREDICT cPCR protocols in Thailand.

- In collaboration with FAO in Indonesia, initiated comparison of viral detection technologies used for testing samples from livestock using traditional PCR for specific pathogens against PREDICT cPCR protocols.
- Initiated discussions with FAO for training of national reference laboratories and sharing of PREDICT viral family protocols.

Activity 2.5. Assisting host country partners in outbreaks

- Engaged EPT partners, including WHO and FAO, at international and regional in-country meetings to build partnerships and increase synergies for outbreak response planning and preparedness.
- Engaged host country governments and relevant national ministries to provide guidance on PREDICT's availability for assistance in outbreak investigations and response activities during outbreaks with undiagnosed causes of illness in humans.
- Worked with EPT partners to compile global and in-country staff contact information to facilitate communication and coordination in the event of an outbreak.
- Upon request from host country governments, assisted with outbreak investigations in five countries for ongoing preparedness and training purposes by providing expertise, and when appropriate field assistance for animal sampling in DRC, Rwanda, Uganda, and Malaysia, and laboratory support for an as yet unidentified cause of disease in humans Thailand.

Objective 3: Characterizing Behavioral Risk

Investigate the correlation of human behavior and zoonotic disease risk to understand the behavioral mechanisms of high-risk pathways for disease emergence and spread; identify potential control points and behavior change options.

Activity 3.1. Standardizing approaches to study human behavioral risk

- Completed analysis of >1000 household-level Deep Forest Human Contact surveys from three countries (Uganda, Brazil, and Malaysia) to characterize human-animal contact across a land-use gradient and by demography. Results from this survey will indicate how human-animal contact, a fundamental but poorly quantified measure in disease systems, might vary with land-use practices and intensity of disturbance, while all data from Deep Forest will be used to inform the likelihood of EID spillover along a pristine-to-disturbed gradient, and subsequently provide an index of risk that can be applied across different landscapes.
- Established the project-wide Behavioral Risk team.

- Collated and reviewed all PREDICT and PREVENT protocols, guides, and reference materials relating to behavioral research to prevent duplication of effort.
- Standardized qualitative behavioral risk research data collection guides, protocols, and training materials developed and pilot tested in live animal markets in the US and China.
- Coordinated with consortium operational teams in the planning and development of standardized implementation activities for the Human Questionnaire (Section 6.1 and 6.2) and to integrate behavioral risk data collection into biological data collection protocols and training materials (Section 6.3).
- Developed globally-standardized qualitative research activities and obtained ethical approval for conduct of activities from the UC Davis IRB in May 2015 (Section 6.3).
- Identified priority countries for qualitative behavioral risk research: Bangladesh, Cameroon, China, DRC, Indonesia, and Uganda.
- Established and/or re-engaged partnerships in all priority countries plus Malaysia for the coordination of observational behavioral research. Conducted trainings in five of six priority countries targeted for behavioral risk research in Year 1 (China, Bangladesh, Uganda, Cameroon, and DRC) and following local IRB approval, initiated data collection in Bangladesh, China, and DRC. Activities will commence in additional countries in Year 2 beginning with Cameroon, Indonesia, and Uganda, with the addition of Malaysia and Viet Nam, as Year 2 priority countries.
- Global team conducted initial site visits with observational research in Bangladesh, China, Indonesia, Egypt, Cameroon, and DRC to identify and evaluate potential data collection sites.
- Initiated preliminary data analysis on available qualitative observational field notes, focus group discussions, and ethnographic interviews.
- Acquired reports and databases from PREVENT documenting longitudinal wildlife market conditions and practices in the Republic of Congo and Democratic Republic of Congo and initiated plans to design additional behavioral risk investigations into the wildlife value chain in these countries that will compliment evolving surveillance and sampling of hunted, traded, and consumed wildlife.
- Prioritized additional countries and initiated planning for further qualitative studies in Nepal, Viet Nam, Republic of Congo, Tanzania, Guinea, Liberia, and Sierra Leone.

Objective 4: Improving Global Surveillance Networks

Strengthen internal data storage and sharing platforms to improve the ease of collection, synthesis, storage, access, and dissemination of relevant animal and human, spatially explicit epidemiological and ecological data.

Activity 4.1. Standardizing data collection

- Fostered consortium-wide collaboration among PREDICT behavioral, laboratory, surveillance, and information management teams to develop revamped and standardized site and event characterization protocols and data collection tools for animals and specimens (Section 6.2 for more information).
- As part of data collection tool development, created 10 specific modules as part of the Human Questionnaire (Section 6.1) to collect detailed data on various key transmission interfaces including but not limited to: animal production facilities, wildlife markets and restaurants, and extractive industry; in addition, developed data collection protocols and tools for animals and specimens and protocols for collecting quantitative behavioral risk data at key interfaces.
- Created a platform-independent data collection application for the Emerging Infectious Disease Information Technology Hub (EIDITH: PREDICT's internal information management system) to facilitate collection of all site, event, animal, and specimen data. The new EIDITH application can run on any tablet or computer and has offline capability, enabling data collection without Internet access and with automated synching with the EIDITH server once Internet connectivity is restored (Section 6.2).
- Adapted the EIDITH database structure to accommodate the new site and event characterization data described above and established links to transfer data between all data collection apps and the EIDITH platform.
- Created tables to hold and display all data from the newly minted apps.
- Using optical character recognition technology, developed a system built on standardized paper forms ("bubble forms" – Section 6.2) and scanners to allow collection and import of data directly to EIDITH when the use of the electronic app for tablets, mobile phones, or laptops is not practical or feasible. This system mirrors the data collection application and provides a functional alternative to electronic data collection while maintaining the inherent standardization benefits.
- Developed software to transfer data from the optical character recognition application (the "bubble form" app) into EIDITH.
- Using the same technology as the EIDITH data collection applications, a platform-independent application with offline capability and its bubble form analog were also created to collect data on PREDICT training activities to enable greater oversight and monitoring of the status of trained personnel for country coordinators and global leads (Section 6.2).

Activity 4.2. Synthesizing global data

- Initiated preliminary discussions on the development of potential uses for the planned global respiratory database.

Activity 4.3. Disseminating global data

- Continued to distribute PREDICT surveillance and digital disease detection data through the open access public site, http://data.predict.global.
- Continued interpretation of PREDICT sequences and provided government result reports.
- Began to submit PREDICT sequences to the Genbank Database.

Objective 5: Validating One Health Approaches

Conduct a systematic and dedicated effort to validate and evaluate the utility of One Health approaches using all available evidence.

Activity 5.1. Promoting policies and practices that reduce the risk of virus evolution, spillover, amplification, and spread

- Developed a structural framework for comparing outcomes of One Health approaches versus other approaches to outbreaks.
- Developed the outline for One Health case studies booklet and selected initial cases to draft. The case studies will also be utilized to inform on One Health best practices and to share with other EPT-2 projects.
- Developed draft of the country-level One Health data collection form that will be used for systematic evaluation of One Health approaches in EPT-2 countries. The draft data collection form includes temporal, economic, health burden, and policy indicators that can be used to assess cost-effectiveness and inform national and international policy actions.
- Identified data parameters for prospective collection by EPT-2 partners to allow for expanded and consistent inputs and precision in cost-effectiveness analysis of One Health approaches.
- Completed a systematic literature review of quantitative and qualitative outcomes reported in One Health articles.
- Established collaboration with the Network for the Evaluation of One Health for sharing of One Health case studies and cost-effectiveness evaluation approaches.
- Published paper (Section 5: Pike et al., 2014) analyzing the cost-effectiveness of implementing a One Health approach to mitigate pandemics.
- Published paper with colleagues from WHO, OIE, and other partners on a cost-effective global strategy for monitoring avian influenza viral diversity (Section 5: Machalaba et al., 2015).
- Published paper on preventive public health systems, highlighting PREDICT approaches to sentinel monitoring and detection (Section 5: Machalaba and Karesh, 2015).

- Published paper with FAO colleagues on policies for mitigating adverse food chain and environment impacts of pharmaceutical residues (PREDICT-adjacent; Section 5: Margalida et al., 2014).
- Liaison appointed to the four-person OFFLU (Network of Expertise on Animal Influenza) Steering Committee and assigned to lead the OFFLU wildlife/wild bird influenza surveillance technical activity, which was established to provide a platform for discussion, coordination, and data sharing between key wildlife experts involved in influenza surveillance and research.
- Highlighted PREDICT approaches in NIH, GHSA, and OIE meetings, including a keynote address for the Global Conference on Biological Threat Reduction.
- Worked with WHO and FAO to produce guidance documents on Ebola transmission via food and animal contact during the West Africa outbreak.
- Liaison served on the WHO Expert Roster on zoonoses.
- Liaison appointed to the “Towards a Safer World” Advisory Board.

Activity 5.2. Improving cross-sectoral collaboration and coordination with EPT-2 partners

- Held quarterly coordination calls with P&R and OHW.
- Compiled and shared list of existing One Health platforms by country with P&R.
- Generated an activity list to support the One Health Workforce workplan, including training, One Health case studies, protocols, and technical advising resources.
- Held coordination meetings and calls with FAO and initiated discussion with CDC on EPT-2 scope of work.
- Began discussing collaboration with The World Bank for a follow-up phase of their “People, Pathogens, and Our Planet” report on the economics of One Health, as well as broad areas of integration on policy-oriented outputs of One Health cost-effectiveness analysis.
- With P&R, reviewed the World Bank’s draft environmental and social safeguards and began developing proposed edits consistent with EPT-2 best practices.
- Developed recommended priority sites for targeted influenza surveillance with FAO and produced report for USAID.
- Developed a guidance document for the OIE as a resource to assist member countries in implementing wildlife disease surveillance. The document includes a budget planning template and highlights the importance of capacity for information sharing.
- Provided input on One Health approaches to emerging infectious disease prevention at the UNEP Convention on Biological Diversity 12th Conference of the Parties in October 2014 (non-PREDICT). Parties recognized “the value of One Health” in their official decision on biodiversity and human health.

- Coordinated infectious disease chapter of the WHO-CBD publication "Connecting Global Priorities: Biodiversity and Human Health, a State of Knowledge Review", highlighting PREDICT as a One Health approach.
- Provided an overview of EPT-2 and an update on emerging disease issues at the Steering Committee meeting of the Global Framework for the Progressive Control of Transboundary Animal Diseases meeting, organized by the FAO and OIE, in October 2014.
- Shared viral family screening protocols with external collaborators, including the Laboratory of One Health Research at Duke-NUS Graduate Medical School Singapore and the University of Pretoria in South Africa.
- Advised FAO on EBOV/filovirus tests and shared PREDICT-2 protocols.

Objective 6: Strengthening Capacity

Add depth and scope to transdisciplinary One Health platforms, thereby strengthening surveillance system capacities; support the training of the next generation of the One Health professionals through coordinated activities with EPT and inter-agency partners.

Activity 6.1. Systems approach to capacity building for wildlife, livestock, and human surveillance

- Conducted monthly Capacity Team coordination teleconference meetings.
- Continued to provide technical support to in-country laboratories.
- Established baseline serologic capacity in collaborating laboratories to support the development of appropriate technologies for PREDICT activities.
- Piloted online platforms with country teams in Africa and Asia to facilitate distance learning and conduct trainings related to new surveillance and information management protocols and data collection tools.
- Revised sample collection guidelines for incorporation into updated field sampling protocols for all taxa and new protocols for human sampling.
- Updated field sampling protocols and training guides for wildlife (bats, rodents, primates), livestock (camels, cattle, small ruminants), and humans, as well as for environmental sampling.
- Updated laboratory safety training modules (in particular to address chemical handling and waste as a result of protocol changes).
- Created new training guides and associated materials (e.g., quizzes, training instruction tools) needed for new project activities in the behavioral sciences (qualitative research to evaluate behavioral risk practices) and for spatial analysis to foster enhanced spatial mapping skills.
- Performed a review of outbreak-related protocols for updating and coordination across partners and field activities and began revising the guide for in order to provide best achievable assistance during zoonotic disease outbreaks.

- Began the design and compilation of all existing and in-development PREDICT training guides, protocols, and capacity strengthening resources into an e-Book intended for PREDICT staff and implementing personnel. The team completed initial sections on: ethical considerations; permissions, permits, and protocols; general field sampling station set-up; safe animal capture and sampling; general data collection; safe disposal of carcasses and infectious material; qualitative research and data collection for behavioral risk investigations; implementing a cold chain for safe sample transport and storage; basic laboratory safety; data policies and plans and data collection for surveillance; biosafety and PPE use; emergency preparedness; cultural considerations for international work; preventing sexual harassment; and spatial analysis using QGIS. The e-Book will be a living document under continual review and adaptation with a completed first edition available online in Year 2.
- Completed an annual capacity tracking activity using Country Coordinators in a key informant approach to guide PREDICT strategic planning.
- Began distribution of PREDICT training resources to participating countries and partners, as needed, to facilitate capacity strengthening in country.

Activity 6.2. Coordinating capacity development across EPT projects

- Participated in discussions with partner groups about timelines and processes for coordination across EPT projects and sharing of capacity strengthening resources including protocols, experiences, and training opportunities:
  - FAO for training of national reference laboratories for potential utilization of PREDICT viral family protocols;
  - WHO for sharing of PREDICT viral family protocols.

Objective 7: Assisting Organization of USAID PIOET Annual Data Review Meetings

In close coordination with USAID and other EPT-2 projects and partners (including FAO, CDC, WHO, etc.), organize annual data reviews to optimize and refine ongoing and future activities.

- USAID requested that first data review meeting occur in 2016.

III. COUNTRY REPORTS

CAMEROON

Highlights and Success Stories:

- PREDICT, together with representatives of the Food and Agriculture Organization of the United Nations (FAO), Preparedness & Response (P&R), One Health Workforce (OHW), and USAID, was received by the Prime Minister of Cameroon to discuss the Emerging Pandemic Threats-2 (EPT-2) program and disease emergence in Cameroon.
- At the invitation of the Minister of Livestock, Fisheries and Animal Industries, PREDICT nominated the Field Coordinator to be a representative to the Cameroon Animal Disease Surveillance Network (RESCAM).

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- Conducted site reconnaissance visits in South Region of Cameroon where hunting and selling of wild animals takes place and where hydroelectric and rubber plantation development is ongoing. Through this process, the team revised sampling focus areas and refined site selection. In addition, some sampling was conducted to determine suitability of the sites for sampling. A total of 1,085 samples were collected from 207 animals, including 96 rodents, 55 bats, and 55 hunted animals.
- Coordinated joint surveillance activities with central and local governmental ministry staff responsible for wildlife and livestock.
- Initiated site scoping visits in villages near two hydroelectric dams under development and within an area of oil palm plantation expansion.
- Liaised with officials from agroindustrial company Sud Cameroun Hevea SA (SUDCAM), a rubber producing company currently expanding plantations in Cameroon, to discuss opportunities for operational alignment and assessed the rubber expansion zone as a possible new surveillance site.
- Provided key support to the development of the pilot human behavioral study protocol; initiated contact with local partners to facilitate implementation of this pilot.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- Successfully tested an Ebola real-time PCR assay using a synthesized positive control.
- Performed 3,213 PCR tests for Influenza virus, Paramyxovirus, and Coronavirus families on 1,619 samples from 1,181 animals, and shipped 80 samples to GATC Biotech (Germany, a commercial sequencing company) for sequencing.
- Repeated analyses on two pools of specimens from PREDICT-1, dividing the pool to determine which specimen was positive for a novel Arterivirus (pool of three rodent samples) and a novel Icavirus (pool of two bat samples).
- Performed deep sequencing to further characterize a rodent pox virus identified during PREDICT-1; awaiting results to determine future steps.

- Collected and tested post-mortem specimens from a patas monkey and a baboon from Limbe Wildlife Centre that died following respiratory difficulties using viral family protocols; all samples were negative, and no further testing is planned.
- Visited BOCOM International, the contracted waste removal company, to ensure proper management of hazardous waste.
- Conducted a comprehensive review of all previous PREDICT laboratory analyses by sample type to characterize gaps and future testing needs. Through this process a series of 945 samples that had not been tested for Influenzaviruses, Coronaviruses, and Paramyxoviruses were identified and 1,386 PCR tests were done.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- Received approval for the publication of the remaining PREDICT-1 results from the Ministry of Defense (MINDEF), Ministry of Wildlife and Forestry (MINFOF), and the Ministry of Environment (MINEPDED).
- Contributed substantively to weekly epidemiological meetings organized by the Ministry of Health (MoH) and briefed the MoH on novel arteriviruses and henipah virus research.
- Engaged visiting P&R team to discuss EPT-2 coordination and joint P&R-PREDICT activities.
- Attended the P&R and National Zoonosis Program (NZP) meetings to discuss the P&R workplan in Cameroon in June.
- Met the Permanent Secretary of the NZP to evaluate the Program workplan and identify opportunities for alignment with PREDICT activities in July.
- Hosted a meeting of USAID EPT-2 (Africa and Cameroon) with PREDICT, OHW, P&R, and FAO representatives to identify alignments between EPT-2 activities and the NZP workplan in August.
- Together with EPT-2 partners (PREDICT staff; USAID staff from DC, Nairobi, and Yaounde; and staff from P&R and OHW), met with NZP staff (1 September 2015) and the NZP Technical Committee (2 September 2015) to present proposed EPT-2 activities.
- Participated in the FAO-led meetings of the Regional Network of National Epidemiosurveillance Systems for HPAI and Other Priority Animal Diseases in West Africa (RESEPI) and the West and Central Africa Veterinary Laboratory Network for Avian Influenza and other Transboundary Diseases (RESOLAB) for Chief Veterinary Officers (CVOs) and laboratory directors from Central Africa.
- Attended the Cameroon One Health partner summit in January with WHO; MoH; Ministry of Livestock, Fisheries, and Animal Industries (MINEPIA); MINEPDED; MINFOF; NZP; and Centre Pasteur at WHO and discussed a subset of PREDICT's scoping plans, presented results from PREDICT-1, and engaged in strategizing critical activities.
- Supported the USAID team in preparing, organizing, and attending the May 2015 GHSA meetings at the ministries of environment, health, wildlife, and livestock.

- Engaged DTRA representatives and contractors undertaking a needs assessment in Cameroon to provide background information and documents and contacts. The finalized needs assessment is an internal USG document.
- Assisted WHO and MoH in the completion of an Ebola readiness assessment.
- Met with the International Atomic Energy Association (IAEA)/FAO joint office in March 2015 to discuss potential collaborations in biosafety & security, Ebola preparedness, and Ebola reservoir surveillance.
- Held discussions with the National Veterinary Laboratory of Cameroon (Laboratoire National Vétérinaire du Cameroun; LANAVET) and the Director of the Institute for Novel and Emerging Infectious Diseases at the Friedrich-Loeffler-Institute (FLI) about potential collaborations on Rift Valley Fever and Henipa viruses.

Other Activities this Period*:*

- Provided technical support and training to the PREDICT Republic of Congo (RoC) team for the initiation of field surveillance activities in RoC.
- Briefed the Director of Veterinary Services and the Director of the Medical and Medicinal Plant Institute of the Ministry of Research on a recent Henipavirus publication.
- Shared a manuscript on new Arteriviruses with the Government of Cameroon (GoC), submitted the manuscript to the Archives of Virology, and shared a Taxonomic Proposal with the International Committee on Taxonomy of Viruses (ICTV).
- Provided shipping materials to CDC Cameron to facilitate export of a monkeypox sample (from the June 2014 outbreak) to the US National Institutes of Health (NIH), to permit additional characterization.
- Provided guidance to CDC Cameroon (Field Epidemiology & Laboratory Training Program) on a draft MoH document detailing roles of Ebola rapid intervention teams.
- Assisted MoH, WHO, and Pasteur Center Cameroon (CPC) and led two training sessions on personal protective equipment (PPE) during two Hemorrhagic Fever Virus workshops in October 2014 and January 2015 targeting physicians and laboratory technicians from 10 different regions of Cameroon.
- Provided technical assistance through presentations on PPE use and supervision of Ebola case simulations during a GoC, CDC, and Public Health England initiative for training of Ebola rapid intervention teams.
- Provided technical assistance for DTRA and CDC-supported emergency operations training in December 2014 and a P&R-supported Ebola scenario workshop in November 2014.
- Attended the EECAS (Economic Community of Central African States) meeting in February 2015 and discussed strategies to fight or prevent the Ebola virus epidemic.
- Provided advice to Limbe Wildlife Centre, Cameroon management staff on setting up a independent laboratory (non-PREDICT) at the centre for onsite animal testing and for recruitment of a lab manager.

- Presented on Ebola reservoirs and origins of outbreaks for the Cameroon Biological Safety Association at the Ministry of Livestock.

Training Summary

Topic	Total # Trained*	# Women Trained	# PREDICT Staff Trained	# Government Ministry or Lab Staff Trained	# Students Trained
Behavior Risk	1	1	1	0	0
Lab Safety	5	1	5	0	0
Information Management	4	1	4	0	0
Ethics	1	0	0	0	0
Grand total	6	1	6	0	0

**Multiple individuals cross-trained in various topics.*

COTE D'IVOIRE

Highlights and Success Stories:

- Finalized work plans and surveillance strategy, including timeline for implementation.
- Identified Institut Pasteur de Côte d'Ivoire (IPCI) and the Laboratoire de Pathologie Animale et Aviaire de Bingerville (LANADA-Bingerville) as key potential collaborators.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- No surveillance or field activities conducted in Year 1.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- No laboratory testing conducted in Year 1.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- Participated in the GHSA technical workshop in Abidjan from July 21-22, 2015 along with US Government (USG) teams from USAID (P&R, FAO), Department of Defense, the US Centers for Disease Control and Prevention (CDC), and other key in-country partners from various research institutions and governmental ministries.
- Organized a workshop at IPCI in Abidjan in September 2015 attended by collaborators from IPCI and LANADA-Bingerville, and reviewed program objectives and strategies and finalized the implementation plan.

Other Activities this Period:

- Held meetings with regional PREDICT teams in Cameroon, RoC, and DRC to synergize workplans and coordinate a regional approach to surveillance.

Training Summary

Topic	Total # Trained	# Women Trained	# PREDICT Staff Trained	# Government Ministry or Lab Staff Trained	# Students Trained
PREDICT Basic Training	15	6	0	15	0

DEMOCRATIC REPUBLIC OF CONGO (DRC)

Highlights and Success Stories:

- Received approval from the Government of the DR Congo to release PREDICT-1 laboratory findings to the scientific community.
- Prepared three genome sequences of the Ebola virus detected during the Boende Ebola Outbreak in DRC (2014) in collaboration with University of California San Francisco (UCSF) lab and submitted the sequences to GenBank (KP271018-KP271019-KP271020). At the time of the outbreak, it was not clear if the Boende outbreak was related to the outbreak in West Africa. By releasing these sequences publicly, PREDICT was able to demonstrate that they were part of a separate outbreak of Ebola virus.
- Upon request from the DRC Ministry of Health (MoH), organized a trip to Boende in the aftermath of the Ebola Virus Disease (EVD) outbreak to collect wildlife specimens for filovirus testing; collected a total of 255 samples (from 41 bats and 2 rodents).
- Received a nomination (Country Coordinator) from the DRC Minister of Health to be a member of the national team of first responders in case of chemical, biological, radiological, and nuclear (CBRN) hazard and contributed to the preparation of the national action plan for CBRN threats.
- Designated by the North Kivu Provincial Division of Health as a standing invitee to its bi-weekly epidemio-surveillance meetings in Goma, where all human disease cases in the Province are reported and discussed.
- Received the express support of the North Kivu Provincial Inspector of Human Health to work in two health zones around Virunga National Park (Bunagana and Rwanguba), enabling Virunga National Park (PNVi) to assign its head nurse to visit 14 community health centres surrounding the Mikeno Sector of PNVi (Bunagana, Bugusa, Kabonero, Shangi, Rutsiro, Kabaya, Kabindi, Tanda, Kazuba, Rugari , Kakomero, Kingarama Gasizi and Kibumba), to identify centres for collaboration, and to assess their capacity to store samples and participate in human health surveillance.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- Granted use of and access to United Nations and other humanitarian flights for PREDICT field surveillance trips.
- Revised sampling sites in accordance with new surveillance guidance.
- Obtained key in-country permits for the conduct of PREDICT activities, including a two-year wildlife sample collection permit from the provincial Ministry of Environment of Kongo-Central (formally Bas-Congo), a one-year wildlife sample collection permit from the Provincial Ministry of Environment of Kinshasa, and Institutional Review Board (IRB) approval for the behavioral pilot study.
- Trained 13 field investigators from the Kinshasa School of Public Health (KSPH) and other in-country institutions and the PREDICT Country Coordinator on qualitative data collection methods and the PREDICT approach to behavioral risk investigations.

- Conducted a field pilot and training (two focus groups and nine ethnographic interviews) using the behavioral data collection tools at the sanctuary of bonobos in Kinshasa.
- Completed a field trip in the Kongo-Central Province and visited five sites including: Kinzau-Mvuete, a city where bush meat vendors sell newly slaughtered wild animals; Lukula, a location with large-scale deforestation for timber, hunting, and bushmeat markets/restuartants and large palm oil, coffee, and rubber plantations; Mangala, the site of the 2009 hemorrhagic fever of unknown origin (FUO) occurrence later identified by PREDICT as having been caused by Bas Congo virus; Inga, site of the DRC's main electrical dam (currently planned for expansion) and an area in which bats ultimately destined for restaurants and markets in Kinshasa and Brazzaville are hunted; and Zongo, a tourist destination known for its waterfalls, where people hunt bushmeat that is sold to tourists and is sent to Kinshasa and other cities for sale in markets and restaurants.
- During the Kongo-Central Province field trip, sampled wildlife (bats and rodents) and collected behavioral data, conducting 39 ethnographic interviews and organizing five focus groups.
- Transcribed all recordings from the behavioral pilot (focus groups and ethnographic interviews) and from Kongo-Central field visits and translated all data collected in the local languages into French.
- Supported the global team by transcribing all behavioral and human questionnaires used in the behavioral pilot study into French, to be used by all PREDICT French-speaking countries.
- Investigated a respiratory disease outbreak in a human-habituated group of mountain gorillas in PNVi at the park's request; observed 24 gorillas with clinical signs (coughing and anorexia); opportunistically collected fecal samples from 14 animals; samples to be shipped to INRB for viral family testing in Year 2.
- Collected samples from a captive mountain gorilla in PNVi, previously confiscated from poachers, that was exhibiting signs of gastrointestinal malaise; samples to be shipped to INRB for viral family testing in Year 2.
- Responded to a request from PNVi to obtain and test samples from baboons raiding park headquarters and Rumangabo village and in some cases severely biting people; while human surveillance protocols are pending, PREDICT is working with PNVi on sample collection and will work with local health centres to obtain samples from people bitten by baboons at a later date.
- Responded to request to support an investigation into a respiratory disease outbreak affecting 26 of 42 captive chimpanzees held at the Lwiro Wildlife Rehabilitation Centre, located adjacent to Kahuzi-Biega National Park in South Kivu province; opportunistically collected blood and swabs from four sick animals with close human contact; samples from one primate shipped to INRB for viral family testing; additional samples to be shipped to INRB for viral family testing in Year 2.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- Expanded lab operations with additional space at the Institut National de Recherche Biological (INRB), allowing separation of pre- and post-PCR activities, reducing the risk of contamination.
- Tested samples collected during PREDICT-1 for Coronavirus, Polyomavirus, Enterovirus, Herpesvirus, Adenovirus, and SFV; all results were entered to the EIDITH database.
- Performed follow-up testing and sequencing to confirm results on samples collected and tested in PREDICT-1, including samples for speciation collected in DRC (194 from NHP and 44 from rodents) and ROC (36 from NHP and 18 from rodents) for better identification and phylogenetic placement of the virus sequences.
- Improved laboratory operations through the introduction of cryo-resistant labels and a bar code scanner.
- Travelled to Nanaimo, Canada (Laboratory Manager) for training on sequence analysis.
- Reviewed and analyzed new test interpretations from the EIDITH team.
- Submitted samples from a captive chimpanzee showing generalized chronic but severe clinical signs of disease to INRB for viral family testing; results pending.
- Assessed power availability and cold-chain capacity at 14 different human health centres surrounding PNVi, In preparation for future human sampling, determining that none had electricity but 10 had kerosene-fueld refrigerators with battery back-up.
- Participated in a WHO-organized training workshop in Brazzaville on safe shipping of biological materials.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- Aligned partners and stakeholders for PREDICT-2 activities: confirmed in-country collaborations with INRB (laboratory testing) and the Kinshasa School of Public Health (KSPH, behavioral studies); prepared a Memorandum of Understanding (MoU) for collaboration with the Mountain Gorilla Veterinary Project, responsible for implementing PREDICT-2 activities in Eastern Congo; and successfully recruited the former PREVENT DRC Country Coordinator for the behavioral pilot study organized in Kinshasa and Kongo-Central.
- Discussed potential collaboration on biological, behavioral, and ecological risk characterization activities with The Bonobo Sanctuary, the University of Lubumbashi/School of Veterinary Medicine, the Awely Program in Basankusu, Equateur Province, and the Central Veterinary Laboratory.
- Initiated a potential partnership with the University of Graben Faculty of Veterinary Medicine for student training and capacity-building through field training opportunities with PREDICT; invited back to make a full presentation to faculty and students in April 2016.
- Briefed the Provincial Inspector of Human Health (point of contact in DRC for the One Health for Central and East Africa network, or OHCEA) in Goma about

PREDICT (December 1, 2014); currently drafting an MOU for future collaboration at community health centres around PNVi.

- Over the course of Year 1, briefed the Director of Disease Surveillance at the MoH, the Director of Animal Production at the Ministry of Agriculture (MoA), and the North Kivu Provincial Environment Minister in Goma on PREDICT-2 plans and activities.
- Briefed the Laboratory Director for the National Animal Health Diagnostic Laboratory in Goma (responsible for provincial animal agriculture inspection) on the project in December 2014.
- Held quarterly meetings (November 2014, January 2015, and March 2015) with the Director and Chief Park Warden of PNVi and the PNVi health department in Goma and in Rumangabo (park personnel village and site of park headquarters); informed about PREDICT-2 surveillance planning.
- Contributed substantively to the development of training manuals and national Standard Operating Procedures (SOPs) for EVD outbreak response, intended for use in the EVD outbreak in West Africa, in collaboration with WHO, UNICEF, and the DRC MoH.
- Attended four in-country implementing partners meetings organized by the USAID mission. These meetings were held to ensure integration on a number of administrative and programmatic issues across the EPT partners and the USAID mission.
- Attended the PREVENT "restitution" (i.e., project wrap-up) meeting in Kinshasa on 12 June 2015, in which PREVENT provided an overview of their survey of bush meat markets. Information was provided on sources of bushmeat, demographic attributes of consumers, biosecurity in markets, and risk perception among vendors and market administrators. Results will inform future PREDICT bushmeat studies on biological and behavioural risk in DRC.
- Discussed PREDICT-1 results with in-country partners from the World Wildlife Fund (WWF)-PICBO project. PREDICT conducted a joint field trip with WWF, the organization responsible for biodiversity surveillance in northwestern DRC, during PREDICT-1, wherein the team conducted village meetings to share information on zoonotic disease prevention and safe butchering practices.

Other Activities this Period:

- Actively participated in the Boende Ebola Outbreak Laboratory and Research Commission and regularly updated PREDICT on Commission activities.
- Presented a poster (Laboratory Manager) on the clinical complications of human monkeypox at the 63rd Annual ASTMH conference in New Orleans, USA, in November 2014.
- Attended a MoH workshop (Laboratory Manager) to prepare for the trial of a new vaccine to prevent human monkeypox.
- Supported PREDICT partners (Country Coordinator) in the roll-out and implementation of PREDICT-2 in West Africa as part of the team visiting new and potential partners in Cote d'Ivoire and Senegal.

- Participated in the Global Health Security Agenda (GHSA) meeting held in Abidjan (July 2015), to assist in the preparation of an action plan for Cote d'Ivoire.
- Presented on diagnostic characterization during the Boende Ebola outbreak, occurrence of herpes viruses in non-human primates, diagnostic characterization of Enteroviruses in captive chimpanzees, and inclusion of local community members in disease surveillance at the 30th anniversary INRB Conference.
- Received acceptance for two abstracts summarizing PREDICT-1 results submitted to the American Society of Tropical Medicine and Hygiene (ASTMH) 64th Annual Meeting .

Training Summary

Topic	**Total # Trained***	**# Women Trained**	**# PREDICT Staff Trained**	**# Government Ministry or Lab Staff Trained**	**# Students Trained**
Behavior Risk	14	2	2	1	4
Packing and shipping biological samples	56	32	0	56	0
Biosafety, PPE, and Safe animal handling and sampling	2	0	0	2	0
Lab safety	56	32	0	56	0
Viral detection and discovery	7	2	0	7	0
Grand total	**77**	**36**	**2**	**66**	**4**

**Multiple individuals cross-trained in various topics.*

EGYPT

Highlights and Success Stories:

- Established data sharing and communication processes with Egyptian government partners at the Ministry of Agriculture; Ministry of Health; and the Ministry of Higher Education, National Research Center to contribute to disease information reporting systems.
- Efforts to expand and collaborate with EPT partners are under way in order to strengthen data platforms and improve the ease of dissemination of relevant animal, human, epidemiological, and ecological data.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- Developed a surveillance plan in conjunction with the PREDICT global team, focusing on high priority pathways for disease spillover, evolution, amplification, and spread at high contact interfaces among humans, livestock, and wildlife.
- Participated in FAO coordinated livestock, wildlife, and human surveillance planning meeting targeting the camel value chain and MERS virus.
- Explored human biological and behavioral risk factors, including population growth, land-use change, and other drivers of disease emergence, spread, and amplification to help guide surveillance plans.
- To assess disease emergence risk, conducted observational research at potential surveillance sites with Ministry of Agriculture representatives in Aswan at the Birqash Camel Market in Giza and at the Daraw Camel Market and quarantine facilities.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- To date, no laboratories have been engaged; future partner laboratories will conduct viral family testing using project protocols with plans to expand list of assays to include additional viral tests and bacteria.
- At the request of potential partners, provided copies of the PREDICT Sample and Data Sharing Policy.
- Toured potential partner laboratories at the US Naval Medical Research Unit No. 3 (NAMRU-3) and the Ministry of Agriculture and discussed the use of viral family protocols especially for Coronaviruses and Influenza viruses to prioritize MERS and Avian Influenza surveillance.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- Met with potential in-country government partners at the Ministries of Agriculture, Ministry of Health, and Ministry of Higher Education to introduce the project and assess interest in collaborative relationships to benefit disease surveillance activities in Egypt.

- Initiated integration of disease surveillance activities to develop ideas and identify projects and/or surveillance sites through meetings with EPT partners including FAO, NAMRU-3, and CDC.
- Distributed the PREDICT-1 Final Report Executive Summary to all potential in-country partners including USAID Egypt.

Other Activities this Period:

- Discussed capacity building needs, particularly concerning laboratory capacity, viral family testing protocols, and wildlife and human surveillance activities.

ETHIOPIA

Highlights and Success Stories:

- Established Addis Ababa University's Aklilu Lemma Institute of Pathobiology (AAU) as the primary implementing partner and identified capacity building and training needs to conduct field and laboratory surveillance activities focused on the animal value chain.
- Liaised with key ministry (Ministry of Health, Ministry of Livestock, and Ministry of Agriculture), US Agency, and in-country GHSA partners including FAO and EPT to coordinate workplans for disease surveillance activities targeting priority human and animal diseases.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- Assessed existing surveillance capacities and evaluated partner and infrastructure gaps for project launch.
- Conducted site visits to the Awash and Afar regions to characterize priority pathways of disease emergence within dromedary camel markets and developed a preliminary surveillance plan focusing on the priority disease pathway animal value chain and risk of viral emergence at the camel-wildlife-human interface.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- Completed preliminary evaluation of partner diagnostic laboratory capacities and networks including AAU and the National Animal Health Disease Investigation Center (NAHDIC).

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- Conducted two scoping visits and held meetings with AAU, NAHDIC, the Ministry of Agriculture, Ministry of Health, Ethiopia Wildlife and Conservation Association, FAO Ethiopia, and USAID/Ethiopia to discuss the project and potential collaborations in human, animal, and livestock disease surveillance.

Other Activities this Period:

- Submitted all required partnership and collaboration agreements to obtain permissions for conducting surveillance activities.

GABON

Highlights and Success Stories:

- Finalized work plans and surveillance strategy, including timeline for implementation.
- Identified the Institut National Supérieur d'Agronomie et de Biotechnologies and the Université des Sciences de la Santé, Libreville as key potential in-country partners.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- No surveillance or field activities conducted in Year 1.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- No laboratory testing conducted in Year 1.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- Held in-country meetings with potential partners from the Institut National Supérieur d'Agronomie et de Biotechnologies and the Université des Sciences de la Santé, Libreville in May 2015.
- Held teleconference calls with potential in-country partners and the PREDICT Cameroon team to facilitate workplan development.

Other Activities this Period:

- Held meetings with regional PREDICT teams in Cameroon, RoC, and DRC to synergize workplans and coordinate a regional approach to surveillance.

GHANA

Highlights and Success Stories:

- Conducted preliminary scoping activities and identified primary subawardees for PREDICT-Ghana implementation.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- Outlined and shared the PREDICT-Ghana Scope of Work and planned Year 2 activities for operational alignment with prospective and planned partners.
- Identified potential field sampling sites for enhanced surveillance along key disease emergence pathways.
- Identified potential ethical approval bodies for consideration of in-country IRB applications.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- Conducted thorough evaluation of in-country human and animal laboratory capacity at the National Public Health Reference Laboratory (NPHRL; Ministry of Health), Noguchi Memorial Institute Research Laboratory (NMIRL; University of Ghana, Legon), and the Accra Veterinary Laboratory (AVL; Ministry of Food and Agriculture).
- Outlined preliminary plans to conduct PREDICT human sample analysis activities at NMIRL, with training and later implementation (pending facility development) at NPHRL; finalized decisions to implement animal sample analysis at AVL.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- Traveled to Ghana in July of 2015 and successfully engaged representatives of the Ghana Health Service, Disease Surveillance Department (Ministry of Health), FAO, and the USAID West Africa and Ghana Missions; established additional communications with the Ministry of Health Emergency Operations Centre.
- Initiated subaward proceedings to secure the Accra Veterinary Laboratory with the Wildlife Division of the Forestry Commission as the primary in-country PREDICT coordinating body.
- Solicited and vetted applications for the position of PREDICT-Ghana Country Coordinator.
- Coordinated with USAID, CDC, and FAO on in-country engagement.

GUINEA

Highlights and Success Stories:

- Official engagement delayed due to ongoing Ebola Virus Disease (EVD) outbreak response; no activities were conducted in Year 1.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- No surveillance or field activities were conducted in Year 1.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- No laboratory activities were conducted in Year 1.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- No stakeholder engagement or partner coordination activities were conducted in Year 1.

Other Activities this Period:

- No activities were conducted in Year 1.

KENYA

Highlights and Success Stories:

- Explored partnership opportunities and collaborations with EPT and US agency partners (FAO and US CDC and Department of Defense) and with in-country organizations, including the International Livestock Research Institute (ILRI); Kenya Wildlife Service (KWS); Department of Veterinary Services, Zoonotic Disease Unit (a collaboration between the Kenya Ministry of Agriculture, Livestock and Fisheries and the Ministry of Health); University of Nairobi Department of Veterinary Medicine; Kenya Wildlife Trust (KWT); Institute of Primate Research; and the National Museums of Kenya, Northern Rangelands Trust, Lewa Conservancy, and the International Centre of Insect Physiology and Ecology (ICIPE).

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- Identified target locations and interfaces for disease surveillance, specifically, camel value chains in the Turkana/Laikipia Region and local consumption and trade of potential Coronavirus reservoirs in Turkana/Laikipia and Nairobi/Kibera.
- Initiated potential collaboration with ILRI to acquire samples collected from baboons with exposure to humans and camels; plans for implementing PREDICT priority viral family testing, as well as MERS-CoV and serologic testing are planned for Year 2.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- Engaged and established an agreement with the International Livestock Research Institute (ILRI) laboratory for diagnostic testing, beginning with the processing of collected baboon samples for MERS evaluation.
- Also initiated discussions with ILRI to plan for MERS-CoV detection and additional viral family testing.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- Initiated a search for a country coordinator.

LIBERIA

Highlights and Success Stories:

- Official engagement delayed due to ongoing EVD outbreak response. No activities were conducted in Year 1.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- No surveillance or field activities were conducted in Year 1.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- No laboratory activities were conducted in Year 1.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- No stakeholder engagement or partner coordination activities were conducted in Year 1.

Other Activities this Period:

- No activities were conducted in Year 1.

REPUBLIC OF CONGO

Highlights and Success Stories:

- Signed a Memoradum of Understanding (MoU) on December 10, 2014 with the Directorate of Military Health at the Ministry of Defense granting PREDICT a permanent office in Brazzaville to support the administrative and programmatic management of the project with full-time staff.
- Granted a scientific permit by the Ministry of Forestry Economy and Sustainable Development covering surveillance activities through the entire period of PREDICT-2.
- With support of the PREDICT Cameroon team and a member of the Department of Forest Economy, the PREDICT RoC team participated in a practical training, with an initial session in Brazzaville and then traveled to the Sibiti region of the Lékoumou Department, 300 km northeast of Brazzaville in August 2015. During the training session, 558 samples were collected from bats and small rodents. During this trip, the team received training and technical assistance from the PREDICT Cameroon team in safe animal sampling methods and completed refresher trainings in information management, illustrating the cross-country collaborations that support a broader African cadre for disease response, including Ebola.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- Developed an implementation plan, including an estimated timeline for field and laboratory activities.
- Continued ongoing collaborations with local governmental authorities, stakeholders, and gobal and regional PREDICT teams to collect intelligence for identification of strategic surveillance and sampling locales.
- Obtained country maps indicating areas of extractive industry activity and identified key regions at high risk for disease transmission along human-wildlife interfaces and produced a table detailing the location and importance of biodiversity and the presence or absence of extractive industries to facilitate site selection.
- Identified potential sites for domestic animal and wildlife surveillance based on epidemiological importance, the volume of exploited species available to sample, and shared sites with FAO: these included farms around Brazzaville and Pointe-Noire, the Bouemba market, Boundji, Loudima, Mindouli, and Oyo.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- Renewed the collaboration between the INRB of Kinshasa DRC and the Laboratoire National de Santé Publique (LNSP) of Brazzaville, established during PREDICT-1, to facilitate testing of samples from RoC in DRC; this collaboration was reinstated through letter N°179/MSP/LNSP/DG/14 from the LNSP Director General.

- Continued analysis of data produced in PREDICT-1 with plans to to finalize an article on Coronaviruses currently in development.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- Together with governmental officials, strengthened communications and established procedures for governmental review and authorization of release and publication of project data.
- In May 2015, provided technical and financial support for the inaugural monthly EPT meeting held under the direction of the International Health Regulations (IHR) Focal Point and in partnership with the General Directorate of Epidemiology and the Fight against Disease (DGELM) and the Directorate of Public Health and Health Promotion (DHPPS). .
- Attended the PREVENT "restitution" (i.e., project wrap-up) meeting in Kinshasa on 12 June 2015, in which PREVENT provided an overview of their survey of bush meat markets. Information was provided on sources of bushmeat, demographic attributes of consumers, biosecurity in markets, and risk perception among vendors and market administrators. Results will inform future PREDICT bushmeat studies on biological and behavioural risk in RoC.

Other Activities this Period:

- Coordinated members of the LNSP, the National Vet Lab in Brazzaville (LNVB), and PREDICT teams in DRC and Cameroon to ensure integration of plans and activities.
- Continued coordination of weekly conference calls involving PREDICT's RoC, Cameroon, and DRC teams to discuss progress and activities.
- Continued to conduct monthly in-country coordination meetings designed to evaluate planning and implementation of project activities.
- Hosted team members from PREDICT Cameroon in Brazzaville in December 2014 for work planning.

RWANDA

Highlights and Success Stories:

- Engaged the Ministry of Health's operational branch, the Rwanda Biomedical Center (RBC) National Reference Laboratory (NRL), as a key partner for human specimen testing through the signing of a memorandum of understanding for collaboration during PREDICT-2.
- Trained six project and government personnel (one project technician, one Rwanda Agriculture Board (RAB) technician and four RBC human technicians) on viral family testing protocols; training was provided on-site by a US-based technician over five weeks in July-August at the NRL and the RAB Wildlife Virology laboratory in Rubilizi.
- Invited to participate in the drafting of a One Health work plan under the Government of Rwanda's One Health Strategic Plan 2014-2018; identified activities for which PREDICT will aim to provide technical support.
- Alerted by the Rwanda Development Board (RDB) to the first ever report of respiratory disease affecting wild human-habituated chimpanzees in Nyungwe National Park, a priority surveillance area; the team was invited by RDB to opportunistically collect fecal samples and forage material from sick chimpanzees in support of Rwanda's expanding response capacity for outbreaks among wildlife populations, especially those that could be hosts or susceptibles of Ebolavirus.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- Developed a wildlife surveillance plan (to be initiated in Year 2) in consultation with the Rwanda Development Board (RDB) with a focus on disease emergence pathways around Volcanoes National Park and in Eastern Province targeting land use commercialization (wildlife tourism); the wildlife surveillance plan will integrate with active governmental influenza, Acute Febrile Illness (AFI), and Severe Acute Respiratory Illness (SARI) surveillance sites identified in collaboration with the Ministry of Health.
- Initiated conversations with the Ministry of Health's operational arm, the Rwanda Biomedical Center (RBC), for potential coordination on human surveillance in Year 2.
- Translated draft human behavioral and biological surveillance questionnaires into Kinyarwanda in anticipation of submission of protocols to the Rwanda Ethics Board for Institutional Review Board approval in Year 2.
- Conducted reconnaissance visits to potential surveillance sites at human-wildlife interfaces and along disease emergence pathways in the greater Nyungwe National Park and Akagera National Park ecosystems, including an on-going primate-human conflict situation near Akagera for which PREDICT assessment was specifically requested by the Rwanda Development Board.

- Opportunistically acquired specimens from 28 primates in close contact with people, including from human-habituated mountain gorillas in Volcanoes National Park and from chimpanzees affected by two respiratory disease outbreaks in Nyungwe National Park.
- Acquired essential field surveillance supplies in preparation for surveillance starting in Year 2.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- Processed 87 (previously extracted) opportunistically collected wildlife samples for transfer to the NRL for viral family testing in Year 2.
- Transferred viral family testing protocols and trained project personnel, as well as RAB and RBC government personnel, on viral family testing protocols in July-August.
- Serviced the generator and laboratory equipment at the RAB Rubilizi Wildlife Virology Laboratory to maintain cold chain for the wildlife samples and biobank.
- Performed a needs assessment of laboratory facilities at the National Reference Laboratory (NRL) and initiated procurement of necessary supplies in preparation for surveillance starting in Year 2.
- Began drafting an *Assessment on Laboratory Collaborations within the One Health Framework,* as requested by the Minister of Health.
- Initiated communications among the National Reference Laboratory; RAB Animal Virology Laboratory; the RAB Wildlife Virology Laboratory; and the University Of California, Davis One Health Institute Diagnostic Laboratory (also a US-based PREDICT reference lab) for external quality assessment and assurance schemes for wildlife zoonoses.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- Introduced PREDICT-2 to the USAID Mission Rwanda, the Rwanda One Health Steering Committee, and to other government partners, including the Rwanda Development Board, Rwanda Agriculture Board, Rwanda Biomedical Center (Ministry of Health), the Government Ministerial social Cluster, and the University of Rwanda Schools of Veterinary Medicine and Public Health in March in Kigali.
- Invited to participate in Rwanda One Health Steering Committee planning meetings held in February and June in Kigali.
- Met with EPT Partners (Preparedness & Response and One Health Workforce) in Kigali to plan and coordinate Year 1 activities in March and April.
- Invited to participate in the Government of Rwanda's weekly briefings on Ebola alertness and preparedness, March to June.

- Provided informational assistance to the Rwanda Agriculture Board's Epidemiology Team during their Rift Valley Fever investigation, including exploring possibilities for wildlife surveillance.

Other Activities this Period:

- Hired a project veterinarian to assist the Country Coordinator with wildlife fieldwork and laboratory activities.
- Familiarized project personnel with the new EIDITH platform and associated data collection tools for wildlife surveillance .
- Participated in the One Health Demonstration site activities organized by the EPT One Health Workforce in Akagera National Park in August, teaching students about PREDICT and identifying potential interns for future participation in surveillance activities.
- Responded to request by the Rwanda Agriculture Board to help visually assess wild ungulate-livestock contact outside Akagera National Park during a suspected Foot and Mouth Disease outbreak affecting cattle. Complied with request in support of GoR outbreak response readiness.

Training Summary

Topic	Total # Trained*	# Women Trained	# PREDICT Staff Trained	# Government Ministry or Lab Staff Trained	# Students Trained
Lab safety	6	1	1	5	0
Viral detection and discovery	6	1	1	5	0
Grand total	**6**	**1**	**1**	**5**	**0**

**Multiple individuals cross-trained in various topics.*

SENEGAL

Highlights and Success Stories:

- Conducted initial scoping visit and identified primary subaward target for PREDICT-Senegal rollout.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- Under advisement from representatives of the Ministère de l'Environnement et du Dévelopment Durable (Ministry of the Environment and Sustainable Development; MEDD), Institut Sénégalais de Recherches Agricoles, Laboratoire National de l'Elevage et de Recherches Vétérinaires (ISRA, LNERV; Senegalese Institute of Agricultural Research, National Livestock and Veterinary Research Laboratory; Ministry of Agriculture), and FAO Senegal, identified key regions for PREDICT surveillance activities.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- Conducted initial scoping of laboratory activities at Institut Pasteur de Dakar (IPD), African Center of Excellence for Genomics of Infectious Disease (ACEGID), and ISRA.
- Targeted a collaborative for human sample testing between Institut Pasteur de Dakar and neighboring GoS African Center of Excellence for Genomics of Infectious Disease (ACEGID); selected ISRA, LNERV for animal sample analysis and country headquarters for PREDICT operations.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- Participated in the GHSA planning meeting in Dakar, Senegal, June 2015; the meeting included representatives from the US Embassy in Senegal's Health Policy Working Group, the US State Department, US CDC, USAID/DC, USAID/Senegal, DoD DTRA, USDA, WHO, FAO, IPD, the Ministère de la Sante et de l'Action Sociale (Ministry of Health and Social Action - MSAS), Ministry of Livestock, Department of National Parks (MEDD), Medecins Sans Frontieres, Inter-Regional Veterinary School of Dakar, PATH, and other local organizations; PREDICT supported USG partners in developing GHSA strategies working towards high-level Action Plans for in-country enagement.
- Traveled to Senegal in July, 2015 and engaged key figures at MEDD, FAO, the MSAS, USAID Senegal, the African Center of Excellence for Genomics of Infectious Diseases (ACEGID; coordinated by MSAS and the University Cheikh Anta Diop), and the International Center of Excellence in Malaria Research (ICEMR).
- Initiated subaward proceedings to retain ISRA for primary coordination of PREDICT-Senegal activities.

SIERRA LEONE

Highlights and Success Stories:

- Official engagement delayed due to ongoing EVD outbreak response. No activities were conducted in Year 1.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- No surveillance or field activities were conducted in Year 1.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- No laboratory activities were conducted in Year 1.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- No stakeholder engagement or partner coordination activities were conducted in Year 1.

Other Activities this Period:

- No activities were conducted in Year 1.

SOUTH SUDAN

Highlights and Success Stories:

- PREDICT engaged Bucknell University in a contract for services to test archived specimens collected in-country as a Coronavirus pilot and to begin preliminary scoping work. Bucknell was selected because of their existing relationships with partners that can be leveraged for success.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- Developed a workplan focused on Years 2-5 and selected sites for zoonotic disease surveillance of animals and people in the Doromo area (Nzara County and Western Equitoria State), including bushmeat markets inside game reserves.
- Conducted a preliminary baseline assessment of wildlife sampling investigations to date and identified approximately 1,000 archived bat and rodent tissue samples from previous collections that could be made available for viral detection and discovery.
- Leveraged a partnership with Bucknell University to pair up with existing activities and gain information from an ongoing survey plan with locally hired personnel on wildlife use and knowledge of behavioral risk; preliminary results suggest widespread bushmeat hunting activities that will inform surveillance priorities.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- No laboratory activities were conducted in Year 1.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- PREDICT global partners have not yet conducted a scoping visit to South Sudan, though partners at Bucknell University have established relationships with the Ministry for Wildlife Conservation and Tourism at the Federal level, as well as at the state and local levels in Central Equatoria State and Western Equatoria State where they have good relationships with the former governor, the minister for local government, and county commissioners for Ezo and Nzara Counties as well as NGO the consortium operating in the region.
- Mission and governmental engagement for implementation of project activities beyond this intial pilot are planned for early in Year 2.

SUDAN

Highlights and Success Stories:

- No activities were conducted in Year 1.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- No surveillance or field activities were conducted in Year 1.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- No laboratory activities were conducted in Year 1.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- Contacted potential partner (University of Khartoum) to prepare for an initial scoping visit tentatively scheduled for April 2016.

Other Activities this Period:

- No activities were conducted in Year 1.

TANZANIA

Highlights and Success Stories:

- Conducted trainings and optimized laboratory operations at the Sokoine University of Agriculture (SUA) lab and a partner lab at the Ifakara Health Institute (planned as a possible site for testing of human specimens in Year 2) to standardize and optimize lab protocols across all sites; trainings included sessions in laboratory safety and updated RNA extraction and viral family level PCR protocols for Arenavirus, Bunyavirus, Coronavirus, Filovirus, Influenzas and Paramyxoviruses, along with best practices for laboratory work flow and data management.
- Contributed to USAID-Tanzania's plan and implementation of the Global Health Security Agenda's (GHSA) action packages in-country during a meeting in Dar es Salaam to coordinate complimentary activities among EPT partners. Attendees included representatives from USAID, DoD DTRA, CDC Tanzania, USAID, OHCEA, Ministry of Health and Social Welfare, Ministry of Livestock and Fisheries Development, National Health Lab, Tanzania Veterinary Laboratory Agency, Tanzania Wildlife Research Institute, and WHO.
- Identified and characterized potential high-risk locations and interfaces in the Coastal (Dar es Salaam and surrounding areas) and Lake Zone (Kagera and Kigoma Districts) to explore biological and behavioral risk factors for disease emergence and to evaluate sites, partnerships, and health facilities for engagement in surveillance activities. The team also held strategic meetings with key local stakeholders, including District Veterinary Officers (DVO's), District Medical Officers (DMO's), District Game Officers (DGO's), the MoH's Director of Epidemiology, and the Director of Veterinary Services, to discuss how to optimize PREDICT's surveillance plans to best target areas of need and to explore opportunities for coordination of human and animal sampling.
- Held planning meetings with Pathogen Detection Lead and lab technicians at the SUA lab in preparation for Year 2 viral detection activities and met with the Director and affiliated scientists of the Government of Tanzania's National Health Laboratory to explore opportunities for collaboration.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- Developed a surveillance plan targeting human and wildlife at the high-risk pathways of intensification of animal production systems and land conversion for commercialization for disease emergence and planned implementation strategies in conjunction with the global team and in-country partners.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- Extracted and transported 50 tissue samples collected from the participatory bushmeat value chain project established in villages in the Ruaha Ecosystem during PREDICT-1 for viral screening; results expected in Year 2.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- Shared bat and rodent test results from PREDICT-1 with the Ministries of Livestock and Fisheries Development, Ministry of Health and Social Welfare, Tanzania Wildlife Research Institute, and National Institute for Medical Research (NIMR).
- Participated in meetings with Ministry of Livestock and Fisheries Development officials led by the Director of Veterinary Services and discussed various livestock intensification practices and common zoonotic disease challenges in Tanzania.
- Participated in meetings with officials from the Ministry of Health and Social Welfare, Preventive Services Department to explore information on geographic areas with reported cases of fevers of unknown origin and influenza like illness in anticipation of initiating human surveillance activities.
- Visited sites in areas targeted for surveillance in PREDICT-1 in the Udzungwa and Ruaha ecosystems to meet with and distribute risk communication materials (project updates, reports, and summarized findings) to park wardens, ecologists, veterinary officers, and medical officers from surrounding health facilities.

Other Activities this Period:

- Trained 14 international veterinary students and one human medical student from Germany in the One Health and PREDICT's Approach to disease surveillance, specifically human-wildlife contact in Kilombero Valley region.
- Shared PREDICT-1 final report with the USAID-Tanzania Mission and all in-country stakeholders.
- Participated (Country Coordinator) in an intensive FAO regional field epidemiology training program for veterinarians held in Arusha in July; and presented (Principal Investigator) on PREDICT's surveillance and risk assessment approach.
- Received acceptance of two abstracts for presentation at the Tanzania Wildlife Research Institute's 9th Scientific Conference in December; presentations are entitled, "Systematic surveillance and capacity strengthening to detect emerging viral zoonoses of wildlife origin in Tanzania" and "Detection of arenaviruses in rodent and shrews from selected wildlife-human interfaces in Tanzania".
- Hosted a journalist from Public Radio International exploring pandemic risk pathways that drive viral emergence between humans and animals during visits to PREDICT-1 surveillance areas in the Kilombero valley; the resulting story is available at http://www.pri.org/stories/2015-04-16/prevent-next-ebola-scientists-try-catch-new-viruses-they-break-out.

Training Summary

Topic	**Total # Trained***	**# Women Trained**	**# PREDICT Staff Trained**	**# Government Ministry or Lab Staff Trained**	**# Students Trained**
One Health Approach	15	15	0	0	15
Field epidemiology	1	0	1	0	0
Lab safety	7	2	3	0	0
Viral detection and discovery	5	2	1	0	0
Grand total	**22**	**17**	**3**	**0**	**15**

**Multiple individuals cross-trained in various topics.*

UGANDA

Highlights and Success Stories:

- Briefed the Government of Uganda's State House in Entebbe in March during a government-led primate capture and sampling exercise on State House grounds and presented on the public health risks posed by human-primate contact and the purpose and objectives of the PREDICT-2 project to the President's office.
- Participated in a workshop with the Ministry of Health and partners in April in Entebbe to review and develop Standard Operating Procedures (SOPs) and guidelines for Ebola and Marburg virus disease management from detection and initiation of effective response to effective implementation of outbreak control measures, taking lessons from the West Africa Ebola outbreak; additional activities included the review of the structure and composition of the National Task Force.
- Signed a renewed cooperative agreement with Makerere University Walter Reed Project (MUWRP) for implementation of viral family testing of animal and human samples at MUWRP's Influenza Research laboratory at Makerere University, Kampala (animal specimens) and at the MUWRP laboratory based at the Uganda Viral Research Institute, Entebbe (human specimens).
- Invited to participate in a Global Health Security Agenda (GHSA) meeting in Kampala in June to help develop the five year Uganda-specific milestones for achieving GHSA objectives according to action packages within the GHSA Prevent-Detect-Respond framework. Identified key partners in implementation of the activities necessary to achieve each milestone.
- Received Institutional Review Board approval from the Uganda Research Ethics Committee (at Mbarara University) and the Uganda National Council for Science and Technology for qualitative research for behavioral risk surveillance and characterization at the animal-human interface.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- Hired a new field veterinarian to assist the Country Coordinator with field surveillance activities.
- Worked with the Uganda Wildlife Authority and the Uganda Wildlife Education Center to collect samples from vervet monkeys that were being trapped and translocated from sites in Entebbe (including the State House) where the level of primate contact with humans had reached nuisance levels; collected approximately 340 samples from 68 vervet monkeys.
- Continued to collaborate with Buhoma Community Hospital and Mutolere Catholic Hospital in southwestern Uganda to discuss and plan partnering on human surveillance starting in Year 2.
- Developed a Year 2 work plan for wildlife and human surveillance in consultation with government partners; visited potential surveillance sites to assess opportunities and feasibility for concurrent wildlife and human sampling.
- Pilot-tested data collection forms and behavioral surveillance data forms at several potential surveillance sites.

- Acquired essential supplies for field surveillance starting in Year 2.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- Provided Makerere University Walter Reed Project (MUWRP) with updated viral family testing protocols.
- Assisted MUWRP with acquisition of essential laboratory supplies in anticipation of laboratory testing commencing in Year 2.
- Serviced subzero freezers to maintain reliable cold-chain for storage of animal samples.
- Inventoried all bio-banked specimens.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- Participated in the Queen Elizabeth National Park (QENP) ecosystem research and development partners' meeting in Kasese in January to identify research and development priorities and to set up strategic collaborations for wildlife and human health in the QENP ecosystem.
- Participated in a Bwindi Mgahinga Conservation Area partners meeting February to discuss potential collaborations on animal health issues including PREDICT.
- Met with the National Animal Disease Diagnostic and Epidemiology Center (NADDEC) of the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) in March in Entebbe to discuss potential collaboration on livestock sampling.
- Met with Chief of Party for Preparedness and Response and his staff in March in Kampala to discuss One Health networks and platforms and to provide an overview of PREDICT-2 surveillance plans.
- Attended a FAO Eastern Africa Regional Animal Health Network meeting in Kampala in September to align EPT partner activities in Uganda.
- Participated in a One Health workshop in Entebbe in September to review the country surveillance and sector preparedness mechanisms within the East African Integrated Disease Surveillance Network.

Other Activities this Period:

- Completed training of project personnel on qualitative survey methods in August in preparation for qualitative survey work in Year 2.
- Provided on-ground technical assistance to Queen Elizabeth National Park in November with investigation of a disease event involving 17 goat mortalities, in support of cross-sectoral outbreak awareness and preparedness training.
- Reviewed all PREDICT protocols and participated in on-line training on the new internal data management system (EIDITH).

Training Summary

Topic	Total # Trained*	# Women Trained	# PREDICT Staff Trained	# Government Ministry or Lab Staff Trained	# Students Trained
Behavior risk	5	3	2	0	2
Safe sample transport	3	1	0	0	3
Biosafety and PPE	3	1	0	0	3
Safe animal handling and sampling	3	1	0	0	3
Grand total	**8**	**4**	**2**	**0**	**5**

**Multiple individuals cross-trained in various topics.*

BANGLADESH

Highlights and Success Stories:

- Formalized partnerships with Government of Bangladesh (GoB) and other in-country organizations through the signing of a Memorandum of Understanding (MOU) to support disease surveillance, wildlife health, ecological and conservation research, and One Health development: MOUs executed with the Ministry of Health and Family Welfare, Forest Department, and Chittagong Veterinary and Animal Sciences University (CVASU).
- Published an article in *Nature Communications* entitled, "Non-random patterns in viral diversity" (Section 5: Anthony et al., 2015).

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- Conducted preliminary site assessments in Dhaka (Old Dhaka and Dhamrai), Narayanganj (Bondor), Gazipur Safari Park, Chandpur, Chakaria Safari Park, Kaptai, Barishal (Uzipur), Shariatpur, Madaripur, Gazipur, Narsingdi, and Sylhet Districts for macaque sampling along the land conversion pathway (including urban, rural, and areas with low anthropogenic disturbance).
- Collected samples from a total of 1,264 macaques along the land conversion pathway from the following districts: Barisal, Chandpur, Cox's Bazar, Dhaka, Gazipur, Madaripur, Narayanganj, Narsingdi, Rangamati, Shariatpur, and Sylhet. Samples were also collected from four bats along the land conversion pathway. The bat samples will be tested in-country at the icddr,b laboratory; macaque samples will be tested at Columbia University's Center for Infection and Immunity (CII).
- As part of the first MERS surveillance activity in Bangladesh, collected samples from 60 dromedary camels from a live animal market in Dhaka. The camels were imported for an annual festival and sampled to screen for MERS coronavirus. These samples will be tested for coronavirus RNA and antibodies against MERS CoV at icddr,b; lab reagents were provided by NIH NIAID Rocky Mountain Labs.
- Developed a surveillance plan to prioritize and coordinate human-animal sampling sites and target populations for biological and behavior risk data collection; targeted sites include high-risk urban, rural, and low disturbance settings with human-macaque interaction along a land conversion gradient.
- Obtained IRB approval for conduct of qualitative and observational research to address people's beliefs and activities concerning their daily interactions with animals to inform on transmission risks and to help identify intervention opportunities. Following IRB approval, the team conducted 40 ethnographic interviews and two focus group discussions at surveillance sites; data from the interviews are being transcribed and translated for analysis.
- Tested and reviewed EIDITH data collection forms (site/event, animal samples and specimens).
- Evaluated EIDITH data collection field tools for the Human Questionnaire (Section 6.1).

- Worked with the global team to design and introduce the in-depth, standardized, qualitative human behavioral risk data collection protocol.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- Tested 452 throat swabs collected from rodents and shrews during PREDICT-1 at icddr,b for six viral families with positive results detected for Adenoviruses, Astroviruses, Influenza viruses, and Rotavirus-A. These results have been reported to the GoB.
- Tested 458 fecal samples collected from rhesus macaques during PREDICT-1 at the Center for Infection and Immunity, Columbia University (CII) using consensus polymerase chain reaction and high-throughput sequencing and detected 184 viruses from 14 viral families. These results were approved by GoB, released on HealthMap, and published in the article referred to above "Non-random patterns in viral diversity" (Section 5).
- Strengthened in-country field and lab cold chain by acquiring additional liquid nitrogen dry shippers and installing a new -80°C ultra low freezer at the Institute of Epidemiology, Disease Control, and Research (IEDCR).

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- Held coordination meetings with the Department of Livestock Services, Forest Department, and Ministry of Health and Family Welfare (IEDCR).
- Together with FAO partners, met with the Department of Livestock Services and developed a plan for concurrent sampling in Year 2 and discussed capacity within GoB veterinary laboratories.
- Maintained regular meetings with the USAID Mission to discuss plans.
- Participated in a workshop organized by WHO and IEDCR for the Development of Tools for Influenza Pandemic Risk Assessment (TIPRA) and its potential use in Bangladesh.
- Organized the One Health Bangladesh Conference with the Epidemiology Unit in the Department of Livestock Services, Epidemiological Association of Bangladesh, Health Population and Nutrition Sector Development Program, Forest Department, Bangladesh Livestock Research Institute, CVASU, Bangladesh Poribesh Andolon, UNICEF, icddr,b, CDC, Massey University, IEDCR, WHO, and FAO and presented PREDICT-1 achievements and future directions.
- Participated in the EPT-2 partner coordination meeting organized by USAID and FAO and presented Year 1 plans and activities.
- Met with the P&R team to discuss project plans and opportunities for collaboration.
- Participated in the Global Health Security Agenda (GHSA) partners' meeting organized by USAID regarding ongoing and upcoming activities and opportunities to link, coordinate, and integrate GHSA and EPT-2.
- Participated in GoB-FAO Technical Planning Workshop for developing activities necessary to implement the USAID-funded EPT-2/GHSA program in Bangladesh.

- Participated in the National One Heath Meeting and presented project activities.
- Participated in the One Health Policy Dialogue Consultative Meeting on the establishment of the One Health Secretariat.

Other Activities this Period:

- Conducted training workshop on qualitative behavioral assessment for 19 participants in collaboration with IEDCR.
- Conducted training for six Forest Department staff and one new PREDICT team-member on zoonotic disease surveillance, biosafety, and field anesthesia of macaques (see Training Summary below).
- Translated ethnographic interview guides, focus group guides, and observational protocols, along with all workshop training materials required for development of behavior risk capacity in-country and completed training of 32 individuals, including four PREDICT team members and five GoB personnel in anticipation of the roll-out of behavior risk activities described above.
- Contributed to a workshop on how to introduce One Health to young professionals designed to explain the One Health concept and its importance to future One Health leaders.
- Participated in a stakeholder workshop sponsored by the Royal Veterinary College, University of London on behavioral adaptations in live-poultry trading and farming systems and zoonoses control in Bangladesh, as part of a project designed to develop policies to reduce the risk of human behavior contributing to the spread of emerging zoonoses in these systems.

Training Summary

Topic	**Total # Trained***	**# Women Trained**	**# PREDICT Staff Trained**	**# Government Ministry or Lab Staff Trained**	**# Students Trained**
Behavior Risk	32	8	4	5	11
Biosafety and PPE	6	0	2	4	0
Safe Animal Capture	3	0	2	1	0
Total	**36**	**8**	**4**	**9**	**11**

**Multiple individuals cross-trained in various topics.*

CAMBODIA

Highlights and Success Stories:

- Engaged government partners from the Cambodia CDC, Ministry of Agriculture, and the Forestry Administration to develop a coordinated One Health field approach to establish a multi-sectoral field team with animal, human health, and forestry government counterparts and successfully went into the field as a One Health team to complete pilot sampling of rodents and bats.
- Received an award for a presentation at the Molecular Epidemiology and Evolutionary Genetics of Infectious Diseases (MEEGID) conference in Bangkok; the presentation featured results obtained from Cambodian and Lao bat Coronaviruses detected at IPC using PREDICT protocols.
- Initiated plans with FAO for coordinated livestock sampling to occur concurrent with wildlife and human sampling at two high-risk interface sites: the rodent trading site in Kandal Province (Koh Thom district) at the border with Viet Nam and bat farms in in the Rokar Ar community in Kampong Cham Province.
- Met with National Institute of Public Health (Ministry Of Health) to initiate process for collaboration to receive human samples for testing at SARI and ILI sites using PREDICT protocols.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- Conducted assessments at the Cambodia-Viet Nam border at a rodent trading site in Kandal Province to evaluate the site for concurrent wildlife, livestock, and human sampling and collected samples from 179 rodents (1664 samples collected) for testing for eight priority viral families.
- Evaluated bat farms as a high-risk interface and disease emergence pathway for future concurrent wildlife, livestock, and human surveillance and collected samples from 109 bats and 16 rodents (420 fecal and urine samples) in and around farms in Kampong Cham province for testing for eight priority viral families.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- Formulated plans and rolled-out updated PREDICT protocols for diagnostic testing targeting eight viral families.
- Initiated high throughput sequencing for further characterization of the genomes of Coronaviruses detected in PREDICT-1 with UC Davis and Columbia University.
- Met with FAO to discuss continued training of laboratory staff from the National Veterinary Research Institute (NaVRI - Ministry of Agriculture, Forestry, and Fisheries) and potential testing of livestock samples at the project lab at the Institute Pasteur de Cambodge.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- Participated in One Health Platform Meeting at the Royal University of Agriculture.
- Met with the Vice Director for International Relations and the Dean of the Faculty of Veterinary Medicine from the Royal University of Agriculture (RUA) to discuss continued training opportunities for students.
- Conducted field sampling together with NaVRI, the Forestry Administration (FA), and the Cambodian Communicable Disease Control Department (CDC).
- Met with relevant NaVRI, FA, and National Institute for Public Health (NIPH) government partners to plan for laboratory training and joint diagnostic testing using PREDICT protocols, including initiation of testing at the government animal health laboratory NaVRI.
- Attended and shared surveillance plans at Zoonotic Technical Working Group meetings (participants included NaVRI, FA, CDC, USAID, USCDC, WHO, FAO, and IPC)

CHINA

Highlights and Success Stories:

- Strengthened laboratory capacity by improving sampling, analysis, data reporting, and quality assurance/control workflow among field sites and both Wuhan Institute of Virology and Guangdong Centers for Disease Control.
- Detected a novel Coronavirus clustering with the SARS-like Coronaviruses in *Rhinolophus* bats from Guangdong (findings are detailed in a manuscript published in *Nature Medicine* this November: Menachery et al., 2015 "A SARS-like cluster of circulating bat coronaviruses shows ponteital for human emergence"). Further characterization of this Beta coronavirus is underway, including sequencing of spike proteins, to determine if it has the potential to infect other hosts.
- Expanded the core capabilities of the China team to include skills and expertise in behavioral risk investigations through trainings in human behavioral data collection in Yunnan, Guangxi, and Guangdong. All materials, guides, and data collection tools for behavioral risk activities (Behavioral Research: "Qualitative Research for Behavioral Risk Surveillance and Characterization") were translated into Chinese and provided to teams including the ethnographic interview guides, focus group guides, and observational protocols. In total, 17 individuals received training with the teams implementing new skills as activities were initiated in Yunnan, Guangxi, and Guangdong. These trainings are part of the six-country qualitative research project that will inform on PREDICT surveillance and in-country intelligence on human-animal contact and surveillance prioritization.
- Conducted approximately 65 ethnographic interviews and four focus groups in Yunnan, Guangxi, and Guangdong. Preliminary findings suggest that there is a consistent perception that wildlife is dwindling, though bats continue to be opportunistically hunted and eaten. One intervention implication is potential conservation readiness, since communities express distress at the change in wildlife abundance due to overhunting and environmental degradation.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- Collected specimens from 459 bats (20 species) from Guangdong (Yingde Huidong, Zengcheng, Zhuhai, and Conghua counties) and Guangxi (Guilin county) provinces in locations identified as proximate to humans and agricultural animals.
- Collected acute syndromic human samples (passive surveillance for five syndromes of unknown origin: hemorrhagic fever, encephalitis, respiratory fever with rash and fever with diarrhea) from 13 hospitals in Guangdong Province.
- Identified Yunnan hospitals with Infectious Disease Departments with the capability, interest, and patient populations relevant to implement surveillance.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- Tested 456 bat samples (rectal swabs and nasopharyngeal samples) for Paramyxovirus and Coronavirus; obtained sequencing results confirming 13 Paramyxovirus-positive and 95 Coronavirus-positive results. Beta Coronaviruses related to SARS or MERS will be identified and spike proteins sequenced.
- Tested 74 encephalitis syndrome samples and 20 respiratory syndrome samples for 12 viruses: Paramyxovirus, Alphvirus, Hantavirus, Seadornavirus, Flavivirus, Bunyavirus, Henipavirus, Coronavirus, Phlebovirus, Rhabdovirus, Filovirus, and Enterovirus; obtained sequencing results confirming one Paramyxovirus and Henipavirus dual positive result (Henipavirus result later confirmed negative).
- Tested 94 human respiratory samples for four viruses: Paramyxovirus, Influenzavirus, Coronavirus, and Filovirus; obtained the DNA sequencing results confirming three Paramyxovirus-positives, three Influenza-positives, and one Coronavirus-positive.
- Conducted a sequence analysis training at Wuhan Institute of Virology and the Pathogenic Microbiology Institute in Guangdong and provided a Geneious license to two personnel at each of these institutes.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- Met with collaborators at Wuhan University School of Public Health to plan behavioral risk research in Year 2.
- In collaboration with FAO, confirmed all Yunnan, Guangdong, and Guangxi field sites for concurrent sampling in Year 2.
- Participated in the China CDC's annual "National Vector-borne Disease Surveillance Workshop, Xiamen" and provided an update on disease control and prevention policy revisions in China.
- Participated in the 6th "Emerging Viral Diseases Symposium" in Wuhan and discussed PREDICT-2 China implementation with implementing partners, as well as in-country teams from GDCDC and Wuhan Institute of Virology.
- Met with collaborators from Fudan University in Shanghai and Oklahoma University, USA to plan avian influenza sampling and human surveillance in Jiangxi Province.
- Participated in the The 6th Annual World Congress of Virus and Infections in Shanghai organized by BIT Congress, Inc.
- Participated in the 7th Annual Global Virus Network Meeting in Beijing; also visited China CDC Laboratory in Beijing; presented on PREDICT work in China at both.

Other Activities this Period:

- Revised laboratory data QA/QC workflow and reviewed sequence result interpretations from PREDICT-1.
- Incorporated data from surveys, trainings, field, and labs into EIDITH forms, with plans to upload all data early in Year 2.

- Secured ethical approval from Wuhan University School of Public Health and Guangdong Center for Disease Control for behavioral research.
- Began preparation of a manuscript: “Zoonotic Transmission Risk in Workers with Wildlife Contact.”
- Published in *Journal of General Virology*, “Detection of diverse novel Astroviruses from small mammals in China.”
- Reviewed result release approval process with in-country partners.

Training Summary

Topic	Total # Trained*	# Women Trained	# PREDICT Staff Trained	# Government Ministry or Lab Staff Trained	# Students Trained
Behavior Risk	17	5	2	15	1
Viral detection and discovery	1	1	0	1	0
Total	**19**	**6**	**3**	**16**	**1**

**Multiple individuals cross-trained in various topics.*

INDIA

Highlights and Success Stories:

- Successfully identified a primary implementing partner (the Public Health Foundation India – PHFI) and hired the Country Coordinator.
- Together with FAO and the USAID India Mission GHSA/EPT Point of Contact, attended the GHSA stakeholder meeting in Delhi, organized by the US CDC, to coordinate activities with the GoI National Centre for Disease Control (NCDC) and other potential GoI partners. During the meeting, PREDICT engaged technical leads from the US CDC and NCDC, the National Institute of Virology (NIV), National Institute of Mental Health and Neurosciences (NIMHANS), India Council for Medical Research (ICMR), the Ministry of Agriculture (MoA), and the Ministry of Health and Family Welfare (MOHFW) and identified potential national and state-level collaborators for upcoming in-country activities. As a result, PREDICT and FAO were encouraged by the MoA's Department of Husbandry, Dairying and Fisheries (DHDF) Director to initiate work at the state level and establish proof-of-principle for proposed GHSA/EPT, multi-sectoral surveillance activities. State level visits will be conducted in early Year 2.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- No surveillance or field activities conducted in Year 1.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- No laboratory testing conducted in Year 1.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- At the request of the Ministry of Agriculture (ICAR) and DHDF, provided 2-page concept notes summarizing EPT/GHSA activities.
- Met with US CDC lead for India to discuss GHSA activity and potential opportunities to coordinate human, wildlife, and livestock surveillance around human acute encephalitis syndrome of unknown origin in northern India (e.g., Uttar Pradesh, West Bengal)

INDONESIA

Highlights and Success Stories:

- The PREDICT Country Coordinator was appointed to the expert panel for the National Committee for Zoonosis Control (KomNas Zoonosis) – a trans-ministry platform that serves as the national task force for addressing zoonotic disease issues.
- PREDICT participated in the workshop on Ebola contingency plans in Bogor. This workshop was conducted by the Indonesian national disaster agency (BPPB) for preparation of contingency plans for Ebola outbreak in Indonesia.
- Over the course of two weeks, successfully trained lab staff (11 individuals, four of them women) from the Ministry of Agriculture Laboratories and Disease Investigation Centers (DICs) Maros and Banjarbaru in laboratory safety and intensive hands-on laboratory investigations from sample extraction to final sequencing of positive specimens. In addition, follow-up trainings were organized in collaboration with FAO on bioinformatic analysis of sequence results from domestic animal screening. During the trainings, mammal and avian domestic animal specimens from DICs at Maros and Banjarbaru were screened for three viral families (Coronaviridae, Paramyxoviridae, Herpesviridae) and two additional viral pathogens (Influenza A, and Encephalomyocarditis virus) using PREDICT protocols. Results were sent by DICs to MoA Director of Animal Health. As a result, MoA and DIC lab staff are well equipped with the knowledge and technical skills to complete viral detection and discovery activities.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- Developed surveillance and specimen collection plans for wildlife, domestic animals, and humans across the animal value chain of Sulawesi, including wet markets of Tomohon and Manado, North Sulawesi; live bat source populations in Gorontalo Province; and frozen bats and domestic animals from South Sulawesi – animal specimen collection is planned for early 2016.
- Continued to implement and improve systems for standardized sampling data collection and tested protocols to characterize pathways for disease emergence within epizones, including optimal collection, processing, storage, and transport.
- In coordination with other EPT partners, identified sites in Manado, Bali, and Banjarmasin for surveillance and concurrent sampling of humans within identified high-risk regions and transboundary epizones and assessed local capacity and logistical issues related to implementation of activities at each site.
- Continued to support logistics for human sampling by providing specimen collection materials (swabs, VTM, and tubes) to local collaborators in Bali, Banjarmasin (South Kalimantan) and Manado (North Sulawesi) for ongoing

surveillance at health facilities targeting patients with fever of unknown origin and undiagnosed severe respiratory infections.
- Contributed to the development of protocols for human sampling and behavioral surveys with global team and conducted preliminary training with staff in behavioral risk survey methods; follow-up training with global staff planned for Year 2.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- Continued to receive and test archived, undiagnosed human specimens from partners in hospitals and universities: Ulin Hospital, Banjarmasin; Warmadewa University, Bali Cipto Mangunkusumo Hospital, Jakarta; Kandou Hospital, Manado; Pajajaran University, Bandung.
- Optimized PCR protocols for expanded viral characterization of archived animal specimens found positive from PREDICT-1 with focus on specific protocol optimization for spike gene of Coronaviruses and fusion gene of Paramyxoviruses.
- Purchased a new -80°C freezer for wildlife specimen storage at PRC-IPB Bogor.
- One PREDICT team member participated in TEIN4 Next Generation Sequencing (NGS) Training at Perdana University, Kuala Lumpur, Malaysia.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- Participated in EPT-2 kick-off and planning meetings to coordinate activities across EPT partners.
- Attended monthly meetings with USAID Jakarta, EPT-2 partners, WHO, FAO, CDC, and other partners.
- Provided technical support during Quarter 1 meetings with Institute of Vector and Reservoir Control Research and Development, Salatiga, for vector and reservoir investigations.
- Participated in focus group discussions with stakeholders and the National Commission for Wildlife Health to finalize the "Guide for Prevention and Control of Infectious Disease in Wildlife"; the resulting document will support training of forest rangers and wildlife staff in future.
- Participated in several coordination meetings with FAO and USAID to synchronize concurrent sampling of wildlife and domestic animals.
- Completed scoping visits to Maros (S. Sulawesi) and Banjarbaru (S. Kalimantan) with FAO ECTAD-Indonesia partners and transferred technology for PREDICT Laboratory Protocols to the Indonesia national veterinary labs functioning under the Ministry of Agriculture, Directorate of Animal Health.

Other Activities this Period:

- Interviewed candidates to expand core project staff with the addition of a new human behavioral research coordinator and an assistant to the country coordinator; both to be hired in Year 2.
- Submitted proposal for qualitative human behavioral research in N. Sulawesi; currently under final review at Ministry of Research, Technology, and Higher Education in conjunction with accompanying Foreign Research Application.
- Attended E-ASIA joint research program scientific workshop on Infectious Diseases and Associated Malignancies inYangon, Myanmar.
- Attended the International Conference on Emerging Infectious Diseases in Atlanta, Georgia and presented a poster presentation with title: "*Coxsackievirus B3: an Etiologic Agent of Acute Febrile Illness in Bandung, Indonesia*."
- Presented PREDICT at the Third International One Health Congress, Amsterdam, Netherlands.

Training Summary

Topic	**Total # Trained***	**# Women Trained**	**# PREDICT Staff Trained**	**# Government Ministry or Lab Staff Trained**	**# Students Trained**
Behavior risk	1	0	1	0	0
Safe sample transport	1	0	0	0	0
Biosafety and PPE	8	3	1	7	0
Safe animal handling and sampling	1	0	1	0	0
Viral detection and discovery	13	4	1	11	1
Total	**13**	**4**	**1**	**11**	**1**

**Multiple individuals cross-trained in various topics.*

LAO PDR

Highlights and Success Stories:

- Organized the "Lao PDR Synchronized Surveillance Planning Meeting" in Vientiane in August with key government partners (the National Animal Health Laboratory, NAHL, and the National Center for Laboratories and Epidemiology, NCLE), the local office of FAO, as well as USAID RDMA staff. The meeting resulted in an integrated work plan for concurrent surveillance with FAO, with potential surveillance sites selected. NCLE will be responsible for all human sample analysis for PREDICT-2, NAHL will undertake all wild-animal sample analysis, and FAO will conduct domestic animal surveillance.
- In collaboration with PREVENT, submitted a manuscript for publication on the disease risks associated with the wildlife trade in Lao PDR; the manuscript is currently in review.
- Identified and hired a country coordinator in Vientiane.
- Established an office at the NAHL; establishing this direct connection with the government collaborator responsible for animal testing for PREDICT-2 activities in Lao PDR will provide opportunities for ongoing collaboration, facilitate protocol implementation, and solidify relationships among collaborators.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- Together with in-country collaborating partners, including NAHL, NCLE, and FAO, identified Champasak Province as a candidate for scoping visits to identify sampling sites for Year 2. From the initial information available from consulting with Lao PDR government staff and FAO, Champasak Province provides excellent opportunities to work at the human-animal interface along the animal value chain pathway due the volumes of wildlife being hunted and traded in the area. Previous PREDICT work in the area suggests that villagers and wildlife traders will be willing to participate in biological and behavioral studies.
- With input from all partners, planned scoping activities for November 2015, with senior representatives from each organization agreeing to be part of the field team.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- Assessed the facilities at NAHL and NCLE, the in-country human and animal laboratories, respectively, and identified equipment and supply needs.
- Held meetings between the Country Coordinator and key senior members of both laboratories to discuss the needs of each as they related to PREDICT-2 activities.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- Participated in the Lao Inception Meeting with the RDMA to discuss the PREDICT-2 scope of work and to coordinate with EPT-2 partners in-country and within the region; meeting attendees included Lao PDR government officials and representatives from PREDICT Global and China, as well as FAO Bangkok and Lao PDR, to encourage a regional and epizonal approach to surveillance and work plan development.

- Prepared a memorandum of understanding to allow work with the Ministry of Health and the Department of Livestock and Forestry.

MALAYSIA

Peninsular Malaysia:

Highlights and Success Stories:

- Assisted the Department of Wildlife and National Parks (PERHILITAN – Ministry of Natural Resources and the Environment) with construction of their new National Wildlife Forensic Laboratory, which includes ISO 17025 standards for forensic work and BSL2 disease diagnostic capabilities; the lab will be online by end of December.
- Worked with the Minstry of Health (MoH) to set up a comparative evalution of the PREDICT protocols with traditional testing at the National Public Health Laboratory (NPHL) and for incorporation into their Standard Operating Procedures (SOP) for patients with unidentified diseases.
- Successfully engaged with US Embassy partners by attendeding dinner at US Ambassador's Residence to discuss PREDICT and meeting with the Embassy's Counselor for Economic Affairs and Environment, Science, Technology and Health Officer to discuss progress. As a result, PREDICT was asked to provide a briefer for US Secretary of State Kerry's visit to Malaysia in October 2015.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- Completed Kuala Lipis Orang Asli and Gua Musang site visits in preparation for human sampling, to evaluate site and request permission to sample wildlife and livestock.
- With PERHILITAN, collected 1,567 samples from 354 animals (108 bats, 324 samples; 46 non-human primates, 368 samples; 145 rodents and shrews, 435 samples; and 55 other taxa, 440 samples); all samples will be entered into EDITH and tested in Year 2.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- Worked with MoH and NPHL to integrate PREDICT testing protocols into NHPL workflow and to strengthen lab capacity for viral detection; samples will be processed by PREDICT and two NHPL staff members to maximize capacity building efforts.
- At the request of the MoH, screened 54 archived Orang Asli samples from patients with undiagnosed acute febrile illness that were originally submitted for culture to NPHL. The samples were screened using PREDICT protocols, and positives were submitted for sequencing to compare to culture results. Data analysis in now in progress. This exercise and identified discrepancies will help us to address any needed optimization in our PCR protocols and in potentially identifying issues in partner labs to help target capacity building efforts.

- Sent PERHILITAN Research Officer in charge of developing diagnostic lab to the Queensland Department of Agriculture, Forestry and Fisheries Biosecurity Sciences Laboratory in Brisbane to observe BSL2 laboratory operations.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- Met with all in-country partners to discuss project aims.
- Held meetings with One Health Workforce to discuss activities and areas for collaboration.
- Received a request to advise PERHILITAN on investigating rabies outbreak in Peninsular Malaysia.
- Updated human surveillance protocols with MoH to conform to PREDICT aims; PERHILITAN to conduct concurrent wildlife sampling in Orang Asli villages; MoH to provide Orang Asli samples from hospital patients with unidentified disease.
- Met with new acting Director General, Dept. of Veterinary Services (DVS) and new Director of the Veterinary Research Institute (VRI) to discuss PREDICT project and concurrent livestock surveillance in the Orang Asli villages.

Other Activities this Period:

- At the request of NPHL began to plan training for designing PCR primers and oligos, molecular cloning, bioinformatics, and sequence analysis; this activity is planned for Year 2.
- Conducted multiple trainings with PERHILITAN: 23 wildlife officers were trained on PPE and Powered Air Purifying Respirator use along with N95 and P100 mask fit tests; 20 wildlife officers were trained in biosafety containment levels, risk assessments for field and lab work, sample handling and required PPE, disinfection, contamination, and laboratory waste management.
- Published a paper in *EID,* "Macacine Herpesvirus 1 (B virus) in Wild-caught Long-Tailed Macaques (*Macaca fascicularis*) Following Capture and Transport in Malaysia" (Section 5: Lee et al., 2015).
- Presented poster "Assessing viral diversity within non-human primates of Peninsular and Bornean Malaysia" at Wildlife Disease Association International Conference, July 2015, Queensland, Australia.

Sabah:

Highlights and Success Stories:

- Successfully recertified the Wildlife Health Genetic and Forensic Laboratory (WHGFL) as a BSL2 laboratory according to NIH and CDC guidelines.
- Assisted the Sabah Wildlife Department (SWD) with lab diagnosis of Hepatitis B in three quarantined Orangutans; the identified Orang strain is not a public health concern.
- Contributed to the development of Malaysia's One Health workforce by training 35 wildlife staff from Sabah Wildlife Department, Lok Kawi Wildlife Park, and Sepilok Orangutan Rehabilitation Centre in zoonoses, biosafety and PPE (with

respirator fit testing), safe animal capture and handling, risk assessment, and lab safety. In addition, conducted multiple trainings with Wildlife Health Unit and DGFC staff, including field and lab first aid trainings for three PREDICT, three WHU, and six DGFC staff, and biosafety and PPE, safe animal handling and sampling of bats and non-human primates, cold chain maintenance, and safe transport of samples for 15 individuals from WHU DGFC, Borneo Sun Bear Conservation Centre, University Putra Malaysia, and British Columbia Institute (See Training Summary below for details). As a result, WHU, DGFC, and other wildlife professionals in Sabah are equipped with the knowledge and technical skills required for field surveillance and safe handling and sampling of wildlife and are also sensitized to animal mortality events that may represent a risk for viral spillover or disease emergence.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- Collected a total of 922 specimens from 78 animals (five bats, nine carnivores, 34 non-human primates, 30 other mammals); all samples will be entered into EDITH and tested in Year 2.
- Began Round 2 of Deep Forest sampling and collected 895 specimens from 129 animals (15 rodents and tree shrews, one other mammal, two carnivores, and 111 bats) at three sampling sites: Pristine 1 and Pristine 3.
- Began site surveys for additional Deep Forest sites in Kinabatangan and Beluran Districts; initiated planning for Round 2 of Human-Animal Contact Survey in Beluran District near Telupid.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- Performed confirmatory barcoding test on a subset of samples from PREDICT-1 where mismatched viral strains appeared; one tree shrew and one squirrel were confirmed to have squirrel Herpesviruses while a macaque was positive for Macacine herpesvirus, and an orangutan was confirmed negative for Macacine herpesvirus.
- Extracted another 108 Deep Forest surveillance swab samples collected in Quarter 4 of Year 1.
- Distributed field SOP, adapted from PREDICT sample collection protocols, to SWD and Danau Girang Field Centre (DGFC) to assist other projects.
- Tested remaining PREDICT-1 samples for Corona, Herpes, and Retro viruses at the WHGFL lab; results include the detection of known and novel herpesviruses including:
    - One new betaherpesvirus in a bat with no evidence to suggest public health threat.
    - One known and 15 novel strains of Herpesviruses in rodents with no evidence to suggest public health threat.
    - One known and six novel strains of Herpesviruses from non-human primates with no evidence to suggest public health threat.

  - All results are sequence confirmed and have been cleared by the government for release.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- Gave a presentation to the UN Special Rapporteur in Kota Kinabalu, Sabah on PREDICT.
- Discussed capacity building, sampling, and testing with SWD, DGFC, and the Department of State Health.
- Met with the new Director of SWD to discuss the project; as a result, SWD has committed to continued collaboration with PREDICT and approved release of all Sabah results to date on HealthMap (http://data.predict.global).
- Met with Deputy Director, Department of State Health, Sabah to discuss the project.

Other Activities this Period:

- Confirmed future SWD support for PREDICT-established lab, promoting sustainability.
- Revised the Wildlife Health Genetic and Forensic Laboratory (WHGFL) SOPs with SWD and DGFC for WHGFL re-certification; conducted emergency drills and generator procedures at WHGFL. WHGFL is the PREDICT diagnostic lab for Sabah, and its certification ensures that the Sabah Wildlife Department will be able to use it both for disease diagnostics and for their forensic work for wildlife crime investigaion/prosecution.
- Presented preliminary Human-Animal Contact Survey analysis to the communities of Sukau and Bilit.
- Discussed the project and provided WGHFL lab tour to University of Malaysia, Sabah faculty.
- Presented two talks at the 3rd International Southeast Asian Bat Conference in Kuching: "Bat viral diversity in different anthropogenic disturbance gradients in Kinabatangan, Sabah, Malaysia" and "Bat diversity survey at Lower Kinabatangan River Valley along a disturbance gradient."
- Featured in Natural Geographic Channel production on "Wildest River"; a program about the Lower Kinabatangan Wildlife Sanctuary that featured the PREDICT team in the field sampling wildlife and the country coordinator discussing the PREDICT/Deep Forest surveillance projects.

Training Summary (Peninsular Malaysia and Sabah)

Topic	Total # Trained*	# Women Trained	# PREDICT Staff Trained	# Government Ministry or Lab Staff Trained	# Students Trained
Packing and shipping biological samples	3	0	0	3	0
Safe sample transport	38	2	0	37	0
Biosafety and PPE	67	17	0	61	5
Safe animal handling and sampling	48	4	0	37	6
Lab safety	37	1	2	37	0
Grand total	**82**	**23**	**2**	**67**	**6**

**Multiple individuals cross-trained in various topics.*

MONGOLIA

Highlights and Success Stories:

- Successfully conducted a scoping visit in June and July and held meetings with the USAID Mission, US Embassy, and representatives from potential Government of Mongolia partner agencies and laboratories.
- Selected and hired a Country Coordinator (Dr. Shiilegdamba Enkhtuvshin), a Mongolian veterinarian with a Masters in Preventive Veterinary Medicine from UC Davis and over 10 years of experience in the wildlife and public health sectors.
- Identified the State Central Veterinary Laboratory (SCVL), which operates under the Veterinary and Animal Breeding Agency (VABA) of the Ministry of Food and Agriculture (MoFA), as the most appropriate government and laboratory partner for the project's influenza-focused work in Mongolia; SCVL confirmed their strong interest to collaborate by re-initiating avian influenza surveillance in wild birds in Mongolia; the selection of SCVL was supported by the USAID Mission and the Epidemiology Department of VABA; confirmed MoFA support for SCVL to act as the governmental focal point for coordinating PREDICT biological surveillance and laboratory diagnostics in country.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- No surveillance or field activities were conducted in Mongolia in Year 1.
- Initiated planning for field surveillance in Year 2 and identified the Ornithology Laboratory of the Institute of Biology, Mongolian Academy of Sciences as a key partner for assessing and selecting avian influenza sampling sites for wild birds; an initial set of surveillance sites in Central and Eastern Mongolia were selected for more detailed assessments and pilot sampling in Year 2.
- Identified the National Center for Communicable Diseases (NCCD) within the Ministry of Health and Sports as the most relevant in-country human health sector stakeholder; formal collaboration between SCVL and NCCD outlined in a Memorandum of Understanding on zoonotic disease surveillance and diagnosis is currently in place, an existing collaboration between the animal and human health sectors that will be leveraged for project activities.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- Completed an initial assessment of the SCVL's capacity to implement PREDICT's viral detection and diagnostic protocols; the Transboundary Animal Disease (TAD) Laboratory within SCVL will be the designated laboratory for all diagnostics as this lab, which contains a Bio-Safety Level III facility and is staffed by trained virologists, conducts molecular diagnostic work, and has existing serological capacity.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- Identified existing in-country influenza and 'One Health' networks, which currently have strong Ministry level representation from the human and animal health sectors and engagement of the environmental sector through the involvement of academic and research institutions and the NGO community.

MYANMAR

Highlights and Success Stories:

- Established a project office in Yangon and launched talent searches for a Country Coordinator, medical surveillance officer, and research scientist to develop an operational platform. Top candidates were identified for each position and include:
    - Country Coordinator – Prof. Tin Tin Myaing, current sitting president of the Myanmar Veterinary Association, Regional Veterinary Moderator at International Society for Infectious Diseases
    - Medical Surveillance Officer – Dr. Aung Than Toe, a medical doctor with extensive knowledge of social and governmental terrain in Myanmar
    - Research Scientist – Dr. Tierra Smiley-Evans, a veterinarian with both experience and published research in zoonotic disease surveillance
- The Yangon office will be the base of operations for Myanmar team members during drafting of agreements with local government, meetings with in-country collaborators, planning of surveillance activities, and coordination of program personnel.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- In collaboration with government, EPT partners, and regional PREDICT teams from China, Laos, and Thailand, developed preliminary surveillance plans targeting high-risk wildlife-human interfaces in Mingaladon Township, Mandalay Region and Tanintharyi Region near Dawei and began exploring opportunities for concurrent wildlife, livestock, and human sampling activities. Targeted sites include:
    - Mingaladon Township – a part of Myanmar's most populous geographical region which is experiencing increasing pig and poultry production with increased risk for domestic animal-human spillover. Additionally, this area contains the Hlwaga National Park with both forested and wetland/lake habitat, providing an opportunity for emergence of diseases associated with wildlife, including primates, bats, pangolins, and waterfowl.
    - Mandalay Region – reported to have bat roosts near caves where humans and macaques mingle, as well as bats, near domestic animal production, posing a potential high risk for cross-species transmission of numerous viral families.
    - Tanintharyi Region near Dawei – undergoing massive land use change as a major international road is constructed through previously undeveloped forest. Aside from road workers being potentially exposed to wildlife while clearing forest, food vendors in the construction zone frequently serve local wildlife, procured from the adjacent forest.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- Explored collaborations with key in-country laboratories, the Department of Medical Research, and the Livestock and Breeding Veterinary Diagnostics Laboratory and conducted preliminary assessments of lab capabilities to inform plans for operationalizing of viral detection activities and opportunities for training and capacity strengthening.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- Initiated Letter of Agreement planning for the Myanmar Ministry of Planning that would enable coordination with several ministries, including the Ministry of Health; Ministry of Environmental Conservation and Forestry; and the Ministry of Livestock, Fisheries and Rural Development.

Other Activities this Period:

- Two team members, the Myanmar project lead and the IRB representative, both based at Smithsonian, completed training on Biomedical Human Subjects Research via the Collaborative Institutional Training Initiative (CITI) – the required Global-level training program for IRB activity oversight.

NEPAL

Highlights and Success Stories:

- Engaged government and key partner stakeholders at FAO, WHO, and all relevant government ministries to introduce EPT-2 and prioritize emerging pandemic threats surveillance and preparedness activities and strengthen One Health platforms in Nepal.
- Identified potential points for PREDICT support for disaster relief efforts following the 2015 earthquake. Contributions to the disaster response included producing and distributing informational disease outbreak prevention and risk communication materials (posters and brochures – Section 6), working with PREDICT partners at HealthMap to develop a digital disease detection and monitoring platform of health alerts and events to improve situational awareness of potential infectious disease threats (the site is publicly available at http://www.healthmap.org/nepal/).
- Recruited and trained seven new Nepali staff (four of them women), including a new project veterinarian, nurse, field staff, and lab team members, and integrated field and lab in-service training sessions for all staff incorporating new project protocols and surveillance guidance. Training sessions covered biosafety and PPE, lab safety, qualitative methods for behavioral risk investigations, safe animal handling and sampling, cold chain and safe sample transport, non-invasive collection of samples from non-human primates, sample processing, RNA extraction, viral family PCR testing, and information management. As a result, the team is now equipped with the knowledge and technical skills to initiate sample collection and testing resolving all remaining capacity gaps in technical expertise prior to implementation of surveillance and laboratory activities.
- Obtained permission from the Nepal Health Research Council (NHRC) to conduct qualitative behavioral research in Kathmandu to better understand perceptions of risk and practices that may be associated with zoonotic disease transmission in high-risk human communities. Began training of Nepali staff in qualitative behavioral research to allow full implementation in Year 2 concurrent with animal sampling at longitudinal surveillance sites to contextualize attitudes, beliefs, and motivations that influence behaviors at high-risk interfaces.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- Developed sampling strategy to integrate concurrent and longitudinal animal and human sampling at high-risk interfaces in Kathmandu at critical pathways of disease emergence and spread: 1) animal production intensification in vulnerable communities in urban landscapes and 2) land conversion for commercialization. The animal value chain pathway, and links to source and end users, was also evaluated to determine high-risk human activities in/around Chitwan National Park.
- Investigated human and animal surveillance opportunities and high-risk human animal contact, including pteropid bat consumption, among the Chepang ethnic

subgroup in Chitwan district where there is extraordinary biodiversity in an area facing ongoing landscape conversion and agricultural intensification.
- Evaluated clinical and hospital sites serving high-risk communities for syndromic surveillance of undiagnosed fevers of unknown origin, with special focus on severe acute respiratory disease and acute encephalitis in humans in Kathmandu and Chitwan districts.
- Collected 163 non-invasive saliva samples in July from macaques at the Sindhupalchowk and Pashupatinath temple complexes in Kathmandu to explore frequency and seasonality of viral shedding in an area with especially high-risk human-animal contact and extensive local and international tourism.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:
- Performed PREDICT-2 priority viral family screening on samples collected from macaques and collaborated with lab team at UC Davis to ensure optimized laboratory procedures and quality assurance in test results.
- Conducted an external evaluation of CMDN's current laboratory waste management system focusing on the optimizing and enhancing protocols for bio-hazardous waste management and handling of all hazardous materials and public health commodities to ensure programmatic compliance for laboratory activities in PREDICT-2.
- Enhanced the laboratory's long-term sample storage capacity with procurement of an additional ultra low freezer and supporting power backup.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:
- Engaged relevant stakeholders to explore collaboration and coordination for concurrent human, livestock, and wildlife sampling activities with FAO Nepal, Central Veterinary Lab (CVL), Walter Reed / AFRIMS Research Unit Nepal (WARUN), WHO Nepal, Department of National Parks and Wildlife Conservation (DNPWC), and Patan Academy of Health Sciences (PAHS); new partnerships have been welcomed and pursued with appropriate implementing partners to facilitate surveillance activities, results reporting, and capacity strengthening.
- Hosted an interactive program in Kathmandu featuring PREDICT's Global Coordinator for Surveillance; the program engaged key stakeholders and participants from One Health-related fields to discuss emerging disease threats in Nepal.
- Played a central support role to the One Health Alliance, Nepal (OHAN) Network through meeting participation and facilitating interactive programs.

Other Activities this Period:
- To continue wildlife surveillance at sites prioritized for longitudinal surveillance, received extensions on research permits through the Ministry of Forestry and Soil and ongoing permission and support for surveillance activities from Kathmandu valley temples.

- Distributed reports summarizing PREDICT-1 findings and activities to USAID-Nepal and local departments within the Nepali government ministries (i.e. the Ministry of Health, the Ministry of Agriculture, and the Ministry of Forestry and Soil).
- Field veterinarians participated in a two-day training on wildlife sample collection and post mortem ungulate necropsy examination techniques facilitated by a US veterinarian in Chitwan, Nepal.
- Assessed displaced persons camps in the earthquake affected district of Sindhupalchowk and engaged with the local authorities and stakeholders in formulating a disease outbreak prevention program.

Training Summary

Topic	Total # Trained*	# Women Trained	# PREDICT Staff Trained	# Government Ministry or Lab Staff Trained	# Students Trained
Behavior risk	7	4	7	0	0
Safe sample transport	7	4	7	0	0
Biosafety and PPE	7	4	7	0	0
Safe animal handling and sampling	3	2	3	0	0
Viral detection and discovery	4	2	4	0	0
Total	**7**	**4**	**7**	**0**	**0**

**Multiple individuals cross-trained in various topics.*

THAILAND

Highlights and Success Stories:

- Published an article in *Virology Journal* entitled "Diversity of coronavirus in bats from Eastern Thailand" (Section 5: Wacharapluesadee et al., 2015).
- Detected the first human MERS-CoV case in Thailand; the MERS-CoV infection was first confirmed at the PREDICT lab at Chulalongkorn University, and viral family protocols were used to compare to the sensitivity of the WHO protocol. The result was reported to MOPH within eight hours with sequence confirmation following within 24 hours after receiving the specimen. The nasopharyngeal swab specimen collected on the same day and tested by other two Thai laboratories showed an inconclusive/negative result.
- Initiated screening of suspect Ebola patients arriving in Thailand using PREDICT protocols.

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- Coordinated surveillance plans with partners at EPT-2 planning meeting in Bangkok.
- Discussed selection of longitudinal animal sampling sites in geographic concordance with existing human surveillance efforts with US CDC; planned for continued testing of human specimens using PREDICT laboratory protocols.
- Discussed triangulated surveillance with FAO and USAID RDMA to synchronize concurrent sampling of wildlife and domestic animals.
- Completed a site survey visit in Loei Province to explore opportunities for surveillance for human, livestock, and wildlife interfaces.
- Participated in the Global Health Security Agenda (GHSA) meeting in Bangkok, Thailand organized by the Thai government and U.S. Agencies (CDC, DTRA and USAID) to discuss strategies for implementing and coordinating GHSA activities in Thailand.
- Developed plan to identify points of contact at field sites for qualitative and/or quantitative human behavioral research to be implemented in Year 2.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- Tested 70 saliva samples from macaques collected at National Park during PREDICT-1 for Herpesviruses.
- Optimized the PCR protocol for amplifying whole spike of coronavirus from archived specimens from PREDICT-1.
- Conducted whole spike gene sequencing in nine samples, five were positive and four were negative; sequence analysis is ongoing to further characterize these viruses.
- Tested 50 specimens from human patients with unidentified cause of disease following routine testing using viral family protocols; viral families selected for testing were dependent on patient symptoms.

- Provided training on basic laboratory safety and completed PREDICT laboratory safety quiz for 10 laboratory staff who will participate in bat specimen collection (see Training Summary below).
- Organized the workshop “Ebola Diagnosis using real-time PCR” with support from the National Science and Technology Development Agency (NSTDA) in Thailand.
- Organized hands-on training workshop “Rabies diagnostic” for Sri Lankan participants and a separate workshop for Myanmar participants with funding support from WHO-SEARO.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- Continued to engage key partners: Kasetsart University, Department of National Parks, Wildlife and Plant Conservation (Ministry of Natural Resources and Environment), Department of Livestock and Development (Ministry of Agriculture and Cooperatives), Department of Disease Control (Ministry of Public Health), Armed Forces Research Institute of Medical Sciences, Zoo Park Organization of Thailand, and Mahidol Universit, along with a number of local stakeholders and communities.
- Maintained extensive coordination with government and EPT partners, including FAO and CDC, especially with regard to planning for triangulated surveillance.

Other Activities this Period:

- Presented at “The future of knowledge and R&D” on Readiness, Prevention, and Resolution of Emerging Infectious Diseases, organized by Ministry of Public Health, Bangkok.
- Presented at the 22nd National Epidemiology Conference on “Conquering Emerging Infectious Diseases,” Bangkok.
- Presented poster on One Health surveillance in Thailand at the 3rd International One Health Congress, Amsterdam, Netherlands.
- Presented on “Laboratory Diagnosis Surge Capacity: Lab Capacity at Chulalongkorn University” at the Provisional Program for Review of National Ebola Virus Disease Preparedness, organized for representatives from WHO, WHO-SEARO and US-CDC by the Ministry of Public Health in Nonthaburi Province.
- Presented “Past, present and future of Ebola virus infection” at the Joint Conference in Medical Science 2015 in Bangkok.
- Presented on Coronaviruses in Thai bats at the “Viruses and Emerging Threat” meeting organized by the Thailand Research Fund (TRF).
- Presented (Country Coordinator) on “Diagnosing MERS-CoV safely and efficiently” while Prof. Hemachudha of Chulalongkorn University presented on “Clinical signs and contagiousness of MERS-CoV in humans” at NSTDA Knowledge Sharing of MERS, Thailand.
- Presented on “First imported case of MERS-CoV infection in Thailand” and poster on “Identification of Coronaviruses in Lyle’s flying fox (Pteropus lylei) in Thailand” at the Third International Congress on Pathogens at the Human-Animal

Interface (ICOPHAI) One Health for Sustainable Development, Chiang Mai, Thailand.

Training Summary

Topic	**Total # Trained***	**# Women Trained**	**# PREDICT Staff Trained**	**# Government Ministry or Lab Staff Trained**	**# Students Trained**
Biosafety and PPE	10	7	9	0	0
Safe animal handling and sampling	10	7	9	0	0
Total	**10**	**7**	**9**	**0**	**0**

**Multiple individuals cross-trained in various topics.*

VIET NAM

Highlights and Success Stories:

- Formalized engagement with the Ministry of Health through the National Institute of Hygiene and Epidemiology (NIHE), Viet Nam's premiere infectious disease laboratory and research institute, with a series of introductory meetings followed by a small research exchange forum and culminating in the drafting of a Memorandum of Understanding (MoU) to support "Collaborative Investigation and Response to Infectious Diseases of Pandemic Potential at High Risk Wildlife/Human Interfaces in Viet Nam, as part of the USAID Emerging Pandemic Threats Program – PREDICT-2 Project, Viet Nam"; NIHE leadership was represented by the Deputy Director, who welcomed the new partnership and accepted the MoU, which will be signed in Year 2.
- USAID and the Ministry of Agriculture and Rural Development (MARD) signed an MoU on July 7, 2015, regarding the Emerging Pandemic Threats Program (EPT) and the Global Health Security Agenda (GHSA), expressing the intent of Participants to "implement the EPT-2 Program, to support the GHSA, and to help improve the technical capacity of relevant Government of Viet Nam ("GVN") entities and partners for the prevention, early identification, and response to dangerous pathogens in animals that may pose significant threats to human health".

Summary of Surveillance and Field Activities for the Period Oct. 2014-Sept. 2015:

- Extended the PREDICT-1 Memorandum of Agreement (MoA) with the Department of Animal Health (DAH) of the Ministry of Agriculture and Rural Development (MARD) through December 31, 2015, pending the completion of a new MoA for PREDICT-2 in Viet Nam; the extended MoA facilitates assessments of PREDICT-2 surveillance sites, opportunistic sampling of wildlife moving through the trade, and continued diagnostic work with laboratory partners; in addition the PREDICT-1 MoU with the Viet Nam National University of Agriculture (VNUA) was also extended through December 31, 2015, pending a new MoU for PREDICT-2, facilitating the storage and completion of diagnostic work on PREDICT-1 samples.
- Under the extended MoA, submitted reports of new PREDICT-1 diagnostic results to DAH in September and November 2014, and May 2015; data was approved for public release and is available online at http://data.predict.global.
- Targeted pangolins, traded in large volumes in the Southeast Asia region and often cited as the most trafficked mammal in the world, for surveillance along the wildlife trade and animal value chain emergence pathway; collected 334 samples (oral swabs, rectal swabs, feces and urine) from 79 individual pangolins over two sampling events in collaboration with the local NGO, Save Viet Nam's Wildlife, and Cuc Phuong National Park in Ninh Binh Province; all samples were transferred to the VNUA PREDICT laboratory for viral family testing planned for Year 2.

- Conducted site assessments in the Southern Vietnamese province of Binh Phuoc, which borders Cambodia, as a possible focus for wildlife trade animal value chain surveillance; the province is known to be an important wildlife trade hub with wildlife moving across the border from Cambodia, consumed in local restaurants, and transported to Ho Chi Minh City and points to the north through distributers based in Binh Phuoc Province.

Summary of Laboratory Development/Testing for the Period Oct. 2014-Sept. 2015:

- Completed laboratory tours and initial laboratory assessments at the National Institute of Hygiene and Epidemiology (NIHE), the designated project laboratory for testing human samples in country.
- Screened 46 samples from common palm civets collected from wildlife farms during PREDICT-1 at the VNUA lab; the samples were screened for Flavivirus, Rhabdovirus, and Coronavirus using PREDICT protocols and for Canine Distemper Virus and Influenza A virus using VNUA standard protocols. PCR products were shipped to US-based reference labs for confirmation and sequencing in Year 2.
- Screened 459 rodent samples collected from wildlife farms during PREDICT-1 at the DAH Regional Animal Health Office No.6 (RAHO6) for Arenavirus, Paramyxovirus, Hantavirus, Bunyavirus, and Rhabdovirus. PCR products will be shipped to US-based reference labs for confirmation and sequencing in Year 2.
- Screened 22 non-human primate samples collected from wildlife farms during PREDICT-1 at UC Davis (the US-based reference lab) for Filovirus, Coronavirus, Paramyxovirus, Arenavirus, Influenza A, Rhabdovirus, Hantavirus, Alphavirus, Henipavirus, and Bunyavirus; two novel Rhabdoviruses were detected in saliva samples from two crab-eating macaques.
- Screened 393 bat samples and 1,771 rodent samples (originally tested at RAHO6 under PREDICT-1) for additional viral families (Bats: Filo-, Corona-, Arena-, Influenza-, Rhabdo-, Seadorna-, Henipa-, and Bunyavirus; Rodents: Corona-, Filo-, and Influenza virus) at the US-based reference lab; results are pending final interpretation, reporting to government, and approval for release.
- Prepared samples prioritized for further viral characterization for shipment to facilities in the US for next generation sequencing to fully characterize detected viruses and to determine any potential health impacts from known and novel viral agents.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2014-Sept. 2015:

- Attended the 'USAID Avian Influenza (AI) and EPT Partner Meeting' at the USAID Mission in Hanoi and presented test results approved for public release; AI and EPT partners shared preliminary work plans and discussed opportunities for collaboration.
- Attended the 'EPT-2 Viet Nam Launch and Work Planning Meeting' organized by USAID Viet Nam and focused on identifying priorities for EPT-2 activities and clarifying opportunities for linkages and collaboration among partners; all EPT

partners joined the meeting, including MoH, MARD, FAO, WHO, UNDP, OHW, P&R, Partnership on Avian and Human Influenza (PAHI), and representatives from Viet Nam One Health University Network (VOHUN), VNUA, DAH, and CITES Management Authority.

- Conducted separate meetings with representatives of P&R and OHW in Hanoi to share contact information and plans for activities and engagement with government partners; also held a joint meeting with P&R and OHW to share updates during the GHSA Zoonotic Disease Action Planning (ZDAP) meeting in Hanoi.
- In collaboration with FAO, held a series of meetings to share surveillance plans and diagnostic approaches and to discuss EPT-2 collaboration; resulting discussions identified a range of interfaces where FAO and PREDICT could cooperate to carry out concurrent surveillance, including "wet markets" where live poultry and live rodents are sold, areas of intensive livestock production (poultry and swine) and international trade routes/borders (China-Viet Nam and Cambodia-Viet Nam); sites for potential concurrent sampling at the provincial level were also identified and included Soc Trang, Dong Thap, and Dong Nai Provinces and the greater Hanoi area.
- Held a series of informal "information sharing" meetings with WHO and CDC staff in Hanoi to clarify in-country programs related to surveillance for Severe Acute Respiratory Illness (SARI) and influenza.
- Attended and participated in three events linked to the launch of the GHSA in Viet Nam including a GHSA work planning meeting organized by the US CDC and USAID Mission, a GHSA Viet Nam Road Map meeting with government stakeholders, and an "International Conference on Zoonotic Disease Prevention and Control: Addressing Health Threats Posed by Zoonotic Diseases - Global Collaboration and Technical Exchange" that aimed to accelerate regional and international collaboration in support of the Zoonotic Disease Action Package.

Other Activities this Period:

- Received the "Best Poster" award for the presentation "Advancing wildlife disease surveillance in Viet Nam through cross sector collaboration" at the 7th annual meeting of the Asian Society of Zoo and Wildlife Medicine held in Tam Dao, Viet Nam in October 2014.
- Participated in the PAHI Secretariat-organized meeting of the 'One Health Communication Network' together with PREVENT, FAO, WHO, Viet Nam One Health University Network (VOHUN), Viet Nam National University of Agriculture (VNUA), CITES, Department of Animal Health (DAH), Viet Nam Farmers Union (VNU), and the MoH; all participants gave updates on ongoing and upcoming communication activities.
- Attended PREVENT's "A Market Chain Analysis of the Cross-Border Rat Trade in Viet Nam and Cambodia: Research Findings Dissemination and Stakeholder Workshop" that convened participants directly involved in the rat trade (venders, traders, and transporters) and the local management agencies, such as the provincial sub-DAH offices; at the workshop, presented along with the Oxford University Clinical Research Unit (OUCRU) on research conducted to date in Viet

Nam on screening samples from rats for viruses of pandemic potential and known zoonotic pathogens.

- Attended the DAH "Veterinary Law Consultation Meeting" to provide comments on provisions related to wildlife health, biosecurity on wildlife farms, and the general importance of collaboration between the animal health and forestry/wildlife sectors in carrying out wildlife disease surveillance.
- Co-chaired the thematic session on the human/wildlife interface with the Viet Nam CITES Management Authority at the "3rd National One Health Conference: Infectious disease risks at the human-animal-ecosystem interface in Viet Nam", and presented a talk in the session highlighting the project's accomplishments in-country, including the achieved capacity for wildlife surveillance and results of laboratory diagnostic work.
- Attended, presented, and contributed ideas to a number of workshops/dialogues organized by PAHI and the Hanoi School Public Health's Center for Public Health and Ecosystem Research with an aim to share information about the project, zoonotic diseases, and wildlife trafficking as a driver of disease emergence and policy development to mitigate the risk of pandemic disease; at these platforms, emerging issues from the 3rd International One Health Congress Workshop in Amsterdam, ZDAP, and GHSA meetings were shared, and different mechanisms, like the One Health Roadmap, designed to coordinate work across projects and share information were identified. The workshops included:
  - 3rd International One Health Congress Follow-up Workshop: Prevention at Sources;
  - Policy Development Workshop - ECOnomic development, ECOsystem MOdifications, and emerging infectious diseases Risk Evaluation (ECOMORE);
  - One Health Roadmap and Matrix;
  - One Health Communication Network.

Training Summary

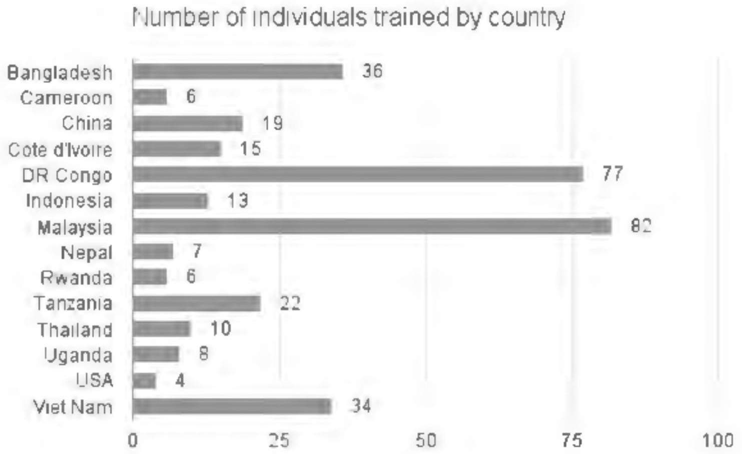
Topic	Total # Trained	# Women Trained	# PREDICT Staff Trained	# Government Ministry or Lab Staff Trained	# Students Trained
One Health Approach	34	9	0	16	0

IV. TRAINING SUMMARY

SECTION 4. PREDICT TRAINING SUMMARY

STRENGTHENING THE ONE HEALTH WORKFORCE

Preparing for emerging disease threats requires investments in infrastructure, institutions, and human resources across a broad array of health and social systems to operationalize One Health platforms. In collaboration with country governments and EPT partners, PREDICT is committed to developing the infrastructure and core skills and capabilities required by tomorrow's One Health workforce.



From October 1, 2014 to September 30, 2015, PREDICT teams around the world trained a total of 339 individuals, including 128 women and 205 government ministry or laboratory personnel, facilitating an extensive network of global One Health professionals to support long-term zoonotic disease surveillance. Trainings covered a variety of topics including: biosafety, ethics, field epidemiology and surveillance, information management, laboratory diagnostics, social sciences and behavioral risk investigations, and modeling and analytics.

PREDICT 2014-2015 Training Summary

Country	Topic	Total # Trained*	# Women Trained	# PREDICT Staff Trained	# Government Ministry or Lab Staff Trained	# Students Trained
Bangladesh	Behavior Risk	32	8	4	5	11
	Biosafety and PPE	6	0	2	4	0
	Safe Animal Handling and Sampling	3	0	2	1	0
	Bangladesh Total	**36**	**8**	**4**	**9**	**11**
Cameroon	Behavior Risk	1	1	1	0	0
	Lab Safety	5	1	5	0	0
	Information Management	4	1	4	0	0
	Ethics	1	0	0	0	0
	Cameroon Total	**6**	**1**	**6**	**0**	**0**
China	Behavior Risk	17	5	2	15	1
	Viral Detection and Discovery	1	1	0	1	0
	China Total	**19**	**6**	**3**	**16**	**1**
Cote d'Ivoire	PREDICT Basic Training*	15	6	0	15	0
	Cote d'Ivore Total	**15**	**6**	**0**	**15**	**0**
DR Congo	Behavior Risk	14	2	2	1	4
	Packing and Shipping Biological Samples	56	32	0	56	0
	Biosafety, PPE, and Safe Animal Handling and Sampling	2	0	0	2	0

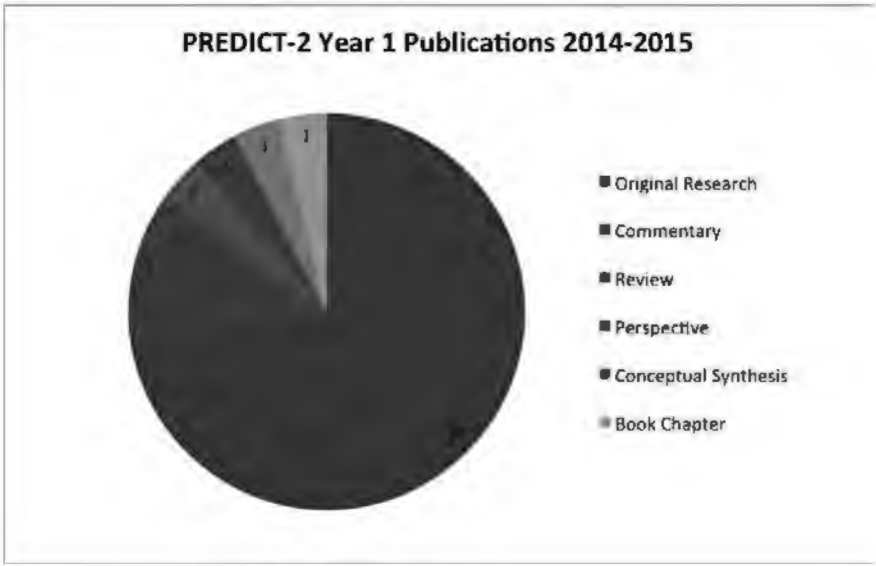
	Lab Safety	56	32	0	56	0
	Viral Detection and Discovery	7	2	0	7	0
	DR Congo Total	**77**	**36**	**2**	**66**	**4**
Indonesia	Behavior Risk	1	0	1	0	0
	Safe Sample Transport	1	0	1	0	0
	Biosafety and PPE	8	3	1	7	0
	Safe Animal Handling and Sampling	1	0	1	0	0
	Viral Detection and Discovery	13	4	1	11	1
	Indonesia Total	**13**	**4**	**1**	**11**	**1**
Malaysia	Packing and Shipping Biological Samples	3	0	0	3	0
	Safe Sample Transport	38	2	0	37	0
	Biosafety and PPE	67	17	0	61	5
	Safe Animal Handling and Sampling	48	4	0	37	6
	Lab Safety	37	1	2	37	0
	Malaysia Total	**82**	**23**	**2**	**67**	**6**
Nepal	Behavior Risk	7	4	7	0	0
	Safe Sample Transport	7	4	7	0	0
	Biosafety and PPE	7	4	7	0	0
	Safe Animal Handling and Sampling	3	2	3	0	0
	Viral Detection and Discovery	4	2	4	0	0
	Nepal Total	**7**	**4**	**7**	**0**	**0**
Rwanda	Lab Safety	6	1	1	5	0
	Viral Detection and Discovery	6	1	1	5	0
	Rwanda Total	**6**	**1**	**1**	**5**	**0**
Tanzania	One Health Approach	15	15	0	0	0
	Field Epidemiology	1	0	1	0	0
	Lab Safety	7	2	3	0	0
	Viral Detection and Discovery	5	2	1	0	0
	Tanzania Total	**22**	**17**	**3**	**0**	**15**

Thailand	Biosafety and PPE	10	7	9	0	0
	Safe Animal Handling and Sampling	10	7	9	0	0
	Thailand Total	**10**	**7**	**9**	**0**	**0**
Uganda	Behavior Risk	5	3	2	0	2
	Safe Sample Transport	3	1	0	0	3
	Biosafety and PPE	3	1	0	0	3
	Safe Animal Handling and Sampling	3	1	0	0	3
	Uganda Total	**8**	**4**	**2**	**0**	**5**
USA	Behavior Risk	4	2	4	0	0
	USA Total	**4**	**2**	**4**	**0**	**0**
Viet Nam	One Health Approach	34	9	0	16	0
	Viet Nam Total	**34**	**9**	**0**	**16**	**0**
Grand Total		**339**	**128**	**44**	**205**	**43**

V. PUBLICATION SUMMARIES

SECTION 5. PREDICT PUBLICATION SUMMARIES

This past year, PREDICT research led to 24 publications, including 19 original research articles, many in top-tier journals like *Nature, Emerging Infectious Diseases, Proceedings of the National Academy of Sciences,* and *The Lancet.* Summaries of publications are provided below, highlighting practical implications for the scientific, policy, and development sectors. A comprehensive bibliography with all PREDICT publications to date may be found online at: http://www.vetmed.ucdavis.edu/ohi/predict/predict_publications.cfm



ORIGINAL RESEARCH

Non-random patterns in viral diversity

Authors: S.J. Anthony, A. Islam, C.K. Johnson, I. Navarrete-Macias, E. Liang, K. Jain, P.L. Hitchens, X. Che, A. Soloyov, A.L. Hicks, R. Ojeda-Flores, C. Zambrana-Torrelio, W. Ulrich, M.K. Rostal, A. Ptrosov, J. Garcia, N. Haider, N.D. Wolfe, T. Goldstein, S.S. Morse, M. Rahman, J.H. Epstein, J.K. Mazet, P. Daszak, and W.I. Lipkin.

In brief: The threat that infectious diseases increasingly pose to both public health and economic stability has excited efforts to establish a predictive understanding of emergence. One area of 'prediction' that would be particularly useful is the ability to forecast how viral diversity might respond to environmental drivers of disease emergence, for example land-use change. However, to date, it has been unclear whether or not changes in viral diversity are inherently predictable. This study investigated whether viral communities in macaques from Bangladesh were influenced by predictable (deterministic) or random (stochastic) forces. The authors collected fecal samples from rhesus macaque monkeys at nine locations across Bangladesh and used both consensus PCR and high-throughput sequencing to identify a total of 184 unique

All summaries appearing herein were developed or reproduced with author permission.

viruses. Statistical analyses of the differences and similarities in strains within and among macaque groups suggested that deterministic forces had affected patterns of viral diversity at different scales, both between sites and within individuals. The authors also showed that the effects of determinism were not absolute, as stochastic (unpredictable) patterns were observed. In conclusion, determinism was shown to be an important process in viral community assembly and that it should be possible to forecast changes to some portion of a viral community, though there will always be a portion for which prediction will be unlikely.

To better communicate the findings of this study, the authors produced a website (www.letspredictviruses.com) that allows visitors to explore some of these concepts, combining an interactive narrative and a challenging retro-style puzzle game that casts viruses as Space Invaders. LetsPredictViruses.com explains two of the patterns governing viral communities included in this paper: *dependence*—when one kind of virus cannot replicate in a host without the presence of a different virus; and *exclusion*—when the presence of one virus excludes another. The video game challenges visitors to spot these patterns in seven levels of increasing difficulty, and is designed to try and reach a broad and diverse audience

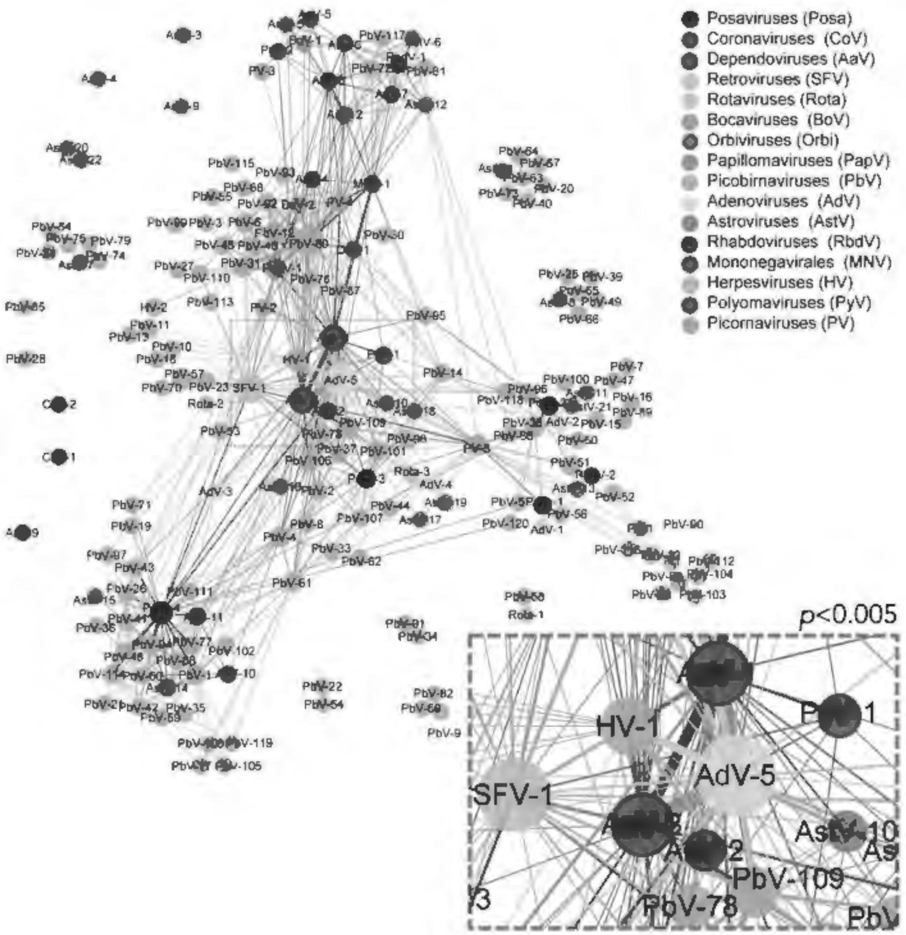


Figure: One-mode affiliation network demonstrating the frequency of viral co-occurrence in the same host. Viruses (colored by family/genus) are linked if found in the same individual. Frequency of co-occurrence indicated by thickness of the edge connecting each node. Insert shows significant (C-score p<0.05) co-occurrence of AaVs with AdV and HV (significance determined using PAIRS).

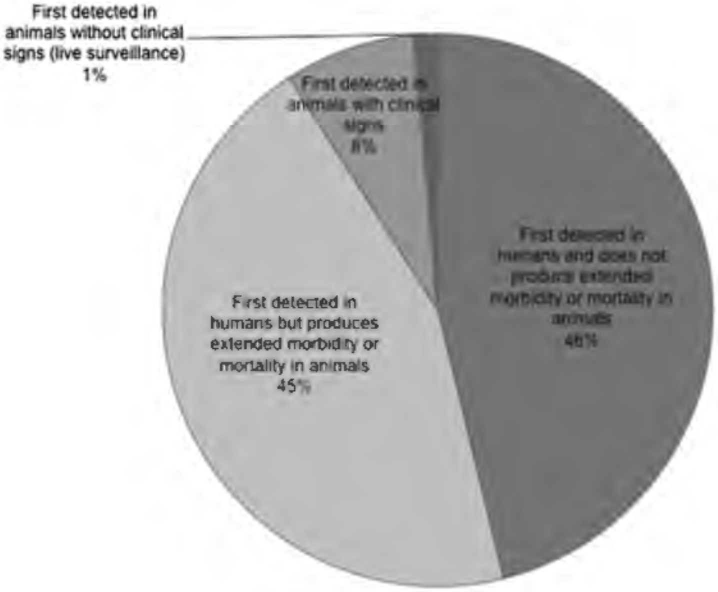
Source: Anthony et al., 2015.

Citation: Anthony, S.J., A. Islam, C.K. Johnson, I. Navarrete-Macias, E. Liang, K. Jain, P.L. Hitchens, X. Che, A. Soloyov, A.L. Hicks, R. Ojeda-Flores, C. Zambrana-Torrelio, W. Ulrich, M.K. Rostal, A. Ptrosov, J. Garcia, N. Haider, N.D. Wolfe, T. Goldstein, S.S. Morse, M. Rahman, J.H. Epstein, J.K. Mazet, P. Daszak, W.I. Lipkin. 2015. Non-random patterns in viral diversity. *Nature Communications* 6:8147. Available online: http://www.nature.com/ncomms/2015/150922/ncomms9147/abs/ncomms9147.html

Early detection of emerging zoonotic diseases with animal morbidity and mortality monitoring

Authors: I. Bisson, B. Ssebide, and P.P. Marra.

In brief: Zoonotic disease transmission continues to affect both animal and human populations globally, with over 50% of emerging infectious human diseases originating in animals and costs estimated at $20-200 billion between 2000-2010. This study assessed emerging diseases that were first discovered through morbidity or mortality reports in animal hosts over a 64-year time period. An analysis of 143 pathogens found that 45% of human outbreaks due to zoonotic pathogens could have benefitted from early detection in animals. This study highlights the importance of an active animal surveillance system that includes reporting on livestock and wildlife morbidity and mortality with passive sampling of live animals who may be asymptomatic reservoirs as an effective method to identify potential zoonotic disease emergence. The authors note a current lack of public health platforms that include animal sampling and recommend both active and passive animal surveillance to enhance zoonotic disease surveillance. Such an approach could provide benefits to public health, animal health, and wildlife conservation due to improved rapid response capacity for diseases in animals and people.



The proportion and location of disease detection. Source: Bisson et al., 2014.

Citation: Bisson, I., B. Ssebide, P.P. Marra. 2014. Early detection of emerging zoonotic diseases with animal morbidity and mortality monitoring. *EcoHealth* 12(1): 98-103. Available online: http://link.springer.com/article/10.1007/s10393-014-0988-x/fulltext.html

Human herpes simplex virus type 1 in confiscated gorilla

Authors: K. Gilardi, K. Oxford, D. Gardener-Roberts, J.F. Kinani, L. Spelman, P. Barry, M. Cranfield, and L. Lowenstine.

In brief: A major concern of the conservation community is the transmission of human viruses to endangered or threatened animals and the potential impacts of human diseases on the health and population of endangered wildlife. In 2007, an illness was detected in five confiscated eastern lowland gorillas (Grauer's gorilla) that were housed in a facility in the Democratic Republic of Congo. All of the affected gorillas presented with lethargy, anorexia, and oral lesions. A biopsy and oral swab was taken from a four-year old female gorilla for analysis and it was determined that the illness was caused by Human Herpes Simplex Virus Type 1 (HSV-1). According to the authors, the transmission of HSV-1 from humans to gorillas was most likely due to human-gorilla and/or gorilla-gorilla contact at the facility. While HSV-1 has been reported in other captive gorillas, it has not been detected in wild gorilla populations. For the rehabilitation and conservation community, the implications of human viral spillover to captive wildlife, like these gorillas, is significant and should be considered in planning for reintroduction of captive animals to protect endangered wild populations from the introduction of new pathogens. To reduce spillover risk for endangered wild gorillas, the authors emphasize the need for complete health screens of human pathogens in captive animals when considering reintroduction.

A captive gorilla and caretaker bonding in the Democratic Republic of Congo. All gorilla caretakers protect the gorillas from human microbes and diseases like HSV-1 by wearing personal protective equipment like masks and gloves. Source: Gorilla Doctors.

Citation: Gilardi, K., K. Oxford, D. Gardener-Roberts, J.F. Kinani, L. Spelman, P. Barry, M. Cranfield, L. Lowenstine. 2014. Human herpes simplex virus type 1 in confiscated gorilla. *Emerging Infectious Diseases* 20(11). Available online: http://wwwnc.cdc.gov/eid/article/20/11/14-0075_article

Detection of diverse novel astroviruses from small mammals in China

Authors: B. Hu, A.A. Chmura, J. Li, G. Zhu, J.S. Desmond, Y. Zhang, W. Zhang, J.E. Epstein, P. Daszak, and Z. Shi.

In brief: Astroviruses have been detected in humans and many animal species worldwide, especially in rodents and bats. To investigate the prevalence, genetic diversity, ecology, and evolution of astroviruses, this study conducted surveillance for astroviruses from 39 different species of small mammals in the Hainan, Guanxi, and Yunnan provinces of Southern China. New astroviruses were detected in species that were otherwise unknown, with notable high genetic diversity in the kachin red-backed vole. The detection of diverse astroviruses among many small mammal species, including the first detection in shrews and pikas, illustrates the importance of systematic surveillance of wildlife as reservoirs in large geographic areas to broaden our understanding of the evolution and distribution of astroviruses and other emerging and zoonotic viruses.

Citation: Hu, B., A.A. Chmura, J. Li, G. Zhu, J.S. Desmond, Y. Zhang, W. Zhang, J.E. Epstein, P. Daszak, Z. Shi. 2014. Detection of diverse novel astroviruses from small mammals in China. *Journal of General Virology* 95: 2442-2449. doi: 10.1099/vir.0.067686-0

Molecular evidence of Ebola Reston virus infection in Philippine bats

Authors: S.I. Jayme, H.E. Field, C. de Jong, K.J. Olival, G. Marsh, A.M. Tagtag, T. Hughes, A.C. Bucad, J. Barr, R.R. Azul, L.M. Retes, A. Foord, M. Yu, M.S. Cruz, I.J. Santos, T.M.S. Lim, C.C. Benigno, J.H. Epstein, L.F. Wang, P. Daszak, and S.H. Newman.

In brief: Reacting to the detection of Reston ebolavirus (RESTV) in domestic pigs and farmers in the Philippines (2008-2009), this study explored bats in the Philippines as possible wildlife reservoirs for RESTV. A total of 464 total bats from 21 species were sampled from two sites in Luzon and tested using molecular (qPCR) and serological (Western blot and ELISA) diagnostics for RESTV. Samples from the common bent-wing bat detected RNA in throat swabs and molecular tests suggest RESTV presence in three additional bat species. Serological tests detected anti-RESTV antibodies in the giant golden-crowned flying fox. Samples resulted in RESTV genetic sequences that varied from the strain detected in pigs and farmers. Results indicate that the ebolavirus is taxonomically widespread in the Philippines. However, this study detected a low ebolavirus prevalence and viral load. The authors recommend expanding future research geographically and taxonomically to better understand the ecology of RESTV in the Philippines and to inform policy to reduce RESTV spillover from bats to livestock and humans.

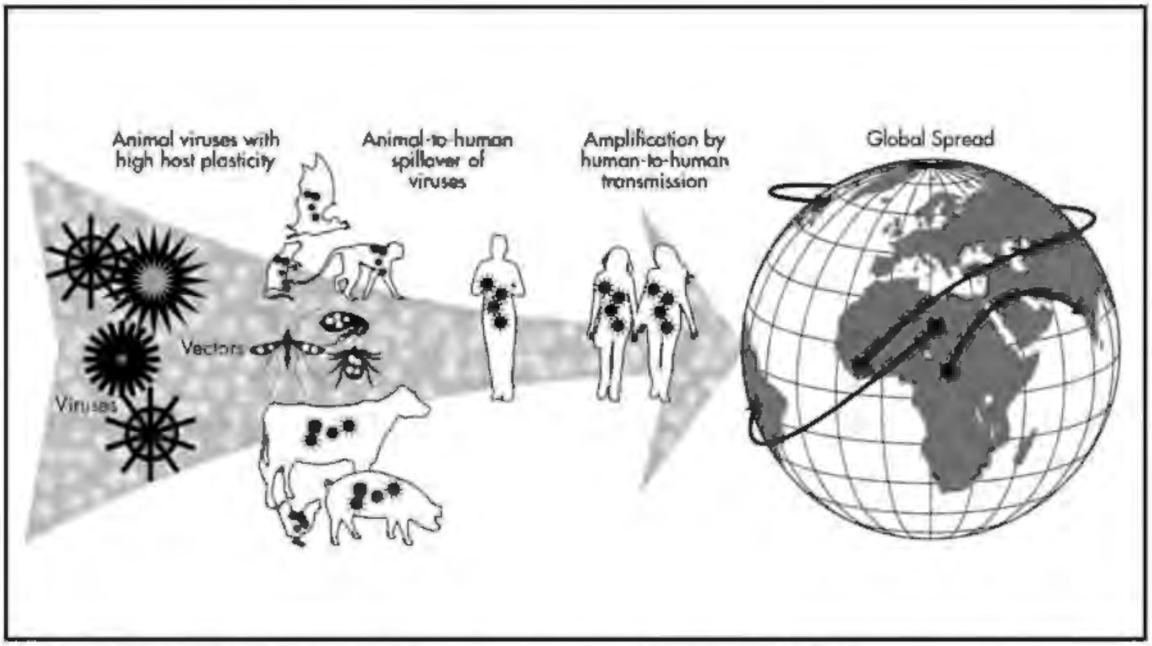
Sample processing with the Philippine team at a site in Bulacan Provinces in Luzon. Source: EcoHealth Alliance.

Citation: Jayme, S.I., H.E. Field, C. de Jong, K.J. Olival, G. Marsh, A.M. Tagtag, T. Hughes, A.C. Bucad, J. Barr, R.R. Azul, L.M. Retes, A. Foord, M. Yu, M.S. Cruz, I.J. Santos, T.M.S. Lim, C.C. Benigno, J.H. Epstein, L.F. Wang, P. Daszak, S.H. Newman. 2015. Molecular evidence of Ebola Reston virus infection in Philippine bats. *Virology Journal* 12:107. Available online: http://virologyj.biomedcentral.com/articles/10.1186/s12985-015-0331-3

Spillover and pandemic properties of zoonotic viruses with high host plasticity

Authors: C.K. Johnson, P.L. Hitchens, T. Smiley Evans, T. Goldstein, K. Thomas, A. Clements, D.O. Joly, N.D. Wolfe, P. Daszak, W.B. Karesh, and J.A.K. Mazet.

Most human infectious diseases, especially recently emerging pathogens, originate from animals, and ongoing disease transmission from animals to people presents a significant global health burden. Recognition of the epidemiologic circumstances involved in zoonotic virus spillover, amplification, and spread is essential for prioritizing surveillance and predicting future disease emergence risk. This study examined the animal hosts and transmission mechanisms involved in spillover of zoonotic viruses to date, and discovered that viruses with high host plasticity (i.e. taxonomically and ecologically diverse host range) were more likely to amplify viral spillover by secondary human-to-human transmission and have broader geographic spread. Viruses are more likely to be transmitted to humans during practices that facilitate mixing of diverse animal species, such as wild animals sold at markets, kept as pets, or maintained in sanctuaries and zoos. Animal-to-human spillover of new viruses that are capable of infecting diverse host species signal emerging disease events with higher pandemic potential in that these viruses are more likely to amplify by human-to-human transmission with spread on a global scale. Heightened surveillance, particularly at high-risk animal-human interfaces in settings with diverse host assemblages that have been under-reported to date, is essential for directing us towards critical control points and behavior change interventions aimed at disease prevention.



Pandemic properties of zoonotic viruses that spill over from animals to humans and spread by secondary transmission among humans, evaluated here for associations with viral traits and high-risk disease transmission interfaces. Source: Johnson et al., 2015.

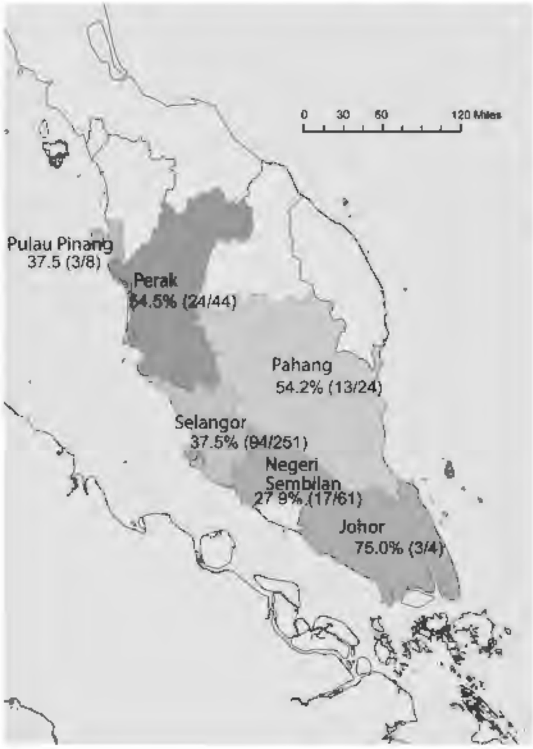
Citation: Johnson, C.K., P.L. Hitchens, T. Smiley Evans, T. Goldstein, K. Thomas, A. Clements, D.O. Joly, N.D. Wolfe, P. Daszak, W.B. Karesh, J.A.K. Mazet. 2015. Spillover and pandemic properties of zoonotic viruses with high host plasticity. *Nature Scientific Reports* 5:14830. Available online: http://www.nature.com/articles/srep14830

Macacine herpesvirus 1 in long-tailed macaques, Malaysia, 2009-2011

Authors: M.H. Lee, T. Hughes, M.K. Rostal, F. Sitam, C.Y. Lee, J. Japning, M.E. Harden, A. Griffiths, M. Basir, J. H. Epstein, N.D. Wolfe, and P. Daszak.

In brief: Macacine herpesvirus 1 (MaHV1; B virus) naturally infects macaques and can be fatal in people, yet very little is known about infection in people outside of lab settings.

Macaques have adapted to urbanized human environments and contact between people, and macaques can occur in a variety of contexts like feeding and population management programs. This study describes the context of potential MaHV1 transmission between macaques and people during the capture and transport of long-tailed macaques in a population management program implemented in Peninsular Malaysia. After capture, samples from 392 macaques were tested for MaHV1 DNA using PCR. Overall, 39% of macaques were shedding MaHV1 DNA. Shedding patterns of MaHV1 among the macaques were explored and suggest that a substantial proportion of animals shed the MaHV1 virus after and potentially during transport, a factor that may be caused by the stress of relocation and which may elevate the risk of exposure to MaHV1 by wildlife personnel or other animal handlers involved in relocation activities. To reduce risk of infection, the authors recommend that appropriate personal protective equipment (PPE) like respirators, gloves, and eye protection be provided for all individuals handling macaques or other wildlife in these circumstances. As a result, the Government of Malaysia Department of Wildlife and National Parks is strengthening its existing policies to require all personnel to wear appropriate PPE, to use proper work area biosafety and disinfection techniques, and to provide training to protect workers and reduce transmission risks; practices that promote the prevention of transmission events for MaHV1 and other potentially dangerous zoonotic pathogens.



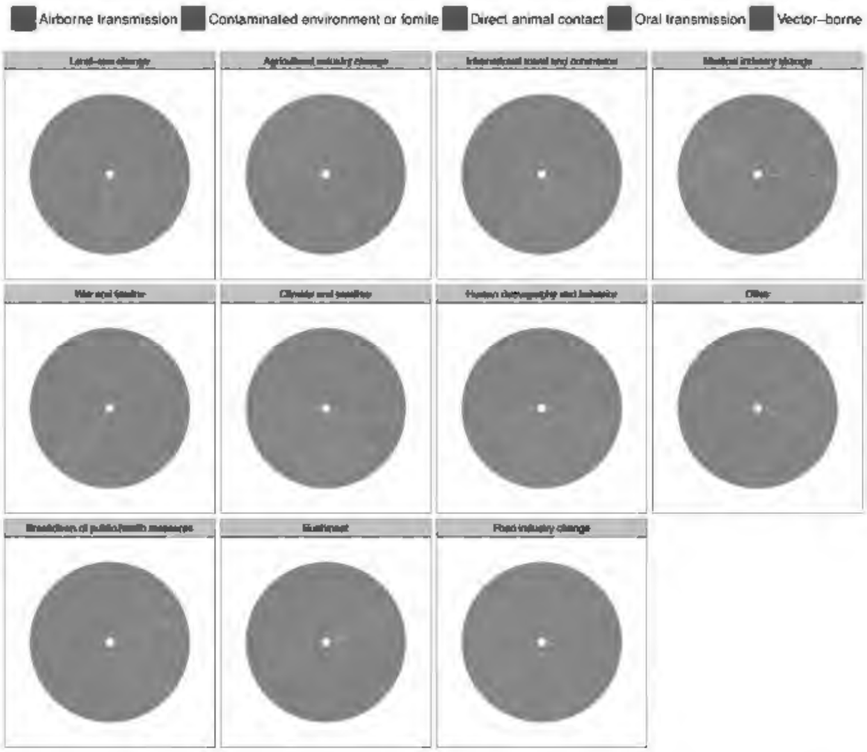
Map of the state of origin and prevalence of macacine herpesvirus 1 shedding within sampled groups of macaques (the number positive/total tested) from Peninsular Malaysia, September 2009-July 2011. Source: Lee et al., 2015.

Citation: Lee, M.H., T. Hughes, M.K. Rostal, F. Sitam, C.Y. Lee, J. Japning, M.E. Harden, A. Griffiths, M. Basir, J. H. Epstein, N.D. Wolfe, P. Daszak. 2015. Macacine herpesvirus 1 in long-tailed macaques, Malaysia, 2009-2011. *Emerging Infectious Diseases* 21(7). Available online: http://wwwnc.cdc.gov/eid/article/21/7/14-0162_article

Targeting transmission pathways for emerging zoonotic disease surveillance and control

Authors: E.H. Loh, K.J. Olival, C. Zambrana-Torrelio, T.L. Bogich, C. Kreuder-Johnson, J.A.K. Mazet, W.B. Karesh, and P. Daszak.

In brief: Factors ranging from agriculture to war can lead new infectious diseases to spillover from the environment into humans and cause disease outbreaks. In addition, humans can acquire infectious diseases through a number of different pathways, such as through vectors (e.g., mosquitoes) or by direct exposure to infectious body tissues or fluids. Are any of these pathways more likely than others to transmit one or more serious diseases? To answer this question, the authors reviewed scientific literature and analyzed a database of all reported emerging infectious diseases (EIDs) to rank the importance of different transmission pathways in different EID settings. Findings suggest that overall the likelihood of transmission through any given pathway is roughly equal to transmission through another. The authors did find, however, that certain factors leading to spillover events or EID drivers, such as changes in land use from forest and wildlife habitat to agricultural use were significantly linked with particular transmission pathways. These findings are particularly relevant for the design of prevention strategies targeting the spillover of new infectious diseases into humans.



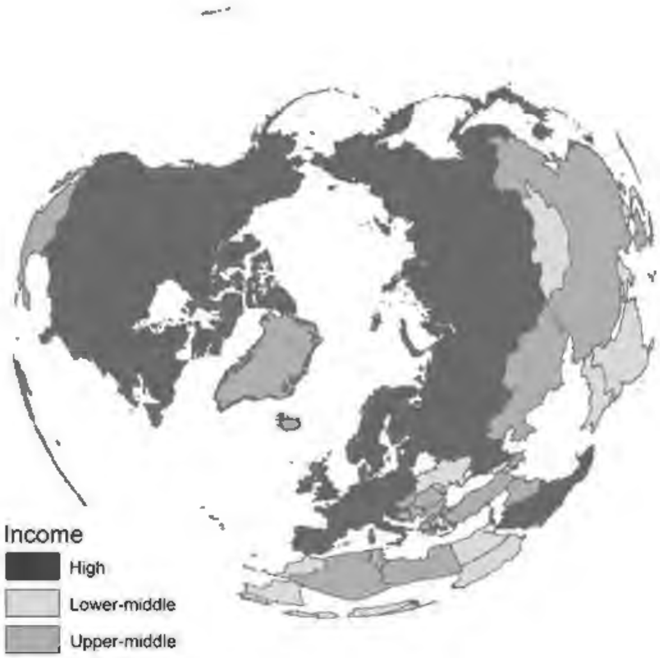
Scaled number of zoonotic emerging infectious diseases (EID) events (n = 145) per transmission route categorized by the primary driver of disease emergence for each pathogen. To calculate which pathways were associated with each EID driver, the authors split the data into subsets by driver, summed the weightsfor each transmission category, and divided the sum by the total number of EID events per driver. Source: Loh et al., 2015.

Citation: Loh, E.H., C. Zambrana-Torrelio, K.J. Olival, T.L. Bogich, C.K. Johnson, J.A.K Mazet, W. Karesh, and P. Daszak. 2015. Targeting transmission pathways for emerging zoonotic disease surveillance and control. *Vector-Borne and Zoonotic Diseases* 15(7): 432-437. doi:10.1089/vbz.2013.1563.

Global avian influenza surveillance in wild birds: A strategy to capture viral diversity

Authors: C. Machalaba, S.E. Elwood, S. Forcella, K.M. Smith, K. Hamilton, K.B. Jebara, D.E. Swayne, R.J. Webby, E. Mumford, J.A.K. Mazet, N. Gaidet, P. Daszak, and W.B. Karesh.

In Brief: Wild birds play a major role in the evolution, maintenance, and spread of avian influenza viruses. However, surveillance for these viruses in wild birds is sporadic, geographically biased, and often limited to the last outbreak virus. To identify opportunities to optimize wild bird surveillance for understanding viral diversity, the authors reviewed responses to a World Organization for Animal Health (OIE)–administered survey, government reports to the OIE, articles on Web of Knowledge, and the Influenza Research Database. At least 119 countries conducted avian influenza virus surveillance in wild birds during 2008-2013, but coordination and standardization was lacking among surveillance efforts, and most focused on limited subsets of influenza viruses. Given high financial and public health burdens of recent avian influenza outbreaks, the authors call for sustained, cost-effective investments in locations with high avian influenza diversity in wild birds and efforts to promote standardized sampling, testing, and reporting methods, including full-genome sequencing and sharing of isolates with the scientific community.



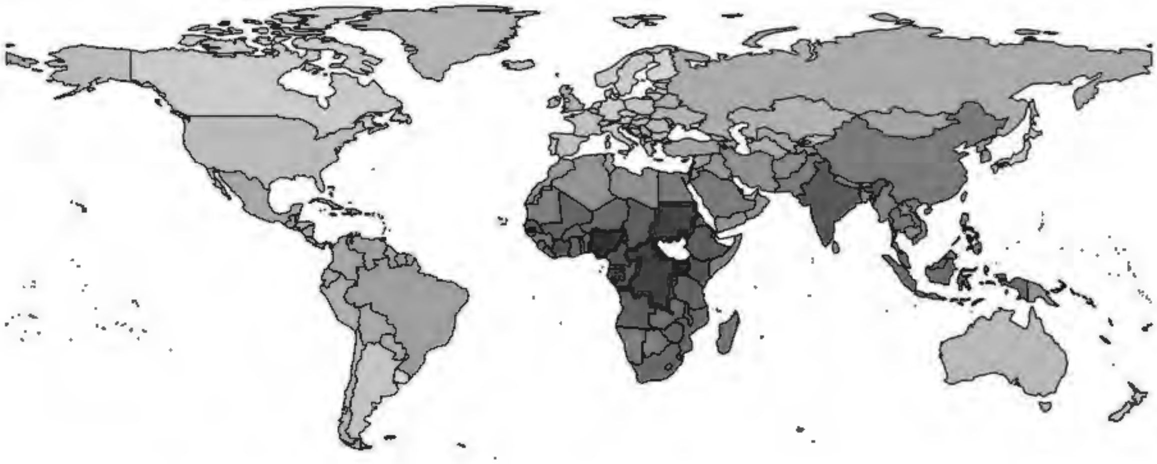
Countries in red, orange, and yellow currently self-report some type of avian influenza surveillance in wild birds, suggesting feasibility of coordinating and improving avian influenza surveillance in wild birds in regions where viral diversity is highest. Source: Machalaba et al., 2015.

Citation: Machalaba, C., S.E. Elwood, S. Forcella, K.M. Smith, K. Hamilton, K.B. Jebara, D.E. Swayne, R.J. Webby, E. Mumford, J.A.K. Mazet, N. Gaidet, P. Daszak, W.B. Karesh. 2015. Global avian influenza surveillance in wild birds: A strategy to capture viral diversity. *Emerging Infectious Diseases* 21(4). Available online: http://wwwnc.cdc.gov/eid/article/21/4/pdfs/14-1415.pdf

Global biogeography of human infectious disease

Authors: K.A. Murray, N. Preston, T. Allen, C. Zambrana-Torrelio, P.R. Hosseini, and P. Daszak.

In brief: Understanding the distributions of infectious diseases is a central public and global health objective. In this study, the authors analyzed the global occurrence patterns of 187 human infectious diseases across 225 countries and seven epidemiological classes (human-specific, zoonotic, vector-borne, nonvector-borne, bacterial, viral, and parasitic) to show that human infectious diseases exhibit distinct spatial grouping patterns at a global scale. The authors use outbreaks of Ebola virus to illustrate how such patterns could be leveraged to provide a "head start" or added focus for risk management activities. Findings show that human infectious diseases exhibit striking biogeographic grouping patterns at a global scale, reminiscent of "Wallacean" zoogeographic patterns. This result is surprising, given the global distribution and unprecedented connectivity of humans as hosts and the homogenizing forces of globalization; despite these factors, infectious disease assemblages remain fundamentally constrained in their distributions by ecological barriers to dispersal or establishment. Biogeographic processes thus appear to provide an overarching context in which other factors promoting infectious disease emergence and spread are set.



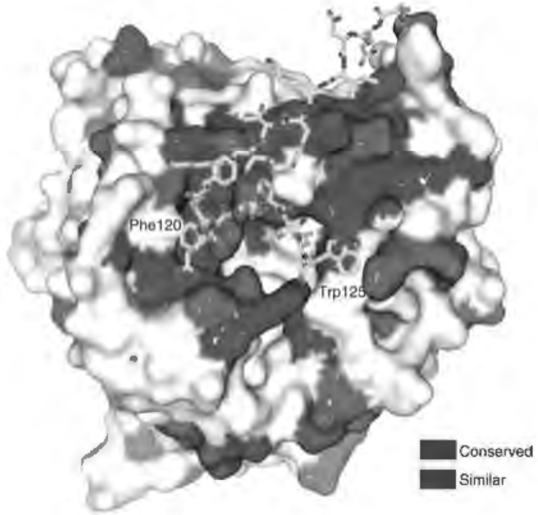
Global human infectious disease pathogeographic patterns. Source: Murray et al., 2015.

Citation: Murray, K.A., N. Preston, T. Allen, C. Zambrana-Torrelio, P.R. Hosseini, and P. Daszak. 2015. Global biogeography of human infectious disease. *PNAS* 12(41): 12746-12751. Available online: http://www.pnas.org/content/112/41/12746.abstract

Evidence of henipavirus spillover into human populations in Africa

Authors: O. Pernet, B.S. Schneider, S.M. Beaty, M. LeBreton, T.E. Yun, A. Park, T.T. Zachariah, T.A. Bowden, P. Hitchens, C.M. Ramirez, P. Daszak, J. Mazet, A.N. Freiberg, N.D. Wolfe, and B. Lee.

In brief: Paramyxoviruses are a part of the henipavirus genus, which includes the highly pathogenic Nipah and Hendra viruses that have a historically high mortality rate of >90% during outbreaks on the Asian and Australian continents. The natural reservoirs for henipaviruses are wild fruit bats that cover a large geographic range, including sub-Saharan Africa. To explore potential zoonotic spillover, this study examined fruit bat (*Eidolon helvum*) (n=44) and human (n=497) blood serum samples from Cameroon and examined factors, such as occupation, deforestation, and hunting/butchering activities, to determine if a specific behavior/activity was associated with henipavirus spillover. Of the 497 humans sampled, 171 reported butchering bats, and a seroprevalence rate of 4% (7/171) was detected for henipavirus in human serum samples. Butchering bats was a risk factor for seroprevalence. Additionally, the seroprevalence rate of henipavirus in sampled fruit bats was 48% (21/44). This study indicates that there may be spillover of henipaviruses into people engaged in the high-risk activity of butchering fruit bats in Cameroon. Due to the high diversity of henipaviruses detected in Africa, the widespread distribution of the reservoir host, and the prevalence of risky activities in the bushmeat trade, the study indicates risk of henipavirus spillover and illness in human populations. To counter this threat, the authors recommend additional surveillance of fruit bat and high-risk human populations, international collaborations to improve monitoring of henipaviruses across a wider geographic space, cross-disciplinary approaches, and bushmeat trade regulations to track and ultimately control henipavirus spillover in Africa.



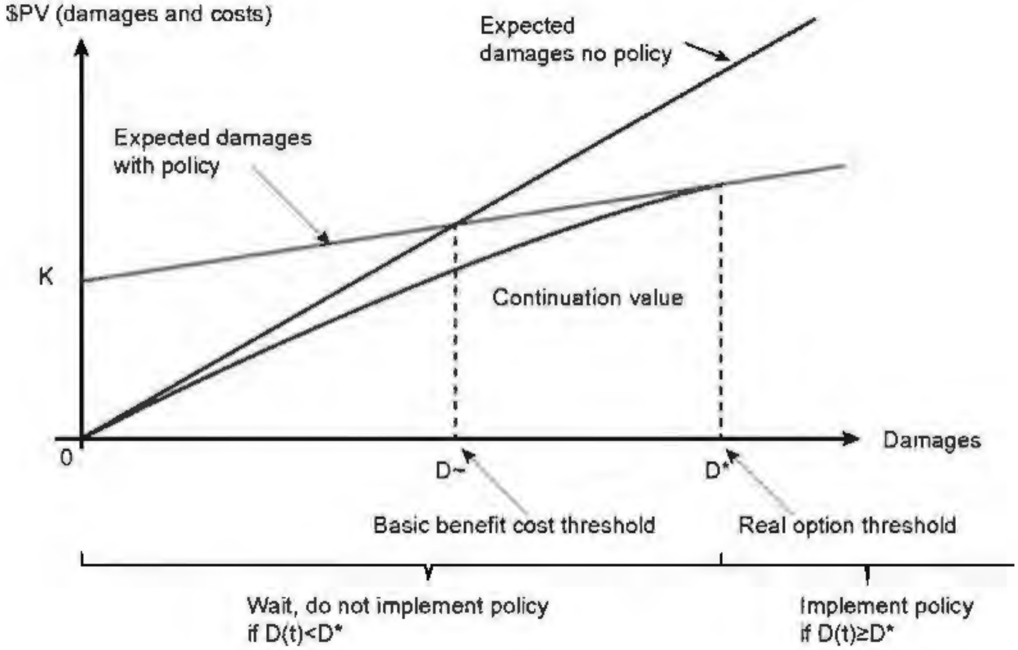
A model of the Nipah virus surface compared for conserved and similar sections of the henipavirus detected in the study (Bat Paramyxovirus Eid_hel/GH-M74a/GHA/2009). Source: Pernet et al., 2014.

Citation: Pernet, O., B.S. Schneider, S.M. Beaty, M. LeBreton, T.E. Yun, A. Park, T.T. Zachariah, T.A. Bowden, P. Hitchens, C.M. Ramirez, P. Daszak, J. Mazet, A.N. Freiberg, N.D. Wolfe, B. Lee. 2014. Evidence of henipavirus spillover into human populations in Africa. *Nature Communications* 5:5342. Available online: http://www.nature.com/ncomms/2014/141118/ncomms6342/full/ncomms6342.html

Economic optimization of a global strategy to address the pandemic threat

Authors: J. Pike, T.L. Bogich, S.E. Elwood, D.C. Finnoff, and P. Daszak.

In brief: Emerging pandemics are increasing in frequency, threatening global health and economic growth. Global strategies to thwart pandemics can be classed as adaptive (reducing impact after a disease emerges) or mitigation oriented (reducing the causes of pandemics). Through economic analysis, the authors show that the optimal time to implement a globally coordinated adaptive policy is within 27 years and that given geopolitical challenges around pandemic control, these should be implemented with urgency. Furthermore, authors find that mitigation policies aimed at reducing the likelihood for disease emergence are more cost effective, and if implemented today could result in savings between $344-361 billion over the next 100 years.



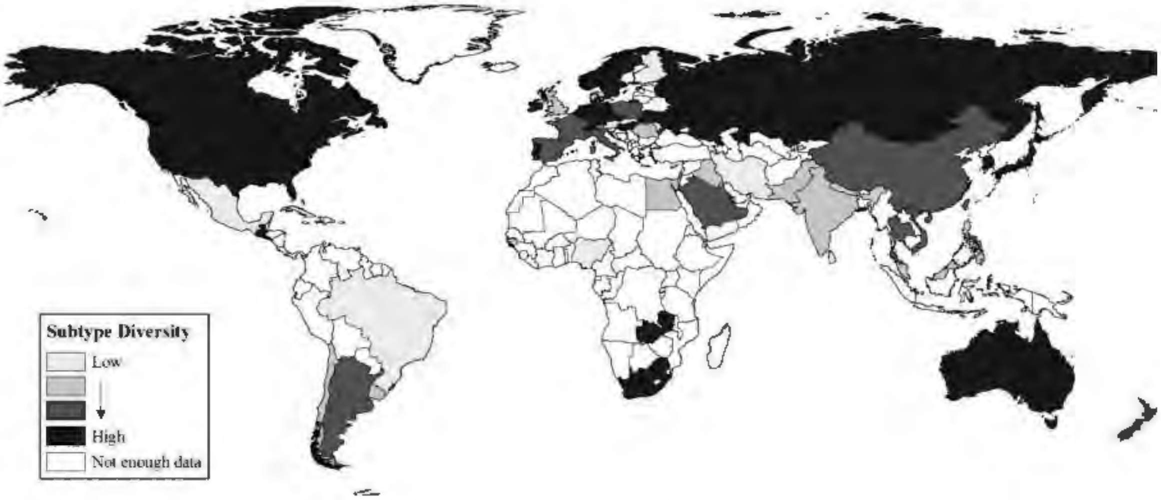
Real option model to determine the optimal timing for reducing emerging infectious diseases; where K=cost and D=threshold in which policy should be implemented. Source: Pike et al., 2015.

Citation: Pike, J., T.L. Bogich, S.E. Elwood, D.C. Finnoff, P. Daszak. 2014. Economic optimization of a global strategy to address the pandemic threat. *PNAS* 111(52): 18519-18523. Available online: http://www.pnas.org/content/111/52/18519.abstract

Evolutionary dynamics and global diversity of influenza A virus

Authors: D. Rejmanek, P.R. Hosseini, J.A.K. Mazet, P. Daszak, and T. Goldstein.

In brief: In recent years, an increasing number of influenza A virus (IAV) subtypes including H5N1, H7N9, and H10N8 have been detected in humans. Their high fatality rates have led to an increased urgency to better understand where and how novel pathogenic influenza strains emerge. Our findings showed that mutational rates of 11 commonly encountered subtypes were higher in East Asian countries compared to those in North America, suggesting there may be a greater risk for the emergence of novel pathogenic strains in East Asia. In assessing the potential drivers of IAV subtype diversity, our analyses confirmed that reporting effort and healthcare spending were the best predictors of observed subtype diversity at the country level. These findings underscore the need to increase sampling and reporting efforts for all subtypes in many under-sampled countries throughout the world such as African, Eastern European and Latin American countries with limited influenza data.



Map of influenza A sub-type diversity. Source: Rejmanek et al., 2015.

Citation: Rejmanek, D., P.R. Hosseini, J.A.K. Mazet, P. Daszak, and T. Goldstein. 2015. Evolutionary dynamics and global diversity of influenza A virus. *Journal of Virology* 89(21):10993-11001. doi: 10.1128/JVI.01573-15.

Evaluation of local media surveillance for improved disease recognition and monitoring in global hotspot regions

Authors: J.S. Schwind, D.J. Wolking, J.S. Brownstein, PREDICT Consortium, J.A.K. Mazet, and W.A. Smith.

In brief: Digital disease detection and early warning systems have increased the rate and geographic coverage of disease event information collection and dissemination. However, digital disease detection has limitations. This research explored the potential for alternative data collection methods to enhance digital surveillance reach through the integration of local media surveillance (LMS). Local print media sources reporting broadly on health or events relevant to disease events or health outcomes were targeted for LMS by PREDICT teams in five low and middle income countries. Results show that LMS can enhance digital surveillance systems by filling gaps in network coverage and by contributing valuable localized information to global databases. Through LMS, 87 unique health events were reported during the 16-week monitoring period including 71 unique reports not detected in the digital network used for comparison (HealthMap). While multiple opportunities were identified to improve operation and efficiency of the LMS approach, this pilot study supports the promotion of LMS as a low cost tool to support digital disease detection systems by closing information gaps in areas with minimal digital surveillance coverage, including many 'hot-spot' regions for emerging infectious diseases.

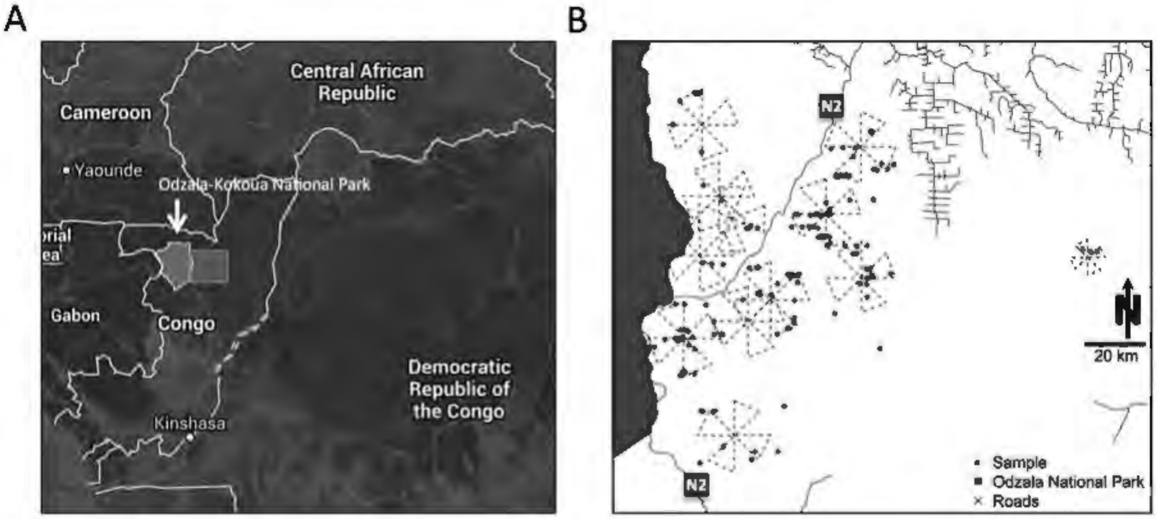
Conceptual model of a local media surveillance system to close information gaps with digital disease surveillance systems in remote areas or areas with limited Internet connectivity. Source: Schwind et al., 2014.

Citation: Schwind, J.S., D.J. Wolking, J.S. Brownstein, PREDICT Consortium, J.A.K. Mazet, W.A. Smith. 2014. Evaluation of local media surveillance for improved disease recognition and monitoring in global hotspot regions. *PLOS One* 9(10): e110236. Available online: http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0110236

Adenovirus and herpesvirus diversity in free-ranging great apes in the Sangha region of the Republic of Congo

Authors: T. Seimon, S. Olson, K.J. Lee, G. Rosen, A. Ondzie, K. Cameron, P. Reed, S. Anthony, D. Joly, W. Karesh, D. McAloose, and W.I. Lipkin.

In brief: Infectious diseases have caused die-offs in both free-ranging gorillas and chimpanzees. Understanding pathogen diversity and disease ecology is therefore critical for conserving these endangered animals. The goals of this study were to investigate the diversity of viruses in free-ranging gorillas and chimpanzees from the Sangha region of the Republic of Congo and estimate viral richness in these populations through pathogen detection in fecal samples. Samples were analyzed to determine ape species, identify individuals in the population, and to test for the presence of viruses. The authors identified 19 DNA viruses representing two viral families, Herpesviridae and Adenoviridae, of which three herpesviruses had not been previously described. Co-detections of multiple herpesviruses and/or adenoviruses were present in both gorillas and chimpanzees. Cytomegalovirus (CMV) and lymphocryptovirus (LCV) were found primarily in the context of co-association with each other and adenoviruses. Using viral discovery curves for herpesviruses and adenoviruses, the total viral richness in the sample population of gorillas and chimpanzees was estimated to be a minimum of 23 viruses, corresponding to a detection rate of 83%. These findings represent the first description of DNA viral diversity in feces from free-ranging gorillas and chimpanzees in or near the Odzala-Kokoua National Park and form a basis for understanding the types of viruses circulating among great apes in this region.



Map of the Republic of Congo (A) showing the location of Odzala-Kokoua National Park (arrow) and the study area (yellow box); The 12 sites (B) where the samples were collected with blue dots showing where each sample was collected and crosses showing the extent of the survey sites. Source: Seimon et al., 2015.

Citation: Seimon, T., S. Olson, K.J. Lee, G. Rosen, A. Ondzie, K. Cameron, P. Reed, S. Anthony, D. Joly, W. Karesh, D. McAloose, and W.I. Lipkin. 2015. Adenovirus and herpesvirus diversity in free-ranging great apes in the sangha region of the Republic of Congo. *PLOS One* 10(3): e118543. Available online: http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0118543

Optimization of a novel non-invasive oral sampling technique for zoonotic pathogen surveillance in nonhuman primates

Authors: T. Smiley Evans, P.A. Barry, K.V. Gilardi, T. Goldstein, J.D. Deere, J. Fike, J. Yee, B.J. Ssebide, D. Karmacharya, M.R. Cranfield, D. Wolking, B.R. Smith, J.A.K. Mazet, and C.K. Johnson.

In brief *(from original abstract):* Wild nonhuman primates are frequent sources of pathogens that could be transmitted to humans because primates are closely genetically related to humans and have direct contact with people in many parts of the world. Sampling primates to screen for diseases is challenging because standard invasive sampling techniques, such as the collection of a blood sample or an oral swab, requires field anesthesia of the animal. This research describes a non-invasive oral sampling technique that involves distributing a rope for primates to chew on that can be retrieved and screened for pathogens. Oral samples were successfully collected from multiple wild primate species in remote field settings and viruses were detected in those samples. This non-invasive sampling method has the potential for future applications in disease studies examining primates as sources of infections that could affect humans in remote high-risk settings, and is now being utilized in the field as a low cost and safe method for diseases monitoring of nonhuman primates in many "hot spot" regions for emerging viruses throughout the world.

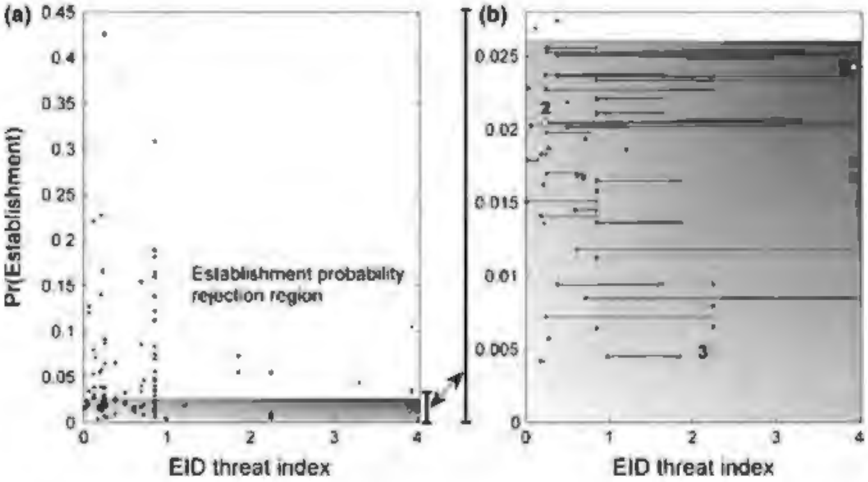
A L'hoest's monkey in Bwindi Impenetrable Forest region, Uganda chews on one of the oral swab ropes with attached retrieval string. Swabs like these are a low cost and safe way to screen wild primates for pathogens. Source: Smiley Evans et al., 2015.

Citation: Smiley Evans, T., P.A. Barry, K.V. Gilardi, T. Goldstein, J.D. Deere, J. Fike, J. Yee, B.J. Ssebide, D. Karmacharya, M.R. Cranfield, D. Wolking, B.R. Smith, J.A.K. Mazet, C.K. Johnson. 2015. Optimization of a Novel Non-invasive Oral Sampling Technique for Zoonotic Pathogen Surveillance in Nonhuman Primates. Rimoin A, ed. *PLoS Neglected Tropical Diseases* 9(6): e0003813. Available online: http://journals.plos.org/plosntds/article?id=10.1371/journal.pntd.0003813.

Integrating invasion and disease in the risk assessment of live bird trade

Authors: M. Springborn, R.P. Keller, S. Elwood, C.M. Romagosa, C. Zambrana-Torrelio, and P. Daszak.

In brief: The international trade in plants and animals is a highly lucrative economic enterprise but is not without costs, as demonstrated by the impacts of invasive species on ecosystems and the introduction of diseases affecting people, livestock, wildlife and the environment. Because current policy responses address the adverse consequences and damage caused by invasive species and international agreements for control and trade target only species with known impacts, this study aimed to develop a rapid risk assessment tool to estimate the likelihood that a traded bird species would cause negative environmental and health impacts if imported into the United States. Using a two-step rapid risk assessment approach that, once developed, can be completed for a species in a matter of days, the authors construct a model of emerging infectious disease threat and then illustrate how the tool can be utilized to identify and prioritize species for regulation. This framework is the first to quantitatively assess expected biological risks due to both environmental and health impacts of a potentially invasive traded wildlife species. In addition, by nesting this risk assessment tool in a cost-benefit-derived decision making framework, the tool enables determination of whether biological risks are justified by trade benefits.



Species plotted by EID threat index versus probability of establishment, Pr(Establishment). Source: Springborn et al., 2015.

Citation: Springborn, M., R.P. Keller, S. Elwood, C.M. Romagosa, C. Zambrana-Torrelio, P. Daszak. 2015. Integrating invasion and disease in the risk assessment live bird trade. *Diversity and Distributions* 21(1): 101-110. Available online: http://onlinelibrary.wiley.com/doi/10.1111/ddi.12281/full

Diversity of coronavirus in bats from Eastern Thailand

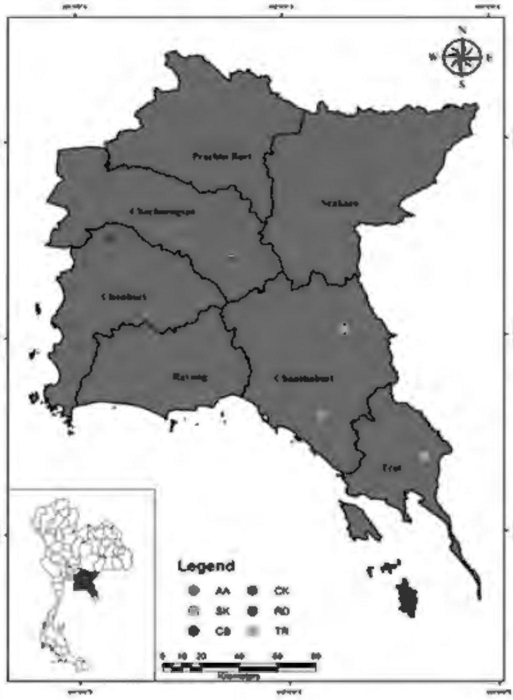
Authors: S. Wacharapluesadee, P. Duengkae, A. Rodparn, T. Kaewpom, P. Maneeorn, B. Kanchanasaka, S. Yinsakmongkon, N. Sittidetboripat, C. Chareesaen, N. Khlangsap, A. Pidthong, K. Leadprathom, S. Ghai, J.H. Epstein, P. Daszak, K.J. Olival, P.J. Blair, M.V. Callahan, and T. Hemachudha.

In brief: Bats are reservoirs for a diverse range of coronaviruses (CoVs), including those closely related to human pathogens such as Severe Acute Respiratory Syndrome (SARS) CoV and Middle East Respiratory Syndrome CoV. There are approximately 139 bat species reported to date in Thailand, of which two are native species that only occur in Thailand, many other species are also found in neighboring countries in Southeast Asia. Due to the disease potential of CoVs, standardized surveillance efforts to characterize viral diversity in wildlife are imperative. In this study, 626 bats from 19 different bat species were individually sampled from five provinces in Eastern Thailand between 2008 and 2013. CoV RNA was detected in 47 specimens (7.6%), from 13 different bat species, using broadly reactive consensus PCR. Thirty-seven alphacoronaviruses, nine lineage D betacoronaviruses, and one lineage B betacoronavirus (SARS-CoV related) were identified, along with six new bat CoV reservoirs. In addition, CoVs from the same genetic lineage were found in different bat species roosting in similar or different locations. These findings suggest that bat CoV lineages are not strictly concordant with their hosts and that there is high diversity and complex ecology of CoVs in bats sampled from specific areas in eastern regions of Thailand. Further characterization of additional CoV genes may be useful to better describe the CoV divergence, which would enhance our understanding and ability to develop prevention and control strategies for CoVs that may present health risks to animals and people.

Detection rate
47/619 = 7.6% (13 spp.)
1.4 - 100% per species
1.6 - 45% per site

● **CB, Chonburi:**
2 families; 5 species
20 specimens (9 positive, 45%)
CoV posilive bats:(no. positive/total)
- *Cynopterus sphinx* (4/7, 57.1%)
  CoV clade-7 [2], -8 [2]
- *Scotophillus kuhlii* (2/3, 66.7%)
  CoV clade-7 [2]
- *Scotophilus heathii* (3/8, 37.5%)
  CoV clade-4 [2], -7 [1]

● **RD, Chachoengsao:**
4 families; 6 species
237 specimens (5 positive, 2.1%)
CoV positive bats: (no. positive/total)
- *Hipposideros armiger* (2/121, 1.6%)
  CoV clade-1 [1], -5 [1]
- *Hipposideros larvatus* (1/20, 5%)
  CoV clade-9 [1]
- *Megaderma lyra* (1/2, 50%)
  CoV clade-5 [1],
- *Taphozous melanopogon* (1/79, 1.3%)
  CoV clade-2 [1]



● **CK, Srakaeo:**
4 families; 10 species
283 specimens (31 positive, 10.9%)
CoV positive bats: (no. positive/total)
- *Hipposideros lekaguli* (10/159, 6.3%)
  CoV clade-1 [2], -5 [6], -7 [1], -8 [1]
- *Miniopterus magnater* (6/30, 20%)
  CoV clade-1 [5], -2 [2**]
- *Miniopterus pusillus* (1/1, 100%)
  CoV clade-3 [1],
- *Miniopterus schreibersii* (12/53, 22.6%)
  CoV clade-1 [3], -2 [1], 3 [8]
- *Rhinolophus shameli* (2/20, 10%)
  CoV clade-5 [1], -6 [1]

○ **AA and ○ SK, Chanthaburi:**
4 families; 7 species
79 specimens (2 positive, 5.5%AA, 1.6%SK)
CoV positive bats (no. positive/total):
- *Cynopterus brachyotis* (1/6, 16.7% -AA)
  CoV clade-5 [1],
- *Taphozous melanopogon* (1/40,2.5%-SK)
  CoV clade-5 [1]

○ **TR, Trat:**
2 families; 4 species
7 specimens
CoV positive bats: *None*

Locations where bats were sampled including detection rates for coronaviruses. Source: Wacharapluesadee et al., 2015.

Citation: Wacharapluesadee S., P. Duengkae, A. Rodpan, T. Kaewpom, P. Maneeorn, B. Kanchanasaka, S. Yinsakmongkon, N. Sittidetboripat, C. Chareesaen, N. Khlangsap, A. Pidthong, K. Leadprathom, S. Ghai, J.H. Epstein, P. Daszak, K.J. Olival, P.J. Blair, M.V. Callahan, T. Hemachudha. 2015. Diversity of coronavirus in bats from Eastern Thailand. *Virology Journal* 12(57). Available online: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4416284/

Mild influenza A/H7N9 infection among children in Guangdong province

Authors: X. Zheng, W. Mai, B. Shu, L. Yi, J. Lu, T. Song, H. Zhong, H. Xiao, D. Guan, J. Wu, L. Liang , C. Monagin , X. Zhang, and C. Ke.

In brief: This study examined seven case studies from the 2013-14 novel avian-origin reassorted influenza A (H7N9) outbreak in Guangdong province, China. Authors describe clinical and epidemiological characteristics for seven children to expand the knowledge on human reactions to H7N9 and to benefit early detection for improved influenza surveillance systems. Recorded clinical signs included fever, throat congestion, cough, rhinorrhea, and upper respiratory infection. Collection and analysis of environmental samples reflected data collected on case source, geographic location, symptom onset, and environmental exposures of the case studies. Poultry markets and residences of the children in the case studies were targeted for potential environmental contamination, and environmental samples from Zhongshan city (25%) and Zhaoqing city (44.3%) tested positive for H7N9. This study highlights children as a high-risk population for influenza and asymptomatic H7N9 carriers and provides sanitation recommendations on for behavioral modifications to disinfect high-risk environments for influenza.

Citation: Zheng, X., W. Mai, B. Shu, L. Yi, J. Lu, T. Song, H. Zhong, H. Xiao, D. Guan, J. Wu, L. Liang, C. Monagin, X. Zhang, C. Ke. 2014. Mild influenza A/H7N9 infection among children in Guangdong province. *Pediatric Infectious Disease Journal* 34(1). doi: 10.1097/INF.0000000000000492

REVIEW

Reservoir host immune responses to emerging zoonotic viruses

Authors: J.N. Mandl, R. Ahmed, L. Barreiro, P. Daszak, J.H. Epstein, H.W. Virgin, and M.B Feinberg.

In brief: Zoonotic pathogens can cause significant disease in humans while seeming to cause relatively insignificant disease in their original reservoir hosts. How do hosts and viruses establish equilibria that lead to decreased or negligible signs of disease? Information on the immunological responses that a virus' reservoir host has to viral infection is key to understanding the characteristics of infection, the nature of host-viral equilibria, and the likelihood of disease transmission to other animals, including other species. In this article, the authors reviewed existing scientific literature on immune functions affecting susceptibility to, tolerance of, and the transmission of viral zoonotic infections. Information from this review identified additional areas of research that together will improve the targeting of future efforts to prevent or diminish the impact of emerging viral diseases.

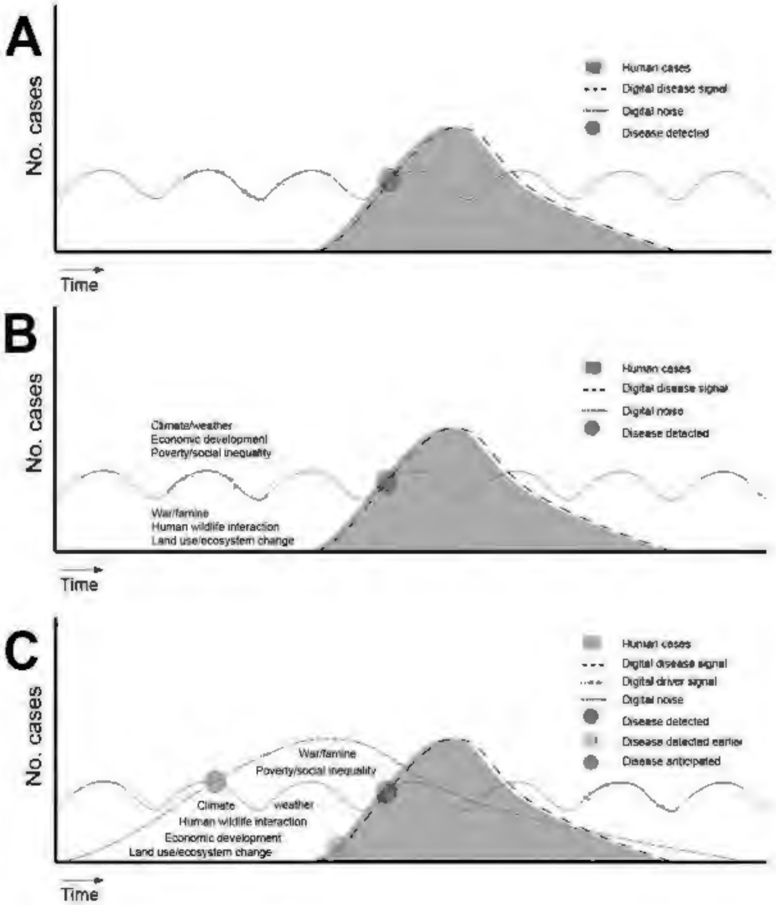
Citation: Mandl, J.N., R. Ahmed, L. Barreiro, P. Daszak, J.H. Epstein, H.W. Virgin, M.B Feinberg. 2015. Reservoir host immune responses to emerging zoonotic viruses. *Cell* 160(1-2): 20-35. doi: http://dx.doi.org/10.1016/j.cell.2014.12.003

PERSPECTIVE

Drivers of emerging infectious disease events as a framework for digital detection

Authors: S.H. Olson, C.M. Benedum, S.R. Mekaru, N.D. Preston, J.A.K. Mazet, D.O. Joly, and J.S. Brownstein.

In brief: Scientists aim to improve the efficacy and timeliness of infectious disease outbreak prediction. Here, the authors suggest that the varied and overlapping conditions ("drivers") leading to disease outbreaks can and should be monitored for signals that suggest outbreaks are likely. Further, the authors propose that drivers of disease emergence and their signals can be measured and digitally analyzed to enhance this "epidemic intelligence," just as meteorologists use weather data to predict storms. This article reviews the limitations of existing global disease driver data, considers the merits of existing disease data technology solutions, and proposes ideal features of future driver monitoring systems. In the building of a disease surveillance platform capable of identifying and describing drivers of infectious diseases, indicating key driver thresholds, and predicting relationships among drivers, the authors view digital disease surveillance as an obtainable and worthy goal capable of leading, in turn, to improvements in active disease surveillance and the prevention and control of infectious disease outbreaks.



Surveillance and detection of disease by traditional (A, B) and digital (C) detection systems. Source: Olson et al., 2015.

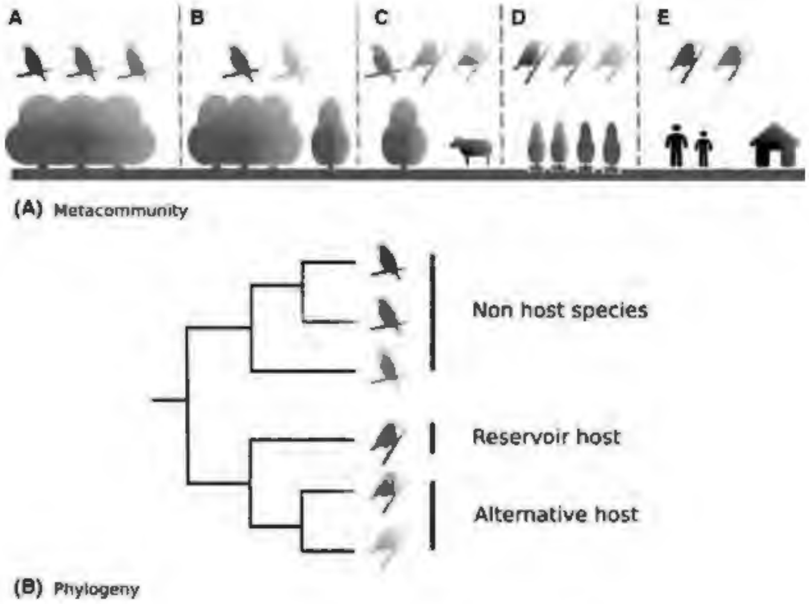
Citation: Olson, S.H., C.M. Benedum, S.R. Mekaru, N.D. Preston, J.A.K. Mazet, D.O. Joly, J.S. Brownstein. 2015. Drivers of Emerging Infectious Disease Events as a Framework for Digital Detection. *Emerging Infectious Diseases* 21(8) Available online: http://wwwnc.cdc.gov/eid/article/21/8/14-1156_article.

CONCEPTUAL SYNTHESIS

Metacommunity and phylogenetic structure determine wildlife and zoonotic infectious disease patterns in time and space

Authors: G. Suzán, G.E. García-Peña, I. Castro-Arellano, O. Rico, A.V. Rubio, M.J. Tolsá, B. Roche, P.R. Hosseini, A. Rizzoli, K.A. Murray, C. Zambrana-Torrelio, M. Vittecoq, X. Bailly, A.A. Aguirre, P. Daszak, A-H. Prieur-Richard, J.N. Mills, and J-F. Guégan.

In brief: Most studies on the ecology of zoonotic diseases caused by pathogens hosted by wildlife reservoirs and vectors (hosts) focus at the level of local populations and communities and the environment in which these interactions occur. Very few consider dimensions at larger scales, such as the landscape and regions that play an important role in infectious disease dynamics. Disease ecology studies using a metacommunity framework can provide novel insights into the mechanisms of emergence of infectious diseases in wildlife including human zoonoses. The authors contribute to the understanding of landscape-level disease dynamics, by proposing a conceptual model of three plausible mechanisms that may influence these dynamics. This conceptual model is a first step in establishing a metacommunity approach to infectious disease transmission. The authors suggest that changes in dispersal, colonization, local extinctions, and biotic interactions resulting from changes in land use and ecosystem alteration can filter and drive patterns of species distribution that subsequently can shape reservoir, vector, and infectious disease occurrences. Importantly, these patterns can be mechanistically and spatially modeled with potentially large benefits for disease management. Furthermore, as the portfolio of infectious disease spread and spatial distribution in metacommunities expands, public health professionals will be better able to evaluate the factors that predispose both a time and place to the origin and emergence of an infectious disease outbreak. This fundamental understanding will help improve the health of humans, wildlife, and domestic animals by mitigating the processes that drive the diversity of infectious disease threats we currently face and will continue to face into the future. Because this study represents the first step in establishing a metacommunity approach to infectious disease transmission, additional mathematical models and empirical studies are needed to further understand the relevance and influence of metacommunities on infectious disease outbreaks and spread.



Conceptual model of ecological and evolutionary relationships within communities that regulate prevalence of infection with a zoonotic pathogen in the reservoir host. Source: Suzán et al., 2015.

Citation: Suzán, G., G.E. García-Peña, I. Castro-Arellano, O. Rico, A.V. Rubio, M.J. Tolsá, B. Roche, P.R. Hosseini, A. Rizzoli, K.A. Murray, C. Zambrana-Torrelio, M. Vittecoq, X. Bailly, A.A. Aguirre, P. Daszak, A-H. Prieur-Richard, J.N. Mills, and J-F. Guégan. 2015. Metacommunity and phylogenetic structure determine wildlife and zoonotic infectious disease patterns in time and space. *Ecology and Evolution* 5(4): 865-873. Available online: http://onlinelibrary.wiley.com/doi/10.1002/ece3.1404/abstract

COMMENTARY

Beyond Ebola: Lessons to mitigate future pandemics

Authors: C. Castillo-Chavez, R. Curtiss, P. Daszak, S. Levin, O. Patterson, C. Perrings, G. Poste, and S. Towers.

In brief: In this commentary, authors reflect on the consequences of outbreaks from zoonotic pathogens, like Ebola hemorrhagic fever, and consider what mitigation strategies to deal with risks of future pandemic threats from emerging diseases might look like. By combining targeted programs for behavior change at high-risk animal-human transmission interfaces, development investments that mitigate potential risks of commercial and livelihood activities that may drive disease emergence, and public health investments into vaccine development and outbreak preparedness and response training, there is great potential for improvements in mitigation at the source of a spillover event or outbreak. Further, future strategies must also be scaleable to mitigate pandemic risk for the global community by engaging diverse sectors and domains with a stake in reducing liability and improving risk assessment through collective investments in public health infrastructure, One Health platforms, improved predictive models of emergence, and surveillance and capacity strengthening programs like USAID's

PREDICT project. While it may be challenging to orchestrate such a suite of strategies globally, pandemics require concerted effort as the costs on our communities and economies when they strike can be devastating.

Citation: Castillo-Chavez C., R. Curtiss, P. Daszak, S. Levin, O. Patterson, C. Perrings, G. Poste, S. Towers. 2015. Beyond Ebola: Lessons for mitigating pandemics. *The Lancet Global Health* 3(7): e354-e355. Available online: http://www.sciencedirect.com/science/article/pii/S2214109X15000686

Envisioning a world without emerging disease outbreaks

Authors: C. Machalaba and W.B. Karesh.

In Brief: Recent outbreaks of emerging infectious diseases (EIDs) have seemingly appeared without warning and have resulted in resource-intensive responses. With our current public health systems largely emphasizing reactive approaches without a lens to ecological links and anthropogenic pressures causing their appearance, new approaches are urgently needed. In the short-term, systems can look toward strengthening capacity for surveillance of infectious disease in human populations, including more rapid and precise detection of cases, effective reporting channels, and collection of samples to document pathogen evolution and guide vaccine or other potential therapeutic development to yield greater infrastructure for early detection of and efficient response to outbreaks. As a long-term goal, public health systems can include paired human-wildlife surveillance and utilize sentinel monitoring toward pre-emption of spillover in humans. While these approaches will require upfront investments, cost-savings can be seen from more integrated and more preventive approaches that can benefit both human and animal health. To support these operational advancements, governance structures are needed that enable a One Health approach that proactively considers connections between human, animal, and environmental health across disciplines.

Citation: Machalaba, C. and W.B. Karesh. 2015. Envisioning a world without emerging disease outbreaks. *Solutions* 6(2): 63-71. Available online: http://www.thesolutionsjournal.com/node/237327

One Health approach to use of veterinary pharmaceuticals

Authors: A. Margalida, G. Bogliani, C.G.R. Bowden, J.A. Donazar, F. Genero, M. Gilbert, W.B. Karesh, J. Lubroth, X. Manteca, V. Naidoo, A. Neimanis, J.A. Sanchez-Zapata, M.A. Taggart, J. Vaarten, L. Yon, T. Kuiken, and R.E. Green.

In Brief: The thousands of tons of veterinary pharmaceuticals produced each year undergo minimal screening for their potential environmental impacts, including contamination threats to non-target species (including humans). Weak environmental assessment was demonstrated in the licensing of the non-steroidal anti-inflammatory drug diclofenac for veterinary use in Spain, despite its link to severe *Gyps* vulture declines in Southeast Asia - and subsequent bans on its use - nearly a decade earlier. As vultures provide critical ecosystem services in their removal of livestock carcasses, Spain's regulatory decision raised concerns about wider implications for economies, ecosystems, and food safety. While placing a lens on veterinary pharmaceuticals, the paper calls for stronger overall environmental stewardship, highlighting the broader benefits of a One Health approach.

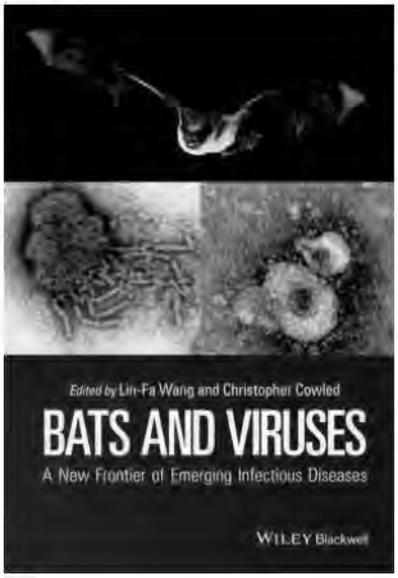
Citation: Margalida, A., G. Bogliani, C.G.R. Bowden, J.A. Donazar, F. Genero, M. Gilbert, W.B. Karesh, J. Lubroth, X. Manteca, V. Naidoo, A. Neimanis, J.A. Sanchez-Zapata, M.A. Taggart, J. Vaarten, L. Yon, T. Kuiken, R.E. Green. 2014. One Health approach to use of veterinary pharmaceuticals. *Science* 346(6215): 1296-1298. Available online: https://www.sciencemag.org/content/346/6215/1296.summary

BOOK CHAPTER

Are bats really 'special' as viral reservoirs: What we know and need to know

Authors: K.J. Olival, C.C. Weekely, and P. Daszak.

In brief: Bats (Order Chiroptera) account for almost a quarter of mammal species in the world and harbor a high proportion of zoonotic viruses. This chapter reviews the recent literature and provides further data analyses exploring whether bats are "special" in their ability to act as hosts for novel and known zoonotic viruses. Ultimately, the scientific literature does not give a clear indication of whether or not bats are "special." Our review suggests that there are major research gaps to be addressed both for bats as well as other mammalian taxonomic groups, and while bats may not be unique in their relationship with viruses, they should continue to be the focus of viral research and discovery.



Edited by Lin-Fa Wang and Christopher Cowled

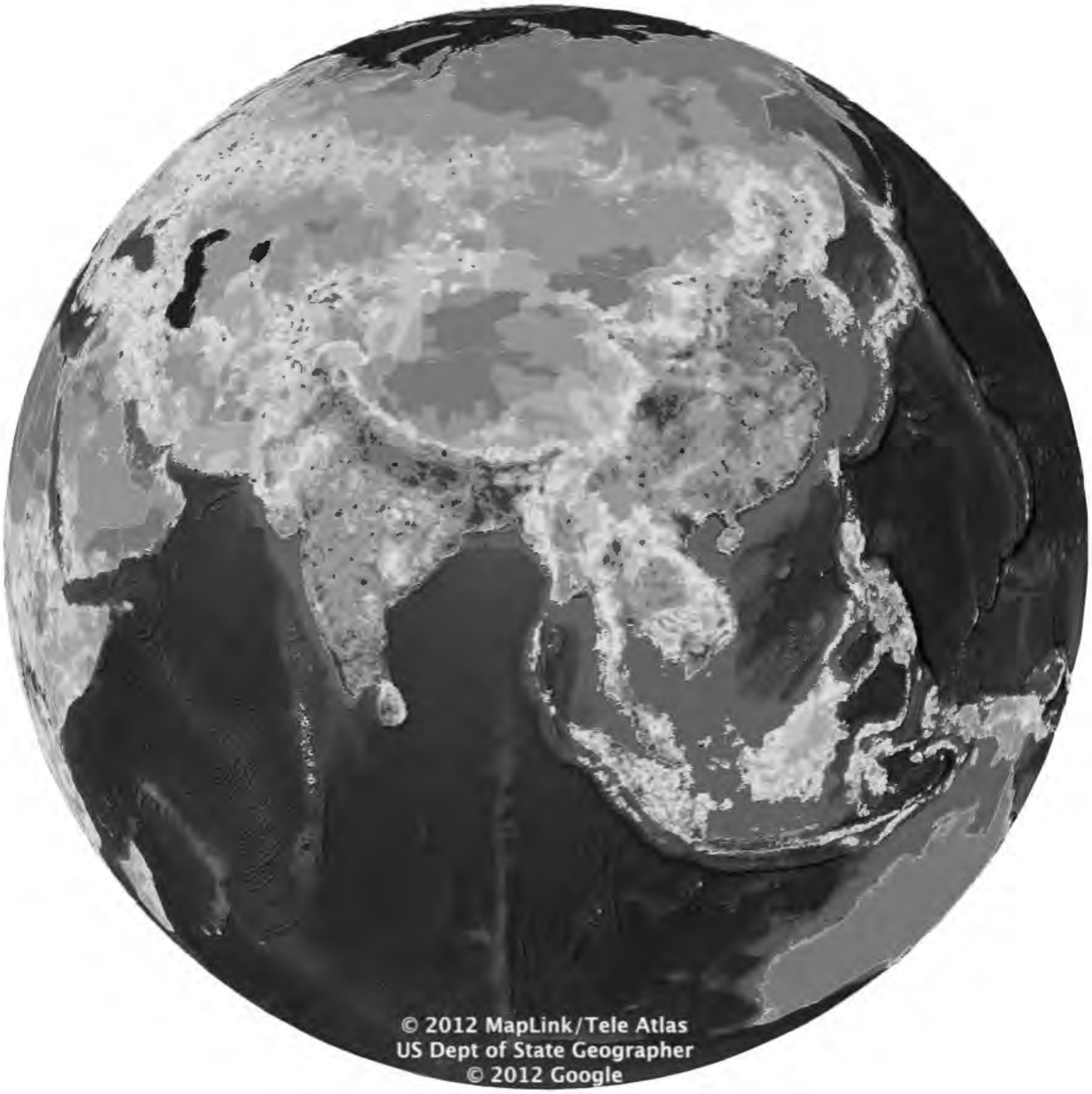
BATS AND VIRUSES

A New Frontier of Emerging Infectious Diseases

WILEY Blackwell

Citation: Olival, K.J., C.C. Weekely, P. Daszak. 2015. Are bats really 'special' as viral reservoirs: What we know and need to know. In Wang, L.F. and C. Cowled (Eds.), *Bat Viruses: A New Frontier of Emerging Infectious Diseases* (281-294). New Jersey: Wiley-Blackwell.

VI. FEATURED PRODUCTS



SECTION 6. PREDICT FEATURED PRODUCTS

6.1 SURVEILLANCE – HUMAN SUBJECTS RESEARCH PROTOCOL, QUESTIONNAIRE, AND HOSPITAL INTAKE FORM

PREDICT's surveillance for emerging pathogens focuses on areas of the world at the highest risk for zoonotic disease emergence. The goal is to move countries away from a reactive post-outbreak response to a proactive approach in which pathogens of pandemic potential are discovered at their source before large-scale epidemics occur in people.

PREDICT's disease surveillance strategy is based on the inextricable link between animals, humans, and the environment. Rather than prescribing an across-the-board surveillance plan, PREDICT works in each focus country to cultivate targeted, measurable, adaptive, and responsive approaches that are integrated across health and environmental sectors.

This year, PREDICT expanded in scope to target biological surveillance of wildlife and people in all areas of engagement to better understand the factors associated with viral spillover, evolution, amplification, and spread. To operationalize human subjects research for biological sample collection in health clinics and hospitals in all focus countries and to ensure that data collected captures behavioral factors that may play a role in disease transmission, PREDICT leveraged consortium expertise to develop a Master Protocol to guide human surveillance activities in all countries and to ensure compliance among all sites engaged in human subjects research at global and local levels. In addition, consortium partners collaborated to develop a Human Questionnaire and Hospital Intake Form (included below) that are now being translated into local languages by country teams. These materials were submitted to the UC Davis Institutional Review Board (IRB) for approval, which the team anticipates receiving in January 2016.

1) Protocol Title: PREDICT - Surveillance for emerging zoonotic disease threats and behavioral risk characterization in high-risk communities in Asia and Africa

Protocol Date: September 1, 2015, revised December 22, 2015

2) Author of Protocol

X UC Davis Researcher
X Researcher from other institution

3) IRB Review History

The PREDICT research team submits this new protocol as a Master Protocol designed to describe all research activities involving human subjects research in participating countries. PREDICT is a collaborative disease surveillance and capacity strengthening program funded through the USAID Emerging Pandemic Threats program. The geographic scope of program activities, including those involving human subjects is dynamic and subject to change. Currently, PREDICT is active in 17 countries in Africa and South and Southeast Asia: Bangladesh, Cambodia, Cameroon, China, Democratic Republic of Congo (DRC), Gabon, Indonesia, Lao PDR, Malaysia, Myanmar, Nepal, Republic of Congo (RoC), Rwanda, Tanzania, Thailand, Uganda, and Viet Nam. PREDICT is expanding in scope with activities planned in Cote d'Ivoire, Egypt, Ethiopia, Ghana, Guinea, India, Jordan, Kenya, Liberia, Mongolia, Philippines, Senegal, Sierra Leone, South Sudan, and Sudan. *A more extensive description of the study sites in the countries currently participating in the PREDICT project is included under #23 "Setting" below.*

PREDICT will seek approval for research activities involving human subjects from all participating countries through Institutional Review Boards, ethical clearance councils/committees, and national research administrations following local regulatory guidelines as appropriate. Separate IRB protocols for each country and any amendments to locally approved research protocols or consent forms diverting from Master Protocol activities will be submitted to the UC Davis IRB Administration for review.

4) Objectives

This research aims to 1) detect and characterize new and known viruses of epidemic and pandemic potential in high-risk communities and patients admitted to hospitals; 2) identify biological, behavioral, and ecological factors influencing the risk of viral spillover, amplification, and spread; and 3) determine potential targets for intervention based on high-risk human behaviors and practices that amplify disease transmission in hotspots for viral evolution, spillover, amplification, and spread.

Surveillance of high-risk human populations, the focus of this protocol, is part of the larger PREDICT project. In addition to the objectives stated above, PREDICT aims to conduct concurrent surveillance in animals that is temporally and spatially aligned with sampling of people in high-risk communities. Our overall goal is to identify animal reservoirs and amplification hosts for zoonotic viruses, strengthen human and animal disease surveillance system capacities in hotspot regions, and establish collaborative One Health platforms to reduce the risk of disease spillover, amplification, and spread.

The PREDICT project is led by a Consortium of organizations in the US based at the University of California, Davis. Consortium members include: UC Davis (UCD), EcoHealth Alliance (EHA), Metabiota, Inc. (MB), Smithsonian Institution (SI), and Wildlife Conservation Society (WCS). Activities in each of the PREDICT countries are implemented by local partners in collaboration with one or more of the PREDICT Consortium partners under the guidance of operational teams, the PREDICT Executive Board, and a Senior Management Team with representation from USAID. Appendix A provides a list of current PREDICT partners by country.

US-based Consortium personnel will provide support for study design and planning, and technical and analytical support during implementation, along with assuring compliance in countries where each partner is lead (see Appendix A for a full list). All research procedures will be conducted by local implementing partners in accordance with local laws and IRB regulations (and/or other relevant governing authority regulations for human ethics as appropriate).

IRB authorization agreements establishing UC Davis as the Reviewing IRB of Record have been established with EcoHealth Alliance and Metabiota, Inc. Documentation for each authorization agreement has been provided in the appendices. Authorization agreements to establish UC Davis as the Review IRB of Record are currently in development with the Wildlife Conservation Society and Smithsonian Institution.

The research will be conducted only after obtaining ethical approval from local institutional review boards at the country-level.

5) Background

Emerging infectious diseases (EIDs) pose substantial threats to the health of animals, people and economies globally (Smolinski et al. 2003; Daszak et al. 2004). Zoonotic pathogens shared with wild or domestic animals account for the majority of EIDs, and viruses comprise 25-44% of these emerging and re-emerging pathogens (Jones et al. 2008; Taylor et al. 2001). Over the past decade, attempts to control deadly zoonotic viruses, like Severe Acute Respiratory Syndrome (SARS) and Middle Eastern Respiratory Syndrome (MERS) coronaviruses and highly pathogenic avian influenza viruses, have been, out of necessity, almost entirely reactionary. Due in large part to USAID's Pandemic Influenza and Other Emerging Threats Program, the world is poised to move beyond this costly approach, which measures impact in death tolls and money spent on diagnosis, treatment and containment. PREDICT is predicated on a proactive paradigm that facilitates the applied use of a growing body of knowledge in which emergent diseases may be identified at their source and intervention strategies developed to prevent spillover or at least control zoonotic pathogens at the source and prevent further disease spread.

As stated above, the PREDICT Consortium is led by a team based at the University of California, Davis. From 2009-2014, the Consortium developed and stewarded the first phase of the PREDICT project in Africa (Cameroon, Gabon, RoC, DRC, Tanzania, Uganda, and Rwanda), Asia and SE Asia (Bangladesh, Cambodia, China, Indonesia, Lao PDR, Malaysia, Nepal, Thailand, Vietnam), and Latin America (Bolivia, Brazil, Mexico and Peru).

Working closely with government ministries, scientific institutions, local organizations, and other stakeholders, the Consortium significantly advanced One Health capacity and infrastructure in these countries. By developing mechanisms for overcoming geographic and disciplinary constraints to public health protection, the Consortium established multidisciplinary collaborations and systems for data sharing across Ministries. High-risk human-wildlife interfaces were selected for investigation of viral spillover from wildlife hosts to humans and their food animals. Human and animal samples were screened for viral families suspected to be sources for new potential zoonotic pathogens impacting people, using consensus PCR and complemented with high-throughput sequencing as needed. In this first phase of the PREDICT project, the Consortium detected more than 100 known viruses and 800 new viruses with the goal to examine these data in the context of human-wildlife contact to assess risk and inform mitigation strategies.

Building on the surveillance activities to date, the Consortium is focusing surveillance in locations where environments and market systems are changing in ways that are conducive to the spillover of viruses from animals to people. Despite greater recognition of emerging zoonoses, the exact mechanisms of viral spillover and transmission from animals to humans are poorly understood (Murray and Daszak 2013). This proposed research aims to provide a better understanding of the drivers and host-pathogen dynamics, including which human behaviors and practices increase risk, and under what circumstances these behaviors facilitate spillover of zoonotic viruses.

This research will also contribute to a better understanding of undiagnosed illnesses experienced by people with exposure to animals. Because the surveillance will be conducted in both community and hospital settings, this research will address limitations in community-based studies for which detecting virus and viral spillover would be near impossible, as well as limitations in hospital-based studies in which patients seeking care might not be representative of people with high-risk animal interactions.

6) Inclusion and Exclusion Criteria

Research subjects to be enrolled in this study will be those living, working, or visiting the locations selected by PREDICT at priority surveillance sites who meet the inclusion criteria outlined below. PREDICT study sites are prioritized according to ecological and epidemiological conditions associated with a high risk for zoonotic disease emergence (i.e. close contact between humans and taxonomic animal groups from which zoonotic viruses have emerged previously).

Research subjects will be enrolled in two settings:

1) People living in, working in, or visiting targeted high-risk communities who have close contact with wildlife and livestock. In high-risk communities, we anticipate interviewing and collecting biological samples from individuals with a range of exposure to animals. Recruitment will also take into account any known or observed differences in animal contact or practices associated with racial/ethnic minority, religious or immigrant status. Enrolled research subjects will provide biological samples and complete a questionnaire that is designed to obtain demographic information, as well as medical history and quantitative data on behavioral interactions with animals. A subset of people in high-risk communities will complete the questionnaire only, and will not provide biological samples, to increase the sample size and broaden the scope of behavioral data collected from these communities.

2) Patients at clinics or hospitals presenting with disease symptoms of unknown origin. In particular, we will target patients that have already tested negative for normative disease screening (e.g., influenza) when routine and reliable diagnostic testing is being done by collaborating clinics and hospitals, so that we can enroll patients with undiagnosed causes of diseases, such as severe acute respiratory disease[1], encephalitis of unknown origin and hemorrhagic fevers. As with the community-based group, biological samples will be collected from the patients, and the patients or his/her designate will complete a questionnaire.

Additional inclusion criteria:

1. Adults (18 years of age or greater) who provide informed consent
2. Children (2 -17 years of age)* with an accompanying parent or guardian who is able to provide informed consent, with assent of children 12 years or older also required
3. Pregnant women will be considered eligible
   **Children defined as 2-17 years unless the age of majority in a participating country differs. In these cases, the age range for children will be listed in the country specific IRB protocols.*

---

[1] WHO SARI case definition: history of fever or measured temperature greater than or equal 38 degrees centigrade, and cough with onset within the last 10 days, and requires hospitalization.

Exclusion criteria:

1. Individuals over the age of 2 years who refuse to provide informed consent
2. Adults unable to provide informed consent, including individuals with physiologically or medically induced cognitive impairments
3. Children without an accompanying parent or guardian who is able to provide informed consent, or a child 12 years or older unable or unwilling to provide assent
4. Children < 2 years of age
5. Prisoners

7) Number of Subjects

This is a multicenter study, and we estimate approximately 4,860 individuals will be enrolled per participating country over the course of the project. This estimate is the target sample size following consent and screening procedures (excluding screen failures). Estimated sample size is based on a sample of 180 individuals per high-risk community, sampled for 2 seasons for 3 years, with replication at 3 high-risk communities (n = 3,240) and a sample of 180 individuals at 3 clinic/hospital sites per country for 3 years (n = 1,620). In addition, only the questionnaire (no biological sampling) will be administered to approximately 1,000 additional human subjects in each country where a particularly high-risk site is identified through on-going work.

Country-specific protocols will be amended to this Master Protocol, and estimated sample size may vary by country according to the number of study sites..

8) Recruitment Methods

In order to recruit individuals within target communities, introductory visits will be made by country project staff to each of the participating sites. These visits will be advertised through word of mouth. During site visits, discussions and meetings will be held to educate, sensitize, and inform people about zoonotic pathogens and potential pathways for disease spread/emergence. These discussions are already conducted in study communities as part of ongoing disease surveillance activities of animal populations. When appropriate and following approval from local authorities, the study team will work with key informants in the community to organize a "town hall meeting" to speak about enrollment. This "town hall" meeting will be completely voluntary, and, based on our experience, those interested would likely attend. Although local authorities may be present to introduce the study team members, they will not be involved in the recruitment and/or consent of the participants for the study. If research visits or recruitment will be held at a workplace, the study team will work with employers to obtain permissions to conduct the study during times that do not disrupt work. Subjects will be clearly informed during the recruitment process that their participation in the study is voluntary and will not impact their employment, that measures will be taken to ensure privacy in participation, and that no information discussed will be shared with employers. Every effort will be made to ensure participation is voluntary and confidential.

An introduction script will be used to inform individuals of proposed project activities (see Appendix B: PREDICT Informed Consent Form). The language will be geared to a 5th grade level in the local language, to ensure that potential community participants understand the study purpose and eligibility inclusion guidelines.

Participation in the study will be strictly voluntary and will require signed, informed consent (Appendix B: PREDICT Informed Consent Form). Participants will be given a consent form prior to being asked to participate in this study. They will review the consent form with the research staff and will be given time to ask questions. After reviewing the consent form, study staff will explain details of the study including: why they were selected, potential risks due to their participation, how their participation is beneficial, that their participation is completely voluntary, and that they can withdraw their participation at any time. Responses will be kept strictly confidential. Measures will be taken to assure the respect, dignity and freedom of each participant. During training of research staff, we will emphasize the importance of avoiding coercion and protecting the privacy of participants.

Community-based recruitment: For the community-based research, cluster sampling will be performed where concurrent sampling of animals is being conducted at high-risk disease transmission interfaces. Cluster sampling is used when constructing a frame of the observation units may be difficult, expensive, or impossible. For example, it may be difficult to determine the total number (denominator) of hunters in a province or district, making it impossible to select a random sample. If the cluster is small enough, the entire cluster of individuals may be recruited for enrollment. However, if the cluster is large (~50 individuals), only a subset from the cluster will be recruited.

In order to obtain a subset of respondents from large clusters of over 50 individuals, research staff will use systematic random sampling, which is a relatively simple method to apply in the field and is the most commonly used method in two-stage cluster sampling. Systematic random sampling is implemented by selecting a random starting point to initiate the questionnaire and sample collection. After the questionnaire and sampling are complete, the research staff will move X units (e.g. market stalls, dwellings, beds in group housing) and select the Xth unit for study participation. For example, in a large wildlife market, the first vendor would be selected at random for study participation. Upon completion of the study requirements, study staff would then move 3 stalls down (if X=3 for desired sample size) and select an individual at the stall on the right for study participation, and so on. Only one person per unit (e.g., household, market stall) will be recruited for study participation.

Clinic and hospital-based recruitment: Patients for enrollment will be identified in the intake area, the emergency room, in the ward, or in the intensive care unit of each participating clinic and hospital by clinic staff according to standard operating procedures at collaborating sites. Employed staff at each location will identify potential participants that fit undiagnosed viral syndromes in patients. Patients will be screened for eligibility according to the inclusion/exclusion criteria based on available clinical information only.

In general, patients will be enrolled using a quota system until approximately 20% of the participants are children < 18 years of age and 80% are adult. For larger hospitals and clinics, interval sampling will be implemented by selecting every Nth case at the site among those individuals who meet enrollment criteria. The interval will be determined by local implementing partners based on an evaluation of the expected number of cases presenting at the site within a given year in order to best meet study design and sample size criteria. For example, in a large hospital with many patients meeting enrollment criteria, the first patient meeting criteria would be selected for study participation followed by selection of every 3rd or 5th individual (depending on the appropriate interval) until the maximum sample size has been obtained.

9) Compensation to the Subjects

Upon completion of study procedures, participants may be provided with a 'gift' or token of appreciation for their time, expertise and participation. Gifts will be valued at no more than 10 USD, and gift items and amounts will be determined by local PREDICT research teams to ensure cultural relevancy and consistency with regulations and research practice. Typically gifts include something like a soda, rice, cooking oil, laundry detergent, or soap, and may include cash.

10) Study Timelines

Patients/participants will volunteer approximately 1 hour of their time for participation in the study including providing biological samples and completing the questionnaire.

The PREDICT project is an ongoing, five year project (end date of September 30, 2019). If funding is available, we may extend the project for another five years (samples/data will be maintained for a maximum of ten years). Completion of preliminary analyses is expected in 2019.

11) Study Endpoints

The primary study endpoints are 1) detection of new and known viruses shared with animals at high-risk human-animal interfaces, and 2) identification of human behaviors and practices facilitating the risk of viral spillover and potential targets for intervention.

Secondary endpoints are to report study findings to communities and medical personnel and to build awareness for zoonotic disease transmission in high-risk communities.

12) Procedures Involved

STUDY DESIGN

All field research procedures including biological sampling and interviews will be conducted by local individuals trained by PREDICT staff listed on this protocol and using PREDICT data collection protocols and training materials. As stated above under

"Objectives", US-based personnel will be minimally involved in the sampling or management of human subject research material or identifiable data. In rare cases where US-based personnel are supporting country teams with specimen collection, interviews, or data management, these personnel will be listed in the country-specific IRB protocols submitted to UC Davis and in the host country IRB protocols to ensure full coverage. US-based PREDICT personnel and Country Coordinators (or their designated project coordinator for human subject research activities) at each site will be required to complete CITI training, as well as all PREDICT training modules, prior to initiation of activities.

Surveillance and behavioral risk characterization will involve individuals from both community-based and hospital settings from PREDICT priority surveillance sites with high-risk for viral spillover, evolution, amplification, and spread. All study participants will be administered a questionnaire (Appendix C – PREDICT Human Questionnaire) that assesses work practices, mobility, illness experiences, and exposure to animals. Hospitalized participants will also be given a specific questionnaire (Appendix D – PREDICT Hospital Intake Form) that targets their symptoms, as well as their work practices and potential exposures to animals.

1) Individuals living, working, or visiting targeted high-risk communities who have close contact with wildlife or livestock:

> Individuals living with or near animals in sites that have been identified as concurrent sampling sites for animals and humans will be asked to provide biological specimens, as well as to complete the questionnaire at the time of specimen collection. The primary goals of this study are to find evidence for zoonotic viral sharing between animals and humans and to examine the high-risk human behaviors and practices that amplify disease transmission, spillover, amplification and spread.
>
> Questionnaires (Appendix C – PREDICT Human Questionnaire) will be administered to all individuals providing biological samples, as well as to additional subjects in high-risk communities who will not provide biological samples. The questionnaire-only participant data is being collected to provide larger sample sizes for analysis and to build and test models of human practices that may be associated with high risk for zoonotic disease exposure. Subjects to receive only the questionnaire will be selected from communities where concurrent sampling of animals is being conducted, following the cluster sampling procedure described above.

2) Hospital and clinic patients with undiagnosed infectious diseases:

> Patients who satisfy inclusion and recruitment criteria as described above will complete the questionnaire (either Appendix C – PREDICT Human Questionnaire or Appendix D – Hospital Intake Form, as appropriate given the clinical setting) and provide clinically relevant biological specimens to be tested using PREDICT protocols. When feasible, admitted hospitalized patients will have 2 blood samples collected, one on the day of enrollment and one taken seven days after enrollment or

before discharge in accordance with standard of care, but will only be administered the questionnaire once upon enrollment.

Biological sample collection:

Duplicate samples will be collected from each research subject by trained staff of in-country implementing partners. These will include:

1. Oral swab
2. Nasal swab
3. Whole blood
4. Serum
5. Other samples that could be collected include oropharyngeal, nasopharyngeal swab, urine, rectal swab, and/or feces in clinical settings as appropriate.
6. For clinic and hospitalized patients, if urogenital swabs, cerebral spinal fluid (CSF), pericardial fluid, pleural fluid, ocular swabs, or other samples have been collected by medical staff for diagnostic purposes, PREDICT testing will be conducted on remaining sample aliquots after standard diagnostic procedures have been completed.

Trained staff will collect oral and nasal swab samples from subjects by gently rubbing a sterile, synthetic swab on the patient's nasal and oral mucosa for 2-5 seconds. For fecal and urine samples, the subject will be provided containers labeled with their ID in which to collect the respective samples and instructions on how to collect uncontaminated samples. Phlebotomists, doctors, or nurses will collect venous blood samples by standard venipuncture from the right or left antebrachium. Blood will be collected into a minimum of 1 vacutainer tube containing EDTA and serum separator tubes for a maximum of 12mL collected per individual (12mL for adults and children aged $\geq$13 years and 6 mL for children aged <12 years). When appropriate in clinical settings, staff will collect nasopharyngeal, oropharyngeal, urogenital, and rectal swabs. Rectal swabs will be collected by gently inserting sterile, flexible, nylon-tipped swabs into the anal canal and moving them from side to side and rotating while removing. Urogenital swabs, CSF, pericardial fluid, and pleural fluid samples will be collected by medically trained personnel in the clinical setting as part of necessary diagnostic procedures with aliquots made available for additional testing using PREDICT protocols when material is available after the required procedure.

For swabs, whole blood, feces, and urine samples, one sample will be collected into Trizol and another in viral transport media (VTM). If only one sample can be collected, it will be collected into VTM. Other fluids, such as CSF, pericardial fluid, serum, and pleural fluid will be collected into vials without Trizol or VTM as appropriate for the primary diagnostic procedure. If these clinically relevant samples are collected from patients, an aliquot may be frozen without Trizol or VTM for later processing. Samples will be frozen in an ultralow (-80°C) freezer for storage until analysis. In the field, samples will be frozen immediately in liquid nitrogen and then transferred to an ultralow (-80°C) freezer for storage until analysis.

Laboratory analysis:

Viral detection and discovery:
Virus detection in human samples will be performed using a combination of consensus PCR (cPCR) and high throughput sequencing (HTS) to detect known and discover novel viruses from different sample types. Viral families/genera targeted are of potential pandemic or epidemic significance, as well as those with previous association with ILI, SARI, FUO, and hemorrhagic disease and may include corona-, paramyxo-, influenza, retro-, arena-, filo-, flavi-, bunya-, reo-, rhabdo-, picorna-, and alpha-viruses. Some viruses will be further characterized using tools, such as full genome sequencing and virus isolation to understand more about viral genetic and phenotypic traits.

Serology to characterize exposure in human and animal populations and detect spillover:
Once new viruses are detected and are prioritized for further characterization we will, on a selective basis, develop serological assays to screen populations of people and animals (both livestock and wildlife) at high-risk interfaces to determine whether pathogen sharing has occurred. Serology may be used to characterize the frequency of host jumping within specific amplification zones, such as on farms and in markets, by screening animal and human populations that are in close contact at high density. When appropriate, serological assays for known agents, such as influenza A, MERS Coronavirus, SARS-like Coronavirus and Ebola virus, will also be used.

Molecular detection of bacterial pathogens:
Consensus or cPCR targeting conserved genes (e.g. 16s) will be used when appropriate to identify the full range of bacterial pathogens and to identify new bacterial agents in specimens from patients with diseases of unknown origin (DUO) where the viral infections have been ruled out.

DATA ANALYSIS

Analysis of questionnaire data will involve calculation of metrics of contact for each risk group under study, such as the proportion of respondents indicating they have butchered live animals, seen wildlife in their homes, been bitten or scratched by animals, etc. Comparisons of metrics of contact between men and women, children and adults as well as different study communities will be conducted in order to explore the environmental and social factors (gender, age, occupation/religion, socioeconomic status (SES)) that influence contact with animals and to determine who is most at risk. Statistics will be computed to identify differences between groups that are significant at $P \leq 0.05$. Various metrics of contact related to different activities within specific groups will be compared to determine the activities that put groups at most risk. Finally, multivariate analysis as appropriate for the outcome measure (e.g. ordinary linear regression, logistic regression, generalized estimating equations that correct for cluster effects and non-normal distributions of outcome, etc.) will be employed to explore the relationship between key metrics of contact and the factors that influence frequency and types of human-animal contact.

Test results and viral sequences obtained from human and animal (wildlife and livestock) samples will be compared and phylogenetic analysis performed to document viral sharing between animals and humans. The test results data will be analyzed in the context of the questionnaire data to identify high-risk human-animal interactions and behaviors or practices that are associated with viral spillover and/or sharing. Specifically, we will calculate odds ratios for demographic and behavioral risk factors associated with the outcomes of viral infection or exposure among communities sampled. Self-report of medical history and illnesses collected through the questionnaires will also be evaluated for associations with demographic and behavioral risk factors. Regression analyses will allow for statistical assessment of both categorical and continuous predictor variables and hierarchical aggregation of data to adjust for correlated factors within communities. Data on self-reporting of illnesses will be triangulated with biological data from the concurrent animal and human sampling to identify symptoms and illnesses that could be correlated with potential pathogens.

Surveillance and behavioral risk findings will be used to identify potential targets for intervention and to inform policy development in collaboration with national authorities in public and animal health. Ultimately, data from viral surveillance and behavioral risk characterization will be integrated with broader economic, anthropologic, and ecological data in an analytical framework to identify risks and trends in disease emergence globally.

13) Data Management and Confidentiality

DATA/SPECIMEN MANAGEMENT PLAN (see also Data Analysis section immediately above)

All research procedures will be conducted by local implementing partners in accordance with local laws and IRB regulations (and/or other relevant governing authority regulations for human ethics as appropriate). Only local partners will have access to identifiable human subjects data. In rare cases where US-based personnel are involved in project implementation, these personnel will be listed in all country-specific IRB protocols to ensure coverage at the local level.

All questionnaire data (including hospital intake form data) and biological samples will be labeled with a unique alphanumeric identification code, assigned to each enrolled, sampled individual that does not identify the individual from whom data are collected. No personal identifying information will be recorded on the sample vials or on the questionnaires.

For community level sampling, biological samples will be stored in locked liquid nitrogen dry shippers following collection in the field and during transport to PREDICT partner diagnostic laboratories. Transport of the samples to the laboratory from the field will be performed by PREDICT in-country personnel.

In the clinics and hospitals, samples will be stored in locked liquid nitrogen vacuum flasks, dewars, or in a locked -80C freezer. Samples will be transported to PREDICT partner diagnostic laboratories by PREDICT personnel in locked liquid nitrogen dry shippers or shipped through approved couriers in dry shippers or in approved secured containers with dry ice.

When shipping samples, the shipper will notify the laboratory on the day of shipment and provide the air bill/tracking number(s) and itemized shipping log. The shipping log will not contain any personal identifying information. Samples will be stored in a locked -80C freezer at the local PREDICT partner diagnostic laboratories or institutes. Only trained clinic and hospital staff and PREDICT personnel will have access to the specimens. Subject privacy and confidentiality practices will be addressed during training of all study personnel.

Safety precautions: PREDICT has standardized protocols and training to ensure the safety of staff involved in research activities, including biological specimen collection. Specimens will be collected by trained clinic staff wearing appropriate PPE, including gloves, fitted and tested N95 masks, gowns, and closed toed shoes. When samples are shipped between countries, they will be packed frozen into dry shippers designed for shipment and approved by the International Air Transport Association (IATA). Any specimens transported by air to regional or reference laboratories as part of continuing PREDICT laboratory network collaboration among established partners will follow safety and IATA guidelines provided to staff. US CDC permits are in place to allow for importation of biological specimens and infectious substances, under which shipping of samples must also comply with the Safe Sample Transport guidelines.

All PREDICT project personnel handling specimens and involved in their transport are trained annually with documentation of training maintained by the PREDICT through our internal database, the Emerging Infectious Disease Information and Technology Hub (EIDITH). Training oversight at each location is provided by the PREDICT Country Coordinator and supported by regional leads under the supervision of the PI.

Data quality control: All data are examined at entry and later upon integration into the study database, for completeness, accuracy, and logical consistency. Once all test results (e.g. initial detection by PCR, subsequent sequencing of viruses, and serology) are available for a given specimen, the results are interpreted in light of all available scientific literature and previous PREDICT findings by team scientists.

Data identification: Data will be identified by a unique identification code assigned to each sampled individual. Participants' names and codes will be recorded in the confidential participant logbook, which is completed in the field by field staff and retained by the PREDICT Country Coordinator. All records that contain names or other personal identifiers, such as informed consent forms and the confidential participant logbook, will be stored separately from study records. All personal information will be stored securely at the country headquarters in locked files cabinets in areas with access limited to study staff. Consortium partner representatives that are not listed in locally approved protocols, including UC Davis personnel, and global consortium partners will have access only to coded data that cannot be linked to identifiable information.

Protection during data transport: All data collected on paper forms will be transported from the study site to the local collaborating laboratory or collaborating institute in locked containers. Password-protected laptops or tablets will be used to collect coded data only. Personal identifying information will not be stored in electronic form. Only PREDICT project laptops or tablets will be used for data collection (i.e. no personal computers or tablets will be used). All data transmitted electronically will be 128-bit encrypted. Email will not be used to transmit personal identifiable data. PREDICT laptops and tablets are inventoried by each local research team and all coded electronic data will be backed-up to secure servers maintained by a secure, 128-bit encrypted and password-protected centralized database. If offline, coded tablet data will be backed-up to secured password protected laptops connected to the centralized database or to micro-SD cards for uploading to project laptops at frequent intervals. In the case of theft, tablets are equipped with remote wipe capability to allow devices and all coded data to be erased remotely; project laptops are secured in all facilities with locks and theft prevention devices.

Data storage: PREDICT specimens will be banked in each country in dedicated collaborating partner facilities and locked ultralow laboratory freezers. Access will be restricted to trained personnel. PREDICT will utilize a secure, 128-bit encrypted and password-protected centralized database to store data for access by the PREDICT consortium only for surveillance data analysis. The database is maintained by the PREDICT information management team. There is no public access to the database.

POWER ANALYSIS

As stated previously, this is a multicenter study, and we estimate approximately 4,860 individuals will be enrolled per participating country over the course of the project. This estimate is the target sample size following consent and screening procedures (excluding screen failures). Country-specific protocols will be added and estimated sample size may vary by country. Estimated sample size is based on a sample of 180 individuals per high-risk community, sampled for 2 seasons for 3 years, with replication at 3 high-risk communities (n = 3,240) and a sample of 180 individuals at 3 clinic/hospital sites per country for 3 years (n = 1,620). This estimated sample size will allow for 80% power to detect a third-fold difference in risk with 95% confidence, assuming 1.2% prevalence in viral detection using the PREDICT PCR protocols for virus detection and adjusting for 0.2 correlation in data. Pilot data from similar studies conducted in high-risk communities during the first phase of PREDICT have indicated a 0.8-1.5% prevalence should be expected for virus detection using PREDICT protocols targeting priority viral families. In addition, the questionnaire only will be administered to approximately 1000 additional human subjects in each country.

14) Data and/or Specimen Banking

Data and specimens will be securely stored for up to ten years as described above with personal identifying information kept in a secure manner. This study could be extended by five-year increments in perpetuity (currently in the second phase of 10-year project). Upon completion of the project personal identifying information will be destroyed unless this protocol is extended or amended for a maximum of ten years of sample and data storage.

HIPAA Standards in International Research:

U.S. federal laws do not apply to studies conducted overseas or in foreign countries. However, human subject standards of protecting confidentiality and privacy for research still apply and will be instituted across PREDICT sites during this project phase and in all subsequent phases. International research subjects do not need to sign an authorization to allow access to their protected health information (PHI).

15) Provisions to Monitor the Data to Ensure the Safety of Subjects

The data collected and the procedures performed are within the scope of good clinical practice and pose no more than minimal risk to the volunteer. Proposed activities are designed for integration into each participating country's emerging pandemic threats surveillance program and no more than minimal risk is anticipated.

Trained health professionals from local clinics/hospitals or otherwise appointed/approved by the country's Ministry of Health will perform all specimen collection. The personnel tasked with conducting this procedure will be well trained in PREDICT protocols and in Universal Precaution Practices to ensure safe sample collection, and to ensure that the sample collection process causes the least discomfort possible to the participant. In addition, they will supervise the administration of questionnaires or hospital intake forms as appropriate. These individuals will be trusted members of the community and will have often treated the participants or their family members before. Every effort will be made by PREDICT trained human data collectors to make sure the respondent is comfortable when answering sensitive questions. Participation in this study will not alter the medical evaluation or therapy provided to the participant by the clinical or medical officer and will be based on the standard of care at the treating facility.

As described above, no identifying information will be stored with or paired with questionnaire data or biological specimens. As the data samples will be coded within the database for the lifetime of the study and the on-site data log will be stored in a secure manner, the risk of a loss of confidentiality is minimized for the study volunteers. In the case of positive results for relevant viral families, a summary report with interpreted results will be provided to the health officials or lead physicians as appropriate, for consideration of potential pathogens to which their patient populations have been exposed. When questionnaires are moved to the country headquarters, records will only contain coded data to ensure the safety and confidentiality of participants and will be maintained in a secure database. The only document that will link the participant with a unique ID number is the consent form, which will be stored in a locked file separately from participant data in the offices of the Country Coordinator.

At the completion of each surveillance period, generally on a calendar year schedule, a data and safety review will be conducted at each site with the clinical staff and the PREDICT country team. At this review, safety information and adverse effects collected during the performance period will be discussed and addressed. Data may include case report forms, notes from study visits, and or any telephone calls to the PI from participants. Adverse effects from PREDICT sampling protocols are expected to be exceedingly rare, but if any unusual conditions are observed by the clinic or clinical team, PREDICT will trigger a notification within 5 working days, to assure that additional data collection and investigations are initiated. As this study will integrate with each country's Ministry of Health emerging pandemic threats surveillance program, minimal risk is anticipated, but each in-country team will work together in the first year to establish criteria about what untoward event might constitute a condition for triggering immediate suspension of the work.

Report summaries of the data generated from the project will be provided to the Ministry of Health and to other in-country collaborating investigators, at their request. Adverse or serious adverse events included in report summaries to the Ministry of Health and other in-country collaborators will be reported to the UC Davis PI following procedures described in Section 20 "Multi-Site Research".

16) Withdrawal of Subjects

There are no anticipated circumstances under which subjects will be withdrawn from the research without their consent. If an individual decides to withdraw from the research study, their samples and data will be removed from analysis and destroyed.

17) Risks to Subjects

Collection of venous blood samples and oral, nasal, nasopharyngeal, and oropharyngeal swab samples pose minimal risk to subjects. Potential complications associated with venipuncture include pain and/or hematoma at the site of collection. Trained medical professionals and/or clinic staff will monitor the blood collection site and treat any complications according to existing health facility protocols. A potential complication of nasopharyngeal, oropharyngeal, and rectal swab sampling is minor irritation at the time of collection. Using trained medical and/or clinic staff to collect blood and swab samples will minimize the potential for complications. No physical risk is associated with subjects collecting their own fecal or urine samples. Clinic staff will give subjects specific instructions on safely collecting fecal and urine samples including appropriate guidelines for hand washing after sample collection. Any additional samples from hospitalized patients (e.g., cerebrospinal spinal fluid (CSF), sputum, pericardial fluid, pleural fluid, and ocular swab samples) will only be collected for routine diagnostic purposes by physicians or trained hospital staff; there is no additional risk to the patient from this study, as PREDICT will only be sourcing remaining sample aliquots for supplemental testing. At the community level, biological sampling will be conducted in a safe private place to ensure that all individuals are treated in a respectful manner and that participation and privacy rights are upheld.

Potential risks associated with providing responses to questionnaires on wild animal contact and consumption could include consequences from local authorities if such practices are prohibited by local laws. To minimize this risk, questionnaire data will be collected in a strictly confidential manner. Individual interviews and biological sampling will be conducted in private, ensuring that others cannot hear the interviews. Individual sessions will be held in areas where there are no other individuals within a 10-foot distance. A barrier will be created so that no other individuals can view the participants while they are in their interview or being sampled. Depending on the location, this could be a private room, behind a building or fence, or behind a line of trees, obstructing view so that confidentiality may be maintained. The interview team will take care to pair interviewers and respondents by sex to ensure protection of women and children and privacy and confidentiality of responses. Children will not be interviewed in the absence of a parent or guardian. In addition, identifying information will not be linked to responses, and data will be stored in secure, password protected files or secured storage facilities.

Another risk that this study may pose concerns the information to be gained on zoonotic viruses newly recognized in the community. We will provide participating hospitals and clinicians with information and background data on target zoonotic viruses to ensure up to date communication of risk. Because of the timeline for diagnostic testing and results interpretation, we are not likely to provide results to participating clinics within a time frame that would be clinically relevant to outbreaks of undiagnosed diseases. Therefore information provided by this project will not impact patient management or outlook.

18) Potential Benefits to Subjects

There is no measureable benefit to the individual participant from taking part in this study. The PREDICT team will inform community participants of the aggregate findings and provide information about zoonotic infections and measures to reduce their risk of infection. One key benefit of this study to the community is to understand the risk of zoonotic infections among high-risk populations. This information may help us to detect and prevent potential epidemics involving emerging zoonotic agents, as well as to eventually counsel communities on practices that could reduce exposure and related health risks. These sentinel populations will be very important in providing cost-effective and timely information on disease emergence. The study will also increase understanding of the conditions and human activities associated with the introduction of zoonotic infections into human populations, which may have implications for disease control worldwide.

19) Vulnerable Populations

Pregnant women and children 2-17 years of age will be eligible to participate in the study if they meet the inclusion criteria provided in #6 above. As stated above, where the age of majority differs from this age range, an updated age range consistent with host country law will be detailed in the country-specific IRB protocols.

Collection of venous blood samples, nasal and oropharyngeal swabs, and fecal samples poses minimal risk to children and pregnant women and their fetuses. Children will only be enrolled in the study if accompanied by a parent or legal guardian and informed consent can be obtained from the parent or legal guardian. Assent will also be obtained from children 12 years and older. The child consenting process will be conducted on all participants aged 2-17, regardless of the age of majority in country.

20) Multi-Site Research

This is a multi-site research project, and activities will be implemented in participating PREDICT countries (see #3 above). Activities at the country-level will be approved by local ethical clearance councils and institutional review boards; such approval will be sought prior to implementation of any activities, and country-specific applications will be appended to this protocol. Modifications and approvals of protocols, as well as training on study protocols, ethics, and conduct of research activities for all participating personnel will be ensured and supervised by project PIs in coordination with the PREDICT Human Subjects Working Group. Communication among all sites, coordination of activities, training and sharing in best practices, and tracking of research activities will be conducted by the PREDICT Executive Board and PREDICT Operational Leads charged with Surveillance, Behavioral Risk, Pathogen Detection, Information Management, and Capacity Strengthening., Adherence to protocols will be tracked by PREDICT's Global Operations Officer at UC Davis.

Adverse events will be reported to the local study site ethical committee and to the UC Davis IRB administration. PREDICT field investigators will be working under direct supervision of the CITI-trained field coordinator who is responsible for reporting any adverse event in a timely manner to the CITI-trained country coordinator. The country coordinator will report the event to the local study site ethical committee and the PREDICT Project Principal Investigator and Operations Officer. The PI will then report the adverse event to the UC Davis IRB administration.

The country coordinator is responsible for ensuring that the following events are reported within the appropriate time frame: 72 hours in case of an adverse event and 24 hours in case of a serious adverse event. Adverse or serious adverse events will be reported by the field coordinator directly to the country coordinator who will then inform the local study site ethical committee or country IRB in writing within the following deadlines: 72 hours in case of an adverse event and 24 hours in case of a serious adverse event. The country coordinator will also report the adverse event to the PREDICT project PI and Operations Officer according to the same deadlines. The PI will report to the UC Davis IRB administration.

When communicating with the country sites, the PI will contact the country coordinator in each country site, who will then inform the field coordinator. In some cases, the country coordinator and the field coordinator will be the same person.

21) Community-Based Participatory Research

This protocol does not include community-based participatory research, though study objectives do target understanding risks and potential interventions to improve community health and some research activities do involve community cooperation. As stated previously, introductory visits will be made by country project staff to each of the participating sites to inform the community or hospital/clinic that a team will be coming to inform the community or hospital/clinic team of the research/surveillance visit(s). During these visits, discussions and meetings will be held to educate, sensitize, and inform people about zoonotic pathogens and potential pathways for disease spread/emergence (discussions and meetings may be held at hospital and clinic sites but only when determined to be appropriate in collaboration with site personnel).

In addition, voluntary "town hall" meetings may be held in participating communities to further dialog about study objectives and participation. Although local authorities may be present to introduce the study team members, they will not be involved in the recruitment and/or consent of the participants for the study. Aside from informational meetings to introduce the study and as necessary, provide feedback from study findings, no further cooperative community involvement will be conducted.

22) Sharing of Results with Subjects

Participating hospitals and communities will receive aggregate site-level data on PREDICT results from our testing platform, which is designed to detect novel viruses with unknown disease-causing potential. As this is a research study, results may not be available for several months. Summarized result reports with interpretations will not be provided for diagnostic purposes, nor could these be provided in a timeframe suitable for patient care.

The confidentiality of test results in the clinic and community will be upheld during this process by providing standardized, summary results reports for the community only. No identifiable information on human subjects will be included in these summary results reports. Because of the timeline for testing and results interpretation, we are not likely to provide results within a time frame that would be clinically relevant, therefore information provided by this project will not impact patient management or outlook.

23) Setting

The PREDICT project is focused in countries in the following regions:

South and Southeast Asia: countries include areas with densely populated tropical zones sometimes with extensive habitat modification; an active wildlife trade; close, potentially high-risk contact among wildlife, livestock, and humans; and documentation of previously emerging zoonotic pathogens including SARS coronavirus, MERS coronavirus, Nipah virus, highly pathogenic H5N1 avian influenza, and Ebola Reston.

Gangetic Plain: countries include areas with densely populated tropical zones sometimes with extensive habitat modification; an active wildlife trade; close, potentially high-risk contact among wildlife, livestock, and humans; and documentation of previously emerging zoonotic pathogens including outbreaks of avian influenza (H5N1) and Nipah virus have been recently documented.

Africa including West, North, Central and Eastern regions: countries include areas with high density human populations living in close contact with wildlife, which has enabled filoviruses such as Marburg and Ebola, and retroviruses such as HIV, and coronaviruses such as MERS, to spillover from animals into humans.

For a detailed list of countries led by each PREDICT Consortium partner and including local implementing partners, please see Appendix A.

Human sampling sites: In-country strategies for accessing individuals within the three critical pathways of disease emergence and spread in Asia and Africa (land conversion from commercialization, intensification of animal production systems, and animal value chains) rely on our strong relationships with local teams. Local team members, including health professionals, scientists, educators, and ministry officials will introduce the human sampling and the questionnaire to all targeted communities.

Potential research subjects will be identified and recruited by field research staff, working in collaboration with Ministries of Health, Environment, and Livestock/Agriculture. After informed consent is received, biological samples will be collected from subjects at designated local clinics or research sites or through home visits, as coordinated with local authorities by the in-country team. Questionnaires will be administered during the same participant session. Each PREDICT country lead will develop a recruitment/enrollment plan for each year of the project, attempting to target critical pathways for disease emergence and spread. PREDICT project sites include wild or domestic animal markets, farms, restaurants, animal sanctuaries, zoos or reserves, and extractive industries that lead to land use change, such as logging or palm oil plantations. In most sites, hospitals and clinics serving communities of highly exposed individuals will also be included.

For more information on the process for local scientific and ethical review structure at the country-level see #20 and #25.

24) Resources Available

The study is supported by a USAID $100 million five-year cooperative agreement with the UC Davis One Health Institute. The PREDICT Consortium has a research presence and years of field experience in most of the PREDICT project countries. The Consortium has partnered with relevant government ministries, veterinary and public health universities, and research institutions in these countries.

Personnel

University of California:

Jonna Mazet, DVM, MPVM, PhD – Project PI.
Dr. Mazet is a Professor in the UC Davis Department of Medicine and Epidemiology and Executive Director of the UC Davis One Health Institute. She has served as the mentor for more than 50 graduate students and postdoctoral fellows and has published over 100 peer-reviewed scientific publications. Dr. Mazet's research focuses on One Health and the promotion of wellness at the wildlife-human domestic animal interface; disease ecology, especially zoonoses; the role of health in endangered species recovery and conservation; risk assessment for informed wildlife management and sound environmental policy; the development and optimization of diagnostic tests for free-ranging wildlife; and the use of key wildlife species as biomarkers of environmental health. Dr. Mazet has received in excess of $80 million in contracts and grants during the past two academic years. Additionally, she is the PI and Global Director of the PREDICT Project, the world's most comprehensive zoonotic disease surveillance and capacity strengthening project. She is overseeing all aspects of this project.

Christine Kreuder Johnson, VMD, PhD – Project Co-PI.
Dr. Johnson is Professor of Epidemiology in the UC Davis Department of Medicine and Epidemiology and Senior Biological and Ecological Surveillance Coordinator for the USAID's Emerging Pandemic Threats PREDICT program. She has led surveillance programs and large-scale population health investigations to inform state and federal agencies on wildlife health and emerging diseases for the past twenty years. She has developed and implemented risk-based approaches to integrate animal and human surveillance and standardized measures of risk assessment to enable systematic data analysis across a range of field studies from the local to global scale. At the One Health Institute, she has directed scientific investigations on wildlife health and conservation, disease events, and threats to public health for state and federal agencies. Since 2009, Dr. Johnson has served as epidemiologist for PREDICT project, designing global surveillance activities to identify infectious disease threats at high-risk animal-human interfaces in Africa and Asia and working with host country governments and international organizations to meet global health priorities and implement concurrent animal and human surveillance to detect zoonotic disease transmission. She will direct biological and syndromic surveillance activities and ensure epidemiologic support for characterization of high-risk animal-to-human disease transmission interfaces.

Tracey Goldstein, PhD – Project Co-PI.
Dr. Goldstein received her PhD from the Graduate Group of Comparative Pathology at UC Davis in September 2003. Following her completion of the PhD program, she completed two post-doctoral programs, one at the Alaska SeaLife Center in Seward

Alaska where she focused on health and diseases in free-ranging sea otters and Steller sea lions in Alaska and Russia, and a second one at The Marine Mammal Center in Sausalito, California where she managed a three-year NOAA-funded Oceans and Human Health Initiative Grant examining the long-term effects of the biotoxin domoic acid on the health and survival of California sea lions as a model for sentinels of human health. She obtained a Research Faculty position at UC Davis in December 2007, overseeing and managing the development of the research and viral diagnostic laboratory for the Wildlife Health Center and One Health Institute. She continues in this position where she now co-manages two objectives and directs one objective for the USAID-funded PREDICT project. Dr. Goldstein has extensive experience in molecular methods and has conducted research on adenoviruses and other pathogens, publishing 26 papers on wildlife and wildlife disease in the past 10 years. She will oversee laboratory work and analyses.

David Wolking, MSc - Global Operations Officer.
Mr. Wolking received his MSc in International Agricultural Development from UC Davis in 2009 with a focus in epidemiology and zoonotic diseases. He has 10 years of experience managing USAID-funded projects in health and natural resource management and has collaborated with and managed multi-national teams in East Africa and South Asia at the interface of health, livelihood improvement, and sustainable agriculture. Since 2009, Mr. Wolking has supported the PREDICT project in the development and implementation of global zoonotic disease surveillance and capacity strengthening programs, managed the country-level programs in Tanzania and Nepal, and directly supported the institutional development of diagnostic laboratories at the Sokoine University of Agriculture's Faculty of Veterinary Medicine and Public Health. He is currently engaged as Global Operations Officer for PREDICT, managing technical operations including coordination of ethical clearances and permissions for human subjects research and supporting the PI to ensure compliance across all sites.

Metabiota:

Nathan Wolfe, DSc, - Metabiota-sub PI.
Dr. Nathan Wolfe is the Lorry I. Lokey Business Wire Consulting Professor in Human Biology at Stanford University. He is Founder and CEO of Metabiota, a company that provides research-based biosurveillance tools to government customers. He is Founder and Chairman of Global Viral, a non-profit that promotes understanding, exploration and stewardship of the microbial world. Dr. Wolfe received his doctorate in Immunology & Infectious Diseases from Harvard in 1998. The recipient of a Fulbright fellowship in 1997, he was awarded the National Institutes of Health (NIH) International Research Scientist Development Award in 1999 and the NIH Director's Pioneer Award in 2005. In 2009, Dr. Wolfe was chosen as a National Geographic Emerging Explorer and in 2010 the World Economic Forum named him a Young Global Leader. Dr. Wolfe has published 90 technical articles and book chapters. His work has been published in or covered by Nature, Science, The Lancet, PNAS, JAMA, The New York Times, The Economist, Wired, Discover, Scientific American, NPR, Popular Science, Seed, The New Yorker, National Geographic Magazine, and Forbes. He has extensive consulting experience and has served on a number of advisory and editorial boards, including, the editorial board of

EcoHealth, the Board of Advisors of Scientific American and DARPA's Defense Science Research Council (DSRC). Dr. Wolfe has over eight years of experience living and conducting biomedical research in Southeast Asia (Malaysia) and sub-Saharan Africa (Cameroon and Uganda). He currently coordinates activities of over 50 scientists and staff from countries around the world and research activities in Cameroon, Chad, China, Democratic Republic of Congo, Equatorial Guinea, Gabon, Indonesia, Malaysia, Republic of Congo, Sierra Leone, Uganda, Ukraine, and Vietnam.

Damien Joly, PhD, Metabiota's Director of Epidemiology.
For over 15 years, Dr. Joly has worked at the interface of human, livestock, and wildlife health, developing field and quantitative techniques to identify the potential consequences of disease outbreaks for wildlife, livestock, and human health; describing spatial and temporal patterns to inform risk assessment and disease management actions; and designing, implementing, and evaluating the efficacy of wildlife disease management options. Dr. Joly is an expert in the development of wildlife health information management systems, having lead a team that developed a global wild bird avian influenza database and most recently with the Emerging Infectious Disease Information Technology Hub (EIDITH), used to collect, manage, and distribute information on over 250,000 wildlife diagnostic specimens collected from 20 countries around the world. Dr. Joly has given 58 invited and contributed scientific presentations and has authored or co-authored 35 peer-reviewed publications since 2000. Dr. Joly has worked on USAID-funded zoonotic disease surveillance projects since 2006, most recently the USAID Emerging Pandemic Threats PREDICT project, for which he serves as information management coordinator and directs Metabiota's overall contribution to the project, including zoonotic disease surveillance in ten countries in Asia and Africa. In addition to Metabiota's Director of Epidemiology, Dr. Joly holds an appointment as Adjunct Associate Professor in the Department of Ecosystem and Public Health, Faculty of Veterinary Medicine, University of Calgary.

Karen Saylors, PhD Metabiota Senior Director, Behavioral Risk Analytics & PREDICT Deputy Director of Behavioral Surveillance.
Dr. Saylors has been working as a medical anthropologist in the public and behavioral health arenas for 18 years, designing, implementing, and managing multicultural health research projects. After receiving her MA working with francophone traditional healers in Louisiana and her PhD in Medical Anthropology from the Université de Montréal, Dr. Saylors conducted applied research as the Director of Research and Evaluation for a Native American non-profit organization, focused on HIV and community-based participatory research, for Navajo Nation, researching traditional and Western treatment modalities and for the New Mexico Department of Public Health conducting population based disease surveillance and field epidemiology. Since 2006, she has run public health research programs for Médecins Sans Frontiers and Metabiota in central Africa and southeast Asia, focused on HIV and zoonotic disease surveillance, exploring behavioral risk, perception, and change in high-risk populations. During the first USAID Emerging Pandemic Threats award, Dr. Saylors worked with the PREVENT project on risk characterization and formative behavioral change research in central Africa and in this second round is the Deputy Director of Behavioral Surveillance for PREDICT.

Corina Monagin, DrPH - Metabiota Director, PREDICT Surveillance Operations.
Dr. Monagin has been working in the international public health field for over 10 years. She received her Bachelor's degree in Biological Anthropology from The George Washington University and her MPH in International Health Systems Management from Tulane University. She received her Doctor of Public Health degree (DrPH) and a Diploma for post-graduate studies (DLSHTM) at the London School of Hygiene and Tropical Medicine for her work on emerging infectious disease policy in SE Asia. Dr. Monagin has many years living abroad working to establish global surveillance networks. She spent several years working in collaboration with the World Health Organization and Tulane University in West Africa developing an international infectious disease laboratory network and assisted in increasing laboratory diagnostic capacity throughout the region. Based in Guangzhou, China, she provided logistical and research operational support for sites in China and SE Asia, increasing capacity to control and respond to emerging infectious diseases in the region, including coordinating international outbreak response teams. Now back in the USA, she oversees wildlife, livestock, and human surveillance programs across the globe.

EcoHealth Alliance:

Peter Daszak, PhD - EHA President and PREDICT Modeling & Analytics Operations Lead.
Dr. Peter Daszak is President of EcoHealth Alliance, a US-based organization that conducts research and outreach programs on global health, conservation, and international development. Dr. Daszak has published extensively on the origins and drivers of Avian Influenza, Nipah virus, SARS, Middle Eastern Respiratory Syndrome (MERS), and global trends in disease emergence and pandemic risk. His seminal work on EID 'hotspots' formed the geographical focus for PREDICT-1, in which he successfully led the modeling objective to produce 'Hotspots II' and a range of other analytical products published in more than 50 key papers in The Lancet, Nature, PNAS, EID, and other leading journals. His research has been instrumental in identifying and predicting the impact of emerging diseases across the globe. His achievements include identifying the first case of a species extinction due to disease, the discovery of the disease chytridiomycosis as the cause of global amphibian declines, identification of the bat origin of SARS, identifying the causes of Nipah and Hendra virus emergence, coining the term 'pathogen pollution', and producing the first ever global emerging disease 'hotspots' map. Dr. Daszak is a member of the Institute of Medicine's Forum on Microbial Threats, and served on the IOM Committee on global surveillance for emerging zoonoses, the NRC committee on the future of veterinary research, the International Standing Advisory Board of the Australian Biosecurity CRC, and he has advised the Director for Medical Preparedness Policy on the White House National Security Staff on global health issues. Dr. Daszak won the 2000 CSIRO medal for collaborative research in the discovery of amphibian chytridiomycosis and is currently Editor-in-Chief of the journal EcoHealth. He has authored over 200 scientific papers, and his work has been the focus of extensive media coverage, ranging from popular press articles to television appearances.

Maureen Miller, PhD - PREDICT Senior Behavioral Surveillance Coordinator.
Dr. Miller, based at EcoHealth Alliance, is a social scientist with degrees in both epidemiology and medical anthropology. She maintains an active faculty appointment in the Department of Epidemiology at the Mailman School of Public Health, Columbia University. Dr. Miller has extensive experience in applied infectious disease prevention research, programming and policy. Dr. Miller, together with Dr. Saylors, provides the technical leadership for the behavior portion of this study. Dr. Miller will provide critical leadership for the behavior portions of all participating country teams and will support training and implementation, data analysis, and results communications.

Emily Hagan, MPH – Research Coordinator.
Ms. Hagan is a Research Coordinator based at EcoHealthAlliance and has a BS in biology and biomedical sciences, an MPH in epidemiology from Columbia University, and an extensive background in infectious disease immunology. Ms. Hagan supports Drs. Miller and Saylors in the design and implementation of the behavior portion of this study, and will provide support and training to local country teams during implementation and analysis.

Smithsonian Institution:

Dr. Suzan Murray – Smithsonian Institution PREDICT Project Lead
Dr. Suzan Murray Heads the Smithsonian's Global health program (SGHP), which addresses urgent global needs and opportunities in emerging diseases and conservation medicine. As a Smithsonian scientist, she engages in a variety of studies related to emerging diseases, biodiversity, and wildlife health. She is the liaison to the Foreign Animal Disease Threat and Pandemic Preparedness subcommittees of the Office of Science and Technology. She received her DVM from Tufts University and is a Diplomat of the American College of Zoological Medicine. Suzan is currently the Project lead for Smithsonian's PREDICT programs in Myanmar and Kenya.

Dr. Kali Holder - Smithsonian Institution Postdoctoral Fellow
Dr. Kali Holder is the Morris Animal Foundation Global Health Fellow and a board certified Veterinary Pathologist. Her research with the Smithsonian is on emerging skin diseases in rhinoceros and giraffe of East Africa and emerging zoonotic diseases in Kenya and Myanmar through the PREDICT program. Dr. Holder received her DVM from the University of Florida and previously completed a postdoctoral research program with the San Diego Zoo's Institute for Conservation Research. Her primary interests are in emerging diseases and applications of pathology and advanced diagnostics to conservation goals.

Wildlife Conservation Society:

Amanda Fine, VMD, PhD - WCS Associate Director & Project Lead
Dr. Fine is the Associate Director, Asia for the Wildlife Health & Health Policy Program at the Wildlife Conservation Society (WCS). Dr. Fine is a graduate of Swarthmore

College and has a degree in veterinary medicine from the University of Pennsylvania and a PhD in Veterinary Epidemiology from Michigan State University. In Mongolia, she opened and staffed the WCS Country Program office in Ulaanbaatar and her principal responsibilities have included oversight for two large landscape-level conservation projects funded by USAID. Dr. Fine now leads the health program in Asia and coordinates WCS wildlife health projects in Vietnam where she is based. Dr. Fine has also been involved in implementing wildlife health projects in Mongolia focused on avian influenza in wild birds and Foot and Mouth Disease (FMD) in wild and domestic ungulates. She has a strong interest in disease at the interface of human, livestock and wildlife health and has conducted research in the U.S. and internationally on brucellosis, parasitic nematodes and bovine tuberculosis. Dr. Fine has an adjunct appointment in the Department of Large Animal Clinical Sciences, College of Veterinary Medicine, at Michigan State University. She is currently serving as WCS's Project Lead for PREDICT.

Sarah Olson, PhD - WCS Wildlife Epidemiologist & Scientific Advisor
Dr. Olson is the Associate Director, Wildlife Epidemiology for the Wildlife Health & Health Policy Program at the Wildlife Conservation Society (WCS). She received a joint PhD in Population Health and Environment & Resources from the University of Wisconsin-Madison and studied how deforestation and climate affect malaria incidence in the Amazon. She has also studied regional landscape drivers of Lyme disease in North America. Dr. Olson's portfolio also includes research on the wildlife trade, avian influenza, Ebola, digital disease detection, and surveillance techniques for free-ranging wildlife. Her broad research interest focuses on the intersection of wildlife, human, and environmental health. She is currently serving as WCS's Wildlife Epidemiologist & Scientific Advisor for PREDICT.

25) Prior Approvals

PREDICT Consortium partners will rely on the UC Davis IRB for review and approval. Authorization agreements establishing UC Davis as the Reviewing IRB of Record have been established with EcoHealth Alliance and Metabiota, Inc. under award AID-OAA-A-14-00102. Documentation for each authorization agreement has been provided in the appendices. Authorization agreements to establish UC Davis as the Review IRB of Record are currently in development with the Wildlife Conservation Society and Smithsonian Institution.

Prior to commencing research at specific sites, we will seek approval of this study from all participating countries through Institutional Review Boards, ethical clearance councils/committees, and national research administrations following local regulatory guidelines as appropriate. Separate IRB protocols for each country and any amendments to locally approved research protocols or consent forms diverting from Master Protocol activities will be submitted to the UC Davis IRB Administration for review.

26) Provisions to Protect the Privacy Interests of Subjects

If an individual decides to participate in this research, his/her participation and all information provided by the participant will be strictly confidential, and personal identifying information will not be shared with anyone outside of the research staff.

Interview locations will be identified before the interview and will be conducted in a quiet and private place in areas where there are no other individuals present within a 10-foot distance. Specific sites for interviews depend on the type of targeted community and may be inside wildlife restaurants, behind animal storage sheds, in private rooms if in dwellings or in offices of business owners, etc. A barrier will be created so that no other individuals can view the participants while they are in their interview. Depending on the location, this could be a private room, behind a building or fence, or behind a line of trees, obstructing view so that confidentiality may be maintained. For clinics, questionnaires will be conducted one on one in a personal office.

Biological specimen collection will be conducted in private areas, such as in a private room in a dwelling, or behind a curtain or similar barrier. All efforts will be made to ensure the privacy and confidentiality of participants.

Participants will not be identified or named in any reports or publications. Questionnaire information and all biological samples will be identified by an alphanumeric code, not by the participant's individual name. All records that contain names or other personal identifiers, such as informed consent forms and the confidential participant logbook, will be stored separately from study records. All personal information will be stored securely at the study site in locked files cabinets or password protected devices in areas with access limited to research staff. Study databases will be secured with password-protected access systems and controlled distribution web-based certificates and will not contain any identifying characteristics in relation to study participants (e.g. name, address, or telephone number). Access to all data will be limited to staff involved in this study. The health information disclosed by an individual will not be used by or disclosed (released) to another institution. Any surveillance report that is published or shared with partners will not contain any personal identifying information for individual participants.

27) Compensation for Research-Related Injury

The proposed biological sample collection poses minimal risk of injury to study subjects.

28) Economic Burden to Subjects

As stated previously, care will be taken to conduct interviews and sampling in private and secure locations to ensure participant confidentiality. There will be no cost for subjects to participate in the study. In some cases, outside of clinic settings, interviews and sampling may require time away from potential livelihood activities and participants will be offered a gift or token of appreciation as compensation (See #9 "Compensation to the Subjects").

PREDICT will cover the costs of any testing that is done for this study. Participants will not be charged a fee for proposed tests. Aggregated summary test result reports will be provided to clinicians presenting data at the community level. These reports might show that one of the participants in the community was infected with a virus that may or may not have an available treatment. However, for the viruses targeted by this protocol, testing and interpretation of results will not be completed in a timeframe that is clinically relevant for disease-causing pathogens. Therefore, PREDICT would not be in a position to support ongoing patient care or treatment costs, if such treatment exists.

In the event PREDICT is requested by the host country government to assist in investigation of a disease outbreak, we will attempt to provide test findings on a timeline that is relevant to disease control in the outbreak situation. In the event serious infectious diseases that may be transmitted to other humans are detected, participant identity may be shared with public health officials as required by host country law or health regulations to expedite disease control.

29) Consent Process

We will be following the SOP: Informed Consent Process for Research (HRP-090). Informed consent forms including the associated project information script are attached to this protocol (Appendix B).

Only consented participants will be enrolled in the research. No research procedures will be undertaken before the participant agrees to enroll in the study and signs a consent form. For the purposes of this study, anyone under the age of 18 years and over the age of 2 years will be considered a child and will be eligible to participate in the research if they meet the aforementioned inclusion criteria. In countries where the age of majority is less than or more than 18 years old, the country-level IRB will specifically describe the age range with corresponding updates to all consent forms. Pregnant women will also be eligible to participate if they meet the above-mentioned inclusion criteria. For children to participate, consent will be required from a parent or legal guardian. For hospitalized patients only, if the patient is judged by the staff to be unfit or unable to provide informed consent, an acknowledged representative (family member) may provide consent on their behalf. If the patient becomes able to consent during the course of the study, the subject will be asked to consent for continuation in the study.

If participants meet the criteria for enrollment, they will be invited to discuss the details of the study. The study staff will review an information sheet and informed consent form with the participant/representative, provide a copy of the information sheet and informed consent form, and explain the details of the study including the study procedures, risks and benefits, financial and confidentiality considerations, alternatives to participating, and how to obtain more information. This process will take approximately five minutes, and the statement will be read in the local language of the country site and in a location ensuring patient or participant privacy as described above. Protocols and informed consent statements for this study will be translated into the local language of the country site. Research team members involved in this consent process will be required to be fluent in the local language in order to ensure that the subjects understand the study and the procedures. Specific country protocols will indicate translated languages and provide copies of all translated documents. For this global master protocol, we are submitting consent forms in English only (Appendix B – PREDICT Informed Consent Form).

The study staff will invite the participant/representative to ask questions and will endeavor to ensure that s/he understands the information provided. The study staff will then ask the participant/representative to consider study participation. Participants will have as much time as required to consider participation. All participants/representatives will be required to sign a consent form. For participation of a child, parent or legal guardian will be present and sign the parental consent form. Parents or guardians of the child will be read a statement describing the study and the benefits and potential risks of participating in the study in a private room by a trained research team member. Date of birth of children will be estimated by asking a parent the age of the child. Children not accompanied by a parent/guardian will not be allowed to participate. Capacity to consent will be evaluated by trained members of the research team with care taken to ensure that only participants that have clearly followed and fully understood the study, along with all associated benefits and risks will be consented.

Those who consent to the study will sign and date two copies of the consent form. The study staff will also sign and date the two copies. A copy of the signed consent must be provided to the subject. If the participant is illiterate, a witness who is not a member of the study staff will be present during the informed consent discussion. The consent form will be read to the participant in the presence of the witness. If the participant agrees to participate, the form will be signed and dated by the witness. In this case, the participant or representative will still be invited to make a mark (e.g., written mark or a thumbprint) in a dedicated location of the form (See Appendix B).

For hospitalized patients, those who refuse to participate or to sign the consent form will be treated with the best available standard of care and will not have any study related procedures performed; no negative repercussions will result from refusal to participate. Informed consent paperwork will be kept for a minimum of three years in a locked box at the local country PREDICT office.

PREDICT global and consortium staff, regional leads supervising surveillance, and country coordinators supervising local implementation of human subjects research will receive Collaborative Institutional Training Initiative (CITI) training for Biomedical Researchers and Staff. Trained staff will supervise activities and observe the consent process to evaluate the local clinical personnel's capacity to obtain informed consent from subjects involved in research. Specifically, CITI trained staff will review the consent form with staff implementing research activities to explain and clarify procedures, observe staff obtaining consent, and review consent forms to ensure compliance and completeness.

30) Process to Document Consent in Writing

We will be following the process as described in "SOP: Written Documentation of Consent (HRP-091)."

31) Drugs or Devices

Not applicable – No drugs or devices will be used in this study.

References

Daszak, P., G. Tabor, A. Kilpatrick, J. Epstein, and R. Plowright. 2004. Conservation medicine and a new agenda for emerging diseases. Annals of the New York Academy of Sciences 1-11.

Jones, K.E., N.G. Patel, M.A. Levy, A. Storeygard, D. Balk, J.L. Gittleman, and P. Daszak. 2008. Global trends in emerging infectious diseases. Nature 451: 990–994.

Murray, K.A., and P. Daszak. 2013. Human ecology in pathogenic landscapes: two hypotheses on how land use change drives viral emergence. Current Opinion in Virology 3:79-83.

Smolinski, M.S., M.A. Hamburg, J. Lederberg (editors), and Committee on emerging microbial threats to health in the 21st Century. 2003. Microbial threats to health: emergence, detection, and response. Washington, DC: The National Academies Press.

Taylor, L.H., S.M. Latham, and M.E.J. Woolhouse. 2001. Risk factors for human disease emergence. Philosophical Transactions of the Royal Society of London B 356: 983-989.

PREDICT INFORMED CONSENT FORM

Adult Participant or Child Participant's Parent/Guardian Information Sheet

Study Title: PREDICT - Surveillance for Emerging Zoonotic Disease Threats and Behavioral Risk Characterization in High-risk Communities in Asia and Africa

Subjects Description: Research subjects to be enrolled in this study are those living, working, or visiting the locations selected by the PREDICT project team as important to monitor for new diseases in two settings: 1) people with close contact with wildlife and livestock; and 2) sick patients at clinics or hospitals.

Study Point of Contact: [Country Specific POC]
Lead Principle Investigator: Professor Jonna A.K. Mazet, University of California, Davis

Sponsor: USAID Emerging Pandemic Threats Program, PREDICT Project
Institutions Implementing the Study: [Country Implementing Partner(s)]

I. Introduction

We would like you or your child to participate in a study entitled "**PREDICT - Surveillance for Emerging Zoonotic Disease Threats and Behavioral Risk Characterization in High-risk Communities in Asia and Africa**". Emerging disease threats could come from animals and make people sick. Before you read more information about this study and decide to provide your consent for participation, it is very important that you understand the following general principles, which apply to all participants in this study:

1. Participation in this study is entirely voluntary.
2. After providing your consent to participate, your may decide to withdraw from this study or decline any part of the study, at any time, without giving a reason for withdrawal. Withdrawal of your consent will not prevent or otherwise affect you or your child from receiving routine health care.
3. After you read the explanation provided below, please feel free to ask any questions that will allow you to clearly understand the study.

II. What is the purpose of the study?

The purpose of this study is to see if people living here might be getting new diseases from animals. The study will help us learn more about diseases people can get from activities such as hunting, butchering, raising, and eating animals. This information will be used to help us learn about diseases in your community and how new diseases might arise. The work may help us to discover ways to reduce the risk of catching these types of diseases.

The *[insert community/clinic/hospital]* is collaborating in this study. This project is a collaborative effort with *[insert in-country implementing partner]* and the University of California Davis and *[Consortium partner]* in the United States. As part of this research we are collecting samples from people in *[insert local country]* and asking them questions about their contact with wildlife and livestock.

I am here today to ask if you, or you on behalf of your child, are willing to consent to participating in this study by talking with me, responding to survey questions about your contact with animals and providing a sample that may include blood, swabs from your mouth, nose, or rectum, as well as urine, and feces. The survey and sample collection will take approximately one hour.

III. What procedures will be performed on participants?

If you, or your child, are eligible and interested in participating, your or your child will be enrolled into the study. The study will involve the following procedures:

1. The first procedure will be to complete and sign the form included at the end of this document. If you are a parent or guardian of a child participant, your child will be asked to provide agreement if they are 12 years or older. You (and your child if relevant) will do this only after you have read this document and received explanation from one of the study members.
2. You, or your child, will then be enrolled in the study, and we will collect some information from you including questions about your family, livelihood, past diseases, and your activities with wildlife and livestock.
3. Once you, or your child, are found eligible and are still interested in participating in the study some of the following samples may be collected:
    a. Two swabs (soft tipped sticks) swiped against the inside of your mouth or back of your throat.
    b. Two swabs (soft tipped sticks) swiped against the inside of your nose or behind your nose.
    c. A small amount of blood (approximately two teaspoons) taken from a vein in your arm.
    d. A sample of your feces or rectal swab (soft tipped sticks swiped against the inside of your rectum)
    e. A sample of your urine or a urogenital swab (soft tipped sticks swiped against the inside of your urethra)
    f. If you are a patient in a hospital and your doctor or care provider has already collected or will be collecting these samples or samples like cerebral spinal fluid (fluid from your spinal column) pericardial fluid (fluid from around the heart), or pleural fluid (fluid from around your lungs) to test for diseases, we will ask your permission to use some of this material in our study.
4. After samples are collected, they will be tested in a laboratory. A summary of the diseases and the findings at this site will be provided to your physician and/or local health officials during the study period. Your personal identification will not be linked to the summary of findings, and your participation will be confidential.

IV. What is the duration of study and participation?

The entire study will last for up to ten years, but sample collection and questions about you or your child's participation may only take one day and should take no more than one hour. If you, or your child, are admitted to a participating hospital or clinic on a different occasion, additional samples may be collected if appropriate.

V. What are the benefits of participation?

You, or your child, will benefit from having been checked for viruses that can be transmitted from animals, as this information will be used to discover ways to avoid or limit disease outbreaks in your community..

VI. Are there any risks or burdens associated with participation?

Minimal discomfort or harm is anticipated during the collection of samples for this study. Minor discomfort may occur during gentle rubbing for swab sample collection.

Bleeding, bruising, soreness or local infection may occur during blood sample collection at the needle site; these are expected to be very minor and to not need treatment unless directed by your doctor.

After receiving summaries of our findings for this site, your physician may communicate with you about diseases in your community. We will provide your doctor or medical care providers with information on these findings so they can talk with you about risk to you or your family and ways to prevent diseases. Because laboratory analysis for these samples takes many months, we will not be able to provide findings to your doctor within time to help with treatment for a disease you have already.

Your answers to a few questions might include activities that are against the local laws. To minimize risk of consequences from authorities, all information will be collected in a strictly confidential manner and stored securely to protect your privacy.

VII. Will participants receive any compensation or payment?

There will be no payment made for your participation. However, you may receive a token of appreciation for your participation.

VIII. May I refuse to participate or withdraw from the study?

Your decision to participate in this study is **completely voluntary**, and you will neither **be influenced nor forced to participate.** You may withdraw from participation **at any time**. Your decision **not** to participate or to **withdraw** your consent to participate will not affect your right to receive care or medical attention.

IX. Will my data and samples be kept confidential?

Information that you or your child provide(s) and laboratory results will remain confidential and will only be used in this study. Information and test results will be coded so that your answers and results are not linked to your name, and information will be kept secured by the study team.

All collected samples and surveys will be coded using a unique identification code assigned to each individual. All records that contain names and other personal identifying information will be stored separately from survey question information and laboratory results. Personal information will be secured in locked facilities and on password protected devices with limited access by study staff. Your health information will not be used by or disclosed (released) to another institution. Any documents produced or reports published or shared will not contain your personal identifying information.

X. Who can I contact if I have questions?

If you have any questions or need clarification at any time before signing the consent form or during the study period, do not hesitate to ask the study team members that have provided you with this information. You can also contact the Lead Principal Investigator at UC Davis or the primary Point of Contact for the country implementing partner *[NAME]* if you have any questions or need clarification related to this study or related to your participation.

Lead Principal Investigator: Professor Jonna A.K. Mazet, UC Davis

Phone/Email: +15307527526/predict@ucdavis.edu

Local Contact: *[Local implementing partner contact]*

Phone:

Email:

IRB Contact: *[Local IRB or ethical committee approving study]*

Phone:

Email:

CERTIFICATION BY A VOLUNTEER (ADULT CONSENT)

I, ____(Volunteer Name and Surname) attest to have received explanation about the aim and procedures of the study entitled above.

I attest to have been given enough time to read the information script above that describes detailed study procedures, including samples to be collected.

I attest to have understood the aim, procedures, benefits and risks and that I was given sufficient time to ask my questions related to the procedures, benefits and risk of my participation and I have received satisfactory answers. I understand that if I have further questions I can contact the study team by telephone or mail using the contact information above.

I also agree that my blood or other samples and related information will be stored for up to ten years and that my personal information will be kept in a secure and protected manner. At the end of this study in ten years, all samples, as well as all accompanying information, will be destroyed.

I VOLUNTARILY AGREE TO PARTICIPATE in the study referenced above.
I understand that I have the right to withdraw my consent at any time.

I do understand that I can be withdrawn, or that the study could be terminated by the principal investigator, for my benefit and/or the benefit of the study. I understand I will be given a copy of the information sheet and consent form to keep for my records.

☐ I consent to full participation in the survey and sample collection for this study.

☐ I consent to participate in ONLY the survey portion of this study.

☐ I decline to participate in this study.

Unique ID: __________ **Date:** _____________

NAME OF PARTICIPANT (PRINT)		
First Name:	Middle Name:	Surname:
Date *(dd/mm/yyyy)*: |__|__|/|__|__|/|__|__|__|__|	Time *(24 hrs)*: |__|__|:|__|__|	Signature:

I have accurately read or witnessed the accurate reading of the consent form to the potential participant, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.

NAME OF PERSON GIVING CONSENT EXPLANATION (PRINT)		
First Name:	Middle Name:	Surname:
Date *(dd/mm/yyyy)*: |__|__|/|__|__|/|__|__|__|__|	Time *(24 hrs)*: |__|__|:|__|__|	Signature:

IF PARTICIPANT IS ILLITERATE

THUMB PRINT (OR OTHER MARK) OF PARTICIPANT

I have witnessed the accurate reading of the consent form to the potential participant, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.

NAME OF WITNESS (PRINT)		
First Name:	Middle Name:	Surname:
Date *(dd/mm/yyyy)*: |__|__|/|__|__|/|__|__|__|__|	Time *(24 hrs)*: |__|__|:|__|__|	Signature:

CHILD PARTICIPANT'S PARENT/GUARDIAN CONSENT FORM

I, ______________________________ (Parent/Guardian's Name) consent to the voluntary participation of my child ___________________________(Child's Name) as a participant in the study, and understand that I have the right to withdraw him/her from the research at any time without it in any way affecting his/her medical care.

I attest to have received explanation about the aim and procedures of the study entitled above.

I attest to have been given enough time to read the information script above that describes detailed study procedures, including samples to be collected.

I attest to have understood the aim, procedures, benefits and risks and that I was given sufficient time to ask my questions related to the procedures, benefits and risk of my child's participation and have received satisfactory answers. I understand that if I have further questions I can contact the study team by telephone or mail using the contact information above.

I also agree that any of my child's blood or other samples and related information will be stored for up to ten years and that the child's personal information will be kept in a secure and protected manner. At the end of this study in ten years, all samples, as well as all accompanying information, will be destroyed.

I VOLUNTARILY AGREE TO MY CHILD'S PARTICIPATATION in the study referenced above.
I understand that I have the right to withdraw my consent for my child's participation at any time. I do understand that my child can be withdrawn, or that the study could be terminated by the principal investigator, for my benefit and/or the benefit of the study. I understand I will be given a copy of the information script above and consent form to keep for my records.

☐ I consent to the full participation of my child in the survey and sample collection for this study,

☐ I consent to the participation of my child in ONLY the survey portion of this study.

☐ I decline to consent for my child to participate in this study.

Unique ID: __________ **Date:** _____________

<table>
<tr><td colspan="3">CHILD’S NAME (PARTICIPANT) (PRINT)</td></tr>
<tr><td>First Name :</td><td>Middle Name:</td><td>Surname:</td></tr>
</table>

<table>
<tr><td colspan="3">PARENT'S/GUARDIAN'S PRINTED NAME (PRINT)</td></tr>
<tr><td>First Name:</td><td>Middle Name:</td><td>Surname:</td></tr>
<tr><td>Date <i>(dd/mm/yyyy)</i>:
|__|__|/|__|__|/|__|__|__|__|</td><td>Time <i>(24 hrs)</i>:
|__|__|:|__|__|</td><td>Signature:</td></tr>
</table>

I have accurately read or witnessed the accurate reading of the consent form to the parent/guardian of potential participant, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.

<table>
<tr><td colspan="3">NAME OF PERSON GIVING CONSENT EXPLANATION (PRINT)</td></tr>
<tr><td>First Name:</td><td>Middle Name:</td><td>Surname:</td></tr>
<tr><td>Date <i>(dd/mm/yyyy)</i>:
|__|__|/|__|__|/|__|__|__|__|</td><td>Time <i>(24 hrs):</i>
|__|__|:|__|__|</td><td>Signature:</td></tr>
</table>

IF PARENT/LEGAL GUARDIAN IS ILLITERATE

THUMB PRINT (OR OTHER MARK) OF PARTICIPANT

I have witnessed the accurate reading of the consent form to the potential participant, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.

<table>
<tr><td colspan="3">NAME OF WITNESS (PRINT)</td></tr>
<tr><td>First Name:</td><td>Middle Name:</td><td>Surname:</td></tr>
<tr><td>Date <i>(dd/mm/yyyy)</i>:
|__|__|/|__|__|/|__|__|__|__|</td><td>Time <i>(24 hrs)</i>:
|__|__|:|__|__|</td><td>Signature:</td></tr>
</table>

CHILD ASSENT - ONLY APPLY IF CHILD IS BETWEEN 12-17 YEARS OLD

Assent

- ☐ Obtained
- ☐ Not obtained because the capability of the child is so limited that the child cannot reasonably be consulted.

I____ (NAME AND SURNAME OF THE PERSON GIVING CONSENT EXPLANATION*)* attest that the child has provided **verbal assent** to participate in this study.

<table>
<tr><td>Date <i>(dd/mm/yyyy)</i>:
|__|__|/|__|__|/|__|__|__|__|</td><td>Time <i>(24 hrs)</i>:
|__|__|:|__|__|</td><td>Signature:</td></tr>
</table>

Human Questionnaire Form

EIDITH
V 1.1

1. Consent Form Administered & Signed ○ yes ○ no Participant ID: ____________

2. Description of Interview Location - Select all that apply.
(To be completed by interviewer prior to administrative questionnaire.
Prepare and download modules in advance.)
- ○ Animal Production or Abattoir Site
- ○ Crop Production Site
- ○ Extractive Industry Site
- ○ Market or Value Chain Site
- ○ Temporary Settlement Site
- ○ Tourism Site
- ○ Wildlife Restaurant
- ○ Zoos or Sanctuaries
- ○ Hospital or Clinic - Health Professional
- ○ Hospital or Clinic - Patient
- ○ Protected Area (eg. forest, public park)
- ○ Other: ____________

3. Date of interview ____________

4. Begin time of interview ____________
(Example: 17:50)

5. End time of interview ____________
(Example: 19:20)

6. Where are you conducting this interview?

Village/Town/City ____________ District ____________ Province/State ____________

Latitude ____________ Longitude ____________
Interviewer: Please collect GPS coordinates if administering using paper and pen.

7. Interviewer Observed Gender ○ male ○ female ○ other

INTERVIEW/QUESTIONNAIRE BEGINS

Demographics Section (include observation question 7)

8. How old are you? ____________
If the exact age is unknown, enter the respondent's estimated age.

9. Where do you live?

Village/Town/City ____________ District ____________ Province/State ____________

Latitude ____________ Longitude ____________
Interviewer: Probe for landmarks or nearest known site if area unknown.
GPS coordinates to be identified and entered after completion of interview.

10. How long have you lived there? Select one option.
- ○ <1 month
- ○ 1 month - 1 year
- ○ >1 - 5 years
- ○ >5 - 10 years
- ○ >10 years

11. How many other people live in the dwelling where you live? ________
Skip to question 14 if answer is 0.

12. How many in the dwelling are children less than 5 years old? ________

Human Questionnaire Form

13. How many in the dwelling are male? ________

14. How many rooms are there in the dwelling where you live? ________
(Do not include bathroom or kitchen)

15. Is the dwelling a permanent structure (that cannot be moved)? ○ yes ○ no
Interviewer: If answer is no, complete temporary settlement questionnaire.

16. Do you get water from:
Select all that apply.
- ○ piped in water/water taps
- ○ covered well
- ○ uncovered well/pond/river
- ○ water truck/rainwater harvest
- ○ other: ____________________

17. Do you treat your drinking water? ○ yes ○ no

18. If yes, how do you treat your water?
Select all that apply.
- ○ boil
- ○ filter
- ○ add chlorine or bleach
- ○ solar disinfection
- ○ other: ____________________

19. Is your source for drinking water ever used by animals? ○ yes ○ no

20. In your dwelling is there a dedicated location for human solid waste/excreta? ○ yes ○ no
(Example: toilet, latrine, designated area)

21. Do you have containers for storing food for the household?
Select all that apply.
- ○ yes, with covers
- ○ yes, without covers
- ○ no

Human Questionnaire Form

Participant ID ____________________
(For reference only)

Livelihood Section

In this section, I'd like to ask you about education and the kinds of work activities that you have done since this time last year.

22. What is the highest level of education you have completed?
Select one option. (Skip for Cameroon.)
○ primary school
○ secondary school
○ college/university/professional
○ none

23. What is the highest level of education that your mother completed?
Select one option. (Skip for Cameroon.)
○ primary school
○ secondary school
○ college/university/professional
○ none

24. Since this time last year what are the activities you have done to earn your livelihood?
Select all that apply.
○ extraction of minerals, gas, oil, timber
○ crop production
○ wildlife restaurant business
○ wild/exotic animal trade/market
○ rancher/farmer animal production business
○ meat processing, slaughterhouse, abattoir
○ zoo/sanctuary animal health care
○ protected area worker
○ hunter/trapper/fisher
○ forager/gatherer/non-timber forest product collector
○ migrant laborer
○ nurse, doctor, traditional healer, community health worker
○ construction
○ other: ______________________________

25. If more than one activity was selected, what is the activity on which you spent the most time since this time last year?*
Select one option.
○ extraction of minerals, gas, oil, timber
○ crop production
○ wildlife restaurant business
○ wild/exotic animal trade/market
○ rancher/farmer animal production business
○ meat processing, slaughterhouse, abattoir
○ zoo/sanctuary animal health care
○ protected area worker
○ hunter/trapper/fisher
○ forager/gatherer/non-timber forest product collector
○ migrant laborer
○ nurse, doctor, traditional healer, community health worker
○ construction
○ other: ______________________________

26. Which best describes your job position?
Select one option.
○ manager/owner/foreman
○ worker
○ live and work at home independently (If chosen, skip to question 28)
○ professional
○ other: ____________________

27. Where do you work?

Village/Town/City ______________ District ______________ Province/State ______________

Latitude ____________________ Longitude ____________________

Interviewer: Probe for landmarks or nearest known site if area unknown.
GPS coordinates to be identified and entered after completion of interview.

Human Questionnaire Form

Participant ID________________
(For reference only)

Medical History Section

In this section, I'm going to ask you about any illness or sickness that is not known or recognized in the community, including by medical or treatment providers.

28. Where do you usually get treatment for medical problems?
Select all that apply.
- ○ clinic/health center
- ○ hospital
- ○ mobile clinic
- ○ community health worker
- ○ traditional healer
- ○ dispensary or pharmacy

29. Have you ever had an unusual illness with any of the following symptoms:
Select all that apply. (READ ONLY SYMPTOMS)
- ○ fever with headache and severe fatigue or weakness (encephalitis)
- ○ fever with bleeding or bruising not related to injury (hemorrhagic fever)
- ○ fever with cough and shortness of breath or difficulty breathing (SARI)
- ○ fever with muscle aches, cough, or sore throat (ILI)
- ○ fever with diarrhea or vomiting
- ○ fever with rash
- ○ persistent rash or sores on skin
- ○ no (Skip to question 33)
- ○ yes but, none of these symptoms-describe: ____________________

30. Since this time last year, have you had any of these symptoms?
- ○ yes
- ○ no (Skip to question 33)

31. If yes, which ones?
Select all that apply.
- ○ fever with headache and severe fatigue or weakness (encephalitis)
- ○ fever with bleeding or bruising not related to injury (hemorrhagic fever)
- ○ fever with cough and shortness of breath or difficulty breathing (SARI)
- ○ fever with muscle aches, cough, or sore throat (ILI)
- ○ fever with diarrhea or vomiting
- ○ fever with rash
- ○ persistent rash or sores on skin
- ○ none of these symptoms-describe:____________________

32. In your opinion, when you were sick, what caused this sickness?
Select all that apply.
- ○ contact with sick people
- ○ contact with wild animals
- ○ contact with other animals
- ○ bad food or water
- ○ bad spirits/witchcraft
- ○ wound or injury
- ○ I don't know
- ○ other: ________________

33. Since this time last year, have any of the people you lived with had any of these symptoms?
- ○ yes
- ○ no (Skip to question 36)

34. If yes, which ones?
Select all that apply.
- ○ fever with headache and severe fatigue or weakness (encephalitis)
- ○ fever with bleeding or bruising not related to injury (hemorrhagic fever)
- ○ fever with cough and shortness of breath or difficulty breathing (SARI)
- ○ fever with muscle aches, cough, or sore throat (ILI)
- ○ fever with diarrhea or vomiting
- ○ fever with rash
- ○ persistent rash or sores on skin
- ○ none of these symptoms-describe:____________________

35. Since this time last year, did anyone you lived with die from this illness?
- ○ yes
- ○ no

Human Questionnaire Form

Participant ID ____________
(For reference only)

Movement Section

In this section, I'm going to ask you about any travel you have done since this time last year.

36. Have you traveled since this time last year? ○ yes ○ no
If answer is no, skip to the next section.

37. Where have you traveled since this time last year? Anywhere else?
Provide details, such as name of town, nearest (or most frequent) well known place if unknown by interviewer (to be linked to GPS coordinates later)
Collect up to 6 locations.
Interviewer: Probe for landmarks or nearest known site if area unknown. GPS coordinates to be identified and entered after completion of interview.

Village/Town/City ____________ District ____________ Province/State ____________
Latitude ____________ Longitude ____________
Notes: ____________

Village/Town/City ____________ District ____________ Province/State ____________
Latitude ____________ Longitude ____________
Notes: ____________

Village/Town/City ____________ District ____________ Province/State ____________
Latitude ____________ Longitude ____________
Notes: ____________

Village/Town/City ____________ District ____________ Province/State ____________
Latitude ____________ Longitude ____________
Notes: ____________

Village/Town/City ____________ District ____________ Province/State ____________
Latitude ____________ Longitude ____________
Notes: ____________

Village/Town/City ____________ District ____________ Province/State ____________
Latitude ____________ Longitude ____________
Notes: ____________

If there are more than six locations check here. ○
Do not collect additional location information.

38. Why have you traveled?
Select all that apply.
○ work
○ visit family
○ moved
○ religious reasons
○ holiday/vacation
○ go to hospital/seek medical care
○ go to market
○ other: ____________

Human Questionnaire Form

Participant ID ____________________
(For reference only)

Animal Contact Section

In this section, I'm going to ask you about the animals in your life since this time last year.

Since this time last year...

39. Has an animal lived as a pet in or near your dwelling? ○ yes ○ no

40. Have you handled live animals? ○ yes ○ no

41. Have you raised live animals? ○ yes ○ no

42. Have you shared a water source with animals for washing? ○ yes ○ no ○ don't know

43. Have you seen animal feces in or near food before you have eaten it? ○ yes ○ no

44. Have you eaten food after an animal has touched or damaged it? ○ yes ○ no ○ don't know
(Example: chew marks or scratches)

45. Do any animals come inside the dwelling where you live? ○ yes ○ no

46. Have you cooked or handled meat, organs or blood from a recently killed animal? ○ yes ○ no

47. Have you eaten raw or undercooked meat or organs or blood? ○ yes ○ no

48. Have you eaten an animal that you knew was not well/sick? ○ yes ○ no ○ don't know

49. Have you found a dead animal and collected it to eat or share? ○ yes ○ no

50. Have you found a dead animal and collected it to sell it? ○ yes ○ no

51. Have you been scratched or bitten by an animal? ○ yes ○ no

52. The last time you were scratched, bitten or cut yourself while butchering or slaughtering, what did you do?
Select all that apply.

○ let someone else take over
○ wash wound with soap and water
○ rinse wound with water
○ bandage wound
○ visit doctor
○ nothing - kept working
○ never butcher or slaughter

Human Questionnaire Form

Animal Contact Section

53. Are there any risks associated with slaughtering or butchering when you have an open wound?

Interviewer: Do not read responses.

○ no
○ yes, but I don't know what they are
○ yes, it can make you sick
○ yes, it can poison you
○ yes, it can infect you with a disease
○ don't know
○ other: ____

54. Have you slaughtered an animal? ○ yes ○ no

55. Have you hunted or trapped an animal? ○ yes ○ no
(If answered yes also ask hunter questionnaire)

56. Interviewer: Circle all headings where “yes” was answered in questions above. Then ask which animals/mammals for each “yes” category. Select all that apply.

	pet (39)	handled (40)	raised (41)	feces in or near food (43)	in house (45)	cooked/ handled (46)	eaten raw/ under cooked (47)	eaten sick (48)	found dead (49/50)	scratched/ bitten (51)	slaugh-tered (54)	hunted/ trapped (55)
rodents/shrews	○	○	○	○	○	○	○	○	○	○	○	○
bats	○	○	○	○	○	○	○	○	○	○	○	○
non-human primates	○	○	○	○	○	○	○	○	○	○	○	○
birds	○	○	○	○	○	○	○	○	○	○	○	○
carnivores	○	○	○	○	○	○	○	○	○	○	○	○
ungulates	○	○	○	○	○	○	○	○	○	○	○	○
pangolins	○	○	○	○	○	○	○	○	○	○	○	○
poultry	○	○	○	○	○	○	○	○	○	○	○	○
goats/sheep	○	○	○	○	○	○	○	○	○	○	○	○
camels	○	○	○	○	○	○	○	○	○	○	○	○
swine	○	○	○	○	○	○	○	○	○	○	○	○
cattle/buffalo	○	○	○	○	○	○	○	○	○	○	○	○
dogs	○	○	○	○	○	○	○	○	○	○	○	○
cats	○	○	○	○	○	○	○	○	○	○	○	○

57. Are you worried about diseases or disease outbreaks in live animals in your local market? ○ yes ○ no

END OF MAIN QUESTIONNAIRE

Directions for selecting modules for the interview

Select module(s) identified in Question 2 (if any).

Conduct the following QUICK CHECKS.

1. Add the primary work activity module (Question 25)
2. Add the Temporary Settlement Module if Temporary Settlement is NOT selected in Question 2 and dwellings is NOT permanent (Question 15)
3. Add Hunter Module if hunter/trapper/fisher is selected in Question 25 or "yes" to Question 55.

Livelihood Module Table (based on response to Question 25)
Complete the modules that correspond with the livelihood chosen as follows:

extraction of minerals, gas, oil, timber – extractive industry module
crop production – crop production module
wildlife restaurant business – wildlife restaurant module
wild/exotic animal trade business – market and value chain module
rancher/farmer animal production business - animal production module
meat processing, slaughterhouse, abattoir - animal production module
zoo/sanctuary animal health care – zoos & sanctuaries module
hunter/trapper/fisher – hunter module
nurse, doctor, traditional healer, community health worker - hospital or clinic health professional module

If no additional modules are selected, the interview is complete.

Human Questionnaire Form ID Instructions

Enter the barcode number to the Human Questionnaire Form ID grid located at the top of each completed module.

The barcode is located at the bottom right hand corner of each page of the Human Questionnaire section. Use the number after the dash (-) and fill the grid with the numbers from top to bottom.

Extractive Industry Module

EIDITH
V 1.0

⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

Add Human Questionnaire Form ID

Participant ID ____________________
(For reference only)

1. What type of work or industry is conducted here?
Select one option.
   - ○ underground mining (by shafts or tunnels)
   - ○ open surface mining
   - ○ hydraulic mining (high pressure water)
   - ○ gathering, panning, or collecting
   - ○ oil well/gas field
   - ○ other: ____________________

2. What product(s) are extracted?
Select one option.
   - ○ coal
   - ○ coltan
   - ○ diamond or other gemstone
   - ○ tin
   - ○ gold/silver
   - ○ lead
   - ○ oil/gas
   - ○ timber/plant
   - ○ other: ____________

3. Do you live on the work site? ○ yes ○ no

4. To the best of your knowledge, how many people work at this site?
Select one option.
   - ○ <10
   - ○ 10-100
   - ○ 101-1000
   - ○ 1001-10,000
   - ○ >10,000

5. How long have you worked at this site?
Select one option.
   - ○ <1 month
   - ○ 1 month - 1 year
   - ○ >1 year - 5 years
   - ○ >5 years

6. Is there on-site food production? ○ yes ○ no

7. If yes, who pays for the cost to grow the food crops? ○ the company ○ the workers

8. Is there meat available for consumption? ○ yes ○ no

Extractive Industry Module

9. If yes, where does the meat come from?
Select all that apply.

○ farmed onsite
○ farmed and purchased from nearby local communities
○ purchased from wholesale market
○ locally caught/hunted
○ bought frozen
○ don't know

10. Is it possible to consume bushmeat/wild animal meat on or near the site?

○ yes
○ no

11. Is there a designated area for rubbish, including animal waste from slaughter/butcher and animal excrement?

○ yes
○ no

12. If yes, do people use the designated location for rubbish?

○ yes
○ no

13. Do any animals raid food supplies or destroy crops?

○ yes
○ no

14. If yes, which animals?
Select all that apply.

○ rodents/shrews
○ bats
○ non-human primates
○ birds
○ carnivores
○ ungulates
○ pangolins
○ poultry
○ goats/sheep
○ camels
○ swine
○ cattle/buffalo
○ dogs
○ cats

15. What is done to stop animals from raiding or destroying food supplies?
Select all that apply.

○ barriers around fields
○ barriers on individual trees
○ fire
○ poison
○ traps
○ shooting
○ loud sounds
○ natural predators
○ flooding
○ chasing animals out
○ nothing

Crop Production Module

EIDITH
V 1.0

⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

Add Human Questionnaire Form ID

Participant ID ____________________
(For reference only)

1. Do you live on the work site?
○ yes
○ no

2. To the best of your knowledge, how many people work at this site?
Select one option.
○ <10
○ 10-100
○ 101-1000
○ 1001-10,000
○ >10,000

3. How long have you worked at this site?
Select one option.
○ <1 month
○ 1 month - 1 year
○ >1 year - 5 years
○ >5 years

4. Which crops are at this site?
Select all that apply.
○ coffee/tea/cocoa plants
○ fruit/nut trees
○ oil tree plantation
○ oil seed crops
○ dry grains
○ sugar
○ vegetable/fruit crops
○ pulses/legume
○ fiber
○ forages
○ cover crops
○ fallow fields
○ rubber

5. Does the farm use manure, guano or night soil to fertilizer the crops?
○ yes
○ no

6. If yes, which types?
Select all that apply.
○ poultry
○ camel
○ swine
○ cattle/buffalo
○ bird guano
○ bat guano
○ night soil

7. Is there meat available for the consumption?
○ yes
○ no

8. If yes, where does the meat come from?
Select all that apply.
○ farmed onsite
○ farmed and purchased from nearby local communities
○ purchased from wholesale market
○ locally caught/hunted
○ bought frozen
○ don't know

9. Is it possible to consume bushmeat/wild animal meat on or near the site?
○ yes
○ no

Crop Production Module

10. Is there a designated area for rubbish, including animal waste from slaughter/butcher and animal excrement?
○ yes
○ no

11. If yes, do people use the designated location for rubbish?
○ yes
○ no

12. Do any animals raid food supplies or destroy crops?
○ yes
○ no

13. If yes, which animals?
Select all that apply.
○ rodents/shrews
○ bats
○ non-human primates
○ birds
○ carnivores
○ ungulates
○ pangolins
○ poultry
○ goats/sheep
○ camels
○ swine
○ cattle/buffalo
○ dogs
○ cats

14. What is done to stop animals from raiding or destroying food supplies?
Select all that apply.
○ barriers around fields
○ barriers on individual trees
○ fire
○ poison
○ traps
○ shooting
○ loud sounds
○ natural predators
○ flooding
○ chasing animals out
○ nothing

Wildlife Restaurant Module

EIDITH
V 1.0

⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

Add Human Questionnaire Form ID

Participant ID ____________________
(For reference only)

1. Do you live on site?
   - ○ yes
   - ○ no

2. To the best of your knowledge, how many people work at this site?
   Select one option.
   - ○ <10
   - ○ 11-50
   - ○ 51-100
   - ○ 101-1000
   - ○ >1001

3. How long have you worked here?
   Select one option.
   - ○ <1 month
   - ○ 1 month - 1 year
   - ○ >1 year - 5 years
   - ○ >5 years

4. What wild animals are on the menu today?
   Select all that apply.
   - ○ rodents/shrews
   - ○ bats
   - ○ non-human primates
   - ○ birds
   - ○ carnivores
   - ○ ungulates
   - ○ pangolins

5. Since this time last year, have you had live animals on site?
   - ○ yes
   - ○ no

6. If yes, where do the animals come from?
   Select all that apply.
   - ○ farmed and/or purchased from nearby local communities
   - ○ wholesale live animal market
   - ○ locally caught/hunted
   - ○ other: ____________________

7. How do the live animals get to the restaurant?
   Select all that apply.
   - ○ transport truck
   - ○ car
   - ○ motorbike
   - ○ cart
   - ○ delivered by hunter
   - ○ public bus
   - ○ brought in by customer
   - ○ other: ____________________

Wildlife Restaurant Module

8. How are live animals stored at night?
Select all that apply.
○ multiple species in one enclosure
○ individual species in one enclosure
○ both multiple and individual species in enclosures

9. Are live animals slaughtered at the restaurant?
○ yes
○ no

10. Do you have special protective equipment (Example: shoes, masks, gloves) only worn at work?
○ yes
○ no

11. If yes, which protective equipment?
Select all that apply.
○ shoes/boots
○ mask
○ clothes
○ gloves
○ gown/apron

12. When do you use protective equipment?
Select all that apply.
○ handling animals
○ slaughter
○ butcher
○ always on at work
○ other: ____________________

13. Do you always use disinfectant to clean?
○ yes
○ no

14. If yes, do you always use disinfectants to clean the following:
Select all that apply.
○ animal enclosures
○ food bins
○ counter tops
○ slaughtering/butchering equipment
○ hands
○ special protective equipment
○ floors

15. Is there a designated area for rubbish, including animal waste from slaughter/butcher and animal excrement?
○ yes
○ no

16. If yes, do people use the dedicated location for rubbish?
○ yes
○ no

17. Do any animals raid food or destroy supplies?
○ yes
○ no

18. If yes, which animals? Select all that apply.
○ rodents/shrews
○ bats
○ non-human primates
○ birds
○ carnivores
○ ungulates
○ pangolins
○ poultry
○ goats/sheep
○ camels
○ swine
○ cattle/buffalo
○ dogs
○ cats

19. What is done to stop animals from raiding or destroying food supplies? Select all that apply.
○ barriers around fields
○ barriers on individual trees
○ fire
○ poison
○ traps
○ shooting
○ loud sounds
○ natural predators
○ flooding
○ chasing animals out
○ nothing

Market & Value Chain Module

EIDITH
V 1.0

⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

Add Human Questionnaire Form ID

Participant ID ______________________
(For reference only)

1. Do you live on the work site?
   - ○ yes
   - ○ no
2. To the best of your knowledge, how many people work at this site? Select one option.
   - ○ <10
   - ○ 10-50
   - ○ 51-100
   - ○ 101-1000
   - ○ >1001
3. How long have you worked at this market? Select one option.
   - ○ <1 month
   - ○ 1 month - 1 year
   - ○ >1 year - 5 years
   - ○ >5 years
4. What animals are you selling today? Select all that apply.
   - ○ rodents/shrews
   - ○ bats
   - ○ non-human primates
   - ○ birds
   - ○ carnivores
   - ○ ungulates
   - ○ pangolins
   - ○ poultry
   - ○ goats/sheep
   - ○ camels
   - ○ swine
   - ○ cattle/buffalo
   - ○ dogs
   - ○ cats
5. Have you sold a live animal today?
   - ○ yes
   - ○ no
6. Who buys the live animals you sell? Select all that apply.
   - ○ customer for home use
   - ○ restaurants/hotels
   - ○ customer who resells at another market
   - ○ other: ______________________
7. Where do the animals come from? Select all that apply.
   - ○ farmed and/or purchased from nearby local communities
   - ○ wholesale live animal market
   - ○ locally caught/hunted
   - ○ other: ______________________
8. How do the live animals get to the market? Select all that apply.
   - ○ transport truck
   - ○ car
   - ○ motorbike
   - ○ cart
   - ○ delivered by hunter
   - ○ public bus
   - ○ other: ______________________

9. How are live animals stored at night?
Select all that apply.
○ multiple species in one enclosure
○ individual species in one enclosure
○ both multiple and individual species in enclosures

10. How long do you keep alive animals before you sell them? (in hours) ____________

11. What do you do when an animal gets sick?
Select all that apply.
○ kill the animal and dispose of the carcass
○ kill the animal and sell it
○ sell the live animal for discounted
○ nothing different
○ get veterinary care
○ report to authorities
○ other: ______________________________

12. Do you have special protective equipment (Example: shoes, masks, gloves) only worn at work?
○ yes
○ no

13. If yes, which protective equipment?
Select all that apply.
○ shoes/boots
○ mask
○ clothes
○ gloves
○ gown/apron

14. When do you use protective equipment?
Select all that apply.
○ handling animals
○ slaughter
○ butcher
○ always on at work
○ other: ______________________

15. Is protective equipment used every time an animal is handled?
○ yes
○ no

16. When butchering animals, what happens to the refuse (blood, organs, skin, sinews, etc)?
Select all that apply.
○ sell
○ throw into refuse bin
○ throw into the street/gutter
○ take home to eat
○ feed to animals
○ no onsite slaughter

17. Do you always use disinfectant to clean?
○ yes
○ no

18. If yes, do you always use disinfectants to clean the following:
Select all that apply.
○ animal enclosures
○ food bins
○ counter tops
○ slaughtering/butchering equipment
○ hands
○ special protective equipment
○ floors

19. How often are the animal enclosures cleaned?
Select one option.
- ○ daily
- ○ weekly
- ○ monthly
- ○ as needed
- ○ never

20. Is there a designated area for rubbish, including animal waste from slaughter/butcher and animal excrement?
- ○ yes
- ○ no

21. If yes, do people use the dedicated area for rubbish?
- ○ yes
- ○ no

22. How often does the market close?
Select one option.
- ○ once per week
- ○ once every 2 weeks
- ○ once per month
- ○ as needed
- ○ only operates 1-5 days per week
- ○ never

23. Since this time last year, has an animal health official inspected your animals?
- ○ yes
- ○ no

24. Since this time last year, has anyone destroyed your animals because of infection or disease?
- ○ yes
- ○ no

25. If yes, which animals?
Select all that apply.
- ○ rodents/shrews
- ○ bats
- ○ non-human primates
- ○ birds
- ○ carnivores
- ○ ungulates
- ○ pangolins
- ○ poultry
- ○ goats/sheep
- ○ camels
- ○ swine
- ○ cattle/buffalo
- ○ dogs
- ○ cats

26. What is done to stop animals from raiding or destroying food supplies?
Select all that apply.
- ○ barriers around fields
- ○ barriers on individual trees
- ○ fire
- ○ poison
- ○ traps
- ○ shooting
- ○ loud sounds
- ○ natural predators
- ○ flooding
- ○ chasing animals out
- ○ nothing

Animal Production or Abattoir Module

EIDITH
V 1.1

⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

Add Human Questionnaire Form ID
Participant ID ____________________
(For reference only)

1. Do you live on site?
   - ○ yes
   - ○ no
2. To the best of your knowledge, how many people work at this site? Select one option.
   - ○ <10
   - ○ 10-100
   - ○ 101-1000
   - ○ 1001-10,000
   - ○ >10,000
3. How long have you worked here? Select one option.
   - ○ <1 month
   - ○ 1 month - 1 year
   - ○ >1 year - 5 years
   - ○ >5 years
4. Which animals are raised here? Select all that apply.
   - ○ rodents/shrews
   - ○ bats
   - ○ non-human primates
   - ○ birds
   - ○ carnivores
   - ○ ungulates
   - ○ pangolins
   - ○ poultry
   - ○ goats/sheep
   - ○ camels
   - ○ swine
   - ○ cattle/buffalo
   - ○ dogs
   - ○ cats
5. How are live animals stored at night? Select all that apply.
   - ○ multiple species in one enclosure
   - ○ individual species in one enclosure
   - ○ both multiple and individual species in enclosures
6. Is there a quarantine period for new animals?
   - ○ yes
   - ○ no
7. Is there on-site food production?
   - ○ yes
   - ○ no
8. If yes, who pays for the cost to grow the food crops?
   - ○ the company
   - ○ the workers
9. Is there meat available for consumption?
   - ○ yes
   - ○ no

10. If yes, where does the meat come from?
Select all that apply.
○ farmed onsite
○ farmed and purchased from nearby local communities
○ purchased from wholesale market
○ locally caught/hunted
○ bought frozen
○ don't know

11. Is it possible to consume bushmeat/wild animal meat on or near the site?
○ yes
○ no

12. Do you have special protective equipment (Example: shoes, masks, gloves) only worn at work?
○ yes
○ no

13. If yes, which protective equipment?
Select all that apply.
○ shoes/boots
○ mask
○ clothes
○ gloves
○ gown/apron

14. When do you use protective equipment?
Select all that apply.
○ handling animals
○ slaughter
○ butcher
○ always on at work
○ other: ______________________

15. Do you always use disinfectant to clean?
○ yes
○ no

16. If yes, do you always use disinfectants to clean the following:
Select all that apply.
○ animal enclosures
○ food bins
○ counter tops
○ slaughtering/butchering equipment
○ hands
○ special protective equipment
○ floors

17. How often are the animal enclosures cleaned?
Select one option.
○ daily
○ weekly
○ monthly
○ as needed
○ never

18. When slaughtering/butchering animals, what happens to the viscara (blood, organs, skin, sinews, etc)?
Select all that apply.
○ sell
○ throw into refuse bin
○ throw into the street/gutter
○ take home to eat
○ feed to animals
○ no onsite slaughter

19. Is there a designated area for the disposal of animal waste?
○ yes
○ no

20. If yes, do people use the dedicated area for animal waste?
○ yes
○ no

Animal Production or Abattoir Module

21. Since this time last year, have the animals received veterinary care?
○ yes
○ no

22. Since this time last year, has an animal health official inspected your animals?
○ yes
○ no

23. What do you do when an animal gets sick? Select all that apply.
○ kill the animal and dispose of the carcass
○ kill the animal and sell it
○ sell the live animal for discounted
○ nothing different
○ get veterinary care
○ report to authorities
○ other: ______________________________

24. Since this time last year, has anyone quarantined or destroyed your animals because of infection or disease?
○ yes
○ no

25. If yes, which animals? Select all that apply.
○ rodents/shrews
○ bats
○ non-human primates
○ birds
○ carnivores
○ ungulates
○ pangolins
○ poultry
○ goats/sheep
○ camels
○ swine
○ cattle/buffalo
○ dogs
○ cats

26. Since this time last year, has there been a disease outbreak among any raised animals or livestock?
○ yes
○ no

27. If yes, which animals? (Indicate the percentage that died during the outbreak.) Select all that apply.

	1-25%	26-50%	51-75%	76-100%	don't know
rodents/shrews	○	○	○	○	○
bats	○	○	○	○	○
non-human primates	○	○	○	○	○
birds	○	○	○	○	○
carnivores	○	○	○	○	○
ungulates	○	○	○	○	○
pangolins	○	○	○	○	○
poultry	○	○	○	○	○
goats/sheep	○	○	○	○	○
camels	○	○	○	○	○
swine	○	○	○	○	○
cattle/buffalo	○	○	○	○	○
dogs	○	○	○	○	○
cats	○	○	○	○	○

28. Do any animals raid or destroy food supplies?
○ yes
○ no

29. If yes, what animals? Select all that apply.
○ rodents/shrews
○ bats
○ non-human primates
○ birds
○ carnivores
○ ungulates
○ pangolins
○ poultry
○ goats/sheep
○ camels
○ swine
○ cattle/buffalo
○ dogs
○ cats

30. What is done to stop animals from raiding or destroying food supplies? Select all that apply.
○ barriers around fields
○ barriers on individual trees
○ fire
○ poison
○ traps
○ shooting
○ loud sounds
○ natural predators
○ flooding
○ chasing animals out
○ nothing

Notes

Hunter Module

EIDITH
V 1.1

○0 ○1 ○2 ○3 ○4 ○5 ○6 ○7 ○8 ○9
○0 ○1 ○2 ○3 ○4 ○5 ○6 ○7 ○8 ○9
○0 ○1 ○2 ○3 ○4 ○5 ○6 ○7 ○8 ○9
○0 ○1 ○2 ○3 ○4 ○5 ○6 ○7 ○8 ○9
○0 ○1 ○2 ○3 ○4 ○5 ○6 ○7 ○8 ○9
○0 ○1 ○2 ○3 ○4 ○5 ○6 ○7 ○8 ○9

Add Human Questionnaire Form ID

Participant ID ____________________
(For reference only)

1. What animals have you hunted since this time last year?
Select all that apply.

○ rodents/shrews
○ bats
○ non-human primates
○ birds
○ carnivores
○ ungulates
○ pangolins

2. Since this time last year, what methods have you used to hunt/trap animals?
Select all that apply.

○ snare
○ bow
○ hands
○ gun
○ machete
○ knife
○ net
○ cage
○ trap
○ other: ____________

3. What is the purpose of your trapping or hunting?
Select all that apply.

	for consumption at home	for use of animal products at home	for sale for consump -tion	for sale alive at market	for sale of animal products	live trapping of nuisance animals for translocation	culling of nuisance animals
rodents/shrews	○	○	○	○	○	○	○
bats	○	○	○	○	○	○	○
non-human primates	○	○	○	○	○	○	○
birds	○	○	○	○	○	○	○
carnivores	○	○	○	○	○	○	○
ungulates	○	○	○	○	○	○	○
pangolins	○	○	○	○	○	○	○

Since this time last year, when you hunt or trap:

4. Are you exposed to blood? ○ yes ○ no

5. Have you been scratched or bitten? ○ yes ○ no

6. Since this time last year, have you seen an outbreak of dead wild animals? ○ yes ○ no

7. If yes, which wild animals?
Select all that apply.

○ rodents/shrews
○ bats
○ non-human primates
○ birds
○ carnivores
○ ungulates
○ pangolins

8. What do you do when you find an animal dead (not in a trap or shot by another hunter)? Select all that apply.
   - ○ touch it to see if it is still fresh
   - ○ butcher in the forest
   - ○ smoke or cook in the forest
   - ○ take home to prepare
   - ○ bury it
   - ○ report it to authorities
   - ○ take it to sell it
   - ○ nothing
   - ○ other: ________________

9. How do you transport a dead animal, if you take it? Select all that apply.
   - ○ not wrapped
   - ○ wrapped in leaves or other natural material
   - ○ wrapped in plastic
   - ○ in a bag
   - ○ in a basket

10. Do you have special protective equipment (Example: shoes, masks, gloves)?
    - ○ yes
    - ○ no

11. If yes, which protective equipment? Select all that apply.
    - ○ shoes/boots
    - ○ mask
    - ○ clothes
    - ○ gloves
    - ○ gown/apron

12. When do you use protective equipment? Select all that apply.
    - ○ handling animals
    - ○ slaughter
    - ○ butcher
    - ○ always on at work
    - ○ other: ________________

Temporary Settlement Module

EIDITH
V 1.0

⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

Add Human Questionnaire Form ID

Participant ID ____________________
(For reference only)

1. What is your nationality? ________________________

2. How long have you lived at this settlement?
Select one option.
○ <1 week
○ 1-4 weeks
○ 1-5 months
○ 6-11 months
○ > 1 year
○ entire life

3. To the best of your knowledge, how many people live at this site?
Select one option.
○ <10
○ 10-100
○ 101-1000
○ 1001-10,000
○ >10,000

4. Are all the people living here from this country? ○ yes
○ no

5. Why did you settle here?
Select all that apply.
○ job/work (voluntary relocation)
○ family (voluntary relocation)
○ marriage (voluntary relocation)
○ conflict (forced relocation)
○ dispossession of previous home (forced relocation)
○ natural disaster (forced relocation)

6. Is there on-site food production? ○ yes
○ no

7. Is there meat available for consumption? ○ yes
○ no

8. If yes, where does the meat come from?
Select all that apply.
○ farmed onsite
○ farmed and purchased from nearby local communities
○ purchased from wholesale market
○ locally caught/hunted
○ bought frozen
○ don't know

9. Is it possible to consume bushmeat/wild animal meat on or near the site? ○ yes
○ no

Temporary Settlement Module

10. Which animals are available for consumption?
Select all that apply.

○ rodents/shrews
○ bats
○ non-human primates
○ birds
○ carnivores
○ ungulates
○ pangolins
○ poultry
○ goats/sheep
○ camels
○ swine
○ cattle/buffalo
○ dogs
○ cats

11. Is there a designated area for rubbish, including animal waste from slaughter/butcher and animal excrement?

○ yes
○ no

12. If yes, do people use the designated location for rubbish?

○ yes
○ no

13. Do any animals raid food supplies or destroy crops?

○ yes
○ no

14. If yes, which animals?
Select all that apply.

○ rodents/shrews
○ bats
○ non-human primates
○ birds
○ carnivores
○ ungulates
○ pangolins
○ poultry
○ goats/sheep
○ camels
○ swine
○ cattle/buffalo
○ dogs
○ cats

15. What is done to stop animals from raiding or destroying food supplies?
Select all that apply.

○ barriers around fields
○ barriers on individual trees
○ fire
○ poison
○ traps
○ shooting
○ loud sounds
○ natural predators
○ flooding
○ chasing animals out
○ nothing

Tourism Module

EIDITH
V 1.0

⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

Add Human Questionnaire Form ID

Participant ID ______________________
(For reference only)

1. What is your nationality? ______________________

2. List all the countries you have visited in the past month.

______________________ ______________________
______________________ ______________________
______________________ ______________________

3. How long have you been at the current location? Select one option.
   - ○ 1 day
   - ○ 2-7 days
   - ○ 8-14 days
   - ○ > 2 weeks

4. Which activities did you undertake on this trip? Select all that apply.
   - ○ wildlife tourism
   - ○ cave tourism
   - ○ camping
   - ○ hunting
   - ○ trekking in natural areas
   - ○ religious pilgrimage
   - ○ visiting wildlife market
   - ○ other: ______________________

5. What animals have you eaten during this trip? Select all that apply.
   - ○ rodents/shrews
   - ○ bats
   - ○ non-human primates
   - ○ birds
   - ○ carnivores
   - ○ ungulates
   - ○ pangolins
   - ○ poultry
   - ○ goats/sheep
   - ○ camels
   - ○ swine
   - ○ cattle/buffalo
   - ○ dogs
   - ○ cats
   - ○ unknown
   - ○ none

Zoos & Sanctuaries Module

EIDITH
V 1.0

⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

Add Human Questionnaire Form ID

Participant ID ____________________
(For reference only)

1. Do you live on site?
   - ○ yes
   - ○ no

2. To the best of your knowledge, how many people work at this site?
   Select one option.
   - ○ <10
   - ○ 11-50
   - ○ 51-100
   - ○ 101-1000
   - ○ >1001

3. How long have you worked here?
   Select one option.
   - ○ <1 month
   - ○ 1 month - 1 year
   - ○ >1 year - 5 years
   - ○ >5 years

4. What species do you work with?
   Select all that apply.
   - ○ rodents/shrews
   - ○ bats
   - ○ non-human primates
   - ○ birds
   - ○ carnivores
   - ○ ungulates
   - ○ pangolins
   - ○ poultry
   - ○ goats/sheep
   - ○ camels
   - ○ swine
   - ○ cattle/buffalo
   - ○ dogs
   - ○ cats

5. Do you have special protective equipment (Example: shoes, masks, gloves) only worn at work?
   - ○ yes
   - ○ no

6. If yes, which protective equipment?
   Select all that apply.
   - ○ shoes/boots
   - ○ mask
   - ○ clothes
   - ○ gloves
   - ○ gown/apron

7. When do you use protective equipment?
   Select all that apply.
   - ○ handling animals
   - ○ slaughter
   - ○ butcher
   - ○ always on at work
   - ○ other: ____________________

Zoos & Sanctuaries Module

8. Do you always use disinfectant to clean?
○ yes
○ no

9. If yes, do you always use disinfectants to clean the following:
Select all that apply.
○ animal enclosures
○ food bins
○ counter tops
○ slaughtering/butchering equipment
○ hands
○ special protective equipment
○ floors

10. How often are the animal enclosures cleaned?
Select one option.
○ daily
○ weekly
○ monthly
○ as needed
○ never

11. Is there a designated area for the disposal of animal waste?
○ yes
○ no

12. If yes, do people use the dedicated area for animal waste?
○ yes
○ no

13. Is there a quarantine period for new animals?
○ yes
○ no

14. Is there a preventative medicine program for the animals?
○ yes
○ no

15. Do any animals raid food or destroy supplies?
○ yes
○ no

16. If yes, which animals?
Select all that apply.
○ rodents/shrews
○ bats
○ non-human primates
○ birds
○ carnivores
○ ungulates
○ pangolins
○ poultry
○ goats/sheep
○ camels
○ swine
○ cattle/buffalo
○ dogs
○ cats

17. What is done to stop animals from raiding or destroying food supplies?
Select all that apply.
○ barriers around fields
○ barriers on individual trees
○ fire
○ poison
○ traps
○ shooting
○ loud sounds
○ natural predators
○ flooding
○ chasing animals out
○ nothing

Human Hospital & Clinic Module for Health Professionals

⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

EIDITH
V 1.0

Add Human Questionnaire Form ID

Participant ID ______________________
(For reference only)

1. What are your human health activities?

○ hospital or clinic administrator
○ hospital or clinic custodial worker
○ hospital or clinic clinician or nurse (medicine specialty)
○ hospital or clinic clinician or nurse (surgery specialty)
○ mobile clinic
○ traditional healer
○ dispensary or pharmacy

2. Do you have special protective equipment (Example: shoes, masks, gloves) only worn at work?

○ yes
○ no

3. If yes, which protective equipment?
Select all that apply.

○ shoes/boots
○ mask
○ clothes
○ gloves
○ gown/apron

4. Is protective equipment used every time you examine or collect specimens from a patient?

○ yes
○ no

5. Is the protective equipment cleaned, sterilized or discarded after each use?

○ yes
○ no

6. Do you always use disinfectants to clean?

○ yes
○ no

Human Hospital & Clinic Module - Patient

EIDITH
V 1.1

⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

Add Human Questionnaire Form ID

Participant ID ______________________
(For reference only)

1. Body temperature at time of sampling (celsius): ________

2. For how many days have you had a fever? ________

3. Date of symptom onset ________________

4. Signs and symptoms of present illness.
Select all that apply.

○ abdominal pain
○ altered consciousness
○ any movement in stomach
○ asphyxiate
○ bleeding
○ chills
○ cold
○ convulsions
○ cough
○ dark urine
○ diarrhea
○ dizziness
○ eye pain
○ fever
○ headache
○ jaundice
○ joint pain
○ malaise
○ muscle pain
○ no appetite
○ rash
○ sore throat
○ stiff neck
○ vomiting
○ other: ________________________
○ Do not use. For future use.

5. Date of hospitalization for present illness ________________

6. Date of specimen collection ________________

7. Antiviral use for present illness at the time of specimen collection? ○ yes ○ no

8. If yes, what type of antiviral use? ________________________

9. Presence of chronic pre-existing medical illnesses:
Select all that apply.

○ chronic respiratory disease
○ asthma
○ diabetes
○ chronic cardiac disease
○ chronic neurological disease
○ chronic neuromuscular disease
○ hematological disorders
○ immunodeficiency disorders
○ HIV or AIDS

Women Only

10. Pregnancy status ○ yes ○ no

11. If yes, how many months pregnant? ________

Appendix D – PREDICT Hospital Intake Form

Hospital Intake Form

All relevant laboratory test results will be given to the doctor who is responsible for the patient. Patient data will be anonymous at the laboratory.

A. General Patient Information

Hospital Name ________________________________ Hospital address (City) __________________

Patient Name: ________________________________

Patient Address (Street name and House number) : ____________________________

Age : _____years _______month sex : € male € female Pregnant € No € Yes

Body Temperature at time of sampling (in C$^{\circ}$) ___________________

Date of onset: _____________________ (dd/mm/yy) Admission date ________________________ (dd/mm/yy)

Symptom	Current condition			Details	Symptom	Current condition			Details	Symptom	Current condition			Details
	Yes	No	unclear			Yes	No	unclear			Yes	No	unclear	
Fever				……. °C	Malaise					Stiff neck				
Chills					No appetite					convulsions				
Headache					Asphyxiate					Eye Pain				
Cough					Diarrhea					Joint pain				
Dizziness					Cold					Muscle pain				
Vomiting					Bleeding					Abdominal pain				
SoreThroat					Dark urine					Any movement in stomach				
Rash					Jaundice					Altered Consciousness				
Other														

Occupation: ___________________________

Travel history (past 2 mo) € None € Yes, to _______________ When? ______________________

Animal contact (indicate yes/no) €Livestock _____ € Birds ______ €Bats ____ € Rodents ______ €Monkeys/Primates € Other animal (please specify) ___________ € if yes for any, please explain type of contact (€ hunt, € butcher, € clean, € eat, € raise/farm, € transport/handle) ____

Animal contact at €work or € in daily activities? € If Yes, When?________________________

Other symptom in family member or member of household? € No € Yes € If Yes, whom and what symptom __________________

Current diagnosis ____________________________

Antiviral use at time of specimen collection € None € Yes, what ______________

B. Type of Specimen

Identity number used in Hospital : _____________________________ assessed by (Initial):___________________________

€Whole blood /serum / plasma (circle one) 1st Sample collection date ___________________ Code specimen: ______________________

€Whole blood / serum / plasma (circle one) 2nd Sample collection date _______________ Code specimen: ______________________

€ Swab nasal / throat / rectal (circle one) Sample collection date ___________________ Code specimen: ______________________

€ Sputum Sample collection date ___________________ Code specimen: ______________________

€ CSF Sample collection date __________________ Code specimen: ______________________

€Other ______________________ Sample collection date ___________________ Code specimen: ______________________

Laboratory Test Request Form

B. Previous Laboratory tests and results:

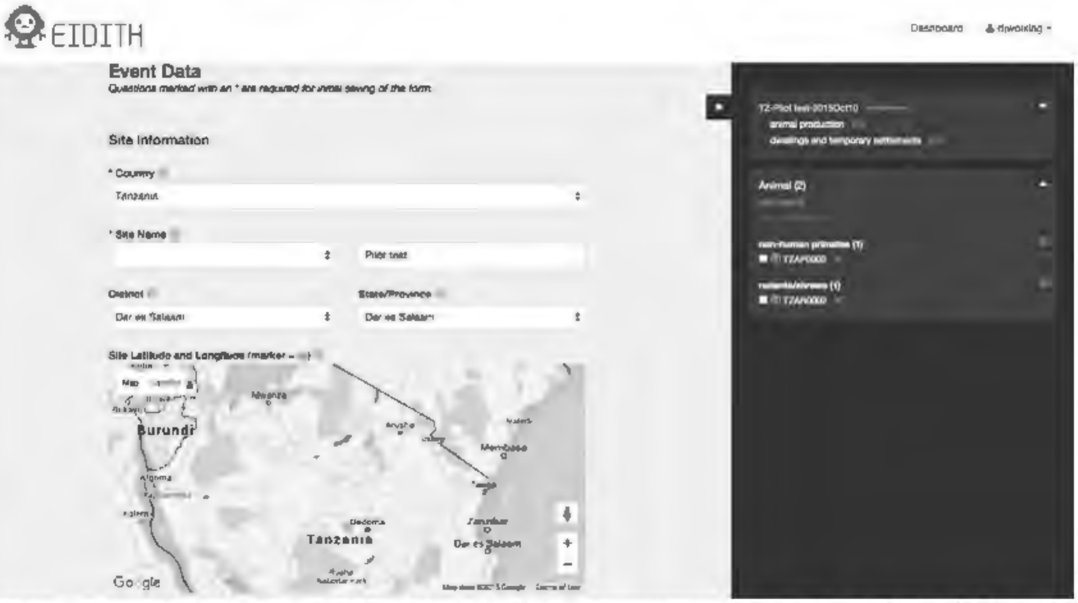
€Influenza virus RT-PCR / virus culture / serology (circle one)	Test Results: ____________________
€Dengue virus RT-PCR / virus culture / serology (circle one)	Test Results: ____________________
€Chikungunya virus RT-PCR / virus culture / serology (circle one)	Test Results: ____________________
€Malaria microscopy / rapid diagnostic test (Binax NOW) / serology (circle one)	Test Results: ____________________
€other (please specify) ______________________________	Test Results: ____________________
€other (please specify) ______________________________	Test Results: ____________________
€other (please specify) ______________________________	Test Results: ____________________

Requested by (name): ____________________ Contact Number: ____________

6.2 INFORMATION MANAGEMENT – NEW EIDITH DATA COLLECTION TOOLS AND MOBILE APPLICATIONS

PREDICT works closely with host governments and partners to interpret and share information through systems designed to protect and ensure data quality and accuracy. PREDICT data are managed in a purposefully-designed internal information management system (EIDITH), in which all data undergo a rigorous quality control process. Diagnostic test results are interpreted in light of all available scientific literature by PREDICT virologists. After interpretation, results are provided to host governments for examination, to inform policy, and for approval for public release through the PREDICT data site powered by our partner HealthMap (http://data.predict.global). This open access platform allows users to visualize PREDICT data along with disease events worldwide.

Surveillance Data Collection Tools. This year, PREDICT's information management team worked together across all project operational teams to develop new data collection tools and applications for surveillance sites and events, for animal sample data, and for behavioral risk data captured during interviews with people at high-risk sites for animal-human contact. These tools are available electronically to all project staff through the PREDICT's Emerging Infectious Disease Information and Technology Hub (EIDITH – eidith.org), as well as through a novel optical mark recognition system (bubble forms) enabling the digitization of data collected on paper-based forms in the field.



Event Data

Site Information

* Country

Tanzania

* Site Name

Pilot test

District

Dar es Salaam

State/Province

Dar es Salaam

Site Latitude and Longitude

Photo 1. Screenshot of the EIDITH Site and Event application now in use and available as a mobile app for all PREDICT country teams.

Training Data Capture Tools. Also this year, to enable better tracking of training events, PREDICT designed training data collection tools and an electronic platform for internal project use in EIDITH to capture training data and generate reports. This platform (*described in depth in Section 1 under Objective 4*) equips

PREDICT leadership with the potential to monitor training status in real time, to ensure all key personnel are up to date on essential skills and techniques, and to support compliance monitoring of all project activities. The application is available electronically to PREDICT staff via "training.eidith.org" or through EIDITH's newly developed optical mark recognition system (bubble forms) for teams requiring paper-based forms for data capture in the field.

Add Participant

Date * 07/04/2015

Participant Information

Participant Country * Tanzania

First Name * Goodluck

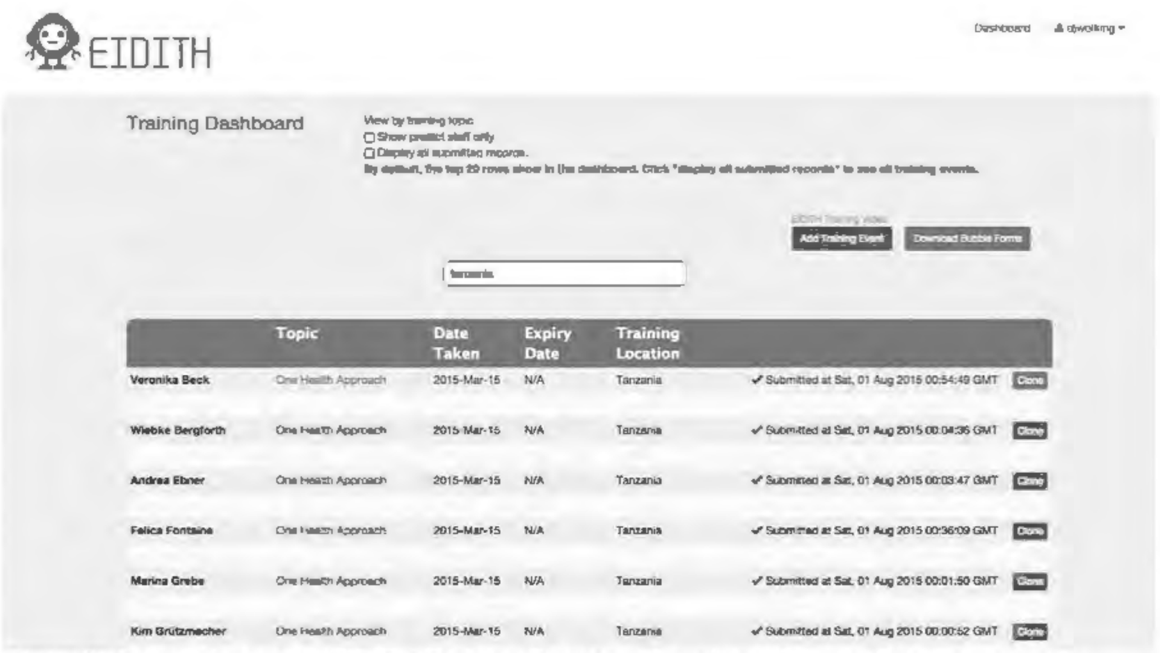
Last Name * Predict

Gender * ○ female ● male ○ unknown

PREDICT Staff? * ● yes ○ no

Student? * ○ yes ● no ○ unknown

Photo 1. Screenshot of the EIDITH Training Application now available to all PREDICT teams for the recording and submission of training event and participant data.



Training Dashboard

View by training topic
☐ Show predict staff only
☐ Display all submitted records.
By default, the top 20 rows show in the dashboard. Click "display all submitted records" to see all training events.

tanzania

	Topic	Date Taken	Expiry Date	Training Location		
Veronika Beck	One Health Approach	2015-Mar-15	N/A	Tanzania	✓ Submitted at Sat, 01 Aug 2015 00:54:49 GMT	Clone
Wiebke Bergforth	One Health Approach	2015-Mar-15	N/A	Tanzania	✓ Submitted at Sat, 01 Aug 2015 00:04:35 GMT	Clone
Andrea Ebner	One Health Approach	2015-Mar-15	N/A	Tanzania	✓ Submitted at Sat, 01 Aug 2015 00:03:47 GMT	Clone
Felica Fontaine	One Health Approach	2015-Mar-15	N/A	Tanzania	✓ Submitted at Sat, 01 Aug 2015 00:36:09 GMT	Clone
Marina Grebe	One Health Approach	2015-Mar-15	N/A	Tanzania	✓ Submitted at Sat, 01 Aug 2015 00:01:50 GMT	Clone
Kim Grützmacher	One Health Approach	2015-Mar-15	N/A	Tanzania	✓ Submitted at Sat, 01 Aug 2015 00:00:52 GMT	Clone

Photo 2. Screenshot of the EIDITH Training Dashboard enabling Country Coordinators and regional and global leads to monitor the status of trainings across the project.

Site and Event Characterization Form

EIDITH
V 1.3

Site Section

1. Site Name ______________________________

2. Country ______________________ 3. State/Province ______________________

4. District ______________________

5. Site Latitude ______________________ Site Longitude ______________________
Preferred method - decimal degress

Event Section

6. Recorder ______________________

7. Recorder's Organization
○ EcoHealth Alliance
○ Metabiota
○ Smithsonian Conservation Biology Institute
○ UC Davis
○ Wildlife Conservation Society

8. Date of Event ______________________
(eg. 2015-Apr-01)

9. Duration of Event (in days)
○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10
○ 11 ○ 12 ○ 13 ○ 14 ○ 15 ○ 16 ○ 17 ○ 18 ○ 19 ○ 20

10. Where are you sampling within the site for this event?

Latitude ______________________ Longitude ______________________
Preferred method - decimal degress

11. Which one of these 4 options best describes the human density and impact at this event site? Select one option.
○ urban
○ peri-urban
○ rural
○ low disturbance

12. What is the target animal-human disease transmission interface for this event? * Select all that apply.

○ animal production
○ crop production
○ dwellings and temporary settlements
○ extractive industry
○ market and value chain
○ natural area
○ wildlife restaurant
○ zoos and sanctuaries
○ human hospital
○ outbreak response

*** Be sure to download modules for all selected interfaces**

13. Does a veterinarian care for animals at the event/site?
○ yes
○ no

Site and Event Characterization Form

14. To the best of your knowledge, what is the estimated size of the area for this event in square meters? Select one option.

○ small <650 sq. m.
○ medium 650 - 3500 sq. m.
○ large 3500 – 7000 sq. m.
○ extra large >7000 sq. m.

15. To the best of your knowledge, what is the estimated number of humans and animals (live or dead) within 0.5 km in any direction? Select one option per row.

	none present	1-10	11-100	101-1000	>1000
humans	○	○	○	○	○
rodents/shrews	○	○	○	○	○
bats	○	○	○	○	○
non-human primates	○	○	○	○	○
birds	○	○	○	○	○
carnivores	○	○	○	○	○
ungulates	○	○	○	○	○
poultry	○	○	○	○	○
goats/sheep	○	○	○	○	○
camels	○	○	○	○	○
swine	○	○	○	○	○
cattle/buffalo	○	○	○	○	○
dogs	○	○	○	○	○
cats	○	○	○	○	○

16. Is water shared between humans and animals for...
Select one option per row.

	yes	no	unknown
drinking	○	○	○
bathing/cleaning	○	○	○

17. Are the toilets, latrines or other public facilities available for people at this site...
Select all that apply.

○ well maintained
○ not maintained
○ used
○ not used
○ none observed

18. Where do people at this site get their drinking water? Select all that apply.

○ fully unprotected: pond, uncovered well
○ rainwater harvesting, water trucking
○ fully protected: water network with taps, covered well
○ none observed

19. How long is the average trip to the drinking water sources? Select one option.

○ <5 minutes walking
○ 5-30 minutes walking
○ >30 minutes walking

20. What types of insect vectors are observed at the site?
Select all that apply.

○ mosquito
○ sand fly
○ tsetse fly
○ tick
○ none observed
○ other: ______________

21. Are vector control measures used at the site?

○ yes
○ no

Animal Production Module

EIDITH

V 1.3

Add Site and Event Form ID:

Site name and date:

____

(For reference only)

⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

1. What is the type of production system? Select one option.
   - ○ family owned
   - ○ corporate
   - ○ government

2. What is the number and density of animals <u>in production</u> at this facility? Select one option per row. If the answer in the number section is NOT "none", then write in the number for each enclosure question.

	none	1-10	11-100	101-1000	> 1000	number of enclosures	average number of animals per enclosure	average size of enclosure (square meters)	average number of freeranging or tethered animals
rodents/shrews	○	○	○	○	○	☐	☐	☐	☐
bats	○	○	○	○	○	☐	☐	☐	☐
non-human primates	○	○	○	○	○	☐	☐	☐	☐
birds	○	○	○	○	○	☐	☐	☐	☐
carnivores	○	○	○	○	○	☐	☐	☐	☐
ungulates	○	○	○	○	○	☐	☐	☐	☐
poultry	○	○	○	○	○	☐	☐	☐	☐
goats/sheep	○	○	○	○	○	☐	☐	☐	☐
camels	○	○	○	○	○	☐	☐	☐	☐
swine	○	○	○	○	○	☐	☐	☐	☐
cattle/buffalo	○	○	○	○	○	☐	☐	☐	☐
dogs	○	○	○	○	○	☐	☐	☐	☐
cats	○	○	○	○	○	☐	☐	☐	☐

Animal Production Module

3. For each taxonomic group, what is the purpose of animal production? Select all that apply for each row.

	for food	for resale of animals	for sale of animal products	for breeding	not observed
rodents/shrews	○	○	○	○	○
bats	○	○	○	○	○
non-human primates	○	○	○	○	○
birds	○	○	○	○	○
carnivores	○	○	○	○	○
ungulates	○	○	○	○	○
poultry	○	○	○	○	○
goats/sheep	○	○	○	○	○
camels	○	○	○	○	○
swine	○	○	○	○	○
cattle/buffalo	○	○	○	○	○
dogs	○	○	○	○	○
cats	○	○	○	○	○

4. Are there multiple taxa in one holding area or cage?
○ yes
○ no

5. Are wild animals and domesticated animals held together in one holding area or cage?
○ yes
○ no

6. For each taxonomic group <u>in production</u>, what is the type of containment for the enclosure/housing?
Select all that apply for each row.

	free-range (open range)	tethered grazing outdoor	fenced outdoor enclosure	outdoor cage	indoor enclosure in fully enclosed facility	not observed
rodents/shrews	○	○	○	○	○	○
bats	○	○	○	○	○	○
non-human primates	○	○	○	○	○	○
birds	○	○	○	○	○	○
carnivores	○	○	○	○	○	○
ungulates	○	○	○	○	○	○
poultry	○	○	○	○	○	○
goats/sheep	○	○	○	○	○	○
camels	○	○	○	○	○	○
swine	○	○	○	○	○	○
cattle/buffalo	○	○	○	○	○	○
dogs	○	○	○	○	○	○
cats	○	○	○	○	○	○

Animal Production Module

7. Are animals slaughtered and butchered on-site?
○ yes
○ no

8. If yes above, is there a designated area for slaughtering and butchering?
○ yes
○ no

9. What type of animal waste is present at the site/event?
Select all that apply.
○ feces
○ soiled bedding (urine and feces)
○ animal tissue and/or blood
○ none

10. What types of biosecurity measures are practiced at the facility?
Select all that apply.

○ hand washing facilities
○ showering facilities
○ footbaths
○ gloves for personnel
○ protective clothing and footwear for personnel and other visitors
○ washing and disinfecting crates or other equipment entering the facility
○ allowing only essential personnel to enter animal buildings
○ quarantine of new and/or diseased animals
○ removal and disposal of dead animals
○ no biosecurity observed

11. Are there animals living in the human dwellings?
○ yes
○ no

Crop Production Module

EIDITH

V 1.3

Add Site and Event Form ID:
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

Site name and date: ____________________

(For reference only)

1. Which crops are planted on the site? Select all that apply.

- ○ coffee/tea/cocoa plants
- ○ fruit/nut trees
- ○ oil tree plantation
- ○ oil seed crops
- ○ dry grains
- ○ sugar
- ○ vegetable/fruit crops
- ○ pulses/legume
- ○ fiber
- ○ forages
- ○ cover crops
- ○ fallow fields
- ○ rubber

2. What type of crop production system is it? Select one option.

- ○ family owned
- ○ corporate
- ○ government

3. What is the purpose of growing crops on site? Select one option for each crop that exists at the site.

	individual household	village level	large scale production	no crop
coffee/tea/cocoa plants	○	○	○	○
fruit/nut trees	○	○	○	○
oil tree plantation	○	○	○	○
oil seed crops	○	○	○	○
dry grains	○	○	○	○
vegetable/fruit crops	○	○	○	○
sugar	○	○	○	○
pulses/legume	○	○	○	○
fiber	○	○	○	○
forages	○	○	○	○
cover crops	○	○	○	○
fallow fields	○	○	○	○
rubber	○	○	○	○

4. What are the observed practices or signs of practices used for preventing crop raiding and pest damage? Select all that apply.

- ○ barriers around fields
- ○ barriers on individual trees
- ○ fire
- ○ poison
- ○ traps
- ○ shooting
- ○ loud sounds
- ○ natural predators
- ○ flooding
- ○ chasing animals out
- ○ none

5. What types of fertilizers are used on the crops? Select all that apply.

- ○ chemical fertilizer
- ○ animal manure or guano
- ○ none

6. What is the source of manure fertilizer? Select all that apply.

	composted or dried manure	fresh manure	none
poultry	○	○	○
camels	○	○	○
swine	○	○	○
cattle/buffalo	○	○	○
bat guano	○	○	○
bird guano	○	○	○

Crop Production Module

7. Are crops stored at this site after harvest?
○ yes
○ no
○ unknown

8. If yes above, what is the storage location of the harvested crops?
Select all that apply for each crop that exists at the site.

	inside dwellings	storage sacks outside	improved silo granary storage	not observed	other (fill in box)	
coffee/tea/cocoa plants	○	○	○	○	○	☐
fruit/nut trees	○	○	○	○	○	☐
oil tree plantation	○	○	○	○	○	☐
oil seed crops	○	○	○	○	○	☐
dry grains	○	○	○	○	○	☐
sugar	○	○	○	○	○	☐
vegetable/fruit crops	○	○	○	○	○	☐
pulses/legume	○	○	○	○	○	☐
fiber	○	○	○	○	○	☐
forages	○	○	○	○	○	☐
rubber	○	○	○	○	○	☐

9. Is there evidence (direct observation, signs, scat, tracks) of animals feeding on or visiting crop fields or stored crops?
Select all that apply.

	in crop fields	in stored crops	none
rodents/shrews	○	○	○
bats	○	○	○
non-human primates	○	○	○
birds	○	○	○
carnivores	○	○	○
ungulates	○	○	○
elephants	○	○	○
pangolins	○	○	○
poultry	○	○	○
goats/sheep	○	○	○
camels	○	○	○
swine	○	○	○
cattle/buffalo	○	○	○
dogs	○	○	○
cats	○	○	○

Dwellings, Buildings and Temporary Settlements Module

EIDITH
V 1.3

Add Site and Event Form ID:
Site name and date:

____
(For reference only)

⓪	①	②	③	④	⑤	⑥	⑦	⑧	⑨
⓪	①	②	③	④	⑤	⑥	⑦	⑧	⑨
⓪	①	②	③	④	⑤	⑥	⑦	⑧	⑨
⓪	①	②	③	④	⑤	⑥	⑦	⑧	⑨
⓪	①	②	③	④	⑤	⑥	⑦	⑧	⑨
⓪	①	②	③	④	⑤	⑥	⑦	⑧	⑨

1. Is this permanent or temporary human settlement? Select all that apply.
   - ○ permanent
   - ○ temporary

2. What is the type of dwelling at sampling site/event? Select all that apply.
   - ○ home
   - ○ work
   - ○ congregation sites
   - ○ schools/universities
   - ○ abandoned building

3. Which animal taxa have you observed inside the dwelling and why? Select all that apply for each row.

	not present in dwelling	unwanted animals entering structure on their own	animals near food preparation and eating areas	animals kept as pets	animals raised or kept for food	butchering of animals on site
rodents/shrews	○	○	○	○	○	○
bats	○	○	○	○	○	○
non-human primates	○	○	○	○	○	○
birds	○	○	○	○	○	○
carnivores	○	○	○	○	○	○
ungulates	○	○	○	○	○	○
poultry	○	○	○	○	○	○
goats/sheep	○	○	○	○	○	○
camels	○	○	○	○	○	○
swine	○	○	○	○	○	○
cattle/buffalo	○	○	○	○	○	○
dogs	○	○	○	○	○	○
cats	○	○	○	○	○	○
unknown taxa	○	○	○	○	○	○

4. Is there a healthcare facility that can be accessed within 1 day?
   - ○ yes
   - ○ no

5. If yes above, do they have:

	yes	no
capacity for medical treatment?	○	○
capacity for preventive services?	○	○
a posted ebola or other disease outbreak preparedness plan?	○	○
capacity for pharmacy services?	○	○

78145-50388

Extractive Industry Site Module

EIDITH
V 1.4

Add Site and Event Form ID:

Site name and date:

____

(For reference only)

⓪	①	②	③	④	⑤	⑥	⑦	⑧	⑨
⓪	①	②	③	④	⑤	⑥	⑦	⑧	⑨
⓪	①	②	③	④	⑤	⑥	⑦	⑧	⑨
⓪	①	②	③	④	⑤	⑥	⑦	⑧	⑨
⓪	①	②	③	④	⑤	⑥	⑦	⑧	⑨
⓪	①	②	③	④	⑤	⑥	⑦	⑧	⑨

1. Is this an existing or planned extractive industry site? Select one option per row.

	none	existing	planned
coal	○	○	○
coltan	○	○	○
diamond or other gemstone	○	○	○
tin	○	○	○
gold/silver	○	○	○
lead	○	○	○
oil/gas	○	○	○
timber/plant	○	○	○
other: ______________	○	○	○

2. For each extractive industry at the site, what was the state of land before conversion? Select all that apply.

	undisturbed habitat	protected area	savannah or grassland	agricultural fields	unknown	other: ______________
coal	○	○	○	○	○	○ ☐
coltan	○	○	○	○	○	○ ☐
diamond or other gemstone	○	○	○	○	○	○ ☐
tin	○	○	○	○	○	○ ☐
gold/silver	○	○	○	○	○	○ ☐
lead	○	○	○	○	○	○ ☐
oil/gas	○	○	○	○	○	○ ☐
timber/plant	○	○	○	○	○	○ ☐
other: ______________	○	○	○	○	○	○ ☐

3. Which of the following are used to move the resource (e.g., timber, ore, oil) and/or staff to and from the facility? Select all that apply.
   - ○ road
   - ○ rail
   - ○ airstrip
   - ○ port
   - ○ river
   - ○ helipad
   - ○ none

4. Are roads being built at the site? ○ yes ○ no

5. Is there a place where meals are provided or food is sold? ○ yes ○ no

6. Is there an on-site healthcare facility available to workers? ○ yes ○ no

7. If yes, do they have:

	yes	no
capacity for medical treatment?	○	○
capacity for preventive services?	○	○
a posted ebola or other disease outbreak preparedness plan?	○	○
capacity for pharmacy services?	○	○

Market and Value Chain Module

EIDITH
V 1.2

Add Site and Event Form ID:

Site name and date:

____

(For reference only)

⓪	①	②	③	④	⑤	⑥	⑦	⑧	⑨
⓪	①	②	③	④	⑤	⑥	⑦	⑧	⑨
⓪	①	②	③	④	⑤	⑥	⑦	⑧	⑨
⓪	①	②	③	④	⑤	⑥	⑦	⑧	⑨
⓪	①	②	③	④	⑤	⑥	⑦	⑧	⑨
⓪	①	②	③	④	⑤	⑥	⑦	⑧	⑨

1. What is the node along value chain? Select one option.
   - ○ source of animals (area of capture or farm)
   - ○ animals in transit
   - ○ distributer/middle man
   - ○ point of sale

2. How many vendors or workers are at the site/event? Select one option.
   - ○ only 1 person
   - ○ <5 people
   - ○ 5-20 people
   - ○ 21-100 people
   - ○ >100 people

3. Which animals are for sale in the market or value chain at this site/event? Select all that apply for each row.

	live	dead	parts	slaughtered at site	none observed
rodents/shrews	○	○	○	○	○
bats	○	○	○	○	○
non-human primates	○	○	○	○	○
birds	○	○	○	○	○
carnivores	○	○	○	○	○
ungulates	○	○	○	○	○
poultry	○	○	○	○	○
goats/sheep	○	○	○	○	○
camels	○	○	○	○	○
swine	○	○	○	○	○
cattle/buffalo	○	○	○	○	○
dogs	○	○	○	○	○
cats	○	○	○	○	○

4. What is the maximum number of taxonomic groups in one holding area or cage? Select one option.
   - ○ 1
   - ○ 2-5
   - ○ 6-10
   - ○ >10

5. Are wild animals and domesticated animals held together in one holding area or cage?
   - ○ yes
   - ○ no

6. What types of biosecurity measures are practiced at the facility? Select all that apply.
   - ○ hand washing facilities
   - ○ gloves for personnel handling animals or raw animal products
   - ○ protective clothing and footwear for personnel performing butchering and slaughtering
   - ○ washing and disinfecting animal crates and equipment in contact with animals or animal products
   - ○ removal of sick or dead animals from live animal settings
   - ○ no biosecurity observed

7. What type of animal waste is present at the site/event? Select all that apply.
   - ○ feces
   - ○ soiled bedding (urine and feces)
   - ○ animal tissue and/or blood
   - ○ none

Natural Areas Module

EIDITH

V 1.2

Add Site and Event Form ID:

Site name and date:

____

(For reference only)

⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

1. Is this a protected area?
   - ○ yes
   - ○ no

2. If yes above, what is the approximate size of protected area in square kilometers? ____________________

3. If yes above, what is the name of protected area? ____________________________________

4. What is the type of setting? Select all that apply.
   - ○ forest
   - ○ grassland
   - ○ riparian/river/stream/lake
   - ○ wetland
   - ○ estuary
   - ○ cave
   - ○ desert/arid
   - ○ urban park/garden

5. What are the human impacts in the natural area? Select all that apply.
   - ○ hunting
   - ○ tourism/recreational
   - ○ land clearing for logging
   - ○ land clearing for infrastructure development (including road building, dams)
   - ○ land clearing for other extractive industry (eg mining, oil and gas, precious metals)
   - ○ land clearing for domesticated animal production
   - ○ land clearing for crop production
   - ○ temporary human settlement
   - ○ permanent human settlement
   - ○ displaced people due to nearby conflict
   - ○ small scale harvest of food, firewood, medicine, etc for personal/home use
   - ○ no apparent human impact

Wildlife Restaurant Module

EIDITH
V 1.2

Add Site and Event Form ID:

Site name and date:

____

(For reference only)

⓪	①	②	③	④	⑤	⑥	⑦	⑧	⑨
⓪	①	②	③	④	⑤	⑥	⑦	⑧	⑨
⓪	①	②	③	④	⑤	⑥	⑦	⑧	⑨
⓪	①	②	③	④	⑤	⑥	⑦	⑧	⑨
⓪	①	②	③	④	⑤	⑥	⑦	⑧	⑨
⓪	①	②	③	④	⑤	⑥	⑦	⑧	⑨

1. How would you best describe this restaurant? Select one option.
   - ○ permanent structure
   - ○ mobile/semi-permanent structure

2. How many chairs are there at the restaurant (inside and outside)? _______________

3. Which taxonomic groups are sold at this restaurant and for what purpose? Select all that apply for each row.

	offered for consumption	held live	sold live	products sold	slaughtered	none observed
rodents/shrews	○	○	○	○	○	○
bats	○	○	○	○	○	○
non-human primates	○	○	○	○	○	○
birds	○	○	○	○	○	○
carnivores	○	○	○	○	○	○
ungulates	○	○	○	○	○	○

4. What type of animal waste is present at the site/event? Select all that apply.
   - ○ feces
   - ○ soiled bedding (urine and feces)
   - ○ animal tissue and/or blood
   - ○ none

5. Is there a designated area for slaughtering and/or butchering animals? Select one option.
   - ○ yes, separate from dining area
   - ○ yes, same as dining area
   - ○ no

6. What types of biosecurity measures are practiced at the facility? Select all that apply.
   - ○ hand washing facilities
   - ○ gloves for personnel handling animals or raw animal products
   - ○ protective clothing and footwear for personnel performing butchering and slaughtering
   - ○ washing and disinfecting animal crates and equipment in contact with animals or animal products
   - ○ removal of sick or dead animals from live animal settings
   - ○ no biosecurity observed

67047-500771

Zoos and Sanctuaries Module

EIDITH
V 1.3

Add Site and Event Form ID:
Site name and date:

____

(For reference only)

⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

1. What is the purpose of holding the animals? Select all that apply.
   - ○ public viewing or education
   - ○ rehabilitation (for release)
   - ○ sanctuary

2. How many visitors are observed during this event? Select one option.
   - ○ none (local staff only)
   - ○ 1-10
   - ○ 11-100
   - ○ 101-1000
   - ○ >1000

3. What is the origin of these visitors? Select all that apply.
   - ○ local visitors
   - ○ regional visitors
   - ○ foreign visitors

4. What is the number and density of held animals at this facility? Select one option per row. If the answer is NOT "none", then write in the number for each enclosure question.

	none	1-10	11-100	101-1000	> 1000	number of enclosures	average number of animals per enclosure	average size of enclosure (square meters)	average number of freeranging or tethered animals
rodents/shrews	○	○	○	○	○	☐	☐	☐	☐
bats	○	○	○	○	○	☐	☐	☐	☐
non-human primates	○	○	○	○	○	☐	☐	☐	☐
birds	○	○	○	○	○	☐	☐	☐	☐
carnivores	○	○	○	○	○	☐	☐	☐	☐
ungulates	○	○	○	○	○	☐	☐	☐	☐
poultry	○	○	○	○	○	☐	☐	☐	☐
goats/sheep	○	○	○	○	○	☐	☐	☐	☐
camels	○	○	○	○	○	☐	☐	☐	☐
swine	○	○	○	○	○	☐	☐	☐	☐
cattle/buffalo	○	○	○	○	○	☐	☐	☐	☐
dogs	○	○	○	○	○	☐	☐	☐	☐
cats	○	○	○	○	○	☐	☐	☐	☐

Zoos and Sanctuaries Module

5. Are there multiple taxonomic groups in one holding area or cage?
   ○ yes
   ○ no

6. Are wild animals and domesticated animals held together in one holding area or cage?
   ○ yes
   ○ no

7. What type of animal waste is present at the site/event? Select all that apply.
   ○ feces
   ○ soiled bedding (urine and feces)
   ○ animal tissue and/or blood
   ○ none

8. What types of biosecurity measures are practiced at the facility? Select all that apply.

   ○ hand washing facilities
   ○ showering facilities
   ○ footbaths
   ○ gloves for personnel
   ○ protective clothing and footwear for personnel and other visitors
   ○ washing and disinfecting crates or other equipment entering the facility
   ○ allowing only essential personnel to enter animal buildings
   ○ quarantine of new and/or diseased animals
   ○ removal and disposal of dead animals
   ○ no biosecurity observed

Animal Data EIDITH

V 1.2

Add Site and Event Form ID:

Site name and date:

____

(For reference only)

⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

1. Animal ID ______________________

2. Recapture? ○ yes ○ no

If different than event include...

3. Sample date: ______________________ (eg. 2015-Apr-01)

4. Recorder: ______________________

5. Sample location: Latitude: ____________ Longitude: ____________

Preferred method - decimal degress

6. Taxa Group - Select one option.

- ○ rodents/shrews
- ○ bats
- ○ non-human primates
- ○ birds
- ○ carnivores
- ○ ungulates
- ○ pangolins
- ○ poultry
- ○ goats/sheep
- ○ camels
- ○ swine
- ○ cattle/buffalo
- ○ dogs
- ○ cats

7. Tag/and/Other ID: ______________________

8. Species Scientific Name ______________________

9. Species English Name ______________________

10. Species Local Name ______________________

11. Animal Classification - Select one option.

- ○ captive wild animal
- ○ free-ranging wild animal
- ○ owned domesticated species
- ○ unowned domesticated species

12. What is the level of certainty of species identification? Select one option.

- ○ actual
- ○ estimate
- ○ unknown

13. Age Class
Select one option.

- ○ fetus
- ○ neonate
- ○ subadult
- ○ adult
- ○ unknown

14. Condition
Select one option.

- ○ alive
- ○ alive (non-invasive sample collection)
- ○ dead (fresh carcass)
- ○ dead (>48 hours)

15. Sex
Select one option.

- ○ male
- ○ female
- ○ unknown

16. Was a necropsy or exam conducted?

	yes	no
necropsy	○	○
physical exam	○	○

17. If answered yes to necropsy, what is observed?

____

____

____

18. Estimate health status at sampling. Select one option.

- ○ apparently healthy
- ○ sick
- ○ injured
- ○ unknown

19. Preservation Method (only if dead) - Select all that apply.

- ○ cooked
- ○ dried
- ○ fermented
- ○ frozen
- ○ powdered
- ○ preserved in liquid
- ○ salted
- ○ smoked
- ○ not preserved

Animal Data

20. Specify clinical signs if found sick or injured. Select all that apply.

○ abscesses
○ abdominal mass
○ amputated body parts
○ broken bones
○ contusions
○ dermatitis
○ diarrhea
○ emaciated
○ external parasites
○ hair loss
○ in shock
○ lacerations
○ lethargic
○ nasal discharge
○ non-responsive
○ paralysis
○ respiratory symptoms
○ skin lesions
○ skin mass
○ swelling
○ other: __________

21. Select the animal to human interfaces that best describe the animal's contact with people in this setting. Select all that apply.

○ hunted
○ for sale in restaurant
○ for sale in small market (< 5 vendors)
○ for sale in medium market (5-20 vendors)
○ for sale in large market (> 20 vendors)
○ private sale
○ raiding markets
○ raiding crops
○ preying on livestock or their food
○ public safety hazard (e.g. threat to humans)
○ in human dwelling
○ at abattoir/slaughterhouse
○ at temporary holding facility in value chain
○ in transit along the value chain
○ private wildlife collection or pet
○ zoo
○ wild animal farm
○ guano or manure farm
○ sanctuary
○ rehabilitation center
○ within 10m of tourists/ ecotourism
○ within 10m of park personnel in intensive wildlife management area
○ within 10m of researchers (other than PREDICT staff)
○ within 10m of workers in extractive industry
○ within 10m of workers harvesting crops
○ contact with domestic animals or humans NOT likely
○ other __________________

22. If this animal or animal product is being produced or sold, what is the intended use of the animal product? Select all that apply.(Associated with animal production, wildlife restaurant or market and value chain modules)

○ food
○ medicine
○ pet
○ research
○ souvenir/trophy
○ spiritual
○ zoo/education
○ unknown
○ other: ________________

Specimen Data EIDITH

V 1.2

Add Animal Data Form ID:
Site name and date:

____
(For reference only)

⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

1. Specimen ID: ______________________________

2. Animal ID: ______________________________
(For your records)

3. Specimen Type - Select one option.

internal fluids
- ○ bile
- ○ cerebrospinal fluid
- ○ milk
- ○ pericardial fluid
- ○ peritoneal fluid
- ○ pleural fluid
- ○ stomach content
- ○ urine

posterior
- ○ cloacal swab
- ○ feces
- ○ guano
- ○ rectal swab
- ○ prepucial swab
- ○ urine/urogenital swab
- ○ vaginal swab
- ○ for future use do not use

anterior
- ○ choanal swab
- ○ nasal swab
- ○ nasopharyngeal swab
- ○ ocular swab
- ○ oral swab
- ○ saliva
- ○ sputum

tissue
- ○ tissue

blood products
- ○ blood clot
- ○ blood (whole)
- ○ buffy coat
- ○ plasma
- ○ red blood cells
- ○ serum

environmental sample
- ○ environmental sample

other specimen type
- ○ other ______________

4. If "tissue", select the type.

- ○ adrenal
- ○ cecum
- ○ colon
- ○ duodenum
- ○ heart
- ○ kidney
- ○ liver
- ○ lung
- ○ muscle
- ○ ovary
- ○ pancreas
- ○ spleen
- ○ testes
- ○ lymph node: ______________
- ○ other: ______________

5. Specimen Medium
- ○ 10% buffered formalin
- ○ lysis buffer
- ○ RNA later
- ○ trizol
- ○ viral transport media (VTM)
- ○ no medium

6. Specimen Container
- ○ cryotube
- ○ glass jar
- ○ plastic container
- ○ whirl pack
- ○ other: ______________

7. Specimen Storage Method
- ○ ultra low freezer (-80c)
- ○ freezer (-20c to -40c)
- ○ liquid nitrogen
- ○ room temperature
- ○ other: ______________

8. Storage facility ____

9. Storage location within facility ______________________________________

77969-105134

PREDICT Training Event Form

EIDITH
v1_2

Date * ______________________

* Required Field

Participant Information

First Name* ______________________ Last Name * ______________________

Gender * ○ Female ○ Male ○ Unknown

PREDICT * Staff? ○ Yes ○ No

Student? * ○ Yes ○ No ○ Unknown

Organization *	Organization Name
○ NGO	______________________
○ Government ministry	______________________
○ Government lab	______________________
○ Research Institute	______________________
○ University	______________________
○ Other: ______________	______________________

Training Information

Workforce development training?*
Was training part of "on the job" training, continuing education, or other type of training to enhance capacity to conduct current work? ○ Yes ○ No ○ Unknown

Refresher Training?* ○ Yes ○ No ○ Unknown

Trainer First Name * ______________________ Last Name * ______________________

Training Topic*
What was the topic of the training session? Select all that apply.

General Training Topics

- ○ Behavioral Surveillance & Qualitative Research Methods
- ○ Biosafety and PPE
- ○ Cold Chain
- ○ Emergency Preparedness & Response
- ○ GIS & Spatial Analysis
- ○ Information Management
- ○ Modeling & Analytics
- ○ One Health Approach
- ○ Outbreak Response
- ○ Packing & Shipping Biological Samples
- ○ Safe Sample Transport & Storage
- ○ Other: ____________

Field Training Topics

- ○ Avian Sampling
- ○ Bat Sampling
- ○ Bushmeat Sampling
- ○ Camel Sampling
- ○ Human Biological Sampling
- ○ Livestock Sampling
- ○ Non-Human Primate Sampling
- ○ Rodent Sampling
- ○ Safe Animal Capturing
- ○ Small Carnivore Sampling
- ○ Other: ____________
- ○ Do not use For future use

Lab Training Topics

- ○ Lab Protocols & Diagnostics
- ○ Lab Safety
- ○ Other: ____________

PREDICT Training Event Form

Location of Training *

○ Bangladesh
○ Burma/Myanmar
○ Cambodia
○ Cameroon
○ China
○ Cote d'Ivoire
○ DR Congo
○ Egypt
○ Ethiopia
○ Gabon

○ Ghana
○ Guinea
○ Jordan
○ Kenya
○ India
○ Indonesia
○ Laos PDR
○ Liberia
○ Malaysia
○ Mongolia

○ Senegal
○ Sierra Leone
○ South Sudan
○ Republic of Congo
○ Rwanda
○ Tanzania
○ Thailand
○ Uganda
○ United States
○ Vietnam

Training duration? *
○ <4 hours
○ 1/2 a day
○ 1 day
○ >1 day (include number of days)________
○ Unknown

Training completed? *
○ Yes
○ No

Training certified?

Did participant receive a training certificate?
○ Yes
○ No
○ Unknown

General notes or feedback on the training session

6.3. BEHAVIORAL RISK – NEW OBSERVATIONAL AND QUALITATIVE RESEARCH PROTOCOL, TOOLS AND TRAINING MATERIALS

PREDICT uses a multidisciplinary approach to identify groups of populations at highest risk of exposure to emerging pathogens, and the ‘how’ and the ‘why’ of risk. Our teams assess community perceptions of animal exposure and disease risk and evaluate widely-held assumptions of community practices (e.g., high risks from bushmeat hunting). PREDICT is identifying and monitoring the risk factors for zoonotic diseases with pandemic threat potential. Our methods will lead to well-rounded understanding of disease spillover and transmission dynamics, essential to the design and evaluation of mitigating interventions, and to informing policy by identifying barriers to change and acceptable alternatives.

This year, PREDICT developed and standardized observational and qualitative research methods for behavioral risk activities and began training and implementation of these methods in multiple countries (for details and achievements see Section 1, Objective 3). Products developed and in use include the “PREDICT-2 Qualitative Research for Behavioral Risk Surveillance and Characterization” protocol, the ethnographic interview and focus group guides, and a protocol for observational research. The full suite of training materials for PREDICT’s behavioral risk activities will be available in the PREDICT e-Book in Year 2.

1) PREDICT 2: Qualitative Research for Behavioral Risk Surveillance and Characterization

Protocol date: May 4, 2015

2) Authors: UC Davis Researchers & Researchers from other institutions

3) IRB Review History

This protocol, which we are submitting for expedited approval, has not been submitted for IRB review by any other institutions or at any other time. A brief protocol expressly focused on pilot testing behavioral data collection instruments was submitted to Western Institutional Review Board for exemption by PREDICT partner Metabiota, and was approved on April 6, 2015.

PREDICT is a collaborative disease surveillance and capacity strengthening program funded through the USAID Emerging Pandemic Threats (EPT) program and the geographic scope of program activities, including those involving human subjects is dynamic and subject to change. Currently PREDICT is active in 17 countries in Africa and South and Southeast Asia: Bangladesh, Cambodia, Cameroon, China, Democratic Republic of Congo (DRC), Gabon, Indonesia, Lao PDR, Malaysia, Myanmar, Nepal, Republic of Congo (RoC), Rwanda, Tanzania, Thailand, Uganda, and Vietnam. PREDICT activities will commence in additional 14 countries (Cote d'Ivoire, Egypt, Ethiopia, Ghana, Guinea, India, Jordan, Kenya, Liberia, Mongolia, Philippines, Senegal, Sierra Leone, and South Sudan) between May and September 2015. *Additional description of the study sites in the countries currently participating in the PREDICT project is included under #23 "Setting" below.*

PREDICT will seek approval for research activities under this study from all participating countries through Institutional Review Boards, ethical clearance councils/committees, and national research administrations following local regulatory guidelines as appropriate.

4) Objectives

Nearly 75 percent of all new, emerging, or re-emerging diseases affecting humans at the beginning of the 21st century are zoonotic (i.e. originated in animals). Notable examples of the global impact of new emergent diseases include HIV/AIDS, severe acute respiratory syndrome (SARS), and most recently Ebola. The speed with which these diseases can emerge and spread represents serious public health, economic, and development concerns. The vast majority of these diseases originated in "hot spot" areas such as central Africa, and South and Southeast Asia where multiple and complex factors contribute to zoonotic disease spillover into human populations.

The EPT program works in developing countries to prevent, detect, and control infectious diseases in animals and people with an emphasis on early identification of, and response to, dangerous pathogens from animals before they become significant threats to human health. The PREDICT project, as part of the EPT program, has two specific goals in support of this work:

1. To identify populations and settings where there is a high risk of zoonotic disease spillover from animals to humans.

2. To develop policies and intervention strategies, which reduce the risk of zoonotic spillover.

The PREDICT project has identified three key 'pathways' of risk. Based on previous research and experience, the 'pathways' have been developed to identify the settings where humans, wildlife, and livestock or domestic animals are most likely to come into contact with each other in a way that increases the risk of zoonotic disease spillover from animals to humans.

1. **Land Conversion for commercialization.** Rapidly changing landscapes that bring humans and animals in closer contact than was previously experienced (e.g. palm oil plantations, mining, logging, crops).

2. **Intensification of Animal Production Systems.** To feed growing global populations there have been major increases in the number of livestock (e.g. chickens, cows, goats) being raised using industrial methods. Frequent direct human- livestock contact occurs, often intermingling with wildlife species, in settings that vary in sanitation.

3. **Animal Value Chains.** Wildlife and domestic animals from remote naturally biodiverse regions are brought to densely populated urban markets that actively trade in varied animal species and products.

A key aim of PREDICT is to better understand the human behaviors and practices that may increase the risk of zoonotic disease spillover, as well as the social, environmental and economic factors that underlie human behaviors and practices. PREDICT is also working to identify potential policy approaches and interventions that could mitigate zoonotic disease transmission risk posed by human-animal interactions in targeted communities. As the first step in this process, qualitative research methods will be used to help identify and understand behaviors associated with zoonotic disease transmission risk. These proposed methods will also help in understanding any alternative futures imagined by people in targeted communities, along with the activities required to achieve those futures to better inform the development of effective policy and intervention strategies.

Human behaviors and practices are key risk components for pathogen spillover, amplification, and spread. We will characterize the type and frequency of contact among people, domestic animals, and potential wildlife reservoirs and investigate the correlation of specific human behaviors and zoonotic disease risk across sites to more deeply understand the behavioral mechanisms involved in the high-risk pathways. Through qualitative research methods, we will identify and monitor behaviors, attitudes, practices, and socio-cultural norms and conditions that facilitate animal-human and animal-animal contact and any alternative futures of individuals in our target communities that might inform potential policy and intervention strategies. We plan to integrate data from behavioral risk characterization, and economic and anthropologic studies using advanced informational technologies and a dynamic analytical framework to identify potential targets for intervention and informed policy development.

Our guiding hypothesis is that risks for disease transmission and spread differ according to behavioral factors. In addition to understanding the contributions of ethnicity/cultural group, occupation, age, gender, our intent is to understand people's behaviors related to contact with wild and domesticated animals and the factors motivating those behaviors, such as occupational exposure in markets or extractive industry zones, or hunting, preparation, consumption and other exposures to wild and domestic animal meat, in order to develop an evidence base for identifying appropriate interventions and messages to decrease exposure to emerging infections.

We will conduct investigations using standardized qualitative research methods in each participating country, including observation, in-depth structured interviews, and focus groups that include a participatory risk mapping exercise. To the extent feasible, data sets collected will include:

- Data on human movements (i.e. home, work, travel, and observed environment), behaviors, and practices and the ecological conditions governing these aspects of human ecology
- Data on socioeconomics (i.e. daily routine, animal responsibilities, education, and economics)
- Data on biosecurity in human environments (i.e. water and food, sanitation, and hygiene)
- Data on illness, medical care/treatment and death of humans (i.e. household illness, illness from animals, medical care/treatment, and death)
- Data on human-animal contact (i.e. indirect contact, direct contact, animal products/rituals, animal health, and perceptions/knowledge)
- Analyses of key characteristics of human behaviors and practices
- Qualitative investigation into risky exposure practices associated with the key pathways of risk (referenced above).

5) Background

Over the past decade, attempts to control deadly viruses like SARS

Coronavirus, Middle Eastern Respiratory Syndrome (MERS), and Influenza have been, out of necessity, almost entirely reactionary. Due in large part to USAID's Pandemic Influenza and Other Emerging Threats Program, the world is poised to move beyond that costly approach, which measures impact in death tolls and money spent on diagnosis, treatment and containment. The time is right for a more proactive paradigm that allows for use of knowledge of what diseases might be emerging and the development of interventions to prevent or at least control the pathogens at their source.

The premise of One Health is that people, animals and the environment form an interdependent ecosystem that needs to be considered in a coordinated manner (FAO et al., 2008; Frank, 2008). It rests on a conceptually simple model that focuses on contact and therefore the potential for transmission of disease between wild and domestic animals and humans (usually depicted as three overlapping circles) in the context of the environment. This model has worked well as an advocacy tool to present the case for coordination in detecting and responding to outbreaks. It has also fostered discussions on the factors that are contributing to spillover of diseases from animals to humans, the first step in an outbreak.

PREDICT 2 is a consortium consisting of teams from the University of California, Davis (UCD), EcoHealth Alliance (EHA), Metabiota (MB), the Smithsonian Institute (SI), and the Wildlife Consortium Society (WCS) using a One Health approach to strengthen capacity and improve zoonotic disease prevention, detection, and response. From 2009-2014, the Consortium developed and stewarded the first PREDICT project in Africa, Asia and SE Asia, and Latin America. Working closely with at least 59 government ministries and dozens of scientific institutions, local organizations, and other stakeholders, the Consortium significantly advanced One Health capacity and infrastructure in these countries. By developing robust mechanisms for overcoming geographic and disciplinary constraints to public health protection, the Consortium established multidisciplinary collaborations and established systems for data sharing and interpretations across Ministries. High-risk human-wildlife interfaces were selected for investigation as targets of opportunity for viral spillover from wildlife hosts to humans and their food animals. Human and animal samples were screened for viral families suspected to be sources for new pathogens impacting people, using novel high-efficiency, high-volume molecular (consensus PCR) techniques that have been readily deployable (technically and financially) in developing countries. In the first five years, the PREDICT Consortium detected a total of 984 unique viruses (815 novel viruses and 169 known viruses) in wild animals and humans, and worked to combine these discoveries with data on rates and types of human-wildlife contact to assess risk and inform mitigation strategies.

Building on these achievements, the Consortium is now incorporating a focus on human behaviors that may amplify risks for disease transmission and spread between animals and people through qualitative research, targeting places where environment and market systems are changing in ways that are conducive to the viral spillover from animals to people. Working on the ground with our local teams, which include health professionals, scientists, educators, and ministry officials, PREDICT will conduct qualitative research to identify areas and behaviors posing the highest risk for exposure to disease, and provide information needed to efficiently design and target intervention strategies at human behaviors that facilitate disease emergence and amplification.

There is very limited data as to the exact mechanisms of spillover transmission from animals to humans. A primary goal of the human behavioral research is to develop a better understanding of which human behaviors and practices are the transmission mechanisms, and under what circumstances these behaviors facilitate spillover.

6) Inclusion and Exclusion Criteria

The study will include adults and children (defined as 10 to 17 years old) living or working in the study sites selected by PREDICT as priority surveillance sites with high risk for viral spillover, evolution, amplification, and spread (i.e., 'hotspots'). PREDICT study sites are prioritized by identifying areas considered high-risk for contact with taxonomic groups known to be associated with zoonotic viral diversity and with ecological and epidemiological conditions associated with disease emergence.

Inclusion criteria: Residents of targeted communities (potential hot spots.

Ethnographic interviews
Only people who are willing to be recorded can participate in interviews in this study. In order to participate in a targeted ethnographic interview, an individual must have contact with live animals. Direct contact includes raising, hunting, selling, trading or purchasing live animals. Indirect animal contact includes animals living in or entering dwellings, buildings or gardens/crops (e.g., bat roosts along roofs, rats or other animals invading stored food or crops).

The interviewer will work with the Country Coordinator or Field Coordinator, as well as local contacts, for introductions to individuals who are eligible and interested in being interviewed.

Approximately 35-40% of participants will be women. Efforts will be made to include a large variety of people, including those of different religions or ethnicities, younger people and older people, and people who have more power or influence (e.g., farm owners), as well as those with less (e.g. market cleaners). It is anticipated that no more than 10% of interviews will be with children less than 18 years of age (but no younger than 10). Children <18 years of age will only be allowed to participate if one parent is present to provide consent and the child provides assent for participation.

Focus groups
Only adults will be recruited for participation in focus groups. In order to participate in a targeted focus group, an individual must have contact with live animals. Direct contact includes raising, hunting, selling, trading or purchasing live animals. Indirect animal contact includes animals living in or entering dwellings, buildings or gardens/crops (e.g., bat roosts along roofs, rats or other animals invading stored food or crops). The moderator will work with the Country Coordinator or Field Coordinator, as well as local contacts, for introductions to individuals who are eligible and interested in participating in a focus group.

One focus group per country will consist of only women. Efforts will be made to include a large variety of people, including those of different religions or ethnicities, younger people and older people, and people who have more power or influence (e.g. farm owners), as well as those with less (e.g. market cleaners).

Exclusion criteria: Refusal to provide informed consent (both interviews and focus groups) and refusal to be recorded (interviews only).

The study will only be conducted after obtaining ethical approval/exemption from local institutional review boards. This study does not include invasive or medical procedures, or medical devices of any kind. Participation in the study will be strictly voluntary. Participants will be given an information sheet prior to being asked to participate in this study.

7) Number of Subjects

The study will target sites planned for inclusion in the PREDICT 2 surveillance program. This is a multi-site study, and we expect to enroll and conduct ethnographic interviews with a maximum of 100 participants per country (3,100 total); approximately 7-10 individuals per site, with children making up no more than 10% of individuals interviewed at each site. All interviews will be conducted by a team trained and supervised by our PREDICT partners at local implementing institutions.

We expect to enroll and conduct focus groups with a maximum of 50 participants per country (1,550 total); approximately 6-10 individuals per site. No children will be recruited for focus group participation. All focus groups will be conducted by a team trained and supervised by our PREDICT partners at local implementing institutions.

8) Recruitment Methods

No advertising materials, printed or broadcasted, will be used to recruit subjects. Research procedures in the current study will not include accessing personal health information.

Ethnographic interviews

In order to participate in a targeted ethnographic interview, an individual must have contact with live animals. Direct contact includes raising, hunting, selling, trading or purchasing live animals. Indirect animal contact includes animals living in or entering dwellings, buildings or gardens/crops (e.g. bat roosts along roofs, rats or other animals invading stored food or crops).

The interviewer will work with the Country Coordinator or Field Coordinator, as well as local contacts, for introductions to individuals who are eligible and interested in being interviewed. Approximately 35-40% of participants will be women. Efforts will be made to include a large variety of people, including those of different religions or ethnicities, younger people and older people, and people who have more power or influence (e.g. farm owners), as well as those with less (e.g. market cleaners).

Focus groups

In order to participate in a targeted focus group, an individual must have contact with live animals. Direct contact includes raising, hunting, selling, trading or purchasing live animals. Indirect animal contact includes animals living in or entering dwellings, buildings or gardens/crops (e.g. bat roosts along roofs, rats or other animals invading stored food or crops).

The moderator will work with the Country Coordinator or Field Coordinator, as well as local contacts, for introductions to individuals who are eligible and interested in participating in a focus group.

One focus group per country will consist of only women. In some cultures, women may not be comfortable speaking in front of elders or rich people, while in others, women may not be comfortable speaking in front of men of any age. It is important to understand gender perspectives, since several zoonotic infections have been found to be more common in women (e.g., HIV).

Efforts will be made to include a large variety of people, including those of different religions or ethnicities, younger people and older people, and people who have more power or influence (e.g. farm owners), as well as those with less (e.g. market cleaners).

Research subjects will be recruited for participation in the study by a local researcher from a PREDICT 2 implementing institution. The study will recruit adults and children aged 10 or older either living at the site or working or visiting the site by asking individuals if they would like to participate. The study is completely voluntary.

To ensure compliance with informed consent procedures, all potential participants and parents of potential minor participants will be given an information sheet prior to being asked to participate in the study. The participant will review the information sheet with the research staff and will be given time to ask questions. Children aged 10 or older will only be allowed to participate if one parent is present to provide consent and the child provides assent for participation. When reviewing the information sheet, study staff will explain details of the study including why they were selected, potential risks to their participation, how their participation is beneficial, that their participation is completely voluntary, and that they can withdraw their participation at any time.

9) Compensation to the Subjects

Interviews/ Focus Groups
In each country, the Country Coordinator or Field Coordinator will identify an item as a token of appreciation to give to each study participant. This item will be appropriate for the context of the country, the study population, and equivalent to no more than $10 USD. The token of appreciation will be given at the end of the interview or focus group.

10) Study Timelines

The study is supported by a USAID $100 million five-year cooperative agreement with the UC Davis One Health Institute. PREDICT 2 and this component project is budgeted and planned for five years (end date of September 30, 2019). However, after five years, USAID may extend the program for an additional five years. We anticipate that it will take the entire 5 years for anticipated enrollment in all PREDICT2 countries and for completion of the study.

11) Study Endpoints

The primary endpoint for this study is the characterization of behavioral risk factors associated with disease transmission. Secondary endpoints are the reporting of findings to partners in all implementing countries, to build awareness of zoonotic disease transmission risk and potential prevention and control options.

We anticipate that it will take the entire 5 years for anticipated enrollment in all PREDICT 2 countries and for completion of the study.

12) Procedures Involved

UCD and US-based researchers from the PREDICT Consortium have designed the study, developed all training materials, and will support implementing teams in each participating country through training in all procedures and methods, in the supervision of study implementation, in data management and analyses, and in the development of any subsequent publications from study findings and outreach materials. UCD and US-based researchers will not directly interact with research subjects as the study is designed for implementation by local in-country research teams and will be conducted in the local languages of each targeted site.

Training of research team

All study staff involved in the implementation of this research will be trained to have a clear understanding of the study objectives, the study instruments, their roles in the study, and the need for good quality data. PREDICT team members will train study staff. Individuals from the PREDICT team who are trained (either by CITI or through University of California Davis) will train local research teams in the conduct of ethical research. During local trainings, we will include individuals who have experience in qualitative research studies and with targeted communities. Records will be maintained of all trained local research personnel and unless a researcher has participated in the full training, they will not be allowed to work in this study.

Training will include an overview of the project and project goals, research ethics, and informed consent guidelines and implementation practices, introduction to ethnographic interviewing with a deep focus on the interview guide, introduction to conducting focus groups with attention to the participatory risk mapping exercise and guiding discussion and practice interviews/focus groups. Coding and preliminary data analysis methods will also be taught. Other topics to be covered include: non-verbal communication, probing for additional information, the voluntary nature of the study, sexual harassment, and confidentiality in data collection. Skills such as how to communicate appropriately with villagers and key informants will also be taught and practiced. Training will emphasize pairing interviewers with participants by sex along with measures to assure the respect, dignity and freedom of each participant. Criteria will be developed for the selection of study staff to ensure that data are collected by competent, empathetic, and trainable individuals.

Enrollment, consent, and confidentiality procedures

Each participant will review the information sheet with the research staff and will be given time to ask questions. When reviewing the information sheet, study staff will explain details of the study including: why they were selected, potential risks to their participation, how their participation is beneficial, that their participation is completely voluntary, and that they can withdraw their participation at any time. The researchers will not share responses, and a small token of appreciation will be given for their time spent in the study. Gifts will not be money and will be valued at no more than 10 USD. Measures will be taken to assure the respect, dignity and freedom of each participant. During training of study staff, we will emphasize the importance of avoiding coercion of any kind.

During individual interviews, confidentiality of study subjects will be emphasized. Individual interviews will be conducted in private, ensuring that others cannot hear the interviews. Individual sessions will be held in areas where there are no other individuals within a 10-foot distance. A barrier will be created so that no other individuals can view the participants while they are in their interview. Depending on the location, this could be a private room, behind a building or fence, or behind a line of trees, obstructing view so that confidentiality may be maintained. The interview team will take care to pair interviewers and respondents by sex to ensure protection of women and children and privacy and confidentiality of responses. Children will not be interviewed in the absence of a parent or guardian.

Steps in the Interview Process

1. Recruit eligible individuals
2. Review the information sheet, allow for questions, and ask for voluntary participation
3. Conduct the ethnographic interview/
4. Provide a token of appreciation to the participant
5. Complete the interview checklist
6. Upload ethnographic interview to computer as soon as possible for transcription

The targeted ethnographic interviews are scheduled for completion within a 4 to 8 week time frame. This includes training, interviewing, and preliminary data analysis. Approximately 60 to 100 individuals will be interviewed in each country. Interviews will last between 60 and 90 minutes. A trained team member will conduct targeted ethnographic interviews with individuals from the 'target population'. The targeted ethnographic interview will take the form of a semi-structured and guided conversation. The topics of conversation have been well defined (see Ethnographic Interview Guide, Appendix B).

Recorded interviews will be uploaded to a computer as soon as possible after the interview is completed. These interviews will then be transcribed and translated to English.

Materials/devices needed for the ethnographic interview: Pen, participant information sheet, interview guide, fully charged tape recorder or PIN protected smartphone equipped with a digital recorder (owned by and provided to interviewers by PREDICT), token of appreciation, checklist, and computer.

Steps in Conducting a Focus Group

1. Recruit eligible individuals
2. Review the information sheet, allow for questions, and ask for voluntary participation
3. Review the Focus Group Rules
4. Conduct the focus group
5. Token of appreciation given to each participant.
6. Upload the focus group recording to computer and transcribe the focus group discussion as soon as possible

The targeted focus groups are scheduled for completion within a 4 to 8 week time frame in each country. This includes training, conducting the focus group, and preliminary data analysis. Approximately 20 to 50 individuals will participate in focus groups in each country. Focus groups will last between 60 and 90 minutes.

Targeted focus groups will be conducted by two people, one who leads the discussion (the moderator) and the recorder/observer who supports the moderator. Focus groups will be conducted with a group of 6 to 10 people from the 'target population.' The moderator will begin with an animal naming exercise, followed by a short participatory risk mapping exercise. On a blank whiteboard, the moderator will begin by marking the current location where the focus group is meeting. The moderator will then ask the group members to identify settings where each mammal and avian species may be found. This exercise is designed to assess the distribution and overlap of animals. This portion of the focus group will be limited to 15 minutes. The map created by the group will then serve as a reference for discussion. The discussion will be semi-structured and guided. The topics of discussion for the group have been well defined (see Focus Group Guide, Appendix C).

The moderator will introduce each question and will try to encourage all focus group participants to contribute to the discussion. The moderator will ask follow-up questions (probing), until the topic is exhausted and no new information is learned. The moderator will make sure that all voices are heard, and that the participants share a full range of information. The recorder/observer will observe the behaviors and responses of the focus group participants, as well as record key notes on the topics discussed, particularly any new or unique information. The recorder/observer may also suggest additional follow-up questions to the moderator. The recorder/observer will also tape record the focus group. Recorded focus group discussions will be uploaded to a computer as soon as possible after the focus group is completed. These focus group discussions will then be transcribed and translated into English, if necessary.

Materials/devices needed for the focus group: Pens, participant information sheet, Focus Group Guide, fully charged tape recorder/smart phone, token of appreciation, large piece of paper or white board for community mapping, colored markers, and computer.

13) Data and Specimen Banking

No biological specimens will be collected under this protocol's activities. All interviews/ and focus groups will be conducted in the local language and translated to English for entry into an electronic database. Data will be recorded without identifiers.

All data collected will be put into an electronic database. Study findings will also be aggregated. UC Davis and U.S.-based Consortium team researchers contributing to study design and development will only be involved in training and will not be involved in data collection or field activities.

14) Data Management and Confidentiality

As noted in *Procedures* above, to ensure compliance with informed consent procedures, all participants will be given an information sheet prior to being asked to participate in this study. Each information sheet will be assigned a unique identification (ID) number **before** the ethnographic interview or focus group takes place. No identifying information of the participant will be collected; information obtained will be recorded in such a manner that participants cannot be identified directly or through identifiers linked to the participant, as there will be no identifiers.

Since the focus group activity participants may know one another, we will request that participants not disclose or repeat any information discussed during the focus group to non-participants.

If an individual declines to participate, the reason for non- participation will be asked to determine if we have selected a biased sample in any way: gender and age will be estimated, as will occupation, religion, and ethnicity if relevant and possible. The information sheet (with unique ID) will be kept for the records and used to determine a rate of participation.

Data generated from the interviewer checklist and audio files from recorded interviews in each country will be digitized and stored electronically in a password-protected file accessible only to local PREDICT team country coordinators. All recordings will be transferred to project computers and deleted from the recording device (digital recorder or smartphone enabled recorder) and stored in password-protected files for transcription and coding. Following transcription and coding, encrypted data intended for analyses will be electronically transferred to and stored in the secured PREDICT project database accessible only to country coordinators and the research team as appropriate. The original checklists (and recordings as noted above) will be destroyed or deleted as appropriate upon confirmed receipt and transfer of the encrypted electronic documents and files.

15) Provisions to Monitor the Data to Ensure the Safety of Subjects

The current study involves collection of behavioral data only, with minimal risk to subjects. No identifiers will be collected.

As such, the study is proposed for IRB exemption and involves minimal risk to subjects.

16) Withdrawal of Subjects

There are no foreseeable reasons to withdraw from the study, as participants are only required to provide a relatively short amount of their time depending on the activity, with focus groups and participatory mapping likely requiring the most time (up to two hours). In the event that participants wish to terminate their participation in any of the qualitative research activities (focus groups, interviews, or mapping activities), the research team will comply, the recording will be destroyed, and corresponding data will not be included in storage or analysis. Under no circumstances will subjects be withdrawn from the study without consent.

17) Risks to Subjects

The proposed study involves tape-recording of ethnographic interviews and focus groups. The only risk to participants is loss of confidentiality. Confidentiality safeguards include not collecting any identifiers and password protected storage of encrypted electronic copies of data. The activity is completely voluntary and due to procedures for the protection of all subjects' identifying information as described above, no foreseeable risks, discomforts, hazards, or inconveniences are anticipated.

18) Potential Benefits to Subjects

This study involves the collection of qualitative research data through ethnographic interviews, and focus groups with participatory mapping activities. As such, there is no direct benefit for participation. Indirect benefits include enhanced understanding of disease risks and identification of behaviors facilitating transmission and spread of infectious diseases in the participating communities.

19) Vulnerable Populations

Pregnant women will be given the option to participate in this study. Children aged 10 and older will also be invited to participate. All children will be required to be accompanied by one parent, to provide assent or consent as age-appropriate, and the parent will need to give parental consent for participation. This will be done through the information sheet process as described above. Prisoners will not be included in this study.

20) Multi-Site Research

This is a multi-site study and research activities will be implemented in all participating PREDICT countries (see #3 above).

Activities at the country-level will be governed by local ethical clearance councils and institutional review boards, from which approval will be sought prior to implementation of any activities.

Training on and adherence to study protocols, ethics, and conduct of research activities for all participating personnel will be supervised by project PIs and U.S.-based PREDICT Consortium research team in coordination with the PREDICT Human Subjects Research Working Group. All U.S.-based research personnel working on this study are included on this protocol. Communication among all sites, tracking of research activities, adherence to protocols, and disclosure of results and study completion will be conducted through PREDICT's Operations Officer at UC Davis (D. Wolking).

21) Community-Based Participatory Research

This study does not involve community-based participatory research.

The Focus Group Guide for this project includes a "participatory risk mapping exercise". ' The moderator will begin with an animal naming exercise, followed by a short participatory risk mapping exercise. On a blank whiteboard, the moderator will begin by marking the current location where the focus group is meeting. The moderator will then ask the group members to identify settings where each mammal and avian species may be found. This exercise is designed to assess the distribution and overlap of animals. The map created by the group will then serve as a reference for discussion. This introductory step also allows the moderator to identify participants who may try to dominate the discussion, as well as those who may be shy.

22) Sharing of Results with Subjects

The PREDICT project encourages communicating research findings to the community. Data from this study will be summarized and general findings from this study with respect to overall risk of zoonotic disease transmission will be shared at the community level through participating sites and with relevant authorities via implementing partners.

23) Setting

PREDICT is geographically focused on countries Asia (focus on South and Southeast Asia), Africa (focus on West Africa, the Congo Basin, and East Africa), and the Middle East and targets disease surveillance in areas considered hotspots for infectious disease spillover from wildlife and amplification and spread into domestic animal, livestock, and human populations. As indicated above, all 31 PREDICT countries (see #3 for details) have the option to participate in this study subject to local ethical clearances and permissions.

For this study, sites for qualitative data collection in each country will focus on areas identified by the local PREDICT country teams as priority sites for characterizing behavioral risks associated with emerging disease threats using criteria specific to each planned activity as indicated below.

Locations of the interviews and focus groups will be in targeted 'hotspot' areas and determined ahead of time by each moderator. Sites will be selected to ensure inclusion of individuals that have contact with live animals through either direct contact (raising, hunting, selling, trading, or purchasing) or indirect contact (animals living in or entering dwellings, buildings, or gardens/crops). Specifically by activity:

> *Ethnographic Interviews*
> Interview locations will be identified before the interview and will be conducted in a quiet and private place in areas where there are no other individuals present within a 10-foot distance. Specific sites for interviews depend on the type of targeted "hotspot" area and may be inside wildlife restaurants, behind animal storage sheds, in private rooms if in dwellings or in offices of business owners, etc. When necessary, a barrier will be created so that no other individuals can view the participants while they are in their interview so that confidentiality may be maintained.
>
> *Focus groups*
> Focus group moderators will work with Country Coordinators in each participating country to select appropriate locations to ensure privacy for group participants during the discussion. Consent will be obtained using the information sheet (describe below) and the study team will request that participants not disclose or repeat any information discussed during the focus group to non-participants.

For a list of PREDICT countries, please see #3 above. For more information on the process for local scientific and ethical review structure at the country-level see #20 above and #25 below.

24) Resources Available

The study is supported by a USAID $100 million five-year cooperative agreement with the UC Davis One Health Institute and by the full research expertise available at Consortium partner and local implementing partner institutions. We anticipate that the research field activity (e.g. focus groups, ethnographic interviews, etc.) will last approximately two months in duration at each site once implementing teams are trained in all research methods and procedures and local ethics approval has been secured.

All research activities, including training in-country research teams, will be coordinated and supervised the PREDICT team under the guidance of C. Johnson, M. Miller, K. Saylors, C. Monagin, D. Wolking, E. Hagan, and T. Gabourie (see brief bio- sketches below).

All in country research activities, including assent and consent using the information sheet described above (see Appendix A for the templates for both interviews and focus groups), will be implemented by research personnel trained by the PREDICT team. The PREDICT researchers will support in country teams with study implementation and data analysis.

Personnel:

Dr. Christine Johnson is the Senior Biological and Ecological Surveillance Coordinator for PREDICT with extensive experience in global health research and in the design and implementation of disease surveillance and risk characterization studies in human and animal populations. As Lead PI at UC Davis, Dr. Johnson will supervise research activities and coordinate with PREDICT's Global Operations Officer (D. Wolking) to assure the study is conducted in compliance with all appropriate ethical and regulatory guidelines at all sites.

Dr. Maureen Miller is the Senior Behavioral Surveillance Coordinator for PREDICT based at EcoHealth Alliance, and is a social scientist with degrees in both epidemiology and medical anthropology. She has extensive experience in applied infectious disease prevention research, programming and policy. Dr. Miller, together with Dr. Saylors, provides the technical leadership for this study and led the design of proposed research methods and development of training protocols and data collection tools. Dr. Miller will provide critical leadership for all participating country teams and will support training and implementation, data analysis, and results communications.

Dr. Karen Saylors is the Deputy Behavioral Surveillance Coordinator for PREDICT, and is a medical anthropologist and Senior Director of Behavioral Risk Analytics with Metabiota Inc. Dr. Saylors has led research in applied anthropology and behavioral sciences in Central and West Africa and Southeast Asia. Together with Dr. Miller, Dr. Saylors provides the technical leadership for this study and led the design of proposed research methods and development of training protocols and data collection tools. Dr. Saylors will provide critical leadership for all participating country teams and will support training and implementation, data analysis, and results communications.

Dr. Corina Monagin is the Lead Surveillance Coordinator for Metabiota, Inc. and has extensive experience in infectious disease and public health surveillance research at the human-animal interface in Africa and Asia. As a member of the PREDICT Behavior Risk team, Dr. Monagin supported the design and development of the proposed study and data collection tools and will provide support to local country teams for training, implementation, and analysis.

Mr. David Wolking is the Global Operations Officer for PREDICT based at UC Davis and has extensive experience in infectious disease research at the human-animal interface in Africa and Asia. As a member of the

PREDICT Behavior Risk team, Mr. Wolking supported the design and development of the proposed study and data collection tools and will provide support to local country teams for training, implementation, and analysis. Mr. Wolking will also support Lead PI (Dr. Johnson) as primary contact to assure compliance with the study protocol across all sites.

Ms. Emily Hagan is a Research Coordinator based at EcoHealth Alliance and has a BS in biology, an MPH in epidemiology, and an extensive background in infectious disease immunology. Ms. Hagan is a member of the PREDICT Behavior Risk team, and will provide support to local country teams during training, implementation, and analysis.

Ms. Taylor Gabourie is the Project Support Coordinator based at UC Davis. An applied anthropologist, Ms. Gabourie is a member of the PREDICT Behavior Risk team, and will provide support to local country teams for training, implementation, and analysis.

25) Prior Approvals

Prior to commencing research at specific sites, we will seek approval of this study from all participating countries through Institutional Review Boards, ethical clearance councils/committees, and national research administrations following local regulatory guidelines as appropriate. Research will not commence until approval has been granted.

26) Provisions to Protect the Privacy Interests of Subjects

If an individual decides to participate in this study, his or her participation and any and all information provided is completely confidential. No personal identifying information will be collected. A unique identification (ID) number will be written on the information sheets BEFORE the interviews, and focus groups begin. That is, before an individual is even identified for an interview or focus group. The number will only serve to monitor participation in the study.

If the results of this study are published, no individual will be identified or named in any reports. No personal identifiers will be collected. All data collected will be uploaded into a secured, encrypted database and paper documents will be destroyed after confirmation that data has been successfully uploaded. Study databases will be secured with password-protected access systems with controlled distribution web-based certificates and will not contain any personal identifiers. Access to all data will be limited to staff analysts and lead researchers involved in this study. Any health information disclosed by an individual will not be used by or disclosed (released) to another institution. Any reports published or shared with partners will not contain any personal identifying information for individual participants.

27) Compensation for Research-Related Injury

NA – Minimal risk

28) Economic Burden to Subjects

NA – There is no cost to subjects to participate.

29) Consent Process

The consent process is not being conducted by UC Davis or Consortium personnel but by the implementing partner research teams in each participating country and will be implemented in accordance with permissions and guidelines through the relevant local authorities.

To ensure compliance with informed consent procedures, all potential participants and parents of potential minor participants (ages 10 to 17 years) will be given an information sheet prior to being asked to participate in the study (for both interviews or the focus groups). The participant will review the information sheet with the research staff and will be given time to ask questions. When reviewing the information sheet, study staff will explain details of the study including why they were selected, potential risks to their participation, how their participation is beneficial, that their participation is completely voluntary, and that they can withdraw their participation at any time. It will be explained that the researchers will not share responses, and a small token or gift will be given for their time spent in the study.

Parental consent will be required for all children aged 10-17 by one parent, and assent will be obtained from all children. Unaccompanied minors living at or visiting sites will not be allowed to participate. Adults unable to consent for any reason will not be included in the study. During the interview, the local research team will take care to ensure all aspects of the consent procedure are followed and that participants fully understand that the activity is completely voluntary and that they may choose to end the interview at any time. Measures will be taken to assure the respect, dignity, and freedom of each participant.

This process will take approximately five minutes and the statement will be read in the local language. The information sheet for this study (both interview and focus group sheets) will be translated from English to the local language by the implementing research team in each country. All field researchers involved in the interview or focus group data collection and consent process will be required to be fluent in the local language in order to ensure that participants understand the study and the interview process.

30) Process to Document Consent in Writing

We are requesting a waiver for written documentation of consent.

31) Drugs or Devices

No drugs or medical devices will be used in this study. Tape recorders will be used to record the ethnographic interviews and focus groups.

References

FAO, UNICEF, UNSIC, WB, WHO, OIE, 2008. Contributing to One World, One Health: Strategic framework for reducing risks of infectious diseases at the animal-human-ecosystems interface (Sharm el-Sheikh, Egypt).

Frank, D., 2008. One world, one health, one medicine. *Can. Vet. J.* 49 (11), 1063e1065.

PREDICT Consortium (eds. Kelly, T., Zielinski, P., Karesh, B., and Mazet, J.A.K.). 2014. *Reducing Pandemic Risk, Promoting Global Health.* One Health Institute, University of California, Davis. Available online: www.report.predict.global

Woldehana, S., and Zimicki, S. 2014. An expanded One Health model: Integrating social science and One Health to inform study of the human-animal interface. *Social Science & Medicine* xxx (2014) 1-9.

Research Subject Information Sheet - Interviews

Sponsor: USAID PREDICT 2
Protocol Title: USAID PREDICT 2 Qualitative Instrument Pilot Testing
Investigator: Dr. Christine Johnson, PhD

Introduction. I (we) work for a project called *PREDICT* funded by the US government and conducted by several U.S. institutions and local partners around the world. We are studying how the health of wildlife, livestock, and people affect each other to better understand patterns of behaviors that may impact health.

Interview. As part of this research, we are speaking with people to better understand the types of interactions people have with wildlife and their domestic animals, as well as how people live their lives, do their jobs, and take care of their families and animals. While you may not benefit directly from this research, the information you share with us may help to improve the health of other people who live near or work with animals. The main risk to you would come from a loss of confidentiality. To decrease any risk of someone else seeing your personal information, we give the information you share with us and the recording of the interview, a code number and use that instead of your name on all information that you provide. Your information is also kept secure in locked files and is considered confidential. We will use this information to better understand disease risks from wild and domestic animals to humans and share this with local and national leaders, non-governmental organizations and the scientific community. When we write about the study, we will not use your name or anyone else's name, or anything about you that someone could recognize. At the end of the interview, we may ask you to refer other people to the study.

I am here today to ask if you are willing to participate in this study by talking with me. Your participation is completely voluntary. You do not have to answer a question if you do not want to. The interview will take about 60-90 minutes depending on the discussion. If you agree, your interview will be audiotaped. If you are not confortable with your interview being recorded you are free to either request an unrecorded interview or to decline to participate in the study.

Additional Information: An Institutional Review Board that is responsible for making sure that research participants are protected from harm has approved this study. If you have any questions now or in the future about your participation in the study or your rights as a research subject, you many contact the project Principal Investigator Dr. Christine Johnson at +1-530-752-5770 (ckjohnson@ucdavis.edu).

APPROVED by the Institutional Review Board at the University of California, Davis	
Protocol	Approved
754490	05/20/2015

Unique ID:_______ Date:______

Statement of Consent

I have had a chance to ask questions about the study. If I do not want the interview recorded, I may say no to participating in the study. Also, someone has explained to me that:

- No personal identifiable information like my name will be recorded, only a code number will be used
- The information I provide is confidential and will be kept in locked files that only the professional research staff will see
- All written and published information will not use my name, anyone else's name, or anything about me that someone could recognize
- There is no punishment or disgrace with saying no to participating in the study. If I decide to participate my decision will not be used against me in any way.

The respondent has voluntarily agreed to participate in this survey.

______ Individual agrees to participate in this survey

OR

______ Individual declines to participate in the survey. Please list why if respondent is willing to explain and thank them for their time.

Reason for not participating: ____

Certified by Interviewer ___________________Initials _________Date _______

APPROVED by the Institutional Review Board at the University of California, Davis

Protocol	Approved
754490	05/20/2015

Research Subject Information Sheet – Focus Groups

Sponsor: USAID PREDICT 2
Protocol Title: USAID PREDICT 2 Qualitative Instrument Pilot Testing
Investigator: Dr. Christine Johnson, PhD

Introduction. I (we) work for a project called *PREDICT* funded by the US government and conducted by several U.S. institutions and local partners around the world. We are studying how the health of wildlife, livestock, and people affect each other to better understand patterns of behaviors that may impact health.

Interview. As part of this research, we are speaking with people to better understand the types of interactions people have with wildlife and their domestic animals, as well as how people live their lives, do their jobs, and take care of their families and animals. This interview is in a group setting with approximately 7 to 10 other people. While you may not benefit directly from this research, the information you share with us may help to improve the health of other people who live near or work with animals. The main risk to you would come from a loss of confidentiality. To decrease any risk of someone else seeing your personal information, we give you a code number and use that instead of your name on all information that you provide. Your information is also kept secure in locked files and is considered confidential. We will use this information to better understand disease risks from wild and domestic animals to humans and share this with local and national leaders, non-governmental organizations and the scientific community. When we write about the study, we will not use your name or anyone else's name, or anything about you that someone could recognize. At the end of the interview, we may ask you to refer other people to the study.

I am here today to ask if you are willing to participate in a group discussion. Your participation is completely voluntary. You do not have to answer a question if you do not want to. The group discussion will take about 60-90 minutes and will be recorded. If you are not confortable with the group discussion being recorded you are free to decline to participate in the study.

Additional Information: An Institutional Review Board that is responsible for making sure that research participants are protected from harm has approved this study. If you have any questions now or in the future about your participation in the study or your rights as a research subject, you many contact the project Principal Investigator Dr. Christine Johnson at +1-530-752-5770 (ckjohnson@ucdavis.edu).

APPROVED by the Institutional Review Board at the University of California, Davis	
Protocol	Approved
754490	05/20/2015

Unique ID:_______ Date:______

Statement of Consent
I have had a chance to ask questions about the study. If I do not want the interview recorded, I may say no to participating in the study. Also, someone has explained to me that:

- No personal identifiable information like my name will be recorded, only a code number will be used
- The information I provide is confidential and will be kept in locked files that only the professional research staff will see
- All written and published information will not use my name, anyone else's name, or anything about me that someone could recognize
- There is no punishment or disgrace with saying no to participating in the study. If I decide to participate my decision will not be used against me in any way.

The respondent has voluntarily agreed to participate in this survey.

______ Individual agrees to participate in this survey

OR

______ Individual declines to participate in the survey. Please list why if respondent is willing to explain and thank them for their time.

Reason for not participating: ____

Certified by Interviewer ___________________Initials _________Date _______

APPROVED by the Institutional Review Board at the University of California, Davis

Protocol	Approved
754490	05/20/2015

ETHNOGRAPHIC INTERVIEW GUIDE

Core Themes

1. Human movement
2. Socioeconomics
3. Biosecurity in human environments
4. Illness, medical care/treatment and death of humans
5. Human-animal contact

HUMAN MOVEMENT

GOAL: To understand living environment and 'home range' (e.g., how far people travel and why).

Home

Where do you live/what kind of dwelling? How many people are in the household? How many rooms? How many are children? Is everyone related? Sleeping arrangements?

How often do you move? Any seasonality of movements?—eg, for work, for food, for safety (e.g., against flood, drought, conflict)?

What are the things you do to protect your home (against predators, animals, outsiders, bad weather)?

Work

What kind of work or activities do you do? What do other household members do? Where do these activities happen?

How do you protect your activities and business interests? (e.g., grazing or crop land, business competition, hunting territory, animal stock)

Travel

How far do household members travel from home and why? (Follow up on animal related issues: shopping, selling/buying/trading, hunting, transport, etc)

How travel (by foot, bike, cart, truck, plane)? Is it ever for overnight? Where stay?

Why traveling? (work/migrant, family, religion, holidays, to sell/trade/buy animals)

Other family members in other areas of the country? Visit often?

Observed environment

Have there been any changes in the environment: new roads, more boats or ports, fields, buildings, population movement (in or out), land clearing or abandonment, new houses, other new buildings

Who is responsible for the changes? Are the changes good or bad?

SOCIOECONOMICS

GOAL: To understand a typical day and how money and social standing impact opportunity and risk.

Daily routine

Tell me about your daily routine (get description of work on a usual day, include purchasing and preparing food, timing of types of meals, responsibilities/duties related to animals, any changes by season)

How do people in the household contribute to earning money and getting food (and water)?

Where do the children play? Who takes care of the children when you are at work?

Animal responsibilities

Describe the animal related jobs and responsibilities for people at every age (i.e., young children, older children, young adults, adults, elderly).

What are the skills/knowledge needed before moving to the next stage of duties/responsibilities?

Are there differences in responsibilities between boys and girls, men and women, by ethnicity or class?

Education

How many children are currently in school? Until what age do your children go to school? (boys and girls?)

What is your level of education? Why did you stop?

Economics

Do you make more money than other people who do the same things as you? Why do you think that is?

Are there times of year when you make less money? What happens then?
Are there times when food is more expensive than others? Tell me about that (eg, different food availability, seasonal, festival related).
Do you think you and your household are better off than most people? Could you do things to make it better?

BIOSECURITY IN HUMAN ENVIRONMENTS

GOAL: To determine if any sanitation or hygiene factors could play a role in disease spillover

Water and food

Is there a central source of water? What is the source? (eg, pond, uncovered well, rainwater, taps, covered well)
Is there a water source you like better?
How far away is the water source? Do animals drink from the same source?
Do you do anything to your drinking water to clean it before you drink it?
How do you store your food? (e.g., open containers, covered, hanging, refrigerate)
Do you eat or drink things where you suspect animal contact? (e.g., teeth/scratch marks, feces or urine seen)
Do you regularly clean your food prep station/kitchen and tools? How?

Sanitation

Are there toilets, latrines or other designated areas for human waste? Are these cleaned and used regularly?
Are butchering and slaughtering areas separate? How often are they cleaned and how? Who does the cleaning?
Are there any official rules or laws about human waste and garbage disposal?
Are there any animal pest control laws? What do you do to control animal pests?

Hygiene

When are the best times to wash your hands? Do you use soap? How much does soap cost and where get it?
Do you wash your hands at home? at work?
How often and where do you and your household members bathe?

ILLNESS, MEDICAL CARE/TREATMENT, DEATH

GOAL: To identify any unusual disease experiences—signs, symptoms and sources

Household illness

Is anyone sick right now?
What do you do when someone in the household gets sick? Who takes care of that person?
The last time someone was seriously sick what happened (explore when, with what, how did they get sick, who told/consulted, anyone else get sick after, final outcome)?
Has anyone ever had an sickness that people don't usually get? What happened? Where did it come from?

Illness from animals

Do you know anyone who has gotten sick from an animal? What animal? What did they get? What happened?
Do you know any other diseases/illnesses people can get from animals? How does the animal give the illness to the person? How often does it happen?

Medical care/treatment

How sick would you have to feel to stay home and not do normal routine?
Where do you go when you are sick?
Do you prefer to use traditional medicine, western medicine or a combination?
How sick would you have to feel to go to doctor/clinic/hospital? What does that cost? (in time, lost wages/business, transport costs, etc) How far away?

Death

What is the tradition when someone dies? (Explore if reported to authorities, differ by age or gender, what happens to the body, does the community come together or is it private.)

HUMAN ANIMAL CONTACT

GOAL: To gain knowledge about interactions with animals, animal health and animal perceptions and knowledge.

Encourage but don't lead discussion about which animals. Allow respondent to name the animals. If no birds or bats are mentioned, follow up by asking specific questions about birds and bats.

Indirect contact

What kind of meat do people in your household eat? How do you get it/where does it come from? What is furthest away an animal comes from?

Is meat dead or alive when you get it? If dead(/prepared), how to tell if good/fresh?

If alive, how long are live animals kept before being sold or eaten? How do you get live animals home?

How is meat prepared (raw/undercooked)? Is meat prepared in the same place as other activities? (e.g., preparing vegetables, cleaning babies/changing diapers, where other food or drinking water is stored)

Do animals come in or near the dwelling? How do you know animals are there? Which animals?

Direct contact

Do you or someone in your household handle live animals? In what context? (e.g. ranching/animal husbandry, hunting, wet markets, work, around dwelling/other building, pets)

What are the animals that you keep/raise or sell? How many different kinds of animals? How many of each? For how long do you have the animals?

Where do live animals come from? Where is the furthest away an animal comes from?

Who buys/trades for your live animals? Where do the animals go?

Have you been bitten, scratched or had bleeding after handling an animal? By a wild animal?

Where are live animals slaughtered? butchered? Do people buy or sell parts?

Do you travel with animals? Explore details of the process, specific routes and encounters (eg, with other animals, with animal transport supporting industries, such as holding areas, restaurants, hotels) along the way.

Explore for differences over time in animal handling, eg, seasonality, legal, religious, animal reproduction

Animal products/rituals

Other uses of animals—e.g., as pets, medicine, magic, fertilizer, for trading

Rules for children around wild animals as pets, playing with wild animals or dead animals

Animal health

How do you care for your animals: how are they fed, what do they eat, where do they eat/graze and sleep? Are they segregated or all together? Differences by season? day/night? Does anyone live or stay with the animals? Is there a central area for animal waste? How often are animal cages, stalls, or penned areas cleaned? Who cleans them?

Do the animals get veterinary care? Vaccinations?

How do you know when an animal is sick? What's the first thing you do about a sick animal?

Have you seen an animal outbreak or die-off? What happened?

Perceptions and knowledge

What are the most unusual animals anyone can buy?—seasonal? Expensive? Who buys?

Are there any animals you avoid eating? Why? Ever heard of anyone eating/selling dead or infected animals?

Do people ever eat non-domesticated animals/wildlife? Where do they get them?

Who usually buys wildlife products? Have there been changes over time?

What do you do when you find a dead animal?

What laws about animals do you know? (eg, limiting/outlawing hunting, reporting and culling of sick animals)

FOCUS GROUP GUIDE Version 2, May 1, 2015

The focus group discussion is initiated by naming all of the animals that can be found in the community. The goal of this exercise is to explore animal diversity.

The community mapping activity locates where the different kinds of animals can be found relative to the site of the focus group. It should be emphasized that this will not be an 'accurate' map. This exercise is designed to assess the distribution and overlap of animals. Prompts such as 'anywhere else?' should be used. The animal list will contain insects, reptiles and fish. ***Map only mammalian and avian species***.

These two activities together should be limited to 10-15 minutes. The themes to be explored in the discussion are 1) contact and context, 2) illness in animals and humans, and 3) rules and restrictions. Events such as animal die-offs should be added to the map, if they are discussed.

1) Contact and context

- Which of these animals do you see the most often? The least? (Probe: where, why)
- What animals do you come into physical contact with? (Probe: where, why, how often)
- Which of these animals do you eat?
    - Where do you get them? How are they prepared? Which are for special occasions only?
- What are animals good for other than food? (probe: labor, medicinal, magic, pets, by-product uses)
- Which animals come into buildings or places where people are? Is water shared with animals?
- How are unwanted animals kept out? (probe: which animals, all methods used)
- Who takes care of the animals? (Probe: who, specific jobs, animal movements)

2) Illness in animals and humans

Animals

- What happens when animals get really sick? How are the animals cared for?
- Has this happened recently? Do people try to hide animal sickness?
- Is animal sickness reported to anyone? (probe for differences between wild and domestic animals)
- Have any animals been destroyed or killed by authorities? Describe.
- What happens to animals when they die? (probe: eaten, buried, left to rot, depends if wild or not)

Humans

- What is the most unusual or memorable sickness anyone has had? What happened?
- What are the causes of illness or sickness?
- Do you know anyone who has gotten sick from an animal? What happened?
- What do you know about animals that can give you infections or diseases?

3) Rules and restrictions

- Are there places in the community where you aren't allowed to go? Why not?
- Are there any rules about hunting or trapping animals? (Probe: cultural, legal)
- Are there any animals that you don't eat or that are avoided? Why?
- Are there official rules or laws about garbage disposal? Human waste? Animal waste?
- Is garbage a problem in this community? What's the problem?

Final question for all: If you could change one thing in your life, what would it be and how would you do it?

PREDICT 2

OBSERVATIONAL RESEARCH PROTOCOL

December 14, 2015

PURPOSE: To provide principles and general guidelines for the conduct of targeted qualitative research to understand the context and potential risk practices and behaviors of individuals at high risk of zoonotic disease spillover.

Prepared by the PREDICT-2 Behavioral Risk Group

Senior Behavioral Surveillance Coordinator: Maureen Miller, PhD
Deputy Behavioral Surveillance Coordinator: Karen Saylors, PhD

TABLE OF CONTENTS

SECTION 1: PROJECT OVERVIEW

1.1 PREDICT PROJECT OVERVIEW & GOALS

The PREDICT project is funded by USAID under the Emerging Pandemic Threats (EPT) program. Nearly 75 percent of all new, emerging, or re-emerging diseases affecting humans at the beginning of the 21st century are zoonotic (i.e. originated in animals). Notable examples of the global impact of new emergent diseases include HIV/AIDS, severe acute respiratory syndrome (SARS), and most recently Ebola. The speed with which these diseases can emerge and spread represents serious public health, economic, and development concern. The vast majority of these diseases originated in "hot spot" areas such as central Africa and South and Southeast Asia where multiple and complex factors contribute to zoonotic disease spillover into human populations.

The EPT program works in developing countries to prevent, detect, and control infectious diseases in animals and people, and places an emphasis on identifying and responding to dangerous zoonotic pathogens from before they can become significant threats to human health. The PREDICT project has two specific goals in support of this work:

1. To identify populations and practices in settings where there is a high risk of zoonotic disease spillover from animals to humans.

2. To develop policies and intervention strategies, that reduce the risk of zoonotic spillover.

The PREDICT project will focus on three key 'pathways' of disease emergence and spillover risk. The pathways strategically identify settings where humans, wildlife and livestock or domestic animals are most likely to come into contact with each other in a way that increases the risk of zoonotic disease spillover from animals to humans

1. **Land Conversion for Commercialization:** Rapidly changing landscapes that bring humans and animals in closer contact than was previously experienced (e.g., palm oil plantations, mining, logging, crops)

2. **Intensification of Animal Production Systems:** To feed growing global populations there have been major increases in the number of livestock (e.g., chickens, cows, goats) being raised using industrial methods. The rapid intensification of these systems has been inadequately regulated, resulting in gaps in biosecurity and biosafety measures. Frequent direct human-livestock contact occurs, often intermingling with wildlife species, in settings that vary in sanitation.

3. **Animal Value Chains:** Wildlife and domestic animals from remote naturally biodiverse regions are brought to densely populated urban markets that actively trade in varied animal species and products.

A key component of PREDICT 2 is to better understand the human behaviors and practices that may increase the risk of zoonotic disease spillover, as well as the social, cultural, environmental and economic factors that underlie human behaviors and practices. As the first step in the process, qualitative research methods will be used.

1.2 QUALITATIVE RESEARCH

Qualitative Research is an exploratory type of research that is used to gain insight into communities and people's lives. Qualitative research may be general and implemented over long periods of time. Alternatively this type of research may be targeted and focused on a set of specific issues, as is the case for PREDICT qualitative research.

This protocol reviews the objectives and methods of conducting observational research. Observational research may be conducted immediately at a site, and can be conducted at any time and over time to monitor observed changes. Observational research does not require institutional review board (IRB) or other in-country ethical committee approvals.

SECTION 2: OBSERVATIONAL RESEARCH

Purpose: Observational Research is a first step in the research process. This type of research is carried out in order to observe settings and people in their natural environments. PREDICT observational research is intended to evaluate sites for potential inclusion, to identify people who may meet the targeted population criteria at the sites, to introduce the study to the community and to monitor any changes in the sites over time.

2.1 OBSERVATIONAL RESEARCH OVERVIEW

What Is It?	Research Goals
• A first step in the qualitative research process • Passive observation and field note taking of the structure and characteristics of the site and the people who inhabit it • Informal conversations with 'key informants' • Mapping of land and community • A way to monitor changes over time	• Identify key informants • Establish relationships with individuals from target populations and key informants • Prepare for next stages of qualitative work (i.e. focus groups and ethnographic interviews) • Write up field notes of observed environment and interactions • Map the setting

Table 1 Observational Research Key Points

2.2 WHO IS INVOLVED IN OBSERVATIONAL RESEARCH

The main individuals involved in observational research are the **Observer**, **Key Informants** and any other individuals interested in speaking with the Observer in an informal way.

Observer: Is the person conducting the observational research (e.g., can be country coordinator, head field worker, or any other PREDICT staff person). The Observer should let people know about the study and the things we would like to learn. This is an excellent opportunity to engage people and to spread the word about the PREDICT project. The Observer should pursue informal and active introductions to people and members of the target communities, especially people of influence. Identification of formal leadership structures will be important in terms of identifying opportunities and challenges for the implementation of the study, as well as any future interventions targeting structural or behavior change.

The Observer is often introduced to people of influence by local contacts that have already been established. This is the easiest way to identify key informants who may then introduce the Observer to others. It is much more challenging to engage in informal conversations without local contacts, but not impossible. Simple observation of the setting should provide clues to identify the people in authority or who have influence. This observed information is just as important and should be collected independently of any informal conversation by the Observer.

Key Informant: To gather information rapidly on a particular topic, such as the locations, practices and activities of the target population, it is necessary to identify people of power in the community (e.g., government officials, business people) or those with influence with the target population (e.g., religious leaders, market managers, community elders). Key informants are often those who are easy to approach. It is important to speak with a range of key informants.

2.3 OBSERVATIONAL RESEARCH METHODS

Observational Research methods include making observations, having informal conversations with community members who are willing to speak with the Observer, and mapping the sites being considered for future surveillance and sampling. All of this research must be documented as Field Notes.

Field Notes (ie, the data collected in Observational Research), can help contextualize subsequent qualitative or quantitative findings. Observational research can be conducted independently by the Observer or with the help of key informants, who guide the observational experience through their intimate knowledge of the area and culture. Excerpts from Field Notes are included in Appendix I.

The observational process entails looking for specific features of a potential research site, meeting people, talking with anyone who is interested, identifying individuals in positions of authority or influence in the target community or those who interact regularly with the target community, and trying to establish relationships with these individuals.

In addition, drawing maps of potential surveillance and sampling sites is an important and visual way to document the human environment. For example, an important feature in a market may include the separation of livestock and wildlife in different sections of the market. Hand-drawn maps can serve as reminders of where specific features are located or, over time, if these features change. Examples of maps are included in Appendix II.

Observational research should continue through the life of the project. Observational research does not require IRB approval.

APPENDICES

I. OBSERVATION FIELD NOTES EXCERPTS

Brief Summary

Observer: Jim Desmond
Date: Sunday, November 2, 2014
Setting: Guangzhou TaiPing Market (SARS market)
Weather: Overcast and comfortable weather
Time: 10:30am – 12:30pm

Tai Ping market is about 100 km southwest of GaungZhou. I had previously visited this market with GuangJian and Jin Ping in 2011. At that time there were many more animals, both domestic and wild, at this market.

The market is quite large, covering a large area. On this particular many of the stalls were closed and there didn't seem to be a lot of activity, not many buyers. The market is divided into two sections. There is a section that contains, reptiles, amphibians, fish and other aquatic animals. The other section contains birds and mammals. We focused solely on the bird and mammal section.

There were approximately 50 vendors – but that is a very rough estimate and it's also difficult to say if some of the closed shops were only closed that day or if they were closed permanently. Of the vendors that were open they generally seemed to sell either birds or mammals but not both. With birds, there was more mixing with vendors selling a variety of chicken, goose and duck breeds as well as pigeons. Some vendors had pheasant or quail. Some of the duck breeds looked like wild birds, for example there were a lot of mallards and there were other ducks that I could not identify the species but they did not look like domestic ducks. My guess is they are farmed but at some point in the past they had been wild caught. There was a roughly and equal number of bird vendors vs. mammal vendors

We observed a wide variety of mammals, a mixture of wild and domestic. However, there were far fewer mammals present and much less diversity than our previous visit in 2011. GJ said that the market had been shut down several months following our visit due to an article published in the paper regarding the illegal wild animal market. All the vendors are aware of the risk of disease. GJ said he overheard some guys talking when we got out of the car and they assumed we were looking for diseases in the animals. The presence of westerners definitely is a red flag for them and maybe even the presence of non-local Chinese. Unless you speak the local dialect, vendors there will be unwilling to speak with you according GJ.

Here is a list of some of the animals seen: wild boar, bamboo rats, another species of wild rat, nutria, raccoon dogs, another type of wild rodent? That looked a bit like a marmot - need to look it up, domestic cats, domestic dogs, goats, cows (jerseys). I may be missing a few but that covers most of it. The raccoon dogs were sort of hidden so they vendors must be concerned about them being seen. There were a lot more wild boar than the last visit but less animals and less diversity overall.

Observer: Arif
Setting: DLS in Dhaka
Dates: Jan 21-28, 2015

I spoke with some persons of DLS and also discussed with cattle traders in Dhaka city market regarding cattle marketing channel across Bangladesh. I visited three cattle Markets in Dhaka for getting information where the cattle come from.

The vast illegal trade thrives since cows are considered holy in India, and New Delhi is unable to legalize their export.It becomes 'legal' when traders pay up revenue officials in Bangladesh

They told that cattle come through Jessore border. Putkhali Khatal in Benapole border in Jessore district where is most of cattle trading occur.

Bangladesh and India share a 4,096-kilometer (2,545-mile)-long international border consisting 28 districts.Cattle traders say that cattle trading is occur in following districts:
Dinajpur, Kurigram , Lalmonirhat , Panchagarh , Thakurgaon , Meherpur , Kushtia , Chuadanga , Jhenaidah, Rajshahi , Chapainawabganj, Naogaon, Nilphamari and Jessore District

Above mentioned districts, Many cattle come across Meherpur border. Although, it is small district only 716 sq km but most are are bordered with India.Cattle trader say that even Beef illegally come through Meherpur border. After slaughtering cattle at night, the beef come across border.

I tend to think that we can choose Meherpur district in Y-1 and Jessore in Y-2.

Near to Nepal border: Thakurgaon & Panchagarh District: there is Banglabandha, a major inland port in northern Bangladesh established to provide a trade link with India, Nepal and Bhutan. The three nations are separated by 52 km only. So either Thakurgaon or Panchagarh District can be choose for Y-3/Y-4 PREDICT-2

Myanmar border: Bangladesh and Myanmar share a 193 kilometer crossing Cox's Bazar (in Teknaf Upazila) and Bandarban District. We can choose some sites with Myanmar border

It seems to me that it will be really good to include Medical doctors of One health scholar for conducting observational research under my supervision.

Finally,the present political situation is not good here . the indefinite transport blockade is still going on.

Observer: Maureen Miller
Date: 1/7/15 Wed morning 8:30 start 11:30a end
Setting: Live animal markets in Queens, New York City
Weather: frigid it snowed last night

Site 1: Almadina Halal poultry shop
Time: 9-9:30

We got lost trying to find the place and got directions from a man coming off the subway. We had to walk through a tunnel and ended up at a cross roads of abandoned looking warehouses. He sent us off in one direction while we walked in another. There were metal shops, glass works and car buyers/repairers/parts shops strewn throughout. There was one section on the opposite side of the street where houses had been converted into 3 or 4 different kinds of church congregations. Nobody was walking on the streets. The sidewalks were unshoveled, some were icy where people had walked.

We started looking for 157th street where the poultry shop we were going to was located. We ended up bumping into the guy who gave us directions at 156th. He was a guard at the blocked off street that led into a factory complex. It turns out that the complex was a distributor of live and butchered animals. We asked another guard for directions. I showed him the address. It was pretty clear that none of these guys knew how to read. I asked about the live poultry shop and he sent us back to exactly where we had come from. One of the abandoned looking buildings was actually Another shop—not the one we had targeted.

There were two delivery trucks out front advertising halal butchered goat and cow. There was also a food cart with a long line of poultry shop workers. The cart looked like regular halal, but most of the workers were buying cup-o-soup by lipton or coffee. As we stepped on the curve, we stepped over a large frozen puddle of blood. There was also quite a bit of feces around.

I went in and asked for Raja—the name of the man I had spoked with. The first guy didn't speak English. The guy behind the clear plastic ribbon protected cutout in the wall directed me to the door next door, which was for employees only. I went in and asked several people for Raja. One finally spoke English and corrected me: Raya. The room was small high ceilinged and dark. There were plastic crates about 8" high filled with chickens that could not stand up: one had 3 chickens but most had 6 or more. There was liquid deep on the floor: a combo of melting snow, urine and feces. The air was fetid, warm and difficult to breathe.

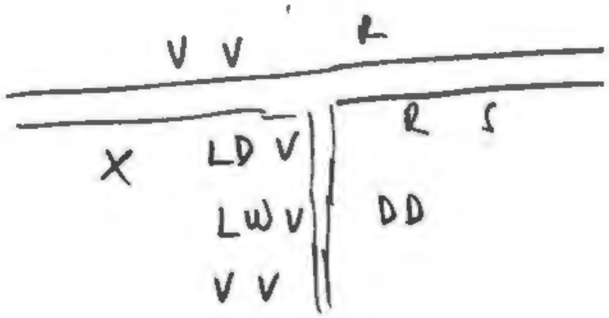
Raya came out. I explained who I was and what we wanted to do. He said he had never spoken to me. I asked if we could observe anyway. He said no, but gave me detailed directions to the shop we were trying to go to. There were many men working there and I saw one woman. I think they were Pakistani.

People were eating and drinking in with the animals and presumably the butchery and slaughter areas too.

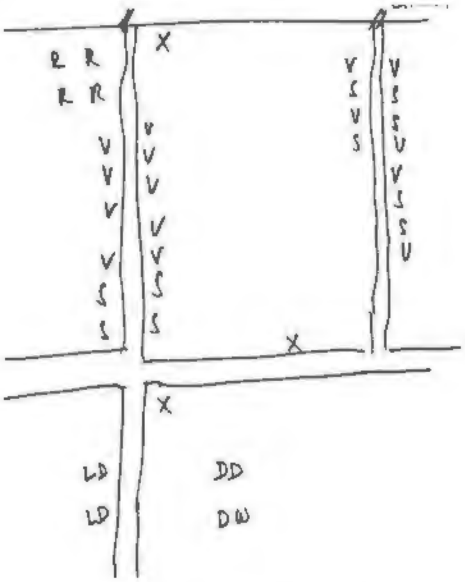
II. OBSERVATIONAL MAP EXAMPLES

Brief Summary

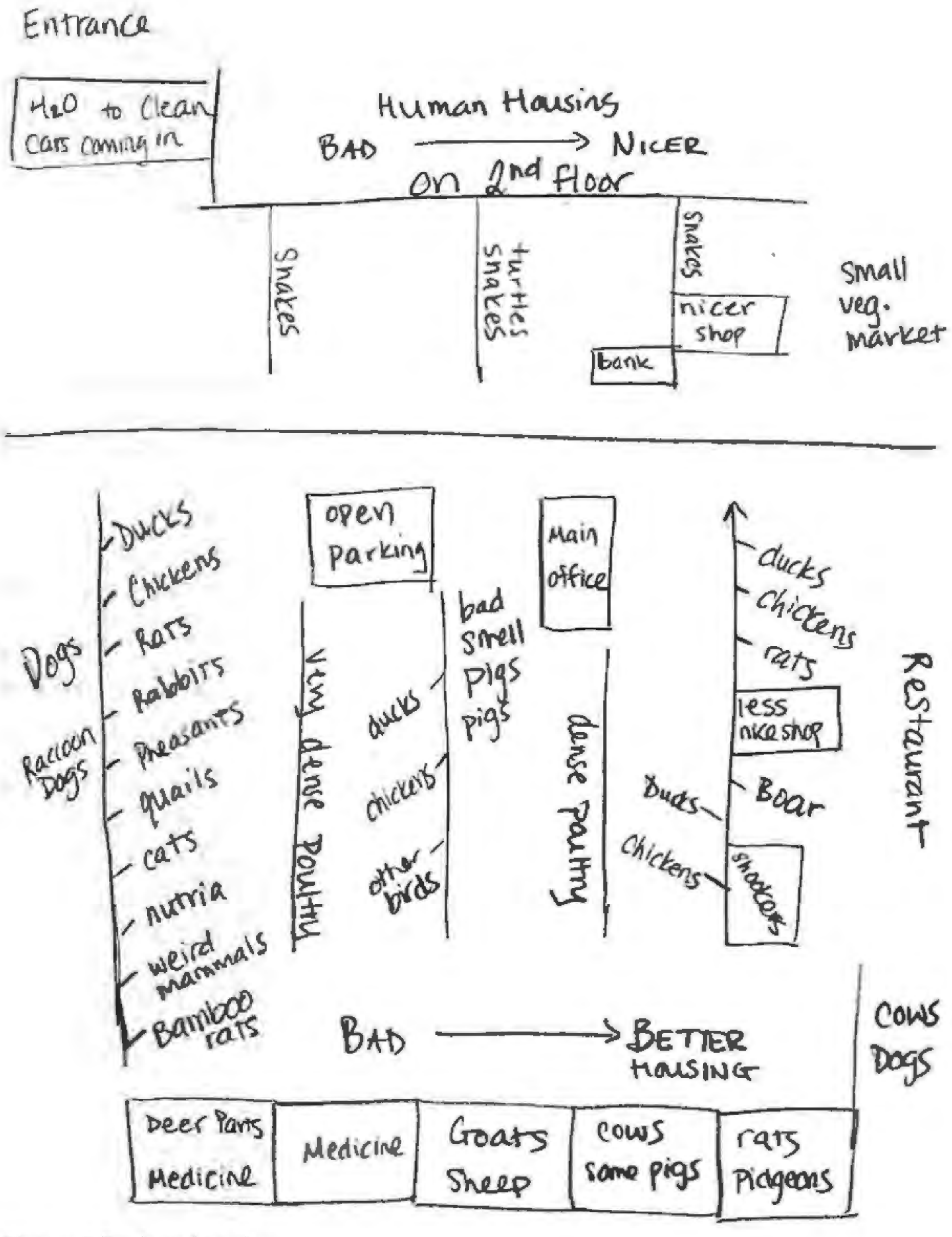
In the market sketches the clustering of vegetables (v) and staples (s) away from live animals (LD/LW) and meat (DD/WD) was considered a market implementing minimal zoning. Picture 1 is an example of a market that did not display minimal zoning as live wild animals (LW), live domestic animals (LD), vegetables (V), and domestic meat (DD) are scattered throughout the market. Picture 2 is a market with zoning – the vegetables (V) and staples (s) are kept separate from the animals and meat. Even the live animals (LW/LD) are kept separate from the animal meat (DD/DW).



Picture 1 Market Without Zoning



Picture 2 Market With Zoning



Picture 3 Enclosed market

Picture 3 is a map of a wet market that sells livestock, domestic animals and wildlife.

6.4 MODELING AND ANALYTICS – NEW RISK MAP and DEVELOPMENT OF OUTBREAK SCENARIOS FOR EMERGING PANDEMIC THREATS

PREDICT is using state-of-the-art modeling and analytic approaches to guide surveillance and help countries develop disease control and prevention strategies. PREDICT is producing next-generation, fine-scale hotspots maps, combining in-country data on land use, socioeconomic, and agricultural changes with surveys of human behavior, market value chains, and livestock production to identify where zoonoses will spillover, where they will amplify, and who is at risk.

As evidence of this approach, this year the PREDICT modeling and analytics team combined ecological niche modeling with country level data on camel density acquired from FAO to produce a hotspot map identifying areas with the greatest probability of MERS-CoV spillover from bats to camels. Findings and conclusions are detailed in the attached “Modeling the Risk of MERS-CoV-like Spillover from Bats to Camels” briefing.

Modeling the Risk of MERS-CoV-like Spillover from Bats to Camels

Challenge: There is strong evidence that MERS-CoV originated in bats and is now endemic in camels in the Middle East. This comes from phylogenetic studies of bat CoVs, evidence of MERS-CoV in one *Taphozous perforatus*, and epidemiological work in camels and people. MERS continues to infect people in Saudi Arabia, but its distribution across the region (in people, camels, or bats) is not fully known. We conducted a modeling and mapping exercise to find out:

- Where is camel production highest in the region?
- Where are bats that could carry MERS-CoV (or similar viruses) found?
- Where is the risk of future MERS-CoV spillover from bats to camels highest?

Aim: to identify potential MERS spillover hotspots so surveillonce efforts can be better focused.

Our approach: We used ecological niche modeling (ENM) to predict the potential distribution of all bat hosts known to carry MERS-like (beta2c clade) coronaviruses based on known occurrence of 10 MERS-like CoV reservoirs and 35 climatic variables (**Figs 1 & 2**). We mapped country level data on camel density from FAO (**Fig. 3**). We then produced a hotspot map that identifies areas with the greatest probability of MERS-CoV spillover from bats to camels (**Fig. 4**).

Analysis and Figures

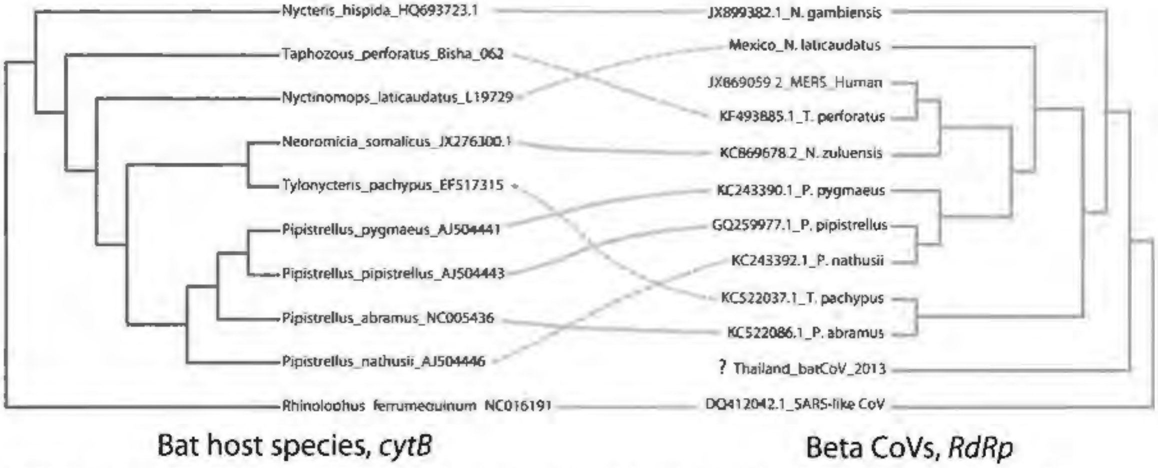
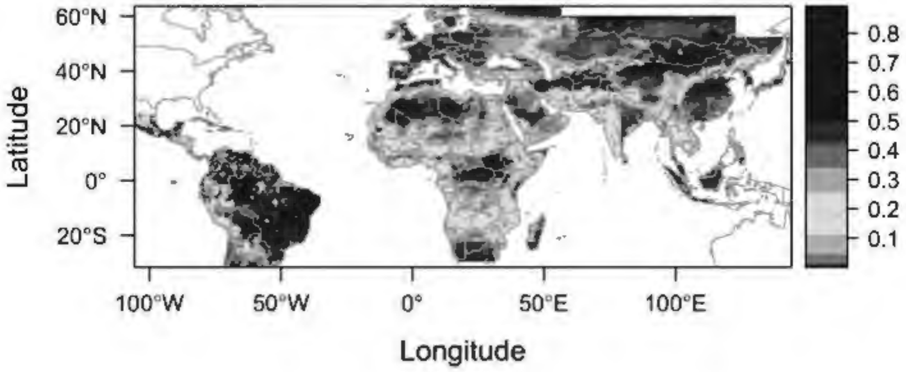


Figure 1. Cophylogeny of bat hosts and their MERS-related CoVs (beta 2c CoVs) from the published reports and PREDICT-1 data. MERS-like CoVs have moved from one bat species to another over recent historical time, and therefore are high risk for future emergence.



Contact olival@ecohealthalliance.org for details

Figure 2. Modeled, projected geographic distribution of 10 species of bats known to be hosts for MERS-like viruses in **Fig. 1**. The map represents the mean relative probability of occurrence of the host bats, where warmer colors show areas with better-predicted conditions based on 35 current climatic variables that would likely affect bat distribution.

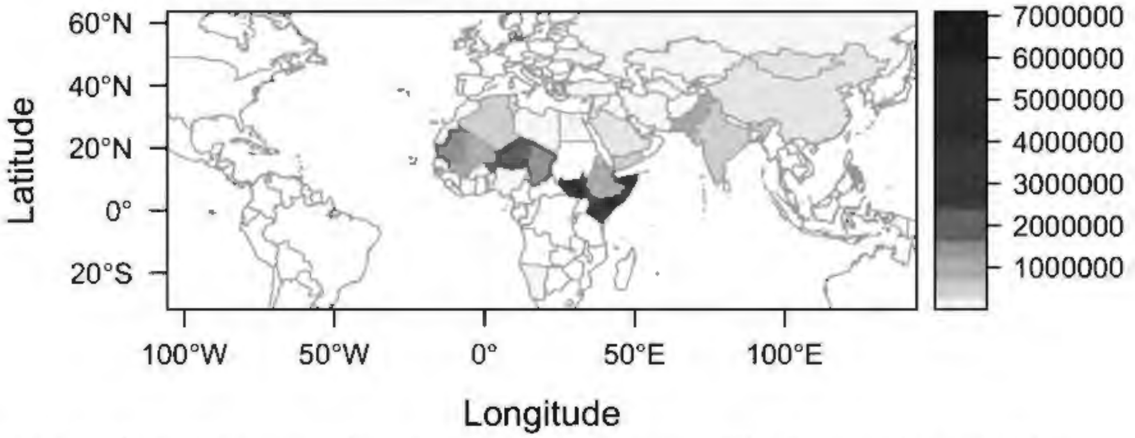


Figure 3. Global camel production (live animals) for the year 2013. This country-level dataset was used as a proxy for fine scale camel density, which is not currently available. Source FAOSTATS 2014.

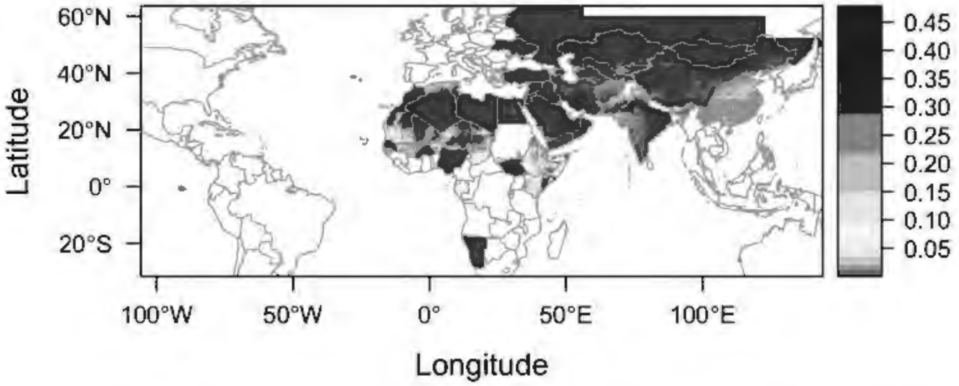


Figure 4. Hotspot map for risk of MERS-like virus spillover from bats to camels based on host distribution data. The color scale (Right) denotes the relative risk of MERS-related bat hosts and camels coming into contact, with darker colored pink areas representing higher relative probability.

Conclusions:

- Surveillance to identify future emergence of MERS should concentrate on regions in East Africa close to the Arabian Peninsula where bats that carry MERS-like viruses are most likely to occur, and where camels are produced in higher numbers.
- MERS-like viruses are probably widely distributed in bats in the Old and New World, and may emerge through other hosts in these regions (e.g. New World camelids), therefore surveillance in these species may identify other risk pathways for MERS emergence.

Contact olival@ecohealthalliance.org for details

6.5 RISK COMMUNICATION – NEW DISEASE RISK REDUCTION MATERIALS FOR COMMUNITIES AFFECTED BY THE EARTHQUAKE IN NEPAL

Following the 2015 earthquake in Nepal, PREDICT identified points of potential support for disaster relief. Contributions to the disaster response included producing and distributing informational disease outbreak prevention and risk communication materials (posters and brochures) and working with partners at HealthMap to develop a digital disease detection and monitoring platform of health alerts and events to improve situational awareness of potential infectious disease threats.

Nepal

9 Dec 2015 - PRO/SOAS> Mushroom poisoning (02) - Nepal (MM)

7 Dec 2015 - Sikyong expresses concern over increasing Hepatitis cases in the .

15 Nov 2015 PRO/AH/EDR> Rabies Nepal (06) human susp. long incubation, RFI

22 Oct 2015 Nepal reports scrub typhus cases BioPrepWatch

21 Oct 2015 PRO/SOAS> Scrub typhus Nepal (02) (Kathmandu)

Photo 2. PREDICT Nepal health alert monitoring platform used for real-time situational awareness following the earthquake. The site is publicly available at: *http://www.healthmap.org/nepal/*

रोग बाट

आफ्नो
परिवारको
समुदायको

सुरक्षा

गर्न हुने

☑ खाना खानु अघि र दिसा गरे पछि अनिवार्य रुपमा साबुन पानीले राम्रोसँग हात धुने, खाना पकाउदा तथा भाडा धुदा सफा पानीको प्रयोग गर्नुहोस् ।

☑ सिल भएको, उमालिएको, निर्मलीकरण वा सोडिस गरिएको पानी मात्र पिउनुहोस् ।

☑ राम्ररी पाकेको खानेकुरा, म्याद ननाघेको र सिल बन्द गरिएका तयारी खानेकुरा खानुहोस् ।

☑ बिसन्चो भएमा तुरुन्तै नजिकको स्वास्थ्य संस्थामा सम्पर्क गर्नुहोस् ।

☑ खोक्दा, हाच्छ्यु गर्दा मुख छोप्ने वा उपलब्ध भएमा (मास्क) को प्रयोग गर्नुहोस् ।

गर्न नहुने

☒ खाना खाने र पकाउने स्थान वरपर पशु पन्छीलाई आउन नदिनुहोस् ।

☒ घर वा अस्थायी वसोवास स्थान वरपर पशु पन्छीहरुलाई आउन नदिनुहोस् ।

☒ बिरामी वा मरेका जनावर हरुलाई जथाभावि छुने वा खाने कार्य नगर्नुहोस् ।

☒ लामखुट्टे र अन्य किराहरुलाई वासस्थान वरपर आउन नदिनुहोस् ।

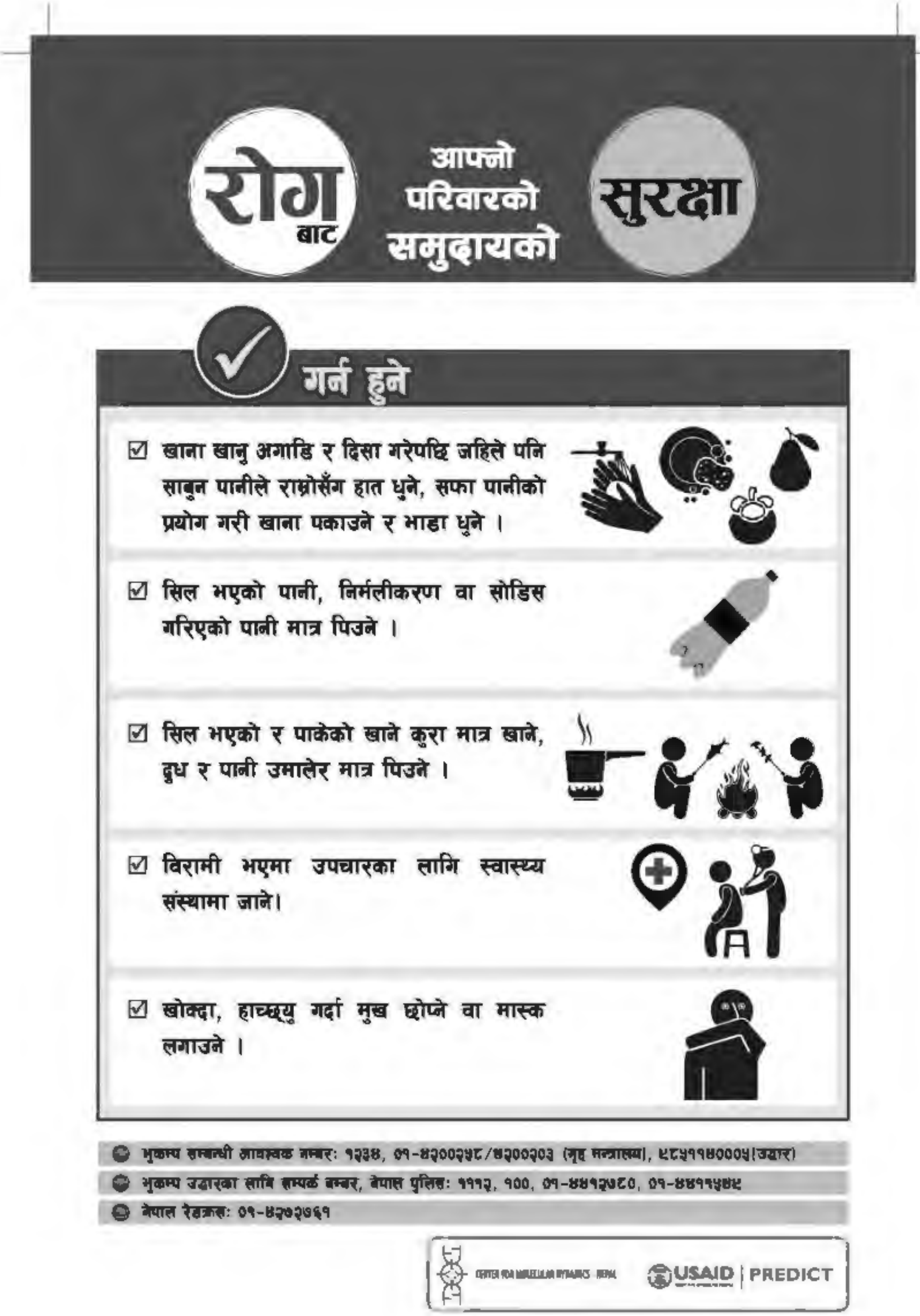
☒ खुला ठाउँमा जताततै दिसा पिसाव नगर्नुहोस् ।

☎ भुकम्प सम्बन्धी आवश्यक नम्बर: १२३४, ०१-४२००२५८/४२००२०३ (गृह मन्त्रालय), ९८५११४०००५(उद्धार)

☎ भुकम्प उद्धारका लागि सम्पर्क नम्बर , नेपाल पुलिस: ११११, १००, ०१-४४१२७८०, ०१-४४११५४९

☎ नेपाल रेडक्रस: ०१-४२७२७६१

Photo 4. Poster used for infectious disease risk communications in communities affected by the Nepal 2015 earthquake.



रोग बाट

आफ्नो परिवारको समुदायको

सुरक्षा

गर्न हुने

☑ खाना खानु अगाडि र दिसा गरेपछि जहिले पनि साबुन पानीले राम्रोसँग हात धुने, सफा पानीको प्रयोग गरी खाना पकाउने र भाडा धुने ।

☑ सिल भएको पानी, निर्मलीकरण वा सोडिस गरिएको पानी मात्र पिउने ।

☑ सिल भएको र पाकेको खाने कुरा मात्र खाने, दुध र पानी उमालेर मात्र पिउने ।

☑ बिरामी भएमा उपचारका लागि स्वास्थ्य संस्थामा जाने।

☑ खोक्दा, हाच्छ्यु गर्दा मुख छोप्ने वा मास्क लगाउने ।

☎ भूकम्प सम्बन्धी आवश्यक नम्बर: १२३४, ०१-४२००२५८/४२००२०३ (गृह मन्त्रालय), ९८५११४०००५(उद्धार)

☎ भूकम्प उद्धारका लागि सम्पर्क नम्बर, नेपाल पुलिस: १११२, १००, ०१-४४१२७८०, ०१-४४११५४९

☎ नेपाल रेडक्रस: ०१-४२७२७६१

CENTER FOR MOLECULAR DYNAMICS NEPAL USAID | PREDICT

Photo 5. Leaflet used for infectious disease risk communications in communities affected by the Nepal 2015 earthquake.

USAID | PREDICT
FROM THE AMERICAN PEOPLE

2016 ANNUAL REPORT

USAID FROM THE AMERICAN PEOPLE · UC DAVIS VETERINARY MEDICINE One Health Institute · WCS · EcoHealth Alliance · METABIOTA · Smithsonian Institution

REDUCING PANDEMIC RISK, PROMOTING GLOBAL HEALTH, SUPPORTING THE GLOBAL HEALTH SECURITY AGENDA

USAID | PREDICT
FROM THE AMERICAN PEOPLE

TABLE OF CONTENTS

ON THE COVER

The wildlife-livestock-human interface in Ghana

Mona monkeys (*Cercopithecus mona*) and sheep feed on discarded corn cobs/husks immediately adjacent to a home in Boabeng Village near the Boabeng-Fiema Monkey Sanctuary. The monkey (far left) is climbing on laundry drying in the sun. The monkeys come into the village daily to feed, freely enter peoples' homes, eat from their kitchens, and feed alongside livestock in the fields and in the forest. In addition, pigs form the village forage in the sanctuary each morning and reportedly consume monkey excreta. Tourists also feed the monkeys, a practice discouraged by the Government of Ghana's Wildlife Division and sanctuary staff. This dynamic interface is representative of many locations where PREDICT is targeting zoonotic disease surveillance activities as these practices pose potential risks for viral spillover and spread. In Ghana, PREDICT is working with the Wildlife Division and other government partners to sample these animals, people in these communities, and to conduct behavioral risk investigations to better understand practices that may be associated with transmission of zoonotic diseases.
Photo: Terra Kelly, PREDICT/Ghana

USAID | PREDICT

FROM THE AMERICAN PEOPLE

2016 ANNUAL REPORT

Global Health Security Agenda

USAID | PREDICT
FROM THE AMERICAN PEOPLE

Global Health
Security Agenda

Supporting the Global Health Security Agenda in Africa and Asia

PREDICT is working to strengthen global capacity for detection and discovery of zoonotic viruses with epidemic and pandemic potential, including the Ebola, influenza, and Zika viruses that have been recent causes of devastating disease and necessary impetuses of dramatic and resource-intensive responses. The project is actively and diligently implementing GHSA activities in target countries aimed at developing and operationalizing strategies to improve disease management efficiencies in the short term and reduce zoonotic pathogen spillover, amplification, and spread in the long term, through improved public health policies and risk-reducing mitigation efforts. In every country of engagement, we work hand-in-hand with governmental and non-governmental stakeholders to develop and implement activities that are tailored to country and regional priorities and specifically designed to strengthen capabilities and ensure lasting positive effects from our engagements.

Using the One Health approach to improve capacity for **zoonotic disease** management and **surveillance** in a cross-sectoral manner and enable early detection of known and emerging disease threats, PREDICT is making significant contributions to strengthen **biosafety and biosecurity**, **national laboratory systems**, and **reporting** efficacy in all engagement-countries, while also improving the stability of these systems through One Health **workforce development**.

USAID | PREDICT   UC DAVIS VETERINARY MEDICINE   WCS   EcoHealth Alliance   METABIOTA   Smithsonian Institution

http://predict.global | predict@ucdavis.edu

PREDICT aims to significantly contribute to the fulfillment of GHSA's vision of "a world safe and secure from global health threats posed by infectious diseases" (http://GHSAgenda.org). To that end, we present an overview of our commitment to GHSA's vision and action packages. This section is followed by country reports highlighting successes, progress, and achievements from each of PREDICT's 21 GHSA member countries over the course of 2015-2016.

PREDICT GHSA Phase 1 and 2 countries

USAID/PREDICT is working with the ministries of health, agriculture, and environment and local university and non-governmental organization partners in 21 GHSA countries (13 in Africa and eight in Asia) to help achieve collaboratively-identified milestones targeting enhancements to national, regional, and global health security systems. While implementing zoonotic disease identification, management, and surveillance activities, we are also improving capacity for investigating the behaviors, practices, and ecological and biological factors driving zoonotic disease emergence, transmission, and spread.

PREDICT Support for GHSA's Vision, Action Packages, and Milestones

PREDICT is working with in-country government partners to strengthen multi-sectoral partnerships and collaborations that will enable rapid detection and response capabilities for zoonotic pathogens in animals and people.

Zoonotic Disease & Real-time Surveillance

Spillover of zoonotic diseases from animals, particularly wild animals, into humans occurs far more frequently than most public health systems currently recognize. Furthermore, well-characterized public health threats often have wild animal sources and spillover mechanisms that go largely undetected, impeding evidence-based policies and practices needed to mitigate zoonotic threats. Zoonotic disease detection in wild animals is still in the earliest stages of development on a global scale, as this sector is often the last to receive public investment in resource-limited countries, particularly when there are still obvious gaps in surveillance for public health and livestock disease. Through implementing partnerships in 21 GHSA countries, the USAID/PREDICT program rapidly strengthens zoonotic disease detection capabilities, not only establishing critically needed zoonotic disease detection capacity in wildlife, but also developing a comprehensive One Health approach to zoonotic disease detection and surveillance, in which zoonotic diseases are detected in the situations in which they are shared between animals and humans, where interventions are most needed, prior to efficient human-to-human spread. This transboundary operational framework incorporates national and international standards to establish One Health best practices all the way from sampling in the field to testing in the laboratory and sharing data on collaborative platforms – every step of which is ultimately needed to identify zoonotic diseases develop surveillance plans and inform on One Health policies and practices that can limit their amplification and spread.

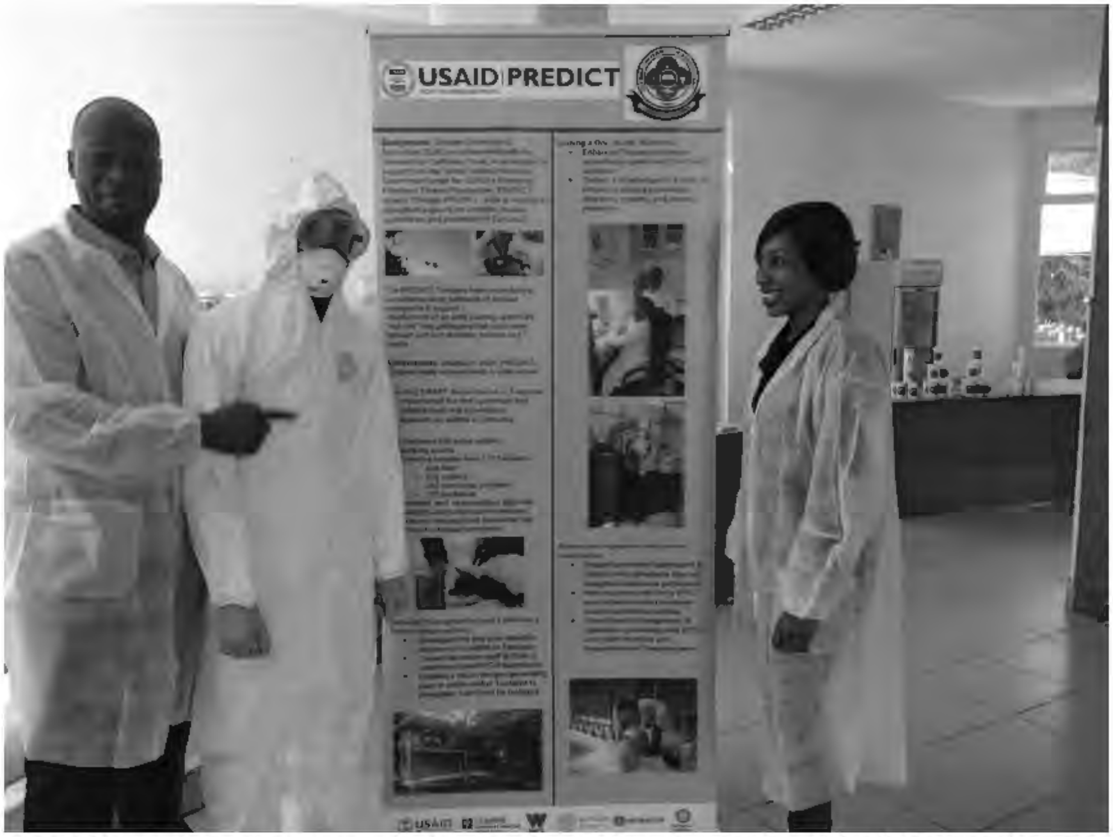
SAMPLED 15,000+ at-risk people, livestock, and wildlife at human-animal interfaces with high-risk and opportunity for viral spillover since 2014.

Since 2014, PREDICT teams have collected samples from over 15,000 individuals in GHSA member countries through surveillance activities designed to enhance national surveillance systems by targeting high-risk human-animal interfaces for viral spillover, amplification, and spread.

PREDICT has established an international framework of partnerships, including experts from the 21 GHSA countries where we work, who have contributed to standards in zoonotic disease surveillance, including animal handling, human behavioral risk characterization, concurrent sample and data collection from animals and humans, virus identification, and data sharing for collaborative zoonotic disease detection. PREDICT is using this One Health framework for zoonotic disease detection and surveillance with implementing partners in all GHSA countries. Zoonotic disease detection and surveillance activities are designed to span wild animals, livestock (in collaboration with FAO), and at-risk humans as appropriate to identify viral sharing at sites representative of circumstances promoting zoonotic disease emergence and spread. Patients with undiagnosed fevers of likely viral origin are targeted for screening for viruses of pandemic potential to further the recognition of zoonotic threats in these high-risk communities. Concurrently collected epidemiologic and behavioral risk data is being used to identify cross species viral transmission and to provide evidence for mechanisms and practices facilitating zoonotic disease emergence and spread. One Health platforms in national governments are being engaged in dissemination of findings and development of next steps for zoonotic disease detection and mitigation.

Biosafety and Biosecurity

Initial site visits and facility, equipment, and personnel capacity is assessed by the PREDICT project to determine if potential field and laboratory partners can safely and securely collect human and animal samples, transport them to laboratories, and perform testing to detect known and newly emerging pathogens. The sample collection and testing platforms that the project uses have some specific equipment and skills needs, but there is also much overlap in needs to successfully and safely perform tasks being implemented by ministries and other partners in support of GHSA milestones. The best practices and training that PREDICT provides are directly increasing overall biosafe and secure capacity. Guidelines are assessed and improved, as needed, to safely handle biological samples during collection, transport, storage, preparation, and testing; to enable appropriate disposal of chemicals and biowaste; and where possible to introduce practices to use more environmentally friendly laboratory reagents. PREDICT is also trying to understand and, where necessary, improve the in-country processes for reporting and transfer of samples that test positive for select agents in each country, to ensure biosafety and security, as well as compliance with international standards. This process has initiated a much-needed dialogue in many countries to identify laboratories with adequate biosafe and secure facilities to receive and archive these samples.



PREDICT/Tanzania staff demonstrating biosafety and PPE to government staff, ministry members, and local stakeholders at the *Nane Nane* Agricultural Fair in Morogoro. At the fair, the PREDICT team briefed representatives from national labs including the Prime Minister on lab safety, biosafety, and biosecurity practices in place at the Sokoine University of Agriculture lab, which serves as an important training center for Tanzania's animal and public health workforce. Photo: PREDICT/Tanzania

PREDICT is targeting 49 laboratories for training and zoonotic viral detection in the 21 GHSA countries in which we work to perform viral family testing on samples from animals and humans. Thus, initial benchmarks are being measured by the number of laboratories with laboratory safety and training protocols in place, including completion of the PREDICT Policies and Plans, Emergency Preparedness, Biosafety and PPE Use, Basic Laboratory Safety, and Outbreak Involvement Guidance training guides and quizzes; and the Environmental Management and Mitigation Report (EMMR). A second benchmark is the compilation of the select agent reporting and process for transfer of samples for safe archiving for participating laboratories to follow, when the situation arises.

DEVELOPING & OPTIMIZING

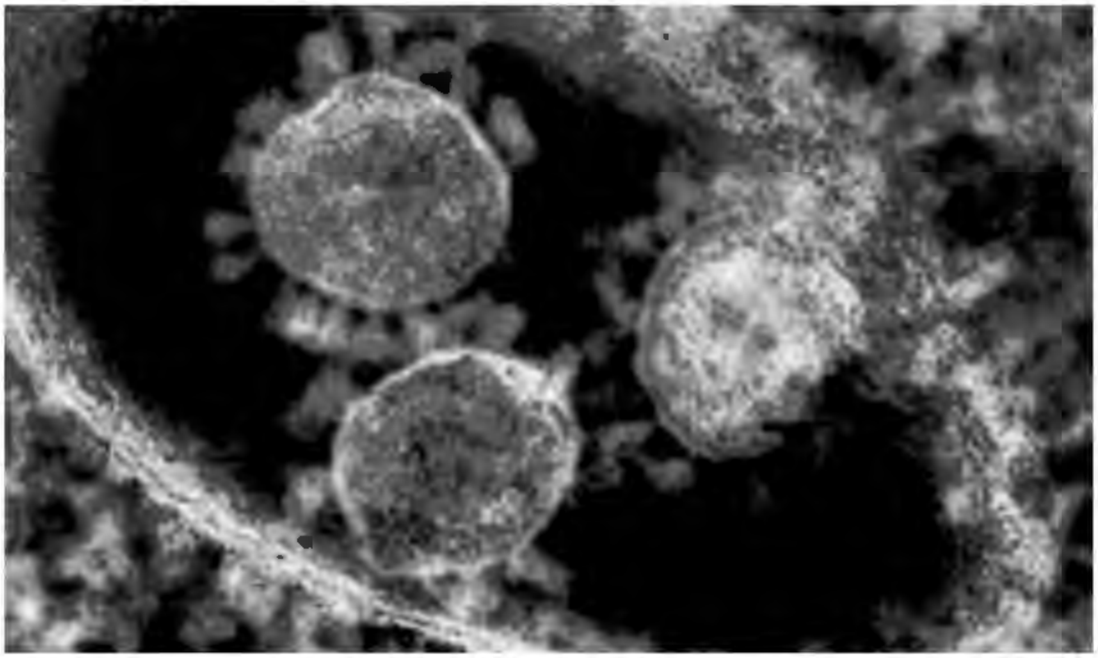
low-cost methods for the detection of viral threats with 49 labs in GHSA countries around the world.

Lab Strengthening Systems

The main approach that PREDICT uses for zoonotic pathogen detection and discovery is broad-level laboratory testing for potentially pathogenic viruses within a particular taxonomic group (family or genus) of viruses – and in so doing allows the ability to not only detect and identify known and new agents belonging to a particular group, but also allows the detection of known viruses that may have mutated making traditional tests no longer able to detect them. It is critical for a country to have the capacity to detect known, new, as well as changing viruses, in order to be truly prepared to detect and surveil for zoonotic diseases.

We are addressing a global challenge to develop and implement a framework for laboratory testing that can be used in multiple specimen types across many host species and to obtain results that can be comparable across host species, laboratories, and regions. Many laboratory assays are designed to detect specific agents and are therefore often more sensitive for detecting those specific agents. However, when specific assays are unavailable or have failed to produce a positive result, viral family testing can be incorporated into laboratory investigations, as they have ability to produce high-resolution data while casting a wide net for potential pathogens. Employing these methods in concert with more traditional ones in human and animal health laboratories allows for the opportunity to test all sample types from all host species, leading to a more sustainable approach to detect new and shared pathogens and diagnosis of mystery illnesses affecting multiple hosts. Thus the USAID/PREDICT project brings an important additional tool to the support of in-country laboratories.

DETECTING viruses in animals and humans, including Ebola, influenza, and SARS – the most comprehensive viral detection and discovery effort to date.



Colorized transmission electronic micrograph showing particles of MERS coronavirus. Credit: NIAID

Basic laboratory capacity, needed to implement PREDICT viral family testing, is similar to and directly transferable for implementing testing for specific pathogens. Thus training and continued mentoring provided by PREDICT, including for sample handling, preparation, testing, and result interpretation, provides important basic training that improves general laboratory capacity for personnel not familiar with molecular techniques and provides reinforcement training for others. Of the 49 targeted laboratories, 26 include national public health and national veterinary laboratories, with the majority still requiring training and/or support for optimal implementation of viral testing. Thus initial benchmarks are being measured by the number of laboratories receiving training, the number of laboratories initiating testing for one viral family, and the number of laboratories performing testing for a minimum of five viral families.

Reporting

Central to the effective protection from the global threats of infectious diseases is the sharing of information and coordination of disease reporting across sectors via multi-sectoral technical working groups. PREDICT has an active and operational system for disease reporting and has taken steps to bolster coordination of disease reporting across sectors, We are continuing to work with ministry partners to enhance information and reporting flows across human and animal health sectors and encourage dialogue concerning potential zoonotic disease threats.

PREDICT is working to ensure that government ministries and local stakeholders continue to receive data and information from zoonotic disease detection and surveillance activities, including results and insight from activities conducted within specific countries and throughout regions. Integrated One Health teams from the public health and animal sectors are receiving training in information management and data sharing and are working with stakeholders to make information on disease threats (including digital disease intelligence) accessible for use in decision-making. PREDICT teams are also providing information and briefings to public and animal health sectors on current and future zoonotic disease risks for use in surveillance prioritization. Provided data and insight will enhance in-country and regional situational awareness of zoonotic disease threats.

D.R. CONGO

The known orthopox virus, Monkey pox, was found in 1 Red-tailed guenon (*Cercopithecus ascanius*). The samples were collected in Dec 2010.

This is the known orthopox virus Monkey pox found in Black-cheeked white-nosed monkeys. Monkey pox is a zoonotic disease that is transmitted to humans from rodents pets and non-human primates.

data.predict.global

Workforce Development

Global workforce development to support the Global Health Security Agenda is integrated across the entire PREDICT project. In-country partner organizations include both government units, as well as universities, to help ensure sustainability for training multi-disciplinary and multi-sectoral teams. Strengthening the human resources in each developing country and region by training in-country scientists, professionals, and ministry personnel is a high a priority for the USAID/PREDICT project and is implemented primarily through in-service training that takes advantage of the ongoing activities associated with fieldwork, laboratory testing to identify known and new pathogens, data and epidemiologic analyses, outbreak response, and reporting/outreach to train personnel. In addition to core field and laboratory teams composed of primarily in-country staff that receive ongoing training for capacity strengthening and workforce development, additional pre- and in-service trainees, often ministry personnel, are invited to participate in focused training sessions and workshops with USAID/PREDICT teams, and PREDICT personnel are encouraged to analyze data and present results at scientific conferences, as well as building their scientific writing skills to publish findings in peer-reviewed publications over the course of the project as opportunities allow. The USAID/PREDICT program has developed a series of training guides, assessment quizzes, and standard operating procedures that are used to train personnel on key knowledge and skills. Once the theoretical mastery is apparent, participants are also trained and evaluated in an on-the-job setting to incorporate best practices into their tasks and activities.

TRAINED 650 government personnel, physicians, veterinarians, resource managers, laboratory technicians, and students in One Health workforce skills since 2014.

Since 2014, PREDICT has trained over 650 individuals in GHSA member countries in skills critical to performing zoonotic disease surveillance and viral detection activities including biosafety, safe sampling of animals and people, behavioral risk investigations, safe sample transport and storage, laboratory safety, and detection of known and emerging viral threats.

PREDICT aims to enhance capacity strengthening activities and workforce development using a train-the-trainer approach to expand the GHSA reach. Now that core PREDICT teams are trained and active in most target countries, they are well-positioned to use their highly competent team members to conduct additional workshops and training sessions that are complementary to ongoing field, laboratory, and data analysis activities that will help to bring training to the front lines of zoonotic disease spillover and detection, as well as surveillance. High-priority training resources have been made publicly available (http://pubications.predict.global). Specific occupational groups are being targeted to include veterinarians, public health personnel, epidemiologists, and other animal health professionals.

The ongoing training of developing country and regionally-targeted scientists using a One Health approach is building a globally-networked community of health professionals who are trained on the same methods for field activities, laboratory testing, data analysis, and outbreak response. This global network of health professionals is gaining key skills and also confidence in their abilities to detect, respond to, and prevent outbreaks of known and newly emerging pathogens. They are breaking down administrative barriers to create multi-sectoral platforms that are better prepared to respond to emerging needs that threaten global health security.

The in-service One Health training approach, utilized by the PREDICT project has strategically complemented other global workforce development efforts that focus on academic training through university degrees. Most of the PREDICT country teams have trained and hired in-country personnel that were previously involved with academic training or internship programs, successfully launching these new graduates into highly respected career tracks of public health and animal health professionals. Some of these promising young in-country scientists are finding their niche in field or laboratory team settings, while others have moved up into programmatic and governmental positions that are also critical to promoting a One Health approach that will be adaptive to emerging global health security agenda needs.

GHSA TRAINING SUMMARY

STRENGTHENING THE ONE HEALTH WORKFORCE

Since the start of activities in October 2014, **PREDICT teams around the world have trained 913 individuals** (including **447 governmental personnel**, **329 in-service professionals**, and **137 students**) **in GHSA countries**, supporting the development of an extensive network of One Health professionals and improving global health security. From 2015 to 2016, trainings intensified in preparation for launch of field and lab zoonotic disease surveillance activities with the number of trained individuals increasing by 169% (from 339 in 2014-2015 to 574 over the past year). Trainings to date covered a variety of critical skills for the One Health workforce, including biosafety, field epidemiology and surveillance, data and information management, laboratory safety and viral detection, social sciences and behavioral risk investigations, and modeling and analytics.

Descriptions of these trainings are provided below; for details on trainings completed in each country please see *the GHSA country reports that follow.*

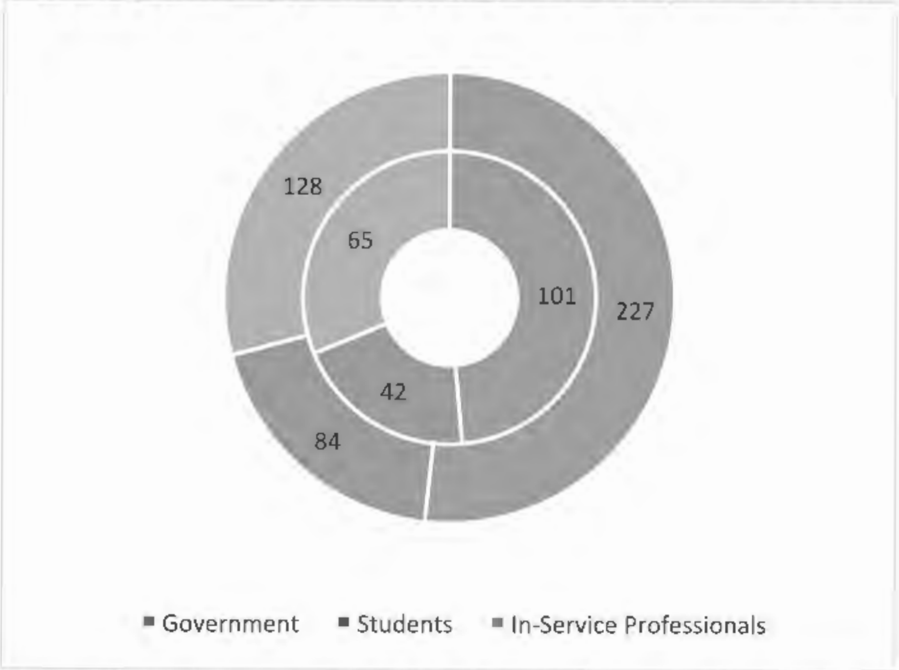
Total Number of Individuals Trained (October 2014 – November 2016)

	Total # of Individuals	Government Personnel	In-service Professionals	Students
Women	208	101	65	42
Men	439	227	128	84
Undeclared	17		17	
Total to Date	**664**	**328**	**210**	**126**
2015-2016 Total	**355**	**138**	**133**	**84**
Increase from 2014-2015*	**115%**	**72%**	**172%**	**200%**

**Includes PREDICT staff.*

Note: Some individuals are represented in more than one category (e.g., Students and In-service Professionals).

NUMBER OF MEN AND WOMEN TRAINED, BY SECTOR



Number of men (outer ring; N = 439) and women (inner ring; N = 208) trained by sector since the start of PREDICT-2 activities in 2014. Seventeen individuals of undeclared gender, all in-service professionals, are not shown in the figure.

Note: Training event totals for Malaysia in this chart are separated by Peninsular Malaysia (Mal-Penn) and Sabah (Mal-Sabah) for consistency with training totals in the corresponding GHSA country report.

TRAINING EVENTS COMPLETED BY COUNTRY (2014-2016)

Country	Total Trainings	# Trainings by Government Personnel	# Trainings by Women	# Trainings by PREDICT staff	# Trainings by Students
Bangladesh	100	23	20	6	76
Cambodia	10	2	2	5	
Cameroon	40	11	13	9	14
Cote d'Ivoire	10	4	2	4	1
DRC	89	67	39	12	5
Ethiopia	2			2	1
Ghana	3	3		3	
Guinea	26		1	16	
Indonesia	31	18	14	7	1
Jordan	7	2	1	4	
Kenya	4	4		3	
Laos PDR	19	15	7	4	
Liberia	14		6	8	
Malaysia	74	71	21	1	
Rwanda	5		1	3	2
Senegal	7	4			
Sierra Leone	49	17	12	41	
Tanzania	36	1	27	13	18
Thailand	27		8	9	
Uganda	9		4	2	6
Viet Nam	102	86	30	5	

Total number of trainings completed since the start of PREDICT-2 activities in October 2014 up to November 18, 2016. Individuals may be represented in multiple columns per row. Totals for Malaysia are consolidated in this table.

USAID | PREDICT
FROM THE AMERICAN PEOPLE

Global Health
Security Agenda

SUPPORTING THE GLOBAL HEALTH SECURITY AGENDA IN CAMEROON

Zoonotic Disease: Through the GHSA, Cameroon has the opportunity to build on previous achievements by working to strengthen the National Program for Zoonoses and to continue development of the One Health National Strategy. In this first year of GHSA activities, PREDICT contributed to work by Cameroon's joint ministry committee and technical advisors to select priority zoonotic diseases, which include avian influenza and viral hemorrhagic fevers caused by the filoviruses, Ebola and Marburg. Additionally **PREDICT helped successfully operationalize and implement Cameroon's One Health National Strategy** by conducting zoonotic disease surveillance in wildlife and livestock populations and initiating investigations into behavioral risks for zoonotic disease transmission. This year, **PREDICT collected samples from 1,144 animals in Cameroon** (402 bats, 551 rodents, 93 non-human primates, and 98 samples from other species) at high-risk human-animal interfaces for zoonotic disease transmission and began testing samples for known and emerging viral threats.

Lab Strengthening Systems: Cameroon's national laboratory network has very advanced capabilities for rapid pathogen detection due in large part to exemplary facilities, such as the Ministry of Defense/Centre for Army Health Research (CRESAR). These laboratories integrate well with the national animal and public health surveillance systems, and their capabilities have been tested repeatedly in recent years by multiple zoonotic disease outbreaks of public health concern (e.g. monkeypox, high-pathogenic avian influenza, yellow fever). This year, **PREDICT worked with CRESAR**, our implementing lab partner, to strengthen capability for rapid detection of a variety of potential disease threats including providing **technical assistance during an H5N1 outbreak** in poultry and by providing assistance to CRESAR staff to **diagnose monkeypox** during an outbreak in chimpanzees.

PREDICT/Cameroon staff assist during wildlife sampling training in Lao PDR. Photo: Matthew LeBreton/Mosaic.

Workforce Development: A well-trained and equipped workforce is critical for health security and for emergency and disaster management and response. This year, PREDICT conducted a number of trainings in Cameroon, making critical contributions to strengthening the One Health workforce for improved global health security. To date, **40 individuals have received in-service training in One Health skills** in Cameroon including 11 government personnel and 14 students, part of tomorrow's One Health workforce.

Additional details and highlights from PREDICT's 2015-2016 activities in Cameroon are provided below and linked to corresponding GHSA Road Map Action Packages and milestones.

Zoonotic Disease Action Package

Milestone: High-risk human/animal interfaces (i.e. "value chains," land use change, etc.) mapped

Surveillance for Priority Zoonotic Diseases and Pathogens

This year, PREDICT continued efforts to map Cameroon's high-risk human/animal interfaces, collecting samples from a total of 1,144 animals (402 bats, 551 rodents, 93 non-human primates, and 98 samples from other species) and initiating viral testing of these samples for known and emerging viral threats using techniques that can detect zoonotic diseases of greatest concern to public health in Cameroon, such as influenza and the filoviruses, Ebola and Marburg.

PREDICT conducted surveillance activities with staff from the Ministry of Environment, Nature Protection and Sustainable Development, the Ministry of Forestry and Wildlife and the Ministry of Livestock, Fisheries, and Animal Industries in the South region of Cameroon where there is significant landscape change associated with the ongoing construction of a hydroelectric dam, expansion of agro-industrial plantations, and expanding livestock production. Samples were collected in Ebolowa, Sangmelima, Djoum, Meyomesalla and Nyabissan.

Focusing on human-animal interfaces in local bushmeat markets, where people are exposed through handling and butchering of animal carcasses and in and around houses where people are at risk through food contamination and exposure to urine and feces, PREDICT collected 3,771 samples from 898 wild animals. All samples were transferred to our partner laboratory CRESAR in Yaoundé for viral testing using techniques that can detect priority zoonotic diseases of public health concern along with emerging viral threats.

Zoonotic Disease Action Package

Milestone: One Health workforce trained in accordance with One Health National Strategy

Strengthening the One Health Workforce

PREDICT continued providing in-service training for health professionals in Cameroon, including government staff from the Ministry of Livestock, Fisheries and Animal Industries (MINEPIA) and the Ministry of Forestry and Wildlife (MINFOF) from the central, regional, divisional, and sub-divisional levels in wildlife surveillance activities and providing on-the-job training in One Health skills and animal capture and sampling during PREDICT field work. This training and experience is increasing the capacity of these institutions to undertake wildlife capture and sample collection for zoonotic disease surveillance, including two of the pathogens prioritized in Cameroon: filoviruses and influenza viruses. In addition, PREDICT worked with government staff to improve occupational health for One Health field investigations, providing rabies vaccinations to permit safe handling of bats.

In support of strengthening regional networks in West Africa and beyond for improving global surveillance of zoonotic disease threats, PREDICT/Cameroon team members travelled to Cote d'Ivoire, Guinea, and Laos to provide training support to new surveillance teams. PREDICT/Cameroon personnel provided training in protocols for biosafety and biosecurity, animal capture and sampling, and sample management and also assisted PREDICT/Sierra Leone staff in the training of government of Sierra Leone and local community collaborators to enhance field skills and learn protocols for biosafety, animal capture and sampling, and cold chain for the Ebola Host Project, which is investigating potential animal hosts for Ebola virus in the countries most affected by the West Africa Ebola outbreak. FAO partners were included in the training sessions in Laos, Guinea, and Sierra Leone.

Subdivisional delegate for Ministry of Livestock, Fisheries, and Animal Industries recording PREDICT specimen data (left). Ministry of Forestry and Wildlife representative for the National Zoonosis Program preparing tubes for specimen collection in Meyomessala (right). Photos: Joseph Diffo, PREDICT/Cameroon.

In addition, PREDICT/Cameroon organized and hosted a week of training exercises and exchanges with the PREDICT/Gabon team (April 6-13, 2016). Training sessions covered protocols for biosafety, animal sampling techniques, viral testing, and information management. The PREDICT teams also worked together to review findings from site reconnaissance in Gabon and help refine targeted surveillance plans. The teams also visited the Gabonese Embassy in Cameroon to inform the Ambassador of the objectives and implementation of PREDICT, the collaborative relationship between the teams in Gabon and Cameroon, and to advocate for multi-sectoral coordination and use of the One Health approach to zoonotic disease surveillance in Gabon.

PREDICT continued to promote the One Health approach in Cameroon through capacity-building activities including lab and pre-service trainings for tomorrow's One Health workforce. PREDICT provided molecular biology training to CRESAR laboratory interns, including10 master's degree students from the Catholic University of Cameroon, two PhD students from the University of Yaoundé I, and a staff member from the Ministry of Defense. A veterinary graduate student from the University of Ngaoundere also participated in an internship and was involved in outbreak response coordination meetings, completed trainings, and assisted PREDICT staff in planning and reporting activities.

PREDICT and CRESAR laboratory staff participated in a training undertaken by US-CDC at CRESAR on techniques for detection of monkeypox using new real time and conventional PCR assays provided by CDC (September 23, 2016). This training was undertaken in response to the detection of recent cases of monkeypox virus infections in chimpanzees at Mfou National Park and increases the laboratory capacity in Cameroon for responding to outbreaks and characterizing the monkeypox virus.

Training Summary

A total of **40 individuals**, including **27 men** and **13 women**, have been trained in Cameroon since the start of PREDICT-2 activities in 2014. Of these, **11 were governmental personnel and 14 were students,** demonstrating PREDICT's commitment to strengthening current and future national capabilities for zoonotic disease surveillance and health security. A number of individuals completed trainings in more than one subject.

Trainings Events by Topic*

Topic	Total Trainings	# Trainings by Government Personnel	# Trainings by Women	# Trainings by PREDICT staff	# Trainings by Students
Avian Sampling	4			3	4
Basic Laboratory Safety	31	8	10	9	31
Bat Sampling	5		1	3	5
Biosafety and PPE	27	8	7	9	27
Bushmeat Sampling	5		1	3	5
Emergency Preparedness	26	8	8	9	26
Human Biological Sampling	3			1	3
Human Syndromic Surveillance	2		1	1	2

Implementing Cold Chain for Safe Sample Transport	7		1	4	7
Information Management	4		1	1	4
Livestock Sampling	1			1	1
Non-Human Primate Sampling	4			3	4
Other (management and administrative trainings)	26	9	7	10	26
Outbreak Response	23	8	8	8	23
Packing and Shipping Biological Samples	5		1	3	5
Policies and Plans	24	6	8	9	24
Qualitative Research and Data Collection	14	1	5	2	14
Rodent Sampling	5		1	3	5
Safe Animal Capture and Sampling	3			2	3
Safe Disposal of Carcasses and Infectious Waste	4		1	3	4
Small Carnivore Sampling	5		1	3	5
Totals	**228**	**48**	**62**	**90**	**228**

*Some individuals were cross-trained in multiple topics. Individuals may be represented in multiple rows per column and multiple columns.

Zoonotic Disease Action Package

Milestone: Continued support to the National Program for Zoonoses to coordinate cross-sectoral engagement and to advance the One Health National Strategy

Multisectoral Coordination to Support Mechanisms for Responding to Zoonotic Diseases

- PREDICT assisted the Ministry of Health in drafting a national contingency plan to improve surveillance and response for Lassa Fever and Zika cases in Cameroon by providing input and advice on the history and ecology of Zika virus to the Ministry of Health staff to inform their ministerial briefings and by coordinating with Centre Pasteur Cameroon to determine the best way to make Zika virus testing available in the country.
- The PREDICT team participated in a National Zoonosis Program (NZP) workshop supported by USAID Preparedness & Response (P&R) on February 8, 2016. This workshop aimed to increase multi-sectoral collaboration in Cameroon by identifying institutional and technical mechanisms of collaboration between human, animal, and environmental disease surveillance, zoonotic disease outbreak investigation, and response systems.
- PREDICT also participated in a National Zoonosis Prioritization workshop convened by the NZP and supported by P&R and US CDC (March 4, 2016), which concluded with the identification of five zoonotic diseases of greatest

concern to public health in Cameroon: rabies, anthrax, influenza, Ebola, and tuberculosis.

- PREDICT coordinated with FAO partners to hold a joint trip to the South Region to examine Emerging Pandemic Threats (EPT-2) surveillance sites, including Ebolowa (September 5-7, 2016). During the trip, the teams presented the GHSA and the USAID EPT-2 program to local authorities and also collected information about the sites related to geography, interfaces and animal production. This joint trip provided an opportunity to brief local partners on joint FAO-EPT and PREDICT surveillance activities. Further, through participation in the FAO-led national consultation meetings (May and June 2016) and through ongoing communication, PREDICT worked to ensure coordination of activities and site selection with FAO in-country, an essential task for implementing One Health surveillance successfully targeting wildlife, livestock, and human populations.
- PREDICT hosted a number of monthly EPT-2 meetings at CRESAR where representatives from P&R, FAO, OHCEA/OHW, and the Metabiota Global Health Security Agenda CDC project exchanged information about current and planned activities of each of the partners in order to align and collaborate on shared activities and objectives.
- PREDICT participated in high-level meetings (May 2016) to discuss the progress and vision of GHSA and PREDICT's supporting role in Cameroon, an integral component to developing and maintaining critical relationships and for garnering government support. Attendees included the Prime Minister, the Minister of Livestock, Fisheries and Animal Industries, the Minister of Environment, Nature Protection and Sustainable Development, the Minister of Higher Education, the Secretary General of the Ministry of Defense, the Secretary General of the Ministry of Forestry and Wildlife, the Director of Disease, Epidemic and Pandemic Control, Director of the National Public Health Observatory, the Administrator of the National Public Health Laboratory, the Director of Military Health, the Deputy Chief of Mission of the US Embassy in Cameroon, the CDC Country Director, and the Centre Pasteur Cameroon.
- PREDICT staff attended quarterly meetings of the South Region Delegation of the Ministry of Forestry and Wildlife (MINFOF) to brief local Ministry staff on disease surveillance activities in the region.
- PREDICT participated in a coordination meeting between the National Zoonosis Program and EPT-2 partners (July 20, 2016), including FAO, Preparedness and Response, One Health Workforce (including representatives from One Health Central and Eastern Africa), and representatives from the Ministry of Livestock, Fisheries and Animal Industries, the Ministry of Forest and Wildlife, the Ministry of Environment, Nature Protection and Sustainable Development, and the Ministry of Higher Education. During the meeting, PREDICT presented the surveillance plan and outlined areas of alignment with the National Zoonosis Program highlighting activities planned to strength the National Zoonosis Program and to promote a cross-sectoral One Health approach.

Lab Strengthening Systems Action Package

Milestone: Continued strengthening of diagnostic capacities of animal labs against agreed upon list of priority zoonotic diseases

Laboratory Testing for Detection of Priority Diseases
PREDICT provided technical support to CRESAR on samples being tested for influenza following a H5N1 outbreak in poultry in Cameroon. Staff provided advice and guidance on sample testing and tested the positive samples using project primers for influenza and other potential causes of mortality such as paramyxoviruses, coronaviruses, and enteroviruses. PREDICT provided support to Cameroon government efforts to combat H5N1 avian influenza in Cameroon by donating personal protective equipment (100 disposable coveralls and 1,000 N95 masks) to the Ministry of Livestock, Fisheries and Animal Industries (MINEPIA) during a period of acute need. Our staff also participated in the national workshop for the preparation of the contingency plan for the Highly Pathogenic Avian Influenza, providing technical input on proposed activities, contributions on previous reports and documents, and knowledge about previous surveillance and existing specimen banks.

PREDICT provided assistance to laboratory staff at CRESAR to diagnose monkeypox in samples from chimpanzees from Mefou National Park. We also provided personal protective equipment to staff at Mefou to enable them to reduce exposure risk when providing care to sick animals. In addition, the PREDICT team and Ministry of Livestock and Ministry of Wildlife staff undertook rapid response surveillance around the chimpanzee enclosures to determine whether rodents in the area were infected with monkeypox virus. Analysis is ongoing for approximately 80 samples collected from four species of rodents.

As part of continuing efforts to assess known and emerging viral threats, PREDICT tested 1,242 oral and rectal swabs collected from bats, rodents, and non-human primates at CRESAR, using techniques that can screen for both novel viruses and detect priority zoonotic diseases of greatest public health concern in Cameroon, such as filoviruses, Ebola and Marburg and influenza. Interpreted results will be shared with government partners for public release.

Approval was received from the Government of Cameroon for the public release of testing data from samples collected between 2009-2014. Results are from a total of 2,048 samples collected from 1,092 animals at high-risk animal-human interfaces including 639 bats, 148 non-human primates, and 304 rodents and shrews. Samples were tested for up to 15 viral families including those that are considered priority zoonotic disease threats like Filoviruses and influenza viruses. All results will be available on the PREDICT's data sharing site (http://data.predict.global).

Additionally, PREDICT contributed to a manuscript reorganizing the Arterivirus family, which was based in part on samples collected and analyzed as part of PREDICT-1 activities (2009-2014). "Reorganization and expansion of the Nidoviral family Arteriviridae" was shared with the government and published in (2016) *Archives of Virology,* 161(3).

SUPPORTING THE GLOBAL HEALTH SECURITY AGENDA IN CÔTE D'IVOIRE

Zoonotic Disease: PREDICT is working with local university and government partners to strengthen capacity to conduct pathogen identification and zoonotic disease detection for both novel and known threats, including Ebola, influenza, yellow fever, and Zika virus, at high-risk wildlife-livestock-human interfaces near protected areas and along the animal value chain identified with local partners as priority areas for strengthening the national surveillance system. Additionally, PREDICT is contributing expertise for the strengthening and operationalization of One Health platforms to facilitate improved zoonotic disease detection and surveillance in-country. This year, PREDICT focused on building the foundations for successful launch of zoonotic disease surveillance activities: **establishing One Health partnerships, obtaining permissions, and strengthening capacities in biosafety, safe animal and human sampling, viral detection, and methods for behavioral risk investigations**.

PREDICT training with partners from Laboratoire d'Appui au Développement Agricole (LANADA) and the Institute Pasteur du Côte d'Ivoire (IPCI). Photo: Beth Edison/PREDICT.

Lab Strengthening Systems: Côte d'Ivoire's national laboratory network is equipped for detection of many known pathogens, and there are opportunities for information sharing between animal and human health laboratory networks through developing multi-sectorial communication channels. However, capabilities are in need of strengthening for detection of novel viruses and pathogens not expected to be in the country. This year, PREDICT's collaborating partners the Laboratoire d'Appui au Développement Agricole (LANADA) and the Institute Pasteur du Côte d'Ivoire (IPCI), key reference labs integrated within the broader national laboratory network and animal and public health surveillance systems, **completed capacity assessments and developed plans to address capacity gaps in preparation for launch of viral detection activities**.

Workforce Development: A well-trained and equipped workforce is critical for health security and for emergency and disaster management and response. This year, PREDICT conducted a number of trainings for the Côte d'Ivoire team with the help of PREDICT/Cameroon and DR Congo staff and our global network of One Health experts. **Ten individuals have been trained to date** through instruction and field-based training sessions covering ethics, biosafety, safe animal capture, handling, and sampling, lab safety, and safe sample storage and transport. As a result, **PREDICT/ Côte d'Ivoire is well prepared for launch of zoonotic disease surveillance activities in the upcoming year**.

Additional details and highlights from PREDICT's 2015-2016 activities in Côte d'Ivoire are provided below and linked to corresponding GHSA Road Map Action Packages and milestones.

Zoonotic Disease Action Package

Milestones: National prioritization of zoonotic diseases; One Health stakeholders strategically identified and a mechanism for multi-sectoral coordination established, aligned with a common mission statement; Assist the government of Côte d'Ivoire by providing preparedness and response support for zoonotic disease outbreaks and technical assistance with investigations of outbreaks of unknown origin

Multisectoral Coordination to Support Mechanisms for Zoonotic Disease Surveillance and Preparedness and Response for Zoonotic Disease Outbreaks

- PREDICT met with the FAO EPT-2 Côte d'Ivoire focal point to share an overview and updates on the project and to work toward establishing ongoing coordination of zoonotic disease surveillance activities (September 9, 2016). Coordinating sites and timing of PREDICT wildlife and human surveillance with FAO livestock surveillance will provide a better understanding of viral transmission between populations.
- PREDICT attended a World Health Organization-hosted disease outbreak response simulation exercise (September 21-22, 2016) in Grand Bassam alongside the Ministry of Animal Production and Fisheries, Direction des Services Vétérinaires; Institut Pasteur Côte d'Ivoire (PREDICT's human lab partner); Laboratoire National d'Appui au Developpement Agricole (PREDICT's animal lab partner); P&R; FAO; USAID; and the Institut National d'Hygiene Publique. The workshop facilitated stakeholder assessment of capacity levels and coordination of national laboratories for management of health crises by identifying gaps during an outbreak response along with proposed solutions.

Zoonotic Disease Action Package

Milestone: High-risk human-animal interfaces (i.e. "value chains, land use change, etc.) mapped

Surveillance to Detect and Discover Zoonotic Viral Threats in Animals and People

PREDICT continued to plan and conduct scoping visits to Taï National Park, Banco National Park, and Marahoué National Park, submitting permit requests to the Ministry of Public Health for human syndromic surveillance at health facilities and to the Ivorian Park and Reserve Office (OIPR) to support animal sampling at each site. Scoping visits support the surveillance plan developed with in-country partners and help build capacity and multisectoral coordination by using a One Health approach across the national, regional, and community levels. PREDICT/Côte d'Ivoire utilized the One Health approach when planning and implementing all scoping visits, incorporating members from both the human and animal health divisions. Team members from LANADA and IPCI participated in both planning and implementation. When in the field, PREDICT also engaged with regional agriculture, forestry, and health government officials, ensuring capacity building at the field site level, as regional government officers have and will continue to participate in scoping and sampling visits. Finally, PREDICT engaged at the community level at each site, meeting community-level stakeholders to present the project and recruit community liaison officers.

Additional scoping visits are planned for November 2016 (following authorization for animal sampling); in addition to conducting further in-depth assessments of all three surveillance sites, upcoming visits will include site scoping for animal sampling activities and for health facilities where syndromic surveillance will take place.

Lab Strengthening Systems Action Package

Milestone: Labs identified for strengthening of diagnostic capacities against agreed upon list of priority zoonotic diseases

Laboratory Testing for Detection of Priority Diseases

PREDICT/Côte d'Ivoire, PREDICT/Cameroon's country coordinator and virologist from the global team visited the Institut Pasteur Côte d'Ivoire (IPCI) and the Laboratoire National d'Appui au Développement Agricole (LANADA) in May 2016. These meetings involved on-site laboratory assessments; tours of the molecular biology, environmental, and epidemic virus departments; discussion of PREDICT testing techniques; and introductions to PREDICT lab personnel.

Following the visit, PREDICT/Cameroon's country coordinator trained Côte d'Ivoire team members at IPCI in project Biosafety and Personal Protective Equipment (PPE) protocols and shared an overview of project objectives and requirements.

PREDICT conducted evaluations of diagnostic capacity with lab personnel at Institut Pasteur Côte d'Ivoire (IPCI), identifying areas for capacity strengthening, and prioritizing and coordinating procurement of PREDICT laboratory equipment and supplies.

Workforce Development Action Package

Milestone: Cadres of animal and human health professionals provided in-service training in requisite One Health skills

Strengthening the One Health Workforce

PREDICT hosted a One Health training for IPCI and LANADA team members (May 11, 2016) providing an opportunity for both institutions to meet and discuss collaboration within the project as well as complete required trainings for the project. The training included review of PREDICT protocols for laboratory biosecurity and biosafety, including safe sample handling, storage, and management. This was the first time that team members from these institutions were brought together, building a bridge between the human and animal health sectors, and is a step towards strengthening One Health laboratory networks in the country to improve capabilities for disease prevention and control.

PREDICT hosted a two-day training (June 16-17, 2016) during which nine participants (two women) were trained by members of the global PREDICT team in qualitative research methodology, including instruction in conducting observational research, ethnographic interviews, and focus groups. Using a train-the-trainer approach, all nine participants are now prepared to pass on knowledge and these methods to additional field staff stationed at remote sites, advancing efforts to broadly assess behavioral risks for viral spillover and transmission.

As part of PREDICT's commitment to strengthening disease surveillance networks in the Central/West Africa region, three PREDICT/Côte d'Ivoire team members travelled to the Democratic Republic of the Congo (July 10, 2016) to complete two weeks of training hosted by PREDICT/DRC. During this period, staff gained technical knowledge and hands-on experience in biosafety practices, animal and human biological sampling, and laboratory analytics. Due to the field and lab-based hands-on approach to training, all three individuals are now prepared to launch surveillance and viral detection activities back home in Côte d'Ivoire.

Training Summary

A total of **10 individuals**, including **eight men** and **two women**, have been trained in Côte d'Ivoire since the start of PREDICT-2 activities in 2014. Four governmental personnel and one student received training from PREDICT staff. A number of individuals completed trainings in more than one subject.

Trainings Events by Topic*

Topic	Total Trainings	# Trainings by Government Personnel	# Trainings by Women	# Trainings by PREDICT staff	# Trainings by Students
Avian Sampling	1			1	
Basic Laboratory Safety	1			1	
Bat Sampling	1			1	
Biosafety and PPE	8	3		4	1
Bushmeat Sampling	1			1	
CITI Biomedical Research	1			1	
CITI Social Behavioral	1			1	
Emergency Preparedness	1			1	
Implementing Cold Chain for Safe Sample Transport	1			1	
Non-Human Primate Sampling	1			1	
Other	15	4	1	10	1
Packing and Shipping Biological Samples	1			1	
Policies and Plans	1			1	
Qualitative Research and Data Collection	2		1	1	
Rodent Sampling	1			1	
Safe Disposal of Carcasses and Infectious Waste	1			1	
Small Carnivore Sampling	1			1	
Totals	**39**	**7**	**2**	**29**	**2**

*Some individuals were cross-trained in multiple topics. Individuals may be represented in multiple rows per column and multiple columns.

Other Activities:

- PREDICT/Côte d'Ivoire coordinated the preliminary translation of the project institutional review board protocol into French for use in submissions to ethics committees in Democratic Republic of Congo, Republic of Congo, and Cameroon, as well as in Côte d'Ivoire.
- PREDICT submitted a proposal for ethics committee approval for human subjects research, which includes human sampling and behavioral risk investigations; preliminary approval was granted and final approvals from in-country and global permitting authorities are expected by December 2016.

USAID | PREDICT

FROM THE AMERICAN PEOPLE

Global Health Security Agenda

SUPPORTING THE GLOBAL HEALTH SECURITY AGENDA IN ETHIOPIA

Zoonotic Disease: PREDICT is working with government and local university partners to strengthen capacity to conduct pathogen identification and zoonotic disease detection for both novel and known threats, including Ebola, at high-risk wildlife-livestock-human interfaces identified with local partners as priority areas for strengthening the national surveillance system. Additionally, PREDICT is collaborating with Ethiopia's national laboratory network and surveillance systems to strengthen capabilities for rapid detection of a variety of potential disease threats. Finally, USAID/PREDICT is contributing expertise for the strengthening and operationalization of One Health platforms to facilitate improved zoonotic disease detection and surveillance in Ethiopia. This year, **PREDICT focused on building the foundations for successful launch of zoonotic disease surveillance-strengthening activities**: establishing One Health partnerships, obtaining permissions, prioritizing and selecting surveillance sites, and strengthening capacities in biosafety, safe animal sampling, and viral detection. **PREDICT successfully launched wildlife surveillance activities at high-risk human-animal interfaces collecting samples from 141 animals** (93 bats and 48 non-human primates).

*A grivet monkey (*Cercopithecus aethiops*) chews a nylon rope that was dipped in mango juice The nylon collects saliva non-invasively, leaving behind a sample used for viral testing in PREDICT's lab. Photo: PREDICT/Ethiopia*

Workforce Development: A well-trained and equipped workforce is critical for health security and for emergency and disaster management and response. This year, PREDICT conducted a number of Ethiopia trainings with the help of PREDICT/Tanzania team and our global network of One Health experts. **Thirty**

one training events have been completed by the PREDICT/Ethiopia team to date through instruction and field-based training sessions covering ethics, biosafety, safe animal capture, handling, and sampling, laboratory safety, and safe sample storage and transport.

Additional details and highlights from PREDICT's 2015-2016 activities in Ethiopia are provided below and linked to corresponding GHSA Road Map Action Packages and milestones.

Zoonotic Disease and Reporting Action Packages

Milestones: Routine information shared among ministries, and following an outbreak/field investigation; Reporting system across different ministries/institutions for routine and event-based data sharing developed

Multisectoral Coordination to Support Mechanisms for Zoonotic Disease Surveillance and Preparedness and Response for Zoonotic Disease Outbreaks

- PREDICT maintained partner engagement with the Ethiopian Wildlife and Conservation Association (EWCA), Ministry of Health (MoH), the newly established Ministry of Livestock and Fisheries (MoLF), the National Animal Health Diagnostic and Investigation Center (NAHDIC), and FAO for coordination of sampling activities at priority surveillance sites.
- PREDICT actively coordinated with in-country representatives from the National Animal Health Diagnostic and Investigation Center (NAHDIC), Ethiopian Wildlife and Conservation Authority (EWCA), FAO-ECTAD, the Ethiopian Public Health Institute (EPHI), CDC Ethiopia, and USAID/Ethiopia to align disease surveillance plans and strategies for capacity strengthening across the field-to-lab spectrum of activities.
- PREDICT worked with EPT-2 partners in regular meetings to discuss in-country scopes of work and to coordinate surveillance, viral detection, and capacity strengthening activities with partners from USAID, P&R, OHW, and FAO-ECTAD.
- PREDICT met with GHSA partners from US CDC Atlanta and CDC Ethiopia to review the CDC national capacity building approaches and needs for surveillance and molecular diagnostics of priority endemic diseases. PREDICT expressed willingness to coordinate with all GHSA partners as needed to meet identified national capacity strengthening needs for improved detection of known and novel viral threats.
- PREDICT's country coordinator attended EPT-2 quarterly partner meetings hosted at the US Embassy with USAID, FAO, OHW, and P&R representatives to plan development of a One Health multisectoral ministry platform.

Zoonotic Disease Action Package

Milestone: Surveillance in wildlife enhanced

Surveillance to Detect and Discover Zoonotic Viral Threats in Animals and People

Addis Ababa University's (AAU) Aklilu Lemma Institute of Pathobiology was engaged as the implementing partner in Ethiopia. AAU integrates and works closely with the national laboratory system in Ethiopia as there is a long-standing history of university-government partnership that facilitates joint research and training endeavors as well as technology transfer from the university to the National Animal Health Diagnostic and Investigation Center (NAHDIC), and then to regional government field offices and laboratories throughout the country.

Through collaborative site visits this year, the AAU team and stakeholders identified the animal value chain and the risk of viral emergence at camel-wildlife-human interfaces as a high priority when selecting surveillance sites for wildlife sampling and where coordination with FAO for livestock sampling has focused.

PREDICT received permissions and approvals for conducting wildlife sampling through the Ethiopian Wildlife Conservation Authority (EWCA) and approval from the Addis Ababa University review board.

PREDICT successfully launched surveillance activities collecting samples from 93 bats in the Awash/Metahara area, a site prioritized to investigate the camel-wildlife-human interface within the camel trade in-country. Samples were stored to await testing using techniques that can detect both known and emerging viral threats.

*An Egyptian free-tailed bat (*Tadarida aegyptiaca*) captured by the PREDICT team for sampling at the Awash-Metehara site. Photo: PREDICT/Ethiopia*

PREDICT also sampled wildlife in the Awash area targeting interfaces where zoonotic viruses may be shared with livestock and people within pastoralist communities surrounding the Awash National Park. The team collected non-invasive samples (saliva and feces) from 48 monkeys (olive baboons, sacred baboons, and vervet monkeys) and stored samples for viral family testing.

Laboratory Testing for Detection of Priority Diseases

PREDICT/Ethiopia AAU laboratory was established in the new AAU ALIPB Institute location in the Sefere Selam area of Addis (July 2016). The new laboratory provides improved infrastructure to conduct viral detection activities, will continue to serve as a key training center for future lab professionals, and will provide support to the national lab system through partners at the National Animal Health Diagnostic and Investigation Center (NAHDIC). Supply procurement was initiated to stock the lab and enable technicians to begin viral screening using techniques with the capability of detecting both known and emerging viral threats of national public health concern; beginning with corona-, filo-, influenza, and paramyxoviruses.

PREDICT initiated desktop training on project standard operating procedures and practices for laboratory work, including basic laboratory safety, emergency preparedness, and safe waste disposal, in preparation for a hands-on training in nucleic acid extraction and viral detection techniques hosted by the PREDICT/Uganda lab team at Makerere University (October 9-16, 2016).

Workforce Development Action Package

Milestone: Universities hosting Field Epidemiology Training Programs (FETP) linked to One Health University platform effort

Strengthening the One Health Workforce

PREDICT/Ethiopia's country coordinator and lead laboratory technician traveled to Tanzania to work with the GHSA/Tanzania team in Morogoro (April 2016), part of the PREDICT project's regional training approach to strengthening surveillance capacity. The field-based training sessions covered field logistics, personal protective equipment (PPE) use, biosafety, safe capture (mist netting) and sampling of fruit bats at tree roosting colonies, sample storage and cold chain, specimen transfer and management with lab personnel, and behavioral surveillance approaches to investigating emerging zoonotic diseases. Training continued in the Udzungwa Mountains of Tanzania, where the Ethiopia team learned non-invasive techniques for sampling non-human primates.

Dr. Nigatu Kebede and Yohannes Negash from PREDICT/Ethiopia with the GHSA/ Tanzania team in Morogoro, Tanzania during a regional training.
Photo: PREDICT/Ethiopia

PREDICT continued efforts to strengthen national capacity for wildlife surveillance by providing trainings for in-country staff in One Health skills and safe animal capture and sampling of rodents, bats, non-human primates, birds, and small carnivores. Following trainings, the team successfully launched wildlife surveillance activities and applied these new skills in the field (July-September 2016), collecting samples from bats and non-human primates at high-risk interfaces for animal-human contact and zoonotic disease transmission in the Awash and Adama areas.

Training Summary

Three individuals, all men, have been trained in Ethiopia since the start of PREDICT-2 activities in 2014, including two students. All of these individuals completed trainings in more than one subject.

Trainings Events by Topic*

Topic	Total Trainings	# Trainings by Government Personnel	# Trainings by Women	# Trainings by PREDICT staff	# Trainings by Students
Avian Sampling	1			1	
Basic Laboratory Safety	3			3	2
Bat Sampling	3			3	1
Biosafety and PPE	4			4	2
Bushmeat Sampling	1			1	
CITI Biomedical Research	1			1	
CITI Social Behavioral	1			1	
Emergency Preparedness	3			3	1
Implementing Cold Chain for Safe Sample Transport	1			1	1
Non-Human Primate Sampling	3			3	1
Other	1			1	
Packing and Shipping Biological Samples	1			1	1
Policies and Plans	1			1	
Qualitative Research and Data Collection	1			1	
Rodent Sampling	3			3	1
Safe Animal Capture and Sampling	2			2	1
Small Carnivore Sampling	1			1	
Total	**31**	**0**	**0**	**31**	**11**

*Some individuals were cross-trained in multiple topics. Individuals may be represented in multiple rows per column and multiple columns.

USAID | PREDICT
FROM THE AMERICAN PEOPLE
Global Health Security Agenda

SUPPORTING THE GLOBAL HEALTH SECURITYAGENDA IN GUINEA

Zoonotic Disease: Through the GHSA, Guinea has the opportunity to improve national capabilities and systems for the prevention and control of zoonotic diseases, including both known pathogens, such as Ebola, and other unknown and emerging zoonotic disease threats. This year, **PREDICT worked with local government partners to initiate the Ebola Host Project (EHP)** to identify potential animal reservoirs and transmission hosts for Ebolavirus in Guinea and across national borders in neighboring Liberia and Sierra Leone. **PREDICT developed the foundation for successful implementation of EHP**: securing permissions, engaging partners across animal and human health sectors, conducting scoping visits to sampling sites, engaging EHP focal points from within local communities, and **officially launching wildlife sampling activities during field-based training exercises, collecting samples from 76 animals.**

A bat sampled during Ebola Host Project training activities in Soyah, Mamou. Photo: PREDICT/Guinea

Lab Strengthening Systems: Guinea's national laboratory network is equipped for detection of some known pathogens, but there are opportunities for strengthening core capabilities for detection of zoonotic disease threats, especially for novel viruses and pathogens not expected to be in the country. This year, PREDICT drafted a Memorandum of Understanding with the Ministry of Higher Education to enable collaboration with the Laboratory of Hemorrhagic Fever in Conakry and Nzerekore and initiated **capacity assessments and development of plans for future launch of zoonotic viral surveillance activities**.

Workforce Development: A well-trained and equipped workforce is critical for health security and for emergency and disaster management and response. This year, PREDICT conducted a number of trainings for the Guinea team with the help of PREDICT/Cameroon and Sierra Leone staff and our global network of One Health experts. **Twenty-six individuals have been trained to date** through instruction and field-based training sessions covering ethics; biosafety; safe animal capture, handling, and sampling; laboratory safety; and safe sample storage and transport. As a result, **PREDICT/Guinea is well prepared for intensifying Ebola sampling activities in the upcoming year**.

Additional details and highlights from PREDICT's 2015-2016 activities in Guinea are provided below and linked to corresponding GHSA Road Map Action Packages and milestones.

Zoonotic Disease Action Package

Milestone: Multi-sectoral coordination mechanism for zoonotic disease prevention established

Multisectoral Coordination to Support Mechanisms for Zoonotic Disease Surveillance and Preparedness and Response for Zoonotic Disease Outbreaks

- PREDICT contributed to the GHSA Planning Workshop in Conakry (February 15-19, 2016), presented an overview of the project, and initiated Ebola Host Project work plan and implementation discussions.
- PREDICT held community engagement meetings in the Mamou region (August 22-September 7, 2016), attended by district, chiefdom, and community stakeholders. At each meeting, community individuals were identified to act as focal points for Ebola Host Project activities, to help organize community events, and to serve as liaisons between the project team and local stakeholders. PREDICT and FAO included these community-identified focal points in their coordinated training event, continuing efforts to strengthen social networks and enhance local capacity for zoonotic disease surveillance and response.

Zoonotic Disease Action Package

Milestones: Initial framework and standardized data collection protocols for high risk zoonotic diseases developed; Data collection and improved capacity to conduct diagnostic surveillance in wildlife for Ebola and other high-consequence pathogens; High-risk "nodes" for spillover of zoonotic threats identified; Behaviors and practices that enable spillover identified; System for sampling and testing wildlife, livestock, and humans to better define risk from selected zoonotic pathogens in animal reservoirs and disease vectors implemented

Surveillance to Detect and Discover Zoonotic Viral Threats in Animals and People

PREDICT received scientific permits for the capture and sampling of wildlife and domestic animals (July 2016) from the Ministry of Forestry and Ministry of Livestock and Animal Resources.

PREDICT officially launched sample collection for the Ebola Host Project during practical training sessions held on September 3-5, 2016 in Mamou (see Workforce Development below for details). As part of the training exercise, a total of 396 samples were collected from 76 animals (17 rodents, 22 bats, 32 goats, and five dogs).

With input from the Ministry of Health and National Agency of Health Security (ANSS), PREDICT identified Boke, Boffa, Conakry, Coyah, Forecariah, Mamou, Faranah, Kissidougou, Kerouane, Siguiri, Gueckedou, Macenta, and Nzerekore as key sites for scoping visits to assess suitability for Ebola Host Project animal sampling activities. These prefectures had the highest number of Ebola Virus Disease cases during the 2014-2016 Ebola outbreak in Guinea, making them sites of interest for the purpose of identifying possible animal hosts of Ebola viruses.

PREDICT and FAO conducted a joint scoping visit to refine surveillance plans at the site of Santiguiyah in the prefecture of Forecariah (September 28-30, 2016). Santiguiyah is an area with a history of cases of Ebola Virus Disease, and multiple wildlife-domestic animal-human interfaces.

Lab Strengthening Systems Action Package

Milestones: Mapping of multi-sectoral laboratory capacity including pathogen testing completed; Capacity of laboratory personnel strengthened through mentoring and provision of technical and management laboratory trainings and testing capacity for select priority diseases established

Laboratory Testing for Detection of Priority Diseases

PREDICT conducted laboratory assessments and initiated discussions with potential in-country collaborators to evaluate resources for cold chain and sample storage, to begin identifying opportunities for strengthening core capabilities of labs, and to develop plans for future viral detection activities in-country.

A Memorandum of Understanding was drafted between PREDICT and the Ministry of Higher Education to enable collaboration with the Laboratory of Hemorrhagic Fever in Conakry and Nzerekore.

Workforce Development Action Package

Milestone: In-service training opportunities related to surveillance, research, and lab testing identified

Strengthening the One Health Workforce

With support from PREDICT/Cameroon and Sierra Leone teams, PREDICT/Guinea held a joint field-based training with FAO (August 29 – September 7, 2016) to prepare for implementation of the Ebola Host Project. A group of 25 individuals, comprised of 24 men and one woman from both PREDICT and FAO teams, received training in EHP protocols for safe animal capture and sampling, biosafety and waste disposal, emergency preparedness, lab safety, cold chain, and packing biological samples. These trained individuals are key to EHP implementation in Guinea and increase in-country capacity for zoonotic disease surveillance and response.

PREDICT/Guinea staff pipette sample preservation media during trainings for Ebola Host Project activities. Photo: PREDICT/Guinea

Training Summary

A total of **26 individuals**, including **25 men** and **one woman**, have been trained in Guinea since the start of PREDICT-2 activities in 2014. A number of individuals completed trainings in more than one subject.

Training Events by Topic*

Topic	Total Trainings	# Trainings by Government Personnel	# Trainings by Women	# Trainings by PREDICT staff	# Trainings by Students
Basic Laboratory Safety	28		1	19	
Bat Sampling	26		1	17	
Biosafety and PPE	29		1	19	
Bushmeat Sampling	26		1	17	
Emergency Preparedness	53		2	35	
Implementing Cold Chain for Safe Sample Transport	26		1	17	
Livestock Sampling	50		2	32	
Other	28		1	19	
Packing and Shipping Biological Samples	26		1	17	
Policies and Plans	2			2	
Rodent Sampling	26		1	17	
Safe Animal Capture and Sampling	25		1	17	
Safe Sample Transport and Storage	1			1	
Total	**346**	**0**	**13**	**229**	**0**

*Some individuals were cross-trained in multiple topics. Individuals may be represented in multiple rows per column and multiple columns.

USAID | PREDICT
FROM THE AMERICAN PEOPLE

Global Health
Security Agenda

SUPPORTING THE GLOBAL HEALTH SECURITY AGENDA IN KENYA

Zoonotic Disease: Kenya is a leader in establishing One Health priorities and encouraging multi-sectoral coordination to address both known and emerging zoonotic disease threats. In 2015-2016, Kenya made progress towards identified GHSA Road Map milestones in the Zoonotic Disease Action Package by strengthening multi-sectoral mechanisms for zoonotic disease prevention, beginning to develop maps of high-risk human-animal interfaces, and working to determine the burden and risk of priority zoonotic diseases. This year, PREDICT worked with government and local stakeholders to contribute to these milestones by holding stakeholder meetings for surveillance planning and prioritization and by identifying options for enhancing national surveillance systems. Also this year, **PREDICT developed the foundation for successful implementation of disease surveillance activities**, securing permissions, engaging partners across animal and human health sectors, identifying surveillance sites, completing core trainings, and **officially launching animal sampling activities by collecting samples from 43 camels at a high-risk interface along the camel value chain.**

A dog scavenging a cattle skull in the rangelands where PREDICT is investigating zoonotic disease transmission between animals and people.
Photo: Suzan Murray, PREDICT/Kenya.

Lab Strengthening Systems: Kenya's national laboratory network is very well equipped for detection of many known pathogens and there is a strong forum for information-sharing between animal and human health laboratory networks through the Zoonotic Disease Unit (ZDU), a collaborative effort between the Ministry of Agriculture, Livestock and Fisheries and the Ministry of Health. This year, **PREDICT formalized relationships with the Institute of Primate Research (IPR)**, a parastatal lab with capacity to serve as a critical support node in Kenya's One Health laboratory network, and fostered collaborative partnership with the International Livestock Research Institute (ILRI), an international center of excellence with expertise in multiple known and emerging disease threats in the animal sector.

Workforce Development: A well-trained and equipped workforce is critical for health security and for emergency and disaster management and response. This year, **PREDICT trained four government health professionals in Kenya**, laying the foundation for further contributions to strengthen the One Health workforce in-country.

Additional details and highlights from PREDICT's 2015-2016 activities in Kenya are provided below and linked to corresponding GHSA Road Map Action Packages and milestones.

Zoonotic Disease Action Package

Milestone: Monitor the burden of zoonotic diseases/pathogens through ongoing sentinel and population-based surveillance

Surveillance to Detect and Discover Zoonotic Viral Threats in Animals and People

PREDICT established the foundation for successful implementation of zoonotic disease surveillance and viral detection activities by engaging the Institute of Primate Research (IPR) as the project implementing partner and developing the Kenya core country team through the hiring of a country coordinator, field veterinarian, and lab technician.

PREDICT worked with local partners to collaboratively identify locations for disease surveillance at the GHSA implementation meeting in Nairobi. During the meeting, GHSA partners identified wildlife as a gap in the national disease surveillance network and, based on discussions, confirmed PREDICT's priority locations for wildlife surveillance near camel markets and along camel trade routes and value chains in the Laikipia and Turkana regions as high-risk interfaces for viral spillover and spread. As a result, PREDICT advanced plans to target sites at these interfaces for triangulated surveillance targeting wildlife, livestock, and human populations along with behavioral risk investigations to improve our understanding of human practices associated with zoonotic disease transmission and to identify potential mitigation and intervention strategies.

This year, PREDICT obtained all necessary approvals and permitting for wildlife capture and sampling through the Kenya Wildlife Service (KWS) and fostered partnerships with FAO and EPT-2 partners for coordination of livestock sampling, data sharing, and One Health capacity building. PREDICT also initiated ethical approvals for human surveillance activities in community and hospital settings with the Kenya Medical Research Institute (KEMRI); permissions will be secured early in 2017, paving the way for launch of human surveillance activities in the upcoming year.

PREDICT successfully launched animal surveillance and sampling activities, collecting over 300 samples, including nasal swabs, rectal swabs, serum, and whole blood, from 43 dromedary camels at Laikipia, Mpala ranch (July 11-13, 2016). The sampled camel herd is an important source of milk products, which are sold in the nearby town of Nanyuki. All camel samples will be tested for coronaviruses (including MERS-CoV) along with other priority viral families (filo-, influenza, and paramyxoviruses) at the project's IPR lab.

PREDICT supported FAO with camel sample collection in Laikipia county (July 4-16, 2016). PREDICT assisted with identifying sites of high livestock-wildlife contact and with coordinating sample collections per PREDICT protocols. A subset of the samples collected will be tested for coronaviruses at the implementing partner lab.

Building on capacity gains through training and initial sample collections, PREDICT also solidified plans for the launch of concurrent sampling of wildlife and livestock surveillance targeting camels, bats, rodents, and non-human primates at high-risk interfaces in Laikipia (scheduled for the first weeks of November 2016).

Lab Strengthening Systems Action Package

Milestone: Acquire technology and improve capacities of laboratories to conduct surveillance of priority diseases in humans and animals

Laboratory Testing for Detection of Priority Diseases

PREDICT engaged IPR as the project laboratory and shared Standard Operating Procedures and universal controls for viral detection activities. The IPR lab will be leading wildlife, livestock, and human testing for priority zoonotic disease threats of public health concern including filoviruses, such as Ebola and Marburg to start, with the addition of viral families as capacity is gained. This year PREDICT initiated basic viral detection training focused on laboratory safety and the viral family approach with IPR technicians; active testing of samples collected in disease surveillance activities are scheduled to begin early in 2016-2017.

PREDICT also fostered a collaborative partnership with the International Livestock Research Institute (ILRI), an international center of excellence with expertise in multiple known and emerging disease threats.

PREDICT participated in laboratory consultative meeting supported by FAO-Kenya in Nakuru organized to discuss capacity at government-affiliated labs and to identify opportunities for collaborative staff training and infrastructural development.

PREDICT/Kenya government partner veterinarian at Kenya Wildlife Service training on laboratory techniques that support One Health capacity building. Photo: Suzan Murray, PREDICT/Kenya.

PREDICT participated in a joint laboratory training with partners working in Kenya (June 23-24, 2016). The training, held at ILRI, included representatives from PREDICT and FAO. FAO participants were trained in biosafety, safe handling of samples and other potentially biohazardous materials, and serological testing using samples jointly collected by FAO and PREDICT teams during prior field training exercises. Additionally, participants were shown how to extract nucleic acid and test for viruses using qPCR techniques.

Real-time Surveillance Action Package

Milestone: One Health national surveillance strategy is agreed upon by all stakeholders

Multisectoral Coordination to Support Mechanisms for Zoonotic Disease Surveillance and Preparedness and Response for Zoonotic Disease Outbreaks

In early 2016, PREDICT held discussions with USAID-Kenya, CDC-Kenya, FAO-Kenya, Kenya's Zoonotic Disease Unit (ZDU), ILRI, the Department of Veterinary Services (DVS), the International Centre of Insect Physiology and Ecology (ICIPE), the Mpala Research Center, the Lewa Conservancy, the Northern Rangelands Trust, and implementing partner IPR to advance collaborative plans for in-country surveillance activities.

PREDICT hosted a successful stakeholder meeting in Kenya (August 4, 2016), engaging representatives from FAO, the US CDC, P&R, USAID, the Department of Veterinary Services, the ZDU, the Ministry of Health, the Kenya Medical Research Institute, ILRI, the International Center of Insect Physiology and Ecology, Mpala Research Center, and Kenya's Public Health Emergency Operations Center (EOC; the body responsible for coordinating response to all outbreaks in the Kenya). At the meeting partners determined that PREDICT would collaborate with FAO whenever possible to collect samples, share data, conduct One Health training, and build capacity in-country. Also at the meeting, partners agreed to share existing data in order to fast-track certain activities, for example, data that could be used to map high-risk areas using geographic information systems (GIS) to help identify potential emerging infectious disease hot spots.

PREDICT participated in validation of the Kenya national surveillance plans for MERS Coronavirus and Ebola (July 2016). This work, supported by Kenya's Department of Veterinary Services (DVS) is a collaboration between PREDICT, DVS, and FAO and is important for aligning EPT-2 objectives with Government of Kenya zoonotic disease surveillance plans.

Workforce Development Action Package

Milestone: In-service training for select cadre of animal and human health professional in requisite One Health Skills

Strengthening the One Health Workforce

PREDICT initiated training of the core Kenya team, which included the country coordinator, field veterinarian, and lab technician. Trainings emphasized the One Health approach for surveillance and provided fundamental tools for launching safe sampling activities in 2016. A solid foundation in biosafety, safe animal handling and sampling, cold chain, and laboratory practices pave the way for concurrent and triangulated sample collection and analysis in the coming year and build capacity for potential outbreak response if needed.

Training Summary

A total of **four individuals** have been trained in Kenya since the start of PREDICT-2 activities in 2014. All of these are governmental personnel. A number of individuals completed trainings in more than one subject.

Trainings Events by Topic*

Topic	Total Trainings	# Trainings by Government Personnel	# Trainings by Women	# Trainings by PREDICT staff	# Trainings by Students
ACU 101	3	3		3	
Avian Sampling	2	2		2	
Basic Laboratory Safety	3	3		3	
Bat Sampling	2	2		2	
Biosafety and PPE	3	3		3	
Bushmeat Sampling	2	2		2	
CITI Biomedical Research	2	2		1	
Emergency Preparedness	3	3		3	
Human Syndromic Surveillance	2	2		2	
Implementing Cold Chain for Safe Sample Transport	3	3		3	
Livestock Sampling	1	1		1	
Non-Human Primate Sampling	2	2		2	
Outbreak Response	2	2		2	
Packing and Shipping Biological Samples	3	3		3	
Policies and Plans	3	3		3	
Qualitative Research and Data Collection	2	2		2	
Rodent Sampling	1	1		1	
Safe Animal Capture and Sampling	2	2		2	
Small Carnivore Sampling	2	2		2	
Total	**43**	**43**		**42**	

*Some individuals were cross-trained in multiple topics. Individuals may be represented in multiple rows per column and multiple columns.

USAID | PREDICT
FROM THE AMERICAN PEOPLE

Global Health
Security Agenda

SUPPORTING THE GLOBAL HEALTH SECURITY AGENDA IN LIBERIA

Zoonotic Disease: Through the GHSA, Liberia has the opportunity to improve national capabilities and systems for the prevention and control of zoonotic diseases, including both known pathogens, such as Ebola, and other unknown and emerging zoonotic disease threats. This year, **PREDICT worked with local government partners to initiate the Ebola Host Project (EHP)** to identify potential animal reservoirs and transmission hosts for Ebolavirus in Liberia and across national borders in neighboring Guinea and Sierra Leone. **PREDICT developed the foundation for successful implementation of EHP**: securing permissions, engaging partners, conducting scoping visits to sampling sites, and **officially launching wildlife sampling activities collecting samples from 249 bats while completing in-service safe sample collection and storage training.**

PREDICT/Liberia's Ebola Host Project team samples bats in Northern Liberia. Photo: Jon Epstein/EcoHealth Alliance

Lab Strengthening Systems: Liberia's national laboratory network is equipped for detection of some known pathogens, but there are opportunities for strengthening core capabilities for detection of zoonotic disease threats, especially for novel viruses and pathogens not expected to be in the country. PREDICT is helping to strengthen laboratory systems in Liberia through strategic partnerships with premier centers for pathogen detection and discovery in the US and by connecting local labs in Liberia like the Liberia Institute for Biomedical Research (LIBR) with our One Health lab network in the West and Central Africa regions. This year, PREDICT engaged LIBR and initiated **capacity assessments and development of plans for future launch of zoonotic viral detection activities**.

Workforce Development: A well-trained and equipped workforce is critical for health security and for emergency and disaster management and response. This year, PREDICT conducted a number of trainings for the Liberia team. **Fourteen individuals have been trained to date** through instruction and field-based training sessions covering ethics; biosafety; safe animal capture, handling, and sampling; and safe sample storage and transport. As a result, **PREDICT/Liberia is well prepared for intensifying Ebola sampling activities in the upcoming year**.

Additional details and highlights from PREDICT's 2015-2016 activities in Liberia are provided below and linked to corresponding GHSA Road Map Action Packages and milestones.

Zoonotic Disease Action Package

Milestone: Multi-sectoral coordination mechanism for zoonotic disease prevention established

Multisectoral Coordination to Support Mechanisms for Zoonotic Disease Surveillance and Preparedness and Response for Zoonotic Disease Outbreaks

- PREDICT/Liberia joined USAID representatives and other EPT-2 partners from FAO and P&R to discuss the Joint External Evaluation (JEE) assessment of Liberia's progress on the GHSA roadmap, focusing on building capacity within the environmental and agricultural health sectors.
- PREDICT attended the World Bank REDISSE meeting (February 8-9, 2016), with other local and international stakeholders and contributed to development of a strategy for the World Bank to support surveillance platforms for Ebola and other zoonoses in West Africa.
- At the request of USAID, PREDICT attended a workshop designed to establish a biobank in Liberia (March 4-5, 2016) with the goal of emphasizing a One Health approach and including human and animal samples in the biobank for long-term sample storage.
- PREDICT attended a 'Laboratory Professionals Meeting' hosted by AfricaBio Enterprises in Monrovia (April 27-28, 2016).

- Together with representatives from the Liberian Ministry of Agriculture, Ministry of Health, and the Forestry Development Authority (FDA), PREDICT participated in an FAO meeting (June 3-4, 2016), in Freetown, Sierra Leone to develop the FAO EPT-2 work plan in coordination with government partners.

Zoonotic Disease Action Package

Milestones: Surveillance priorities and strategies for one to three high-priority zoonotic viruses established; High-risk human/animal interfaces (e.g. "value chains", land-use change, etc.) and their interfaces mapped; High-risk "nodes" for spillover of zoonotic threats established; Behavior and practices that enable spillover identified; System for sampling and testing wildlife, livestock, and humans to better define risk from selected zoonotic pathogens in animal reservoirs and disease vectors implemented

Surveillance to Detect and Discover Zoonotic Viral Threats in Animals and People

In preparation for launch of the Ebola Host Project (EHP) in Liberia, PREDICT obtained permission to conduct wildlife disease surveillance through our government partner the FDA. In addition, PREDICT engaged the Society for Conservation of Nature of Liberia (SCNL) as the local implementing partner and hired a local team of eight research technicians, two social scientists, three drivers, and one country coordinator to lead EHP activities.

To complement EHP animal sampling activities, PREDICT made plans to conduct behavioral risk investigations and submitted an application for ethical clearance to the National Ethics Review Board. Approval is pending. Together with experts from PREDICT's global behavioral risk team, observational studies were launched in Nimba County, near Yekepa with insights informing EHP sampling activities and future behavior investigations planned for 2017 once ethical approval is obtained.

PREDICT established a partnership with Arcelor Mittal Liberia (AML), a large international iron ore mining company present in Northern Liberia and conducted training exercises and sampled bats on AML property to determine whether animals have been exposed to or are shedding Ebola virus.

PREDICT worked very closely with EPT-2 partners on coordination of activities specifically with regard to coordinated livestock sampling under the Ebola Host Project with FAO and One Health network and platform strengthening with P&R.

PREDICT/Liberia's EHP team conducted site scoping visits to potential field sites in Lofa and Nimba Counties (April 2016) and met with community leaders and government officials to describe the goals of the project and prepare plans for EHP sampling activities. Following these visits, PREDICT conducted three field expeditions to Nimba County and collected samples from a total of 249 bats of two different species (46 *Mineopterus inflatus* and 200 *Hipposideros rubor*).

Lab Strengthening Systems Action Package

Milestones: Mapping of multi-sectoral laboratory capacity including pathogen testing completed; Priority pathogens and diseases identified (including zoonotic diseases); Government of Liberia's has capability to conduct diagnostics for Ebola as well as rapidly test suspected Ebola samples

Laboratory Testing for Detection of Priority Diseases

PREDICT initiated discussions with the Liberian Institute for Biomedical Research (LIBR) to obtain laboratory space and build capacity within their existing infrastructure. PREDICT is also exploring potential partnerships with other GHSA and USG agency partners in residence at LIBR (NIH, Navy Medical Research Unit (NAMRU)). Partnerships may include co-training, research, and resource/lab equipment sharing.

While local viral detection capacity is being developed, PREDICT shipped bat samples to the project's global reference laboratory for viral testing. A total of 174 samples have been shipped and analyzed to-date with results pending.

Workforce Development Action Package

Milestone: Cadres of animal and human health professionals provided in-service training in requisite One Health skills ongoing

Strengthening the One Health Workforce

Through a combination of didactic lectures and practical field training, PREDICT conducted all core trainings (biosafety and PPE use, safe animal capture and sampling, safe sample storage and shipping, and emergency preparedness and response) for project staff, including Ebola Host Project protocols.

Training Summary

A total of **14 individuals**, including **eight men** and **six women**, have been trained in Liberia since the start of PREDICT-2 activities in 2014. A number of individuals completed trainings in more than one subject.

Training Events by Topic*

Topic	Total Trainings	# Trainings by Government Personnel	# Trainings by Women	# Trainings by PREDICT staff	# Trainings by Students
Basic Laboratory Safety	13		6	7	
Bat Sampling	13		6	7	
Biosafety and PPE	13		6	7	
Emergency Preparedness	13		6	7	
Qualitative Research and Data Collection	1			1	
Safe Animal Capture and Sampling	2			1	
Total	**55**	**0**	**24**	**30**	**0**

*Some individuals were cross-trained in multiple topics. Individuals may be represented in multiple rows per column and multiple columns.

USAID | PREDICT
FROM THE AMERICAN PEOPLE

Global Health
Security Agenda

SUPPORTING THE GLOBAL HEALTH SECURITY AGENDA IN SENEGAL

Zoonotic Disease: PREDICT is working with government, local university, and national reference laboratory partners to strengthen capacity to conduct pathogen identification and zoonotic disease detection for both novel and known threats, including Ebola, Rift Valley Fever, influenza, and other high priority viral families at high-risk wildlife-livestock-human interfaces identified with government partners as critical gaps in the national surveillance system. In addition, PREDICT is contributing expertise in the implementation of the One Health approach to zoonotic disease detection and surveillance in support of the drafting and operationalization of Senegal's One Health Strategy. This year, **PREDICT focused on building the foundations for successful launch of zoonotic disease surveillance activities:** establishing One Health partnerships, evaluating capacities for surveillance and conducting scoping visits with partners to identify surveillance sites at high-risk animal-human interfaces for zoonotic disease transmission.

PREDICT meets with stakeholders during scoping visits to surveillance sites in Senegal.
Photo: Yaghouba Kane, PREDICT/Senegal

Lab Strengthening Systems: PREDICT is collaborating with the national labs and local university partners that are well integrated with Senegal's national laboratory network, as well as animal and public health surveillance systems. This year, **PREDICT worked to engage collaborating laboratory partners, to initiate capacity assessments, and to develop plans to address capacity gaps**.

Workforce Development: A well-trained and equipped workforce is critical for health security and for emergency and disaster management and response. This year, PREDICT introduced trainings to government personnel and the growing Senegal team. **Seven individuals have been trained to date** in ethics, biosafety, the One Health approach to surveillance, and observational research methods for behavioral risk investigations. As a result, **PREDICT/Senegal is well positioned for launch of zoonotic disease surveillance activities in the upcoming year**.

Additional details and highlights from PREDICT's 2015-2016 activities in Senegal are provided below and linked to corresponding GHSA Road Map Action Packages and milestones.

Zoonotic Disease Action Package

Milestone: One Health stakeholders strategically identified and a mechanism for multi-sectoral coordination established, aligned with a common mission statement

Multisectoral Coordination to Support Mechanisms for Zoonotic Disease Surveillance and Preparedness and Response for Zoonotic Disease Outbreaks

- Participated in the Government of Senegal's GHSA Operational Planning Workshop organized by USAID/Senegal. PREDICT successfully liaised with key Government of Senegal ministry focal points, USG, and GHSA partners, including the Prime Minister's Office Technical Representative, the Secretary to the Government of Senegal, the Ministry of Health and Social Action, Ministry of Interior, Ministry of Environment and Development, Ministry of Agriculture, Ministry of Livestock, Institute Pasteur Dakar, the US State Department, the US CDC county office, USDA APHIS, the US Defense Threat Reduction Agency Collaborative Biological Engagement Program (DTRA-CBEP), FAO, OHW, and P&R. During the workshop, participants led by Government of Senegal GHSA focal points, discussed activities and key partners and developed plans required to operationalize the Year 1 GHSA workplan in Senegal.
- Extensively liaised and coordinated with GHSA and other global partners operating in-country including: USAID's Human Resources for Health 2030 program (HRH2030), DTRA CBEP, US CDC, USDA, and the World Bank (REDISSE). PREDICT regularly connects with the above-mentioned partners to discuss respective activities in Senegal, specifically addressing mutual interest in capacity development.
- Actively engaged partner and stakeholder involvement and assessed proposed activities at USAID/Senegal's Annual Workplan National Consultations.

- At the request of USAID/Senegal, reviewed proposals from GHSA partners DTRA CBEP, the US CDC, and REDISSE to explore synergies and opportunities for coordinating activities.
- Engaged and advanced subaward processes with in-country implementing partners: Ecole Inter Etats des Sciences et Médecine Vétérinaires (Inter States School of Science and Veterinary Medicine; EISMV); Parasitology, Mycology and Virology Laboratory at Université Cheikh Anta Diop (Cheikh Anta Diop University; UCAD); and Institut Sénégalais de Recherches Agricoles / Laboratoire National d'Elevage et de Recherches Vétérinaires (Senegalese Institute of Agricultural Research / National Livestock and Veterinary Research Laboratory; ISRA/LNERV).
- Selected a candidate and initiated formal procedures to engage a country coordinator based at the EISMV, PREDICT/Senegal's planned headquarters.
- Collaborated with representatives of FAO-Senegal to formulate plans for coordinated partner engagement; training; and concurrent human, wildlife, and livestock sampling activities in-country.

Zoonotic Disease Action Package

Milestones: High-risk human-animal interfaces (i.e. "value chains, land use change, etc.) mapped; High-risk "nodes" for spillover of zoonotic threats established; behavior and practices that enable spillover identified upon completion of mapping in year 1; System for sampling and testing wildlife, livestock, and humans to better define risk from selected zoonotic pathogens in animal reservoirs and disease vectors implemented

Surveillance to Detect and Discover Zoonotic Viral Threats in Animals and People

PREDICT worked together with FAO to conduct a collaborative site selection and prioritization workshop with partners and stakeholders. The workshop informed subsequent scoping visits that evaluated the suitability of proposed sites for triangulated human-wildlife-livestock surveillance activities.

This year, PREDICT conducted three scoping visits to potential surveillance sites identified as high priority locations for pathogen spillover at the above mentioned workshop. Preliminary assessment of regions surrounding Parc National des Oiseaux du Djoudj and Reserv Sylvo-Pastorale des Six Forages identified that these sites did not meet selection criteria. The Niokolo Koba region in South-East Senegal was identified as a high priority for zoonotic disease surveillance. A scoping visit to the Niokolo Koba region was conducted in collaboration with partners and stakeholders, including local and national representatives from the Direction of Parks (Ministry of the Environment and Sustainable Development) and project investigators from the Université Cheikh Anta Diop (UCAD), Ministry of Health and Social Action, Ecole Inter Etats des Sciences et Médecine Vétérinaires (EISMV), and representatives from FAO and the Direction of Veterinary services (Ministry of Livestock and Animal Production). The collaborative team visited four villages situated on the border of Niokolo Koba National Park (Diénoun Diala, Mansa Dala, Gamon, Bélli Wamédaka) and one village near the border with Guinea (Bandafassi). Within the villages, the team observed activities and interactions between wildlife, livestock, and humans and assessed the health facilities available for treatment of human illness. Each location was assessed against selection criteria. It was concluded and agreed upon among attendees that communities in the environs of Bandafassi were of significant interest due to their extensive interaction, primarily through hunting with primates, rodents, and bats, as well as the presence of livestock and domestic animals in the villages. In addition, several villages surrounding Bandafassi are served by a rural clinic with high incidence of fevers of unknown origin in the human population. The ability to conduct triangulated surveillance of wildlife, livestock, and humans in a coordinated manner within a location that has several high-risk interfaces for zoonotic disease transmission led the team to propose Bandafassi as the priority site for surveillance.

Lab Strengthening Systems Action Package

Milestones: Mapping of multi-sectorial laboratory capacity including pathogen testing and animal health completed; Identify laboratories for strengthening diagnostic capacities for priority zoonotic diseases;

Laboratory Testing for Detection of Priority Diseases

PREDICT toured laboratory facilities and conducted capacity assessments of partner labs at UCAD (the human lab) and ISRA/LNERV (the animal lab). Training will commence upon execution of subaward contracts.

Workforce Development Action Package

Milestone: Cadres of animal and human health professionals provided in-service training in requisite One Health skills

Strengthening the One Health Workforce

PREDICT initiated training of the proposed ISRA Principal Investigator. Trainings included introductions to project strategies for surveillance, laboratory development, behavior risk investigations, information management, modeling and analytics, and reporting and communications.

PREDICT conducted field training using the One Health approach to surveillance site assessment and characterization exploring animal-human interfaces and risks for zoonotic viral spillover and spread. During scoping visits to multiple locations in the Niokolo Koba region and Bandafassi, participants were trained in techniques used to evaluate suitability of sites, including observational assessments and evaluation of animal-human interactions. Trainees included the interim country coordinator, local and national representatives from the Direction of Parks (Ministry of the Environment and Sustainable Development) and project investigators from UCAD, Ministry of Health and Social Action, and EISMV. Other participants included FAO and a representative from the Direction of Veterinary services (Ministry of Livestock and Animal Production).

Gaining experience using a One Health approach to surveillance site characterization during visits to villages near protected areas with high-risk for contact and disease transmission between animal and human populations. Photo: Yaghouba Kane, PREDICT/Senegal

Training Summary

A total of **seven individuals**, **all men**, have been trained in Senegal since the start of PREDICT-2 activities in 2014. Four of these individuals are government personnel. One individual completed trainings in more than one subject.

Training Events by Topic*

Total Trainings	Total Trainings	# Trainings by Government Personnel	# Trainings by Women	# Trainings by PREDICT staff	# Trainings by Students
Information Management	1	1			
One Health Approach	4	4			
Qualitative Research and Data Collection	1	1			
Total	**6**	**6**	**0**	**0**	**0**

*One individual was cross-trained in multiple topics. Individuals may be represented in multiple rows per column and multiple columns.

USAID | PREDICT Global Health Security Agenda

SUPPORTING THE GLOBAL HEALTH SECURITY AGENDA IN SIERRA LEONE

Zoonotic Disease: Through the GHSA, Sierra Leone has the opportunity to improve national capabilities and systems for the prevention and control of zoonotic diseases, including both known pathogens, such as Ebola, and other unknown and emerging zoonotic disease threats. This year, **PREDICT worked with local government partners to initiate the Ebola Host Project (EHP)** to identify potential animal reservoirs and transmission hosts for Ebolavirus in Sierra Leone and across national borders in neighboring Guinea and Liberia. **PREDICT developed the foundation for successful implementation of EHP**: securing permissions, engaging partners across animal and human health sectors, conducting scoping visits to sampling sites, engaging EHP focal points from within local communities, and **officially launching EHP sampling activities and collecting samples from 1,973 animals.**

Pigs root around the outskirts of a slum in Salone, Sierra Leone, one of the communities devastated by the West African Ebola Outbreak. This year, PREDICT launching the Ebola Host Project in Guinea, Liberia, and Sierra Leone to investigate animals, including pigs, as potential hosts of the virus. Photo: PREDICT/Sierra Leone

Lab Strengthening Systems: Sierra Leone's national laboratory network is equipped for detection of some known pathogens, but there are opportunities for strengthening core capabilities for detection of zoonotic disease threats, especially for novel viruses and pathogens not expected to be in the country. PREDICT is collaborating with the University of Makeni research laboratory and the Central Animal Lab TEKO, which are well integrated with Sierra Leone's national laboratory network and surveillance systems. This year, PREDICT worked to initiated **capacity assessments and development of plans for future launch of zoonotic viral detection activities**.

Workforce Development: A well-trained and equipped workforce is critical for health security and for emergency and disaster management and response. This year, PREDICT conducted a number of trainings with the Sierra Leone team. **Forty-nine individuals have been trained to date** through instruction and field-based training sessions covering ethics; biosafety; safe animal capture, handling, and sampling; laboratory safety; and safe sample storage and transport. As a result, **PREDICT/Sierra Leone is well prepared to continue intensifying EHP sampling activities in the upcoming year**.

Additional details and highlights from PREDICT's 2015-2016 activities in Sierra Leone are provided below and linked to corresponding GHSA Road Map Action Packages and milestones.

Zoonotic Disease Action Package

Milestone: Multi-sectoral coordination mechanism for zoonotic disease prevention established

Multisectoral Coordination to Support Mechanisms for Zoonotic Disease Surveillance and Preparedness and Response for Zoonotic Disease Outbreaks

- PREDICT provided technical support and coordination of the weekly post-Ebola enhanced epidemiological surveillance meetings organized by the Ministry of Health and Sanitation in Western Area and at the national level (January-February 2016).
- PREDICT engaged with key district and national stakeholders from government and communities in Bombali and Western Area to increase their understanding of implementation, objectives, and their roles in the Ebola Host Project (EHP). The meetings in Bombali (February 11, 2016) and in Western Area (February 20, 2016) were attended by the District Medical Officers for the two districts, the Parliamentarian for the Western Area sites, Freetown City Council Chairman, a representative of the Mayor of Freetown, Council representatives, the Deputy Director of Livestock at the Ministry of Agriculture, a representative of the Office of National Security for Bombali, and other district officers.
- PREDICT held community meetings with key representatives for the 26 selected sites to discuss EHP implementation and promote community engagement. Participants included the paramount chief, section chief, town chief, youth and women's leader, and other community development groups. Meetings were held in February for Bombali and Western Area and in August for Kono, Kambia, and Koinadugu districts, with over 400 district and community stakeholders in attendance.
- The PREDICT team contributed substantively to the development of the surveillance and laboratory strategy for the Regional Disease Surveillance Systems Enhancement (REDISSE) program during a workshop organized by the Ministry of Health and Sanitation and partners in February 2016. PREDICT will continue to provide support to this project as needed to

promote One Health capacity in the country, alongside the World Health Organization and US Centers for Disease Control and Prevention

- PREDICT staff participated in the quarterly USAID implementing partners' conference held in Freetown, Sierra Leone (September 22, 2016). In this meeting, chaired by the USAID/Sierra Leone team lead and the Head of the Mission, PREDICT presented an update on Ebola Host Project activities and plans. Participants included Helen Keller International (HKI), John Snow, Inc. (JSI), Concern Worldwide, United Nations International Children's Education Fund (UNICEF), and FAO, as well as the visiting USAID/Guinea and Sierra Leone Mission Director. This meeting provided an opportunity to review each program, discuss how activities are supporting the government agenda, and highlight successes and challenges in order for partners to offer insights to each other for future improvements.

Zoonotic Disease Action Package

Milestones: Initial framework and standardized data collection protocols for high risk zoonotic diseases developed; Data collection and improved capacity to conduct diagnostic surveillance in wildlife for Ebola and other high-consequence pathogens; High-risk "nodes" for spillover of zoonotic threats identified; Behaviors and practices that enable spillover identified; System for sampling and testing wildlife, livestock, and humans to better define risk from selected zoonotic pathogens in animal reservoirs and disease vectors implemented

Surveillance to Detect and Discover Zoonotic Viral Threats in Animals and People

PREDICT Sierra Leone received approval of the Service Level Agreement from the Sierra Leone Ministry of Health and Sanitation (MoHS) and obtained authorization for animal capture and sample collection by the Ministry of Agriculture, Forestry and Food Security (MAFFS) in January 2016.

PREDICT identified 26 Ebola Host Project implementation sites in five districts and established framework necessary for animal sampling and behavioral surveillance. For every site, there were six district-level representatives (two from MoHS, four from MAFFS) and two community-level representatives identified, trained, and vaccinated. These trained personnel are now able to assist the PREDICT team with Ebola Host Project wildlife and livestock surveillance.

PREDICT conducted animal registration to estimate numbers to be targeted for domestic and peri-domestic sampling for selected sites (January-July, 2016) with support from MAFFS, MoHS, and selected district-level community liaisons.

PREDICT facilitated community engagement (February-July, 2016) with animal owners in all selected districts of interest to discuss EHP implementation and address their questions and concerns. Over 250 domestic animal owners were engaged in these discussions and prepared for sampling of their animals.

PREDICT officially launched EHP animal sampling activities to identify the potential animal host range for ebolaviruses, collecting a total of 14,516 samples from 1,973 animals (296 bats, four cats, 259 dogs, 711 goats and sheep, one non-human primate, 549 pigs, and 153 rodents). Samples were stored for viral detection activities planned for early in 2016-2017.

Lab Strengthening Systems Action Package

Milestones: Mapping of multi-sectoral laboratory capacity including pathogen testing completed; Priority pathogens and diseases identified (including zoonotic diseases); Government of Sierra Leone has capability to conduct diagnostics for Ebola and other zoonotic pathogens in animal and humans; Diagnostic testing implemented and optimized for viral pathogens in wildlife, livestock, and humans

Laboratory Testing for Detection of Priority Diseases

PREDICT established a partnership and signed an official agreement with University of Makeni (UNIMAK) Infectious Disease Research Lab (January 2016).

PREDICT safely processed and securely stored 14,516 animal samples collected during training and surveillance activities over the past year. Samples will be shipped to project global reference laboratory for viral testing as efforts continue to increase capacity of the project laboratory in Sierra Leone; the team plans to begin testing samples in 2017.

Workforce Development Action Package

Milestone: Established in-service training for public health workers on surveillance, research, and laboratory testing methods

Strengthening the One Health Workforce

With assistance from PREDICT/Cameroon, the Sierra Leone team conducted a training workshop in Makeni for 39 people from the Ministry of Health and Sanitation and from site communities. Trainings focused on project protocols, biosafety, and practical skills for animal sampling. These trainings were observed by the Deputy Chief Medical Officer, District Medical Officer for Bombali, the Vice Chancellor of the University of Makeni and the District Agriculture Officer for Bombali. All 39 trainees received vaccination against rabies and as a result were prepared to engage in safe animal sampling with the PREDICT team.

PREDICT conducted training for 34 additional field personnel (June-July, 2016). Individuals from the Ministry of Agriculture, Forestry and Food Security (MAFFS) and the Ministry of Health and Sanitation (MoHS) were trained in animal sampling, while individuals from the University of Sierra Leone Medical School and the University of Makeni were trained in human behavioral surveillance methods (planned to begin once permissions are obtained). Ten individuals from MAFFS were trained to conduct animal sampling for the FAO EPT team; PREDICT will assist with the completion of practical field training for these FAO EPT personnel when their vaccinations are complete in early 2017.

PREDICT provided biosafety and first aid training to ten personnel (August 5, 2016) to ensure that Ebola Host Project field teams are well equipped to handle emergencies that may arise in remote field locations.

PREDICT continued to strengthen local capacity for wildlife and livestock surveillance in Sierra Leone by providing biosafety and animal sampling training to 24 governmental and non-governmental community liaisons in Kono (August 24, 2016), Kambia (August 27, 2016), and Koinadugu (August 31, 2016). Through this training, community members developed foundational surveillance skills and were prepared to assist the PREDICT team with Ebola Host Project activities.

PREDICT/Sierra Leone hosted training for PREDICT/Guinea personnel in late September 2016 to facilitate EHP implementation in Guinea. Training focused on PREDICT protocols for wildlife and livestock sampling and included practical field sessions for sampling techniques.

Training Summary

A total of **49 individuals**, including **37 men** and **12 women**, have been trained in Sierra Leone since the start of PREDICT-2 activities in 2014. Seventeen of these individuals are governmental/FAO staff. A number of individuals have completed trainings in more than one subject.

Training Events by Topic*

Topic	Total Trainings	# Trainings by Government Personnel	# Trainings by Women	# Trainings by PREDICT staff	# Trainings by Students
ACU 101	1			1	
Basic Laboratory Safety	16		4	16	
Bat Sampling	45	17	11	37	
Biosafety and PPE	39	16	7	32	
Bushmeat Sampling	12		4	12	
CITI Biomedical Research	2			2	
CITI Social Behavioral	2			2	
Emergency Preparedness	15		4	15	
Human Syndromic Surveillance	1			1	
Implementing Cold Chain for Safe Sample Transport	46	21	7	32	
Information Management	12	5		5	
Livestock Sampling	44	17	11	36	
Other	61	27	7	39	
Outbreak Response	23	4	4	18	
Packing and Shipping Biological Samples	23	11	7	23	
Policies and Plans	24	4	4	19	
Qualitative Research and Data Collection	12		5	12	
Rodent Sampling	46	17	11	38	
Safe Animal Capture and Sampling	13	5		6	
Safe Sample Transport and Storage	11	5		4	
Small Carnivore Sampling	1			1	
Total	**449**	**149**	**86**	**351**	

*Some individuals have been cross-trained in multiple topics. Individuals may be represented in multiple rows per column and multiple columns.

USAID | PREDICT
FROM THE AMERICAN PEOPLE

Global Health
Security Agenda

SUPPORTING THE GLOBAL HEALTH SECURITY AGENDA IN TANZANIA

Zoonotic Disease: PREDICT is working with government, local university, and NGO partners to strengthen capacity to conduct pathogen identification and zoonotic disease detection for both novel and known threats, including Ebola, influenza, and Rift Valley Fever at high-risk wildlife-livestock-human interfaces identified with government partners as critical gaps in the national surveillance system. This year, **PREDICT contributed expertise in the development of Tanzania's One Health Coordination Unit and in support of the operationalization of the national One Health Strategy**. Also this year, PREDICT continued assessing risks for zoonotic disease transmission and working to identify enabling behaviors and practices by **collecting samples from 275 animals** (175 bats and 100 rodents) at high-risk human-animal interfaces for viral spillover and spread, beginning **testing samples for known and emerging zoonotic viral threats, including priority zoonoses of greatest public health concern**, and preparing to launch behavioral risk investigations.

Rousettus bats (a known host of Marburg virus) roosting inside a cave in the Kagera District, one of PREDICT's priority surveillance sites. Local dogs reportedly consume the bats, and people frequent the cave. The bats also feed on local fruit trees presenting other possibilities for contact and viral spillover. Photo: PREDICT/Tanzania

Lab Strengthening Systems: Tanzania's national laboratory network integrates national labs with zonal reference and district-level labs with varying capabilities and is generally well equipped for detection of many pathogens. PREDICT is collaborating with the national labs and local university and NGO partners that are well integrated with Tanzania's national laboratory network, as well as animal and public health surveillance systems, to identify gaps in the system and to work to strengthen capability for rapid detection of a variety of potential disease threats. This year, PREDICT worked with the Sokoine University of Agriculture (SUA) and Ifakara Health Institute (IHI) labs, our implementing lab partners representing animal and human health sectors respectively, to **strengthen capability for rapid detection of viral threats including zoonotic diseases of greatest**

public health concern. Both SUA and IHI labs gained critical capacity for viral detection and are now prepared to test samples using techniques that can detect known and novel viral threats including the filoviruses (such as Ebola and Marburg), coronaviruses (such as SARS and MERS), paramyxoviruses, flaviviruses, and influenza viruses. The SUA lab is now actively testing wildlife samples for all five of these viral families.

Workforce Development: A well-trained and equipped workforce is critical for health security and for emergency and disaster management and response. This year, PREDICT conducted a number of trainings in Tanzania and with partners in the greater East Africa region, making critical contributions to strengthening the world's One Health workforce for improved global health security. To date, **36 individuals have received in-service training in One Health skills** in Tanzania including one government personnel and 18 students. In addition, **the Tanzania GHSA team provided field-based training to members of the new PREDICT/Ethiopia team**, part of our regional approach to capacity strengthening. Following training, PREDICT/Ethiopia returned home and successfully sampled bats at the camel-human interface as part of GHSA activities targeting zoonotic disease threats.

Handling and sampling a fruit bat during surveillance activities. PREDICT worked with local District Veterinary Officers in the Lake Zone this year introducing techniques for safe wildlife capture, handling, and sampling. Photo: PREDICT/Tanzania

Additional details and highlights from PREDICT's 2015-2016 activities in Tanzania are provided below and linked to corresponding GHSA Road Map Action Packages and milestones.

Zoonotic Disease Action Package

Milestones: One Health Strategy drafted, including identification of priority zoonotic diseases; One Health strategy operationalized, ensuring plan is sensitized across sectors, ministries, and OH networks; Framework for improving capacity at all levels for preparedness to respond to zoonotic disease outbreaks developed

Multisectoral Coordination to Support Mechanisms for Zoonotic Disease Surveillance and Preparedness and Response for Zoonotic Disease Outbreaks

- PREDICT held discussions (October 2015) with the Ministry of Health and Social Welfare, Department of Preventive Services to explore potential human surveillance sites with documented cases of febrile illnesses of undetermined origin.
- Together with representatives from Tanzania, Rwanda, and Uganda, PREDICT attended the One Health Central and Eastern Africa (OHCEA) conference in Kampala, Uganda (November 2015) and engaged with and shared plans for linking future surveillance activities with EPT partners FAO and OHW.
- PREDICT participated in a "Collaborative Stakeholders Meeting" in Dar es Salaam (January 25, 2016) for the launch of two One Health research projects in-country that will be implemented through PREDICT partners SUA and IHI.
- PREDICT held discussions with the P&R team (January 2016) to strengthen in-country collaborative partnerships and shared plans for linking future surveillance activities at the OHW stakeholder meeting in Dar es Salaam (also in January 2016).
- PREDICT personnel assisted with the GHSA Country Assessment in Tanzania (February 2016), the first country assessed using the new Joint External Evaluation tool that was recently developed to include both the eleven GHSA Action Packages and the additional eight areas of concern for the International Health Regulations (IHR). The PREDICT Tanzania country coordinator helped to develop the countries internal assessment report and PREDICT's global EPT Liaison served on the external assessment team.
- PREDICT participated with P&R and other USAID EPT-2 partners and in-country stakeholders in the FAO Implementation Planning workshop held in Dar es Salaam (March 30-31, 2016). At the meeting, the FAO EPT-2 national implementation plan for Tanzania was shared and input was sought from EPT-2 partners and stakeholders. Follow-up meetings between FAO and PREDICT are planned for the upcoming EPT-2 Tanzania Quarterly meeting to discuss how the two partners will harmonize livestock activities.
- PREDICT participated in a One Health Roundtable discussion held in Dar es Salaam with participants from the US, Tanzania, and international organizations (April 28, 2016). The event, organized by USAID, P&R, DTRA, and CDC-Tanzania, brought participants together to discuss the current status of One Health activities in-country and to explore opportunities for cooperative plans and partnerships. PREDICT contributed to efforts to bring together One Health partners to advance the implementation of the signed Tanzania One Health Strategic Plan for 2015-2020.

- To further advance collaborations for joint wildlife and livestock surveillance with FAO and ministry partners, PREDICT hosted officials from FAO's - Emergency Center for Transboundary Animal Diseases in Tanzania, the MALF, and TVLA at PREDICT's Iringa field station for a meeting exploring areas for cooperative partnership and joint coordination surveillance and sampling activities (June 14, 2016).
- At the invitation of FAO, PREDICT participated with Government of Tanzania stakeholders (Department of Veterinary Services, Ministry of Agriculture, Livestock, and Fisheries; Tanzania Veterinary Laboratories Agency; and the Tanzania Wildlife Research Institute) in the three-day "Workshop for Development of a National Surveillance Plan for Filoviruses in Livestock" in Bagamoyo, and led sessions and working groups in the design of the draft surveillance plan, including targeting of surveillance areas, sampling targets, and technical and logistical considerations.
- As part of the SUA's College of Veterinary and Medical Sciences, PREDICT participated in the annual regional agriculture fair (August 1-8, 2016) in Morogoro. PREDICT shared its ongoing work with the public, providing overviews of field and lab surveillance activities and demonstrations of appropriate PPE worn by surveillance teams during sample collection at high-risk human-animal interfaces. The fair was officially opened by the Prime Minister of Tanzania, who, together with SUA's Vice Chancellor, visited the PREDICT team to learn about the project's One Health surveillance and capacity building approach and protocols to improve biosafety.

Professor Kazwala, PREDICT/Tanzania's Principal Investigator describes the project to the Prime Minister (Kassim Majaliwa - right) and SUA Vice Chancellor Professor Gerald Monela (left) at the NaneNane *agricultural fair in Morogoro. At the fair, PREDICT also demonstrated safe use of personal protective equipment (right). Photos: PREDICT /Tanzania*

- PREDICT was invited to present its experience on occupational hazards and safety procedures during a training of trainers of animal health personnel on surveillance protocol of filoviruses in livestock. This training was held at the Centre for Infectious Diseases and Biotechnology at the Tanzania Veterinary Laboratory Agency(TVLA) headquarters, Dar es Salaam (August 10-12, 2016). The training attended by 32 participants from the Ministry of Agriculture, Livestock, and Fisheries (MALF), TVLA, and District Veterinary Officers (DVOs), as well as by two resource persons from FAO headquarters.
- PREDICT team members attended the launch of the One Health Tanzania Coordination Unit in Dar es Salaam (September 2016). At the session, participants brainstormed on how the One Health strategy should be rolled-out and operationalized and discussed plans for the first 90 days.

Zoonotic Disease Action Package

Milestone: Zoonotic disease transmission assessed and enabling behaviors and practices identified

Surveillance to Detect and Discover Zoonotic Viral Threats in Animals and People

PREDICT held strategic meetings with government stakeholders in the Lake Zone (near the borders with Rwanda and Burundi), including District Medical Officers (DMO) and District Veterinary Officers (DVO), to identify priority surveillance sites and strengthen collaborative partnerships (March 2016). The team then launched wildlife surveillance activities collecting wildlife samples at high-risk animal-human interfaces and by assessing sites and partnerships for triangulated sampling of humans, wildlife, and livestock (planned to kickoff in November 2016).

This year, PREDICT collected samples from 175 fruit bats (March and July 2016) from an abandoned mine and roosts near village buildings at prioritized human-wildlife interfaces. Species sampled included *Rousettus* bats (a known Marburg virus host species) that are reportedly hunted and consumed by village dogs. PREDICT also collected samples from 100 rodents at another prioritized high-risk human-wildlife interface in the Lake Zone (July 2016) as part of planned dry season wildlife surveillance activities. Biological samples, including blood, serum, and oral and fecal swabs, were collected from all animals for training of personnel in zoonotic disease surveillance and subsequent viral testing.

A fruit bat captured in a mist net awaits handling and sampling. Several fruit bat roosting sites were targeted for sampling in the Lake Zone where bats interact with humans and domestic animals like dogs. Photo: PREDICT/Tanzania.

PREDICT assessed the capacity of four health centers to participate in human surveillance activities in areas identified by the Ministry of Health's Director of Epidemiology as priorities for the surveillance of zoonotic viruses.

Lab Strengthening Systems Action Package

Milestone: Plan in place to strengthen animal health laboratories for diagnosis of priority zoonotic diseases

Laboratory Testing for Detection of Priority Diseases

PREDICT completed extraction of genetic material and cDNA synthesis from 150 fruit bat specimens (75 oral and 75 rectal swab samples) and completed viral family screening of samples collected from 40 fruit bats at high-risk human-animal interfaces in the Lake Zone, including species known as hosts for Marburg virus. Samples were screened for five viral families (filo-, influenza, paramyxo, corona-, and flaviviruses) using techniques that also detect pathogens of regional concern, such as Ebola, Marburg, and influenza viruses. Viral family screening of samples from an additional 40 fruit bats is also ongoing, as is nucleic acid extraction and preparation for screening of 400 oral and fecal swab samples collected from 100 fruit bats and 100 rodents at high-risk interfaces in the Kigoma District.

PREDICT's global reference lab provided in-service training (November-December 2016) to a project scientist from the East Africa region charged with management and oversight of viral detection and discovery activities; the new scientist then worked closely with project technicians at the SUA lab to optimize and enhance throughput of all viral diagnostic activities and to provide support to the IHI lab as they prepared for implementation of human viral detection activities.

This year, PREDICT trained five laboratory technicians at SUA's lab and two technicians from the IHI lab on project zoonotic viral family protocols. Both labs now have the capacity to test samples, and these technicians at the SUA lab are now actively screening samples for priority zoonotic viral families.

Workforce Development Action Package

Milestones: Animal and human health professionals provided in-service training in requisite One Health skills

Strengthening the One Health Workforce

PREDICT trained government veterinary personnel (a district veterinary officer - DVOs) on bat handling and sampling (March and July 2016) and assessed the capacity of four health centers at animal-human interfaces. Following training, DVOs and local staff were engaged in surveillance activities further enhancing their skills through field-based instruction in bat capture and sampling and through exposure to sample storage, cold chain, and data management best practices.

PREDICT provided pre-service training to university students in biosafety and PPE, laboratory safety, and molecular and serological laboratory techniques at the project lab at Sokoine University of Agriculture's (SUA) College of Veterinary Medicine (August and September 2016). These trainings were part of a five-week laboratory placement required for completion of degree and diploma programs and addressed a total of nine trainees (seven Biotechnology and Laboratory Science degree students and two Laboratory Technology diploma students).

PREDICT presented a One Health lecture on Emerging Pandemic Threats at SUA as part of One Health Central Eastern Africa (OHCEA) network training activities for postgraduate students on infectious disease prevention, detection, and response (September 14, 2016). Participants included 16 postgraduate students from various SUA and Muhimbili University degree programs: Msc Public Health, Msc Epidemiology, Msc Preventive Veterinary Medicine, Msc Health of Aquatic Resources, Msc Wildlife Ecology, Msc Food Science, and SUA Tutorial Assistant.

For details on laboratory trainings completed this past year please see the Laboratory Systems Strengthening *section above.*

Training Summary

A total of **36 individuals**, including **nine men** and **27 women**, have been trained in Tanzania since the start of PREDICT-2 activities in 2014. Eighteen students and one governmental representative have received training to date. A number of individuals completed trainings in more than one subject.

Training Events by Topic*

Topic	Total Trainings	# Trainings by Government Personnel	# Trainings by Women	# Trainings by PREDICT staff	# Trainings by Students
Basic Laboratory Safety	18		11	11	3
Bat Sampling	5	1	1	4	
Biosafety and PPE	18	1	9	10	3
CITI Biomedical Research	4		1	1	
CITI Social Behavioral	5		1	2	
Emergency Preparedness	17		9	10	3
Human Syndromic Surveillance	2		2	2	
Implementing Cold Chain for Safe Sample Transport	9	1	4	5	3
Information Management	2	1	1	1	
Lab Protocols and Diagnostics	3		2	2	
One Health Approach	15		15		15
Other	1			1	
Packing and Shipping Biological Samples	5		4	2	3
Policies and Plans	13		7	8	3
Rodent Sampling	3			3	
Safe Animal Capture and Sampling	5	1	1	4	
Total	**125**	**5**	**68**	**66**	**33**

*Some individuals were cross-trained in multiple topics. Individuals may be represented in multiple rows per column and multiple columns.

Other Achievements:

- Presented two abstracts at the 9th Tanzania Wildlife Research Institute (TAWIRI) Scientific Conference in Arusha (December), entitled, "Systematic surveillance and capacity strengthening to detect emerging viral zoonoses of wildlife origin in Tanzania" and "Detection of Arena viruses in rodent and shrews from selected wildlife-human interfaces in Tanzania".
- Submitted permit renewals and progress reports to Tanzania Wildlife Research Institute (TAWIRI) to extend permissions for wildlife surveillance activities.
- Prepared, submitted, and received permission from the Ifakara Health Institute Institutional Review Board and National Ethical Review Committee for human surveillance activities, the first stage of permissions required for implementation of planned human sampling and behavioral risk investigations.

USAID | PREDICT
FROM THE AMERICAN PEOPLE

Global Health Security Agenda

SUPPORTING THE GLOBAL HEALTH SECURITY AGENDA IN UGANDA

Zoonotic Disease: PREDICT is working with government, local university, and NGO partners to strengthen capacity to conduct pathogen identification and zoonotic disease detection for both novel and known threats, including Ebola, influenza, yellow fever, and Zika virus at high-risk wildlife-livestock-human interfaces identified with government partners as critical gaps in the national surveillance system. This year, **PREDICT contributed expertise to Uganda's National Task Force and to P&R partners in planning for the development of the National One Health Platform.** Also this year, PREDICT continued zoonotic disease surveillance activities **collecting samples from 90 animals** (80 dromedary camels and 10 non-human primates) at high-risk human-animal interfaces for viral spillover and spread and laying the foundation for human surveillance and coordinated livestock sampling activities with key partners. In addition, **PREDICT launched behavioral risk investigations, conducting 48 ethnographic interviews and four focus groups. Finally,** PREDICT's lab at the Makerere University Walter Reed Project (MUWRP) continued **testing samples for known and emerging viral threats including priority zoonoses of greatest public health concern**.

PREDICT's country coordinator collecting samples from dromedary camels in the Karamoja Region of northeastern Uganda. Photo: PREDICT/Uganda

Lab Strengthening Systems: Uganda's national laboratory network has very advanced capabilities for rapid pathogen detection due in large part to exemplary facilities like the Uganda Viral Research Institute (UVRI) and Makerere University Walter Reed Project (MUWRP) facilities. PREDICT is collaborating with the UVRI and MUWRP labs, as well as with ministry and NGO partners that are well integrated with Uganda's national laboratory network and surveillance systems, to identify gaps and to work to strengthen capability for rapid detection of a variety of potential zoonotic disease threats. This year, PREDICT worked with the MUWRP lab to **strengthen capability for rapid detection of viral threats** including the filoviruses (such as Ebola and Marburg), bunyaviruses (such as Rift Valley Fever), flaviviruses (such as yellow fever and Zika), and influenza viruses. **The MUWRP lab is actively testing animal samples for all of these viral families**, as well as for rhabdoviruses (such as rabies).

Workforce Development: A well-trained and equipped workforce is critical for health security and for emergency and disaster management and response. This year, PREDICT conducted a number of trainings in Uganda, making critical contributions to strengthening the world's One Health workforce for improved global health security. To date, **nine individuals have received in-service training in One Health skills** in Uganda, including one government personnel and six students.

Additional details and highlights from PREDICT's 2015-2016 activities in Uganda are provided below and linked to corresponding GHSA Road Map Action Packages and milestones.

Zoonotic Disease Action Package

Milestones: Demonstrated shared network of reporting between animal and human health platform

Multisectoral Coordination to Support Information Sharing and Mechanisms for Zoonotic Disease Surveillance and Preparedness and Response for Zoonotic Disease Outbreaks

- Participated in a National Task Force (NTF) workshop in Jinja to finalize development of handbooks for community-based disease surveillance and guidelines and Standard Operating Procedures for Ebola/Marburg outbreak response.
- Participated in the NTF's response planning meetings for disease outbreaks in Uganda, including in NTF Surveillance Subcommittee meetings to discuss activation of the National Response Plan in response to reports of Crimean Congo Hemorrhagic Fever (CCHF); in general, NTF meeting activities focused on the strategic alignment and allocation of efforts among multi-sectorial partners.
- Participated in quarterly EPT-2 and GHSA meetings at USAID/Uganda to discuss project implementation and facilitate coordination across the EPT-2 projects.
- Participated in stakeholder meetings at the P&R project offices in Kampala on the establishment of the National One Health Platform (NOHP) in Uganda. The purpose of these meetings was to plan and provide updates on the establishment of NOHP and the National One Health Technical Working Group, the official launch of the platform, and to discuss stakeholders and partners support for the platform.

- Attended USAID's EPT-2 and Government of Uganda (GOU) One Health meeting (March 11, 2016) to share information on progress to operationalize and institutionalize One Health in Uganda: explored with GOU partners and other stakeholders the ways in which key stakeholders are currently approaching the One Health paradigm and updated GOU partners on USAID EPT-2 project progress in support of the GHSA.
- Participated in a retreat organized by FAO held in Mukono (July 4-8, 2016) on formulation of a National Surveillance Plan and Protocols that will guide domestic animal risk-based zoonotic disease surveillance and outbreak investigation activities under GHSA. The objectives of the retreat included: development of the national surveillance methodology and protocol for Ebola and other filo-, corona-, influenza, paramyxo-, and flaviviruses in livestock; discussion of the sample targets, species, locations, and timelines; and to harmonize, synchronize, and align these activities with other on-going surveillance programs of government and other GHSA partners.
- Contributed to a workshop on developing a Certificate and Diploma program in Infectious Diseases (November 2-6, 2015) and hosted by One Health Central and East Africa (OHCEA) with support from the OHW project, in order to create a long-term sustainable workforce for infectious disease surveillance and control in Uganda.
- Attended a meeting of Uganda Wildlife Authority (UWA) in Fort Portal (July 28, 2016) to review the sensitivity atlas of the Queen Elizabeth Protected Area ecosystem in southwestern Uganda. The atlas was developed to guide oil/gas development decision-making, given the sensitivity of this area in terms of tourism and biodiversity conservation. The associated risks to both animal and human health were included in the development of the atlas.

Zoonotic Disease Action Package

Milestones: Demonstrated capability for identifying 2 of 5 priority zoonotic diseases in humans and 1 of 5 priority zoonotic diseases in animals; 3-year longitudinal study across wildlife, livestock, and at-risk human populations to identify pathways for disease emergence completed

Surveillance to Detect and Discover Zoonotic Viral Threats in Animals and People

PREDICT coordinated with FAO in Kampala to initiate joint and concurrent zoonotic virus field sampling activities for wildlife and livestock populations and worked together to share surveillance plans and targeted sites and species. Initial discussions culminated in an in-country planning meeting held in Entebbe (March 23-24, 2016) to discuss FAO's work plan for the year and to identify opportunities for synergy and functional partnerships among key national animal resources institutions and organizations. Partners made plans to align wildlife and human sampling (PREDICT) with domestic animal sampling (FAO) and to align PREDICT human behavioral survey sites with FAO animal value chain analysis sites.

PREDICT conducted site characterizations and sampled 80 dromedary camels along the animal value chain pathway in the Karamoja region (Moroto and Amudat districts) of northeastern Uganda. Some of the camels in Amudat district are imported from as far as Kenya and Somalia and transported to abattoirs in as far as Kampala. The team collected approximately 320 blood, oral, and rectal swabs and fecal specimens; specimens are undergoing testing at the Makerere University Walter Reed Project (MUWRP) laboratory for viral family testing.

PREDICT opportunistically collected 420 samples from 10 ill or dead human-habituated mountain gorillas in Bwindi Impenetrable National Park; samples are stored at the MUWRP project lab.

As part of a global pilot effort to optimize qualitative research methods and improve quantitative data collections tools, PREDICT's newly trained social sciences team completed human behavioral risk investigations in southwestern Uganda in and around the Bwindi Mgahinga Conservation area. The team conducted 15 days of in-depth ethnographic interviews with 48 individuals, four focus group discussions, and observational work and transcribed interviews in preparation for data analysis.

In preparation for human surveillance activities, PREDICT submitted and obtained Institutional Review Board (IRB) approval from the Research Ethics Committee at Mbarara University for administering questionnaires and obtaining samples from people at clinics and in communities at planned surveillance sites along the land conversion for commercialization and wildlife value chain emergence pathways. PREDICT subsequently registered the approved IRB protocol with the Uganda National Council of Science & Technology and obtained final approval from the US IRB. In addition, PREDICT confirmed Bwindi Community Hospital (BCH, in Buhoma) as a primary site for hospital-based human surveillance and finalized plans for human surveillance, including drafting an implementation plan and addressing logistical details (particularly regarding sampling materials and staff time requirements). Human surveillance activities are scheduled to begin in 2016-2017.

Lab Strengthening Systems Action Package

Milestones: Mapping of national laboratory capacity for animals; Diagnostic capacity established for most common (half of priority list), known IDSR diseases at national level; Integration of veterinary and human health surveillance and report systems to promote One Health and information sharing

Laboratory Testing for Detection of Priority Diseases

PREDICT continued to work with the Uganda Viral Research Institute (UVRI) and Makerere University Walter Reed Project (MUWRP), implementing partner labs to advance zoonotic viral detection capabilities and plans. PREDICT transferred updated viral family testing protocols the MUWRP lab, which is actively testing animal samples for viral families identified as zoonotic disease priorities in Uganda including: filo-, flavi-, influenza, rhabdo-, and bunyaviruses.

This year, PREDICT prepared and submitted wildlife specimens to the MUWRP lab for viral testing including 87 marabou stork specimens and 204 vervet monkey specimens collected previously (during PREDICT-1 and PREDICT-2 Y1), and 154 domesticated camel specimens. All samples will be tested for zoonotic viral families active at the MUWRP lab.

PREDICT received the first batch of test results from viral family testing at MUWRP from 442 specimens collected from primates, marabou storks, and camels. Results are pending confirmation and interpretation, after which time they will be shared with government partners for review and approval for public release.

PREDICT worked with MUWRP lab partners to optimize a system for data management and test result reporting to enable data tracking and sharing.

Workforce Development Action Package

Milestones: Animal and human health professionals provided in-service training in requisite One Health skills

Strengthening the One Health Workforce

PREDICT continued efforts to strengthen national capacity for wildlife surveillance by providing trainings for in-country staff in One Health skills and safe animal capture and sampling of rodents, bats, non-human primates, birds, and small carnivores. As well, PREDICT trained staff and volunteers on behavioral risk investigations to better understand behavioral drivers for potential zoonotic disease spillover into human communities. The team applied their training by conducting 48 ethnographic interviews and four focus groups.

PREDICT hosted a One Health Fellow (a graduate student in the MS in International Infectious Disease Management program at the One Health Institute, Makerere University) for a three month intensive interdisciplinary training program in collaboration with the One Health Central and Eastern Africa (OHCEA). PREDICT staff participated in an OHCEA stakeholders' engagement meeting (May 20, 2016) at the Makerere University College of Veterinary Science and Animal Biosecurity to discuss expectations, student outputs, mentorship, faculty supervision, and collaboration during field attachment of the One Health Fellows with GHSA partners. This year, the fellow began working with PREDICT's behavioral risk team to learn methods for analysis of qualitative data collected during ethnographic interviews and focus groups to draw insights for targeting surveillance activities and to identify possible risk mitigation opportunities.

Training Summary

A total of **nine individuals**, including **five men** and **four women**, have been trained in Uganda since the start of PREDICT-2 activities in 2014. Six students and one governmental representative have received training from PREDICT. A number of individuals have completed trainings in more than one subject.

Training Events by Topic*

Topic	Total Trainings	# Trainings by Government Personnel	# Trainings by Women	# Trainings by PREDICT staff	# Trainings by Students
Avian Sampling	1			1	
Basic Laboratory Safety	1			1	
Bat Sampling	2			2	
Biosafety and PPE	6		1	2	4
Bushmeat Sampling	1			1	
CITI Social Behavioral	1			1	
Emergency Preparedness	2			2	
Implementing Cold Chain for Safe Sample Transport	1			1	
Non-Human Primate Sampling	3			2	1
Packing and Shipping Biological Samples	4		1	1	3
Qualitative Research and Data Collection	5	1	3	2	2
Rodent Sampling	2			2	
Safe Animal Capture and Sampling	6		1	2	4
Safe Disposal of Carcasses and Infectious Waste	1			1	
Safe Sample Transport and Storage	1				1
Small Carnivore Sampling	1			1	
Total	**38**	**1**	**6**	**22**	**15**

*Some individuals were cross-trained in multiple topics. Individuals may be represented in multiple rows per column and multiple columns.

Other Activities:

- Published: Evans, TS, KVK Gilardi, P Barry, BJ Ssebide, JF Kinani, F Nizeyimana, JB Noheri, DK Byarugaba, A Mudakikwa, MR Cranfield, JAK Mazet, and CK Johnson. Detection of viruses using discarded plants from wild mountain gorillas and golden monkeys. American Journal of Primatology. Published 22 June 2016, DOI: 10.1002/ajp.22576. (See Section 6 – Publications Summary for details).
- Submitted: Anthony SJ, K. Gilardi , T Goldstein, R Baric, B Ssebide, R Mbabazi, I Navarete, D Byarugaba, M Cranfield, I Lipkin, and J Mazet. Further evidence for bats as the evolutionary source of MERS Coronavirus.

SUPPORTING THE GLOBAL HEALTH SECURITY AGENDA IN DEMOCRATIC REPUBLIC OF CONGO

Zoonotic Disease: Through the GHSA, the Democratic Republic of Congo (DRC) has the opportunity to build on previous achievements by working to strengthen interministerial coordination across animal and human health sectors for improved zoonotic disease surveillance. **PREDICT is a member of the GHSA steering committee** charged with supporting the development of the country's GHSA Road Map. This year, **PREDICT supported outbreak investigations/responses and conducted surveillance at high-risk human-animal interfaces, collecting samples from 499 wild animals** (70 bats, 41 rodents, 388 non-human primates) **and 24 livestock** (16 small ruminants, seven ducks, and one pig) and began testing samples for known and emerging viral threats. In addition, the team **launched behavioral risk investigations at markets along the bushmeat value chain** and conducted 47 ethnographic interviews and a focus group with seven individuals.

PREDICT overcomes logistical challenges to assist with an investigation into an unusual animal die-off in Monkoto, DRC.
Photo: Ipos Ngay, PREDICT/DRC

Lab Strengthening Systems: DRC's national laboratory network has very advanced capabilities for rapid pathogen detection due in large part to exemplary facilities, such as the Institut National de Recherche Biomédicale (INRB), which is integrated into the national lab and surveillance systems, and whose capabilities has been tested repeatedly in recent years by multiple zoonotic disease outbreaks of public health concern (e.g. yellow fever and Ebola virus). This year, **PREDICT worked with INRB**, our implementing lab partner, to strengthen capability for rapid detection of a variety of potential disease threats including providing **technical assistance during a yellow fever outbreak and viral detection support for multiple animal die-offs and a suspected human outbreak of unknown origin**. The lab also served as a regional resource in Central Africa, testing samples from neighboring Republic of Congo and providing trainings for visiting technicians from the greater West and Central Africa regions.

Workforce Development: A well-trained and equipped workforce is critical for health security and for emergency and disaster management and response. This year, PREDICT conducted a number of trainings in DRC, making critical contributions to strengthening the One Health workforce for improved global health security. To date, **89 individuals have received training in One Health skills** in DRC including 68 government personnel and five students, part of tomorrow's One Health workforce.

Additional details and highlights from PREDICT's 2015-2016 activities in DRC are provided below and linked to corresponding GHSA Action Packages. *As a Phase 2 GHSA country, the Road Map for DRC with specific milestones has not been publicly released.*

Zoonotic Disease Action Package

Surveillance to Detect and Discover Zoonotic Viral Threats in Animals and People

PREDICT conducted scoping visits to refine surveillance plans at the following sites: Lukaya, N'Sele and Kinkole (Kinshasa), Inongo (Mai-Ndombe province), Gemena (Sud-Ubangi province), Rumangabo (North and South Kivu provinces), and Bukima (eastern DRC). Sites prioritized in Kinshasa were selected due to proximity to a bonobo sanctuary surrounded by several farms with cattle, goats, sheep, pigs, and poultry along the intensification of animal production and land change pathways of viral emergence. Inongo was selected because of significant wildlife hunting, butchering, and trade in markets and restaurants. Gemena was selected because of the presence of refugees from the Central African Republic and the resulting impact on the landscape, which may elevate risks of viral emergence from wildlife and promote the transborder bushmeat trade across Democratic Republic of Congo, Republic of Congo, and Central African Republic. Finally Rumangabo was selected due to the proximity to Virunga National Park (PNVi), the rich animal-human interface (evidenced by recent reports of baboons raiding park headquarters and biting people), and human movement in the area, as well as productive discussions with human health division partners in the Rumangabo, Rutshuru, and Rwanguba health sectors that manage health centres around PNVi.

PREDICT supported an investigation into an animal die-off that began in January 2016 in the Monkoto health zone, Tshuapa province at the request of the DRC Secretary General of Agriculture, Fishery, and Livestock. The investigation team included the PREDICT field coordinator, staff from the Central Veterinary Laboratory of Kinshasa, and local staff from the Ministries of Agriculture, Health, and Environment. During the investigation, the team collected samples from 24 animals, including dead sheep, live and dead goats, and sick ducks and pigs from affected villages (April 7-14, 2016) and transferred the samples for analysis at the Central Veterinary Laboratory of Kinshasa and at the project laboratory at INRB. Samples were also collected from freshly hunted animals at the Monkoto bushmeat market, including non-human primates and rodents. All samples were tested for viral families and shipped to collaborative laboratories for further analysis.

As part of continuing wildlife surveillance activities at high-risk human-animal interfaces, PREDICT collected a total of 551 samples from 49 bats and 40 rodents (trapped around human dwellings) and 39 non-human primates (freshly hunted and sold in markets) in Inongo, Mai-Ndombe province in February and March 2016. During this trip, the team also continued to develop national wildlife capture and sampling capacity by providing training to the DRC Provincial Coordinator for Environment in safe animal capture and sampling techniques.

Freshly hunted wild animals arrive for sale at the Inongo central Market, DRC. Photo: Ipos Ngay, PREDICT/DRC

In addition, PREDICT collected a total of 130 samples from 21 bats and one rodent in an area where local communities collect bat guano for fertilizer during sampling trips in July and September 2016 in Kimpese, Kongo-Central province. All samples were tested for priority viral families, including filo-, corona-, influenza, and paramyxoviruses.

PREDICT provided technical expertise and played a key role in sampling endangered mountain gorillas in the Virunga Massif, assigning staff to assist with the field effort and providing essential supplies for collection of samples (approximately 300 fecal specimens) from night nests of human-habituated and non-habituated gorillas in Virunga National Park (PNVi). In addition, the team opportunistically collected samples from wild human-habituated eastern gorillas (n=5) in Virunga and Kahuzi-Biega National Parks and from captive primates (n=36) in sanctuaries that were exhibiting signs of illness or injury, as well as from a free-ranging baboon (n=1) in Rumangabo village.

As part of a human behavioral study investigating risk of viral spillover associated with the wildlife value chain, PREDICT conducted 47 ethnographic interviews and one focus group with bushmeat hunters, transporters, sellers, suppliers, buyers, market administrators, and cleaners (22 interviews and the focus group in Inongo and 25 interviews in six Kinshasa bushmeat markets). The PREDICT team completed transcriptions and translations of all audio recordings from the interviews and focus group to facilitate data analysis, which is ongoing.

To increase in-country capacity for data analysis and to enhance the quality of data collected for behavioral surveys, PREDICT/DRC staff were trained in June 2016 on analytical techniques for qualitative data collected through ethnographic interviews and focus group discussions. Analyzing behavioral qualitative data in DRC not only increases country capacity but will better enable PREDICT to identify important trends in human behaviors associated with viral spillover and spread for eventual risk mitigation.

Multisectoral Coordination to Support Mechanisms for Zoonotic Disease Surveillance and Preparedness and Response for Zoonotic Disease Outbreaks

- PREDICT, together with USAID, CDC, and various international agencies, provided technical assistance to efforts responding to the yellow fever outbreak, which was declared by the Ministry of Health on June 20, 2016. PREDICT facilitated laboratory diagnosis of samples from suspected cases of yellow fever and joint field investigation by teams from DRC government and CDC in sites where suspected cases had been reported. Additionally, PREDICT enabled nationwide vaccination campaigns that were conducted in Kinshasa and in six other provinces in August: Bas-Uele, Kasai, Kongo Central, Kwango, Lualaba, and Tshuapa. PREDICT also helped procure a new mobile laboratory for INRB that will be deployed for follow-up surveillance in the Haut-Katanga Province at the border with Angola and that will also support disease surveillance, enhancing the country zoonotic disease and diagnostic capabilities.
- PREDICT initiated discussions with the Ministry of Agriculture Direction of Animal Production and Health, the Central Veterinary Laboratory of Kinshasa, the Institut Congolais pour la Conservation de la Nature, the Kinshasa School of Public Health, and the Ministry of Health Direction of Disease Surveillance (4th Direction) to work towards development of a national multidisciplinary surveillance team for zoonoses.
- PREDICT participated in a workshop for the development of a national plan of action for the fight against Nuclear, Radiological, Biological, and Chemical (NRBC) threats (October 1-2, 2015), which includes an integrated approach for capacity building in preventing, detecting, and

responding to NRBC threats. PREDICT was invited to support the development of this action plan, particularly in the area of biological threats, including strengthening biosecurity and biosafety in public health and veterinary laboratories.

- PREDICT hosted the US CDC Division of Global Health Protection (DGHP) team at the project laboratory at INRB (December 1, 2015). The DGHP team was in DRC to engage in a series of discussions concerning the strengthening of public health systems and priority areas for capacity development, in full support of the International Health Regulations (IHR). US government staff at the Embassy, Ministry of Health subject-matter experts (SMEs), and in-country partners were also involved in these discussions.
- PREDICT attended three meetings of the GHSA interagency working group (March 9 and 23, and April 6, 2016), organized to prepare the national road map. Meetings were hosted by USAID, the Korean Agency of International Cooperation (KOICA), and WHO and were also attended by CDC staff. This working group discussed a template for the country GHSA road map and shared each agency's planned activities related to the GHSA action packages over the next five years.
- PREDICT participated in a meeting (April 8, 2016) organized by the Ministry of Health, the Kinshasa School of Public Health, and the CDC with the objective to establish a national steering committee for the prevention, detection, and response to priority zoonotic diseases in DRC, a critical component of the GHSA. PREDICT is a member of this successfully-established steering committee. Others in attendance included the Institut Congolais pour la Conservation de la Nature; the Ministry of Agriculture, Fishery and Livestock (MoAFL); the Secretary General of Health; the Ministry of Health Director of Disease Surveillance and Director of the National Program for Monkeypox and Viral Hemorrhagic Fevers; WHO; USAID; CDC; the Central Veterinary Laboratory of Kinshasa; the MoAFL Director of Animal Surveillance; and the National Division of Hygiene and Sanitation.
- Attended the GHSA Planning Workshop in Guinea (February 15-21, 2016) as part of continuing efforts to strengthen PREDICT's networks in Central and West Africa. During this trip, PREDICT/DRC staff participated in laboratory visits and capacity assessments, provided expertise on implementing project activities in West Africa based on experience in the Central Africa region, and have since provided support for program implementation in Guinea.
- PREDICT/DRC participated in USAID partners meeting in Goma (February and June 2016) and was designated by the North Kivu Provincial Division of Health as a standing invitee to its bi-weekly epidemio-surveillance meetings held in Goma. These meetings are where all human disease cases in the province are reported and discussed and provide opportunities to communicate updates on activities and plans for surveillance, including a specific meeting on Ebola virus surveillance and

planning for control should an outbreak occur. The Provincial Division of Health also discussed the availability of a QUICKNAVI-EBOLA kit for rapid detection of Ebola cases in humans (and potentially animals). PREDICT participated in a national consultation organized on August 23, 2016 in preparation for FAO EPT activities, aimed to increase zoonotic disease surveillance in-country and to encourage collaboration and coordination between EPT-2 partners and national stakeholders. PREDICT contributed to the proposed schedule of activities, as well as in site selection, sharing experience from past project activities in DRC and knowledge of zoonotic disease. Participants included the Ministry of Agriculture (Directorate of Animal Health and Production, Central Veterinary Laboratory), the Ministry of Public Health (National Institute for Biomedical Research, Directorate for the Fight against Disease), the Ministry of Environment (Congolese Institute for Nature Conservation), the DRC Veterinary Association, USAID, One Health Workforce, CDC, World Wildlife Fund, WHO, Kinshasa School of Public Health, and the National Pedagogy University.

Lab Strengthening Systems Action Package

Laboratory Testing for Detection of Priority Diseases

PREDICT's partner lab at the INRB continued to demonstrate advanced capacity for rapid testing and viral detection this year conducting zoonotic viral testing on both animal and human samples collected during project surveillance activities and in response to animal die-off events and suspected outbreaks of human disease. The INRB lab has current capacity to screen samples for coronaviruses, filoviruses, paramyxoviruses, influenza viruses, flaviviruses, orthobunyaviruses, hantaviruses, herpesviruses, adenoviruses, enteroviruses, polyomaviruses, simian foamy viruses, and encephalomyocarditis virus. In addition the lab continued to serve as a training and reference center for advancing viral detection capability throughout the West and Central Africa region.

PREDICT attended a Regional GHSA Consultation Meeting focused on laboratory strengthening, organized by the African Society for Laboratory Medicine (ASLM) and the World Health Organization Regional Office for Africa (WHO-AFRO), in Freetown, Sierra Leone (October 15-16, 2015). The objectives of this meeting were to discuss approaches for the establishment of functional laboratory networks for early detection and responses to emerging disease threats in Africa, and to develop indicators for measuring progress in these laboratory networks. PREDICT provided a project overview and shared experiences, strengthening laboratory capacity for the detection of emerging zoonotic pathogens of pandemic potential.

PREDICT met with the US CDC Senior Laboratory Advisor (November 27, 2015) to discuss possible opportunities for collaboration with public health and veterinary laboratories located in Lumbumbashi, Kisangani, and Goma and the possibility of a coordinated laboratory assessment at the INRB designed to survey facility infrastructure, personnel training, logistical support, and biosecurity and biosafety systems.

The project lab at INRB received 488 samples including whole blood and oral and rectal swabs from 23 bats and 60 rodents collected by the PREDICT/Republic of Congo team in December; 177 oral and rectal swabs were prioritized for zoonotic viral testing with the remaining blood samples stored for future analysis.

PREDICT optimized the protocol for cloning viral nucleic acids (products of amplification), an important technique to allow pathogen detection and characterization from samples with very little viral genetic material, and initiated cloning of plasmids for 33 samples collected during PREDICT-1 activities (2009-2014).

PREDICT tested seven samples from a chimpanzee that died on May 9, 2016, in the Kahuzi-Biega National Park, South-Kivu province in Eastern DRC for orthobunya-, corona-, influenza-, paramyxo-, hanta-, and herpesviruses. Aliquots of blood samples from this animal were shipped to the Columbia University collaborative laboratory for further analyses.

This year, PREDICT tested a total of 593 PREDICT-2 samples (308 collected in DRC and 285 collected by the PREDICT team in neighboring Republic of Congo). The samples collected in DRC originated from 98 bats, 42 rodents, seven non-human primates (bonobos), as well as seven goats from a die-off investigation, Samples were tested for corona-, paramyxo-, influenza-, filo-, flavi-, orthobunya-, hanta-, entero-, and herpesviruses. The samples collected in ROC were from 86 bats and 57 rodents and were tested for corona-, paramyxo-, influenza-, and filoviruses.

Also this year as part of ongoing training, the project lab at INRB re-tested 202 PREDICT-1 samples from 98 non-human primates, 33 rodents and five bats (129 collected in DRC and 73 from ROC). Samples were tested for adeno-, corona-, entero-, herpes-, polyoma-, and Simian Foamy Viruses.

Following the death of five bonobo monkeys (*Pan paniscus*) showing signs of neurological disorder at the Lola Ya Bonobo Sanctuary in Kinshasa, the project lab tested samples from the bonobos with lab tests indicating the presence of viral genetic material in the animals' central nervous systems. Arrangements for confirmatory testing were made with collaborating laboratories and in partnership with INRB, PREDICT made plans to provide technical support to the Sanctuary for an ecological investigation.

PREDICT received samples (June 17, 2016) from two people admitted to a hospital in Kinshasa, who presented with symptoms suggestive of viral infection after close contact with primates. Given a history of recent bonobo deaths in the region, their samples were sent to the INRB lab for detection of potential zoonotic pathogens. Tests for eight viral families were negative, and the results were shared with the hospital.

PREDICT participated in a coordination meeting (June 22, 2016) with Japan International Cooperation Agency (JICA), USAID/DRC, WHO, INRB, and other Ministry of Public Health partners, including the University of California Los Angeles (UCLA) DRC research program. The meeting was organized by the INRB and held to discuss a JICA-supported opportunity for building a P3 laboratory and a regional laboratory training center for Central Africa on the INRB campus. The meeting focused on how PREDICT, WHO, and other programs could contribute to the P3 development plan, along with opportunities for collaborations with JICA on One Health workforce development.

PREDICT procured essential cold-chain equipment (a -80C freezer) for project headquarters in Eastern DRC (Goma), enabling for the first time the safe and effective storage of wildlife samples in this region of the country.

Workforce Development Action Package

Strengthening the One Health Workforce

PREDICT DRC staff attended a meeting (May 20, 2016) organized by One Health for Central and Eastern Africa (OHCEA), a university network supported by EPT-2 and the One Health Workforce, to discuss the OHCEA annual work plan and coordination with in-country partners, including participation of OHCEA trainees in project field activities and sites where OHCEA will train provincial administrative teams in prevention and response to epidemics alongside PREDICT field surveillance activities.

As part of continuing efforts to strengthen One Health networks and in-country laboratory capacity, the PREDICT/DRC laboratory team trained 12 molecular biology students from the University of Kinshasa in the cloning of plasmids, a laboratory technique that can maximize the chance of detecting pathogens from biological specimens with very low quantities of genetic material.

PREDICT also conducted trainings for five project staff and government personnel (agriculture ministry) in the Eastern DRC region on updated project protocols covering PPE use, biosafety, basic laboratory and safety, animal capture and handling, animal sampling, cold chain management, emergency preparedness, and Safe Carcass Infectious Waste Disposal.

PREDICT staff completed ethics trainings and training in the project's human surveillance and sampling protocols in Kinshasa. As a result staff are now prepared to launch human surveillance activities, including community-level sampling and behavioral risk investigations and syndromic surveillance in health clinics and hospitals.

As part of efforts to strengthen capacity in the greater West and Central Africa region, PREDICT/DRC continued to support program implementation in Côte d'Ivoire by hosting a training session for the PREDICT/Cote d'Ivoire team (July 11- 22, 2016). After a week of training focused on program management, administration, and completion of project training modules, the second week of training was held in the field and laboratory and featured visits to Kimpese, Kongo Central, and Western DRC, all surveillance sites with a high-risk human-wildlife interface and where training was centered on the organization and implementation of field work, biosafety, and sampling of targeted animals. During the traning, the PREDICT/Cote d'Ivoire team helped collect 54 samples (oral and rectal swabs and blood) from eight bats and one rodent. Laboratory training was conducted on organization and workflow in the laboratory and the use of viral detection protocols and covered basic molecular biology techniques, such as conventional PCR and cloning.

PREDICT participated in a training in biosecurity and biosafety risk management organized at INRB (September 23-25, 2016) and sponsored by the Kinshasa School of Public Health and the US CDC. This training focused on the concepts of biological risk management: risk assessment, risk mitigation and management performance, and the importance of good laboratory and clinical practices. Participants included biologists, medical doctors, veterinarians, nurses, laboratory technicians, as well as biosafety and quality assurance officers from the University Clinic of Kinshasa, INRB, Central Veterinary Laboratory, Kinshasa Nursing School, PREDICT/DRC staff, and the Provincial General Hospital of Kinshasa.

Training Summary

A total of **89 individuals**, including **50 men** and **39 women**, have been trained in the Democratic Republic of the Congo since the start of PREDICT-2 activities in 2014. Sixty-eight governmental personnel and five students have received training from PREDICT. A number of individuals completed trainings in more than one subject.

Training Events by Topic*

Topic	Total Trainings	# Trainings by Government Personnel	# Trainings by Women	# Trainings by PREDICT staff	# Trainings by Students
ACU 101	1			1	
Avian Sampling	4			4	1
Basic Laboratory Safety	71	56	36	14	2
Bat Sampling	7	3		4	1
Biosafety and PPE	15	1	3	13	2
Bushmeat Sampling	6	2		4	2
CITI Biomedical Research	7			7	1
CITI Social Behavioral	3			3	1
Emergency Preparedness	14		3	13	2
GIS and Spatial Analysis	1			1	1
Implementing Cold Chain for Safe Sample Transport	5		1	5	1
Lab Protocols and Diagnostics	10	5	4	5	
Non-Human Primate Sampling	6	1		5	2
Other	15		2	15	
Outbreak Response	1			1	
Packing and Shipping Biological Samples	60	56	33	4	1
Policies and Plans	9		3	9	1
Qualitative Research and Data Collection	13	4	2	1	4
Rodent Sampling	6	3		3	1
Safe Animal Capture and Sampling	7	3		4	1
Safe Disposal of Carcasses and Infectious Waste	3			3	1
Safe Sample Transport and Storage	1			1	1
Small Carnivore Sampling	3			3	1
Totals	**268**	**134**	**87**	**123**	**27**

*Some individuals were cross-trained in multiple topics. Individuals may be represented in multiple rows per column and multiple columns.

Other Activities this Period:

- For outreach, systems' strengthening, and professional development, PREDICT staff participated in the 64th Annual Conference of the American Society of Tropical Medicine and Hygiene (ASTMH) held in Philadelphia, Pennsylvania (October 25-29, 2015), presenting two posters on PREDICT-1 success stories, including the inclusion of rural community members in the surveillance of zoonoses and the diagnosis and characterization of the Ebola virus responsible for the 2014 outbreak in DRC.

- PREDICT country coordinators from DRC, Rwanda, and Nepal attended the 2016 Annual Consortium of Universities for Global Health (CUGH) conference in San Francisco, California (April 9-11, 2016). On a panel entitled “On the Front Lines of One Health” moderated by PREDICT’s Global Surveillance Lead. The country coordinators spoke about their efforts to implement One Health programs in real-life, on-the-ground scenarios. PREDICT’s DRC country coordinator spoke about the project’s involvement in the early detection and control of an Ebola outbreak in the Democratic Republic of Congo.

USAID | PREDICT
FROM THE AMERICAN PEOPLE

Global Health
Security Agenda

SUPPORTING THE GLOBAL HEALTH SECURITY AGENDA IN GHANA

Zoonotic Disease: Through the GHSA, Ghana has the opportunity to build on previous achievements by working to strengthen multisectoral coordination across animal and human health sectors for improved zoonotic disease surveillance. This year, **PREDICT worked with GHSA partners on the Ghana Joint External Evaluation (JEE) self-assessment and the GHSA 5-year Roadmap Zoonoses Action Package**. Also this year, PREDICT developed the foundation for successful implementation of disease surveillance activities: securing permissions, engaging partners across animal and human health sectors, identifying surveillance sites, completing core trainings, and **officially launching wildlife sampling activities during field-based training exercises by collecting samples from 89 animals.**

Mona monkeys and sheep forage on discarded corn husks near the Boabeng-Fiema Monkey Sanctuary, one of the sites identified by PREDICT/Ghana for surveillance activities as a key animal-human interface for viral spillover and spread. Photo: Terra Kelly/PREDICT

Lab Strengthening Systems: Ghana's national laboratory network has very advanced capabilities for rapid pathogen detection. This year, **PREDICT formalized relationships with the Accra Veterinary Laboratory**, Veterinary Services Directorate, at the Ministry of Food and Agriculture **and the Noguchi Memorial Institute for Medical Research**. These labs, both critical nodes in Ghana's animal and human laboratory network, are well integrated with national surveillance systems and will serve as the centers for viral detection activities and training working to advance Ghana's capabilities for detecting known and novel viral threats.

Workforce Development: A well-trained and equipped workforce is critical for health security and for emergency and disaster management and response. This year, PREDICT trained three government health professionals in Ghana, laying the foundation for further contributions to strengthen the One Health workforce in-country.

Additional details and highlights from PREDICT's 2015-2016 activities in Ghana are provided below and linked to corresponding GHSA Action Packages. *As a Phase 2 GHSA country, the Road Map for Ghana with specific milestones has not been publicly released.*

Zoonotic Disease Action Package

Surveillance to Detect and Discover Zoonotic Viral Threats in Animals and People

In collaboration with EPT-2 stakeholders, PREDICT prioritized locations for surveillance activities at sites in the northern, middle, and southern zones of the country based on key criteria, including disease emergence pathways, high-risk disease transmission interfaces, and reports of undiagnosed human illness.

PREDICT conducted reconnaissance visits to sites prioritized by stakeholders for surveillance activities. The team traveled to locations in the Northern, Brong-Ahafo and Central regions to assess human-animal interactions within markets serving as important wildlife and livestock trade centers (with cross-border movements of animals and people) and at sacred sites where local community members and tourists have close interactions with bats and non-human primates.

Monkeys scavenge on food in cooking areas in the villages. The monkeys have close contact with people as well as sheep, pigs, and chickens in and around the surrounding communities. Tourists visiting the sanctuary also closely interact with the monkeys.
Photo: Terra Kelly/PREDICT

PREDICT secured permissions and agreements to conduct project activities including: a Memorandum of Understanding with the Wildlife Division of the Forestry Commission in the Ministry of Land and Natural Resources; a wildlife research permit from the Wildlife Division; Institutional Review Board protocol with Noguchi Memorial Institute for Medical Research; a letter of collaboration from Ghana Health Service to conduct human sampling and behavioral risk research; and Institutional Animal Care and Use Committee protocol to conduct wildlife sampling with Noguchi Memorial Institute for Medical Research.

In addition, to prepare for wildlife surveillance activities, PREDICT completed inventory surveys and ordered supplies to equip partners at the Veterinary Services Department and Wildlife Division for non-invasive field sampling of bats, rodents, and non-human primates.

Following receipt of permissions and supplies, PREDICT/Ghana officially launched wildlife surveillance activities during training exercises (see Workforce Development for details below) collecting samples from 89 animals including 69 non-human primates, 15 rodents, and five bats. All samples were stored in cold chain to await viral family testing at the Accra Veterinary Laboratory, the project collaborating lab.

Multisectoral Coordination to Support Mechanisms for Zoonotic Disease Surveillance and Preparedness and Response for Zoonotic Disease Outbreaks

- PREDICT appointed a country coordinator and facilitated official introductions to the national partner network. The country coordinator was formally engaged in the project, including completion of training and receipt of the global certifications required to conduct project human subjects research.
- PREDICT worked with Ghana Health Service (Ministry of Health) and other partners on the Ghana Joint External Evaluation (JEE) self-assessment and the GHSA 5-year Roadmap for the Zoonoses Action Package to aid with the assessment of Ghana's current capacity to prevent, detect, and rapidly respond to public health threats.
- PREDICT engaged in-country and EPT-2 partners and initiated implementation of activities by conducting a multi-sectoral stakeholder group meeting (January, 2016) with representatives from the Ministry of Food and Agriculture; Ministry of Land and National Resources; Ministry of Health (Ghana Health Service, National Public Health Reference Laboratory, and Emergency Operations Center); Noguchi Memorial Institute for Medical Research; USAID; FAO; CDC; NAMRU-3; Ministry of the Interior (National Disaster Management Organization); WHO; and Partnership for Health Care Improvement, to work together to prioritize locations for project surveillance activities and evaluate plans and coordination details for program implementation.

- PREDICT joined partners for the EPT-2 Implementation Planning Workshop in Accra (September 8-9, 2016) to share the achievements from the past year, introduce and seek input from partners through breakout sessions on priorities and plans for upcoming zoonotic disease and laboratory activities, and discuss how the EPT-2 program can support the institutionalization of One Health in Ghana. Participants included representatives from the Ministry of Health; Veterinary Services Directorate of the Ministry of Food and Agriculture; Wildlife Division of the Ministry of Land and Natural Resources; FAO; US CDC; WHO; Noguchi Memorial Institute for Medical Research, University of Ghana; Ghana Armed Forces; National Disaster Management Organization; Japan International Cooperation Agency; and the Norwegian Institute of Public Health. The workshop included a presentation by Noguchi Memorial Institute for Medical Research (PREDICT's planned implementing partner for human surveillance) on One Health and a framework for operationalizing the approach in Ghana followed by a panel discussion on One Health in Ghana. Representatives from the Ministry of Health, Veterinary Services Directorate (PREDICT's current animal laboratory partner), and the Wildlife Division (the project's partner for wildlife surveillance) participated in the panel, sharing their vision for One Health operationalization in Ghana and how EPT-2 program can contribute to this vision. They also discussed with partners their recommendations for coordination and the way forward for institutionalizing One Health in Ghana.
- PREDICT continued discussions with FAO's EPT-2 regional representative and FAO's national coordinator for Ghana to discuss joint coordination of surveillance activities and learn more about FAO's priority sampling locations and plans for sample testing and data collection in Ghana.

Lab Strengthening Systems Action Package

Laboratory Testing for Detection of Priority Diseases

PREDICT engaged partner laboratories at the Accra Veterinary Laboratory, Veterinary Services Directorate, at the Ministry of Food and Agriculture (animal lab and part of the national lab system) and the Noguchi Memorial Institute for Medical Research (human lab well networked with the public health and national surveillance systems). Points of contact were identified and initial steps were taken to develop plans for capacity assessments and trainings.

PREDICT/Ghana's lead animal laboratory coordinator and country coordinator completed training on project standard operating procedures and practices for laboratory work including basic laboratory safety, emergency preparedness, and safe waste disposal in preparation for diagnostic testing activities.

Workforce Development Action Package

Strengthening the One Health Workforce

Completed trainings for project staff on PREDICT protocols covering PPE use, biosafety, animal capture and handling, cold chain management, emergency preparedness, outbreak preparedness, and waste management.

PREDICT/Tanzania country coordinator, Dr. Zikankuba Sijali, shares his expertise on rodent trapping with members of the PREDICT/Ghana team.
Photo: Terra Kelly/PREDICT

As part of project efforts to further strengthen One Health networks and enhance zoonotic disease workforce skills in the greater Africa region, PREDICT/Tanzania's country coordinator accompanied a member of the global team to conduct a week-long in-service training exercise with PREDICT Ghana's Wildlife Division of the Forestry Commission (Ministry of Land and Natural Resources) and Veterinary Services Directorate (Ministry of Food and Agriculture) team members. The training (October 1-9, 2016) was conducted at project surveillance sites selected as high-risk animal-human interfaces near Techiman and covered One Health-related field skills for conducting surveillance activities including biosafety and use of personal protective equipment (PPE); safe capture and sampling of bats and rodents; non-invasive sampling of non-human primates; safe transport of and maintaining cold chain for biological specimens; and surveillance data entry and management. During the training, the team gained hands-on experience and collected samples from 69 non-human primates, 15 rodents, and five bats. Samples were frozen and stored and will be used in upcoming viral detection trainings with project labs.

Training Summary

A total of **three individuals**, all men, have been trained in Ghana since the start of PREDICT-2 activities in 2014. All three are governmental personnel. All individuals completed trainings in more than one subject.

Training Events by Topic*

Topic	Total Trainings	# Trainings by Government Personnel	# Trainings by Women	# Trainings by PREDICT staff	# Trainings by Students
Avian Sampling	3	3		3	
Basic Laboratory Safety	3	3		3	
Bat Sampling	2	2		2	
Biosafety and PPE	3	3		3	
Bushmeat Sampling	2	2		2	
CITI Biomedical Research	1	1		1	
CITI Social Behavioral	1	1		1	
Emergency Preparedness	3	3		3	
Implementing Cold Chain for Safe Sample Transport	3	3		3	
Information Management	2	2		2	
Non-Human Primate Sampling	2	2		2	
Packing and Shipping Biological Samples	3	3		3	
Policies and Plans	2	2		2	
Qualitative Research and Data Collection	1	1		1	
Rodent Sampling	2	2		2	
Safe Animal Capture and Sampling	2	2		2	
Safe Disposal of Carcasses and Infectious Waste	3	3		3	
Small Carnivore Sampling	2	2		2	
Total	**40**	**40**	**0**	**40**	**0**

*All individuals were cross-trained in multiple topics and are represented in multiple rows per column and across multiple columns.

Other Activities:

- PREDICT finalized subagreements with the Veterinary Services Directorate of the Ministry of Food and Agriculture and the Wildlife Division of the Forestry Commission, Ministry of Land and Natural Resources as the implementing partners for wildlife disease surveillance and diagnostic activities in Ghana. PREDICT has formally engaged Noguchi Memorial Institute for Medical Research at the University of Ghana as the implementing partner for human disease surveillance and diagnostic activities in Ghana and is coordinating with FAO on joint surveillance activities in-country.

- Delivered an invited presentation on PREDICT for a One Health session at the Rabies in West Africa Conference in Accra hosted by the Rabies in West Africa Ghana Chapter, Ghana Ministry of Food and Agriculture and Ministry of Health among others and attended by global experts who convened to discuss surveillance capacity building and One Health approaches.

USAID | PREDICT
FROM THE AMERICAN PEOPLE

Global Health
Security Agenda

SUPPORTING THE GLOBAL HEALTH SECURITY AGENDA IN RWANDA

Zoonotic Disease: Through the GHSA, Rwanda has the opportunity to build on previous achievements by working to strengthen interministerial coordination across animal and human health sectors for improved zoonotic disease surveillance. **PREDICT is a member of the Rwanda One Health Steering Committee (ROHSC), an integral catalyst organizing the technical working group for developing the national GHSA Road Map along with thematic areas and milestones.** This year, **PREDICT conducted surveillance at high-risk human-animal interfaces, collecting samples from 471 wild animals** (366 bats, 38 rodents, 205 non-human primates) **and began testing samples for known and emerging viral threats**. In addition, **PREDICT supported an investigation into a die-off of fruit bats** at an urban human-animal interface in Kigali, collecting samples and providing technical assistance through the project's global network of specialists and reference labs (investigation ongoing).

The PREDICT/Rwanda team examines an emaciated bat during an investigation into a bat die-off of an urban fruit bat colony in Kigali (left). A live but weakened fruit bat (right) hangs on a wall at the site where the die-off occurred. Photos: PREDICT/Rwanda.

Lab Strengthening Systems: Rwanda's national laboratory network has advanced capabilities for pathogen detection and has taken steps to integrate animal and human laboratories. This year, PREDICT continued to work with the national laboratory system through the project lab at the Rwanda Agriculture Board's Wildlife Virology Laboratory and established a Memorandum of Understanding to engage the Ministry of Health's Rwanda Biomedical Center/National Reference Laboratory as a core project lab for viral detection activities. **These partnerships formalize PREDICT's One Health Laboratory network in-country and establish training centers across animal and human health sectors for the advancement of national capacity for the detection of known and novel viral threats.**

Workforce Development: A well-trained and equipped workforce is critical for health security and for emergency and disaster management and response. This year, PREDICT conducted a number of trainings in Rwanda, making critical contributions to strengthening the One Health workforce for improved global health security. To date, **11 individuals have received training in One Health skills** in Rwanda, expanding the country's One Health workforce.

Additional details and highlights from PREDICT's 2015-2016 activities in Rwanda are provided below and linked to corresponding GHSA Action Packages. *As a Phase 2 GHSA country, the Road Map for Rwanda with specific milestones has not been publicly released.*

Zoonotic Disease Action Package

Surveillance to Detect and Discover Zoonotic Viral Threats in Animals and People

This year PREDICT collected 1,038 samples from 366 bats in human dwellings and at ecotourism interfaces; 114 samples from 67 non-human primates at crop raiding and ecotourism interfaces; and 143 specimens from 38 rodents in human dwellings, all at the land conversion for commercialization emergence pathway around Nyungwe National Park, Volcanoes National Park and Kigali.

In addition, PREDICT investigated a bat die off in Kigali and collected 101 specimens from 18 dead and dying bats. The project lab processed samples and prepared them for shipment to the project reference lab for confirmatory testing and sequencing. Preliminary histopathological examinations were performed in September 2016, and results were shared with the Rwanda Development Board/Department of Tourism and Conservation.

In addition to aforementioned primate sampling, PREDICT played a key role in censusing endangered mountain gorillas in the Virunga Massif, assigning staff to assist with the first-phase field effort and providing essential supplies for collection of samples (approximately 138 fecal specimens) from night nests of human-habituated and non-habituated gorillas in Volcanoes National Park. The majority of wild mountain gorillas in the Virungas are human-habituated to facilitate a multimillion-dollar ecotourism trade that brings thousands of people from around the world into close proximity with the gorillas every day, creating significant risk for bidirectional human-primate pathogen transmission. The census occurs every 5-10 years and presents a unique opportunity to non-invasively obtain samples from all gorillas, which can be screened for potentially zoonotic viruses adding to our understanding of the dynamics of viral spillover and spread at this critical human-animal interface.

PREDICT obtained approval from the Rwanda Ethics Board and globally from the UC Davis Institutional Review Board (certified by the US Department of Health and Human Services) for human surveillance activities (planned to begin in 2017). In preparation for the launch of human surveillance in

Rwanda, PREDICT hired a human surveillance technician, who completed trainings in human sampling work and initiated coordination of human surveillance activities in selected sites around the country with hospitals and health centers.

Multisectoral Coordination to Support Mechanisms for Zoonotic Disease Surveillance and Preparedness and Response for Zoonotic Disease Outbreaks

- Participated in multiple meetings of the interministerial Rwanda One Health Steering Committee (ROHSC) to evaluate the current status of One Health implementation in Rwanda, including challenges, opportunities, and ideas about future programmatic directions, and to update and review potential partners on the ROHSC's collaborative approach.
- With the ROHSC, PREDICT updated USAID/Rwanda on One Health activities and discussed plans for the national launch of the Global Health Security Agenda.
- PREDICT participated in the One Health Workforce One Health demonstration site (around Akagera National Park) results discussion and partners briefing with the University of Rwanda Schools of Public Health, Veterinary Medicine, Environmental Health, Human Medicine, and Nursing (October 4, 2015)
- The PREDICT country coordinator participated in a yellow fever technical planning meeting with the ROHSC (March 22, 2016) to discuss the current resurgence of yellow fever cases in east-central Africa and the preventive measures that can be put into place to minimize the spread of the disease into Rwanda. Also discussed were ways in which Rwanda could strengthen its surveillance system and laboratory diagnostic abilities through the ROHSC framework to prepare for the potential spread of other vector borne diseases that occur in neighboring nations (e.g., West Nile, dengue, chikungunya, and Zika viruses).
- PREDICT participated with EPT-2 partners in GHSA planning meetings with the ROHSC members on April 15, 2016, which established a Technical Working Group on developing a GHSA roadmap and on August 24-25, 2016 to harmonize EPT-2 partners and ROHSC strategic plans with GHSA thematic areas and milestones.

Lab Strengthening Systems Action Package

Laboratory Testing for Detection of Priority Diseases

PREDICT signed a Memorandum of Understanding with the Ministry of Health's Rwanda Biomedical Center (RBC) National Reference Laboratory for viral family PCR testing of both wildlife and human biological samples collected during triangulated field surveillance efforts; this advanced regional One Health capacity by enabling for the first time in-country capabilities for detection of emerging viral threats from wildlife in Rwanda.

PREDICT has been working with the Rwanda Agricultural Board's Wildlife Virology Laboratory, which combined with a partnership with RBC's National Reference Lab constitutes a One Health national lab network with current capacity to screen samples for corona-, filo-, influenza-, and paramyxoviruses. In addition the lab network will serve as a critical training and reference center for advancing viral detection capability in-country.

This year, PREDICT processed 26 fecal samples collected from chimpanzees, 13 fecal samples collected from mountain gorillas, 85 rectal swab samples from bats, and five rectal swab samples rodents at the RAB's Wildlife Virology Laboratory and submitted extracted samples for testing using viral family testing protocols. The team also prepared cDNA and PCR products for shipment to the global reference lab for confirmatory sequencing (results are expected in 2016-2017).

PREDICT continued to reinforce laboratory training conducted in 2014-2015 with ongoing consultations and mentorship from our global laboratory and viral detection team helping improve lab management and advance capabilities for wildlife sample processing and viral detection.

Workforce Development Action Package

Strengthening the One Health Workforce

PREDICT continued efforts to strengthen national capacity for wildlife surveillance by providing trainings for in-country staff in One Health skills and safe animal capture and sampling of rodents, bats, non-human primates, birds, and small carnivores. Following trainings, the team engaged in wildlife surveillance activities, collecting samples from bats, rodents, and non-human primates at high-risk interfaces for animal-human contact and zoonotic disease transmission in the areas around Volcanoes and Nyungwe National Parks. As well, trainees initiated laboratory testing of specimens for four priority viral families.

Training Summary

A total of **11 individuals**, including **eight men** and **three women**, have been trained in Rwanda since the start of PREDICT-2 activities in 2014. Two of these individuals are students. Some individuals completed trainings in more than one subject.

Training Events by Topic*

Topic	Total Trainings	# Trainings by Government Personnel	# Trainings by Women	# Trainings by PREDICT staff	# Trainings by Students
Avian Sampling	1			1	
Basic Laboratory Safety	3			3	
Bat Sampling	1			1	
Biosafety and PPE	3			3	
Bushmeat Sampling	1			1	
Emergency Preparedness	3			3	
GIS and Spatial Analysis	1			1	
Implementing Cold Chain for Safe Sample Transport	1			1	
Non-Human Primate Sampling	1			1	
Packing and Shipping Biological Samples	1			1	
Policies and Plans	2			2	
Qualitative Research and Data Collection					
Rodent Sampling	1			1	
Safe Animal Capture and Sampling	1			1	
Safe Disposal of Carcasses and Infectious Waste	1			1	
Small Carnivore Sampling	1			1	
Total	**25**	**0**	**1**	**23**	**2**

*Some individuals were cross-trained in multiple topics. Individuals may be represented in multiple rows per column and multiple columns.

Other Activities*:*

- Published Evans, TS, KVK Gilardi, P Barry, BJ Ssebide, JF Kinani, F Nizeyimana, JB Noheri, DK Byarugaba, A Mudakikwa, MR Cranfield, JAK Mazet, and CK Johnson. Detection of viruses using discarded plants from wild mountain gorillas and golden monkeys. American Journal of Primatology. Published 22 June 2016, DOI: 10.1002/ajp.22576.
- Submitted: Evans, TS, LJ Lowenstine, KV Gilardi, PA Barray, BJ Ssebide, JF Kinani, F Nizeyimana, JB Noheri, MR Cranfield, A Mudakikwa, T Goldstein, JAK Mazet, and CK Johnson. Mountain gorilla lymphocryptovirus has Epstein-Barr virus-like epidemiology and pathology in infants.

USAID | PREDICT
FROM THE AMERICAN PEOPLE

Global Health
Security Agenda

SUPPORTING THE GLOBAL HEALTH SECURITY AGENDA IN BANGLADESH

Zoonotic Disease: While training and providing proof-of-concept for One Health application to successful zoonotic disease management, PREDICT targeted high-risk interfaces for zoonotic disease transmission and spread and worked to enhance Bangladesh's surveillance system by integrating sampling of wildlife and livestock (with FAO support) with behavioral risk investigations among at-risk human communities. This year, **PREDICT supported the Government of Bangladesh (GoB) in responding to two outbreak investigations and worked with GoB partners to investigate the risk of MERS-Coronavirus along the camel value chain**. Also this year, **PREDICT collected samples from 5,519 animals** (5,291 samples from wildlife and 228 samples from livestock) at high-risk human-animal interfaces for zoonotic disease transmission **and began testing samples for known and emerging viral threats. PREDICT also conducted behavioral risk investigations completing 78 ethnographic interviews and three focus groups** with insights from interviews identifying a bat hunting and consumption interface as particularly high-risk for viral spillover and spread.

A PREDICT/Bangladesh field investigator carefully removes a crow from a mist net for sampling (a safe method for capturing birds) as part of a One Health investigation into a suspected H5 influenza outbreak. Photo: PREDICT/Bangladesh

Lab Strengthening Systems: PREDICT is working to directly strengthen capacity for detection of priority zoonotic disease threats in animal and human laboratories and to contribute to operationalization of a One Health laboratory network in Bangladesh by fostering communication and coordination between human and animal partner laboratory facilities and ministries. This year, **PREDICT worked with icddr,b and the Institute of Epidemiology, Disease Control, and Research (IEDCR)**, our implementing lab partners, to identify opportunities for capacity strengthening to enable more rapid detection of both known and novel zoonotic disease threats.

Workforce Development: A well-trained and equipped workforce is critical for health security and for emergency and disaster management and response. PREDICT investments are making an impact on Bangladesh's One Health workforce though the provision of in-service training to health professionals in the human and animal health sectors from the district to national levels. This year, PREDICT conducted a number of trainings in Bangladesh, including **a seven-day field-based training for GoB forestry officials and veterinarians in wildlife disease surveillance**, making critical contributions to strengthening the One Health workforce for improved global health security. To date, **100 individuals have received training in One Health skills** in Bangladesh including 23 government personnel and 76 students, part of tomorrow's One Health workforce.

Additional details and highlights from PREDICT's 2015-2016 activities in Bangladesh are provided below and linked to corresponding GHSA Road Map Action Packages and milestones.

Zoonotic Disease Action Package

Milestones: Assist Bangladesh partners during outbreaks; Map high-risk human/animal interfaces (i.e. "value chains," land use change, etc.); Detect and discover prioritized viral families in Bangladesh through partners; Standardize approach to study human behavioral risk; High-risk "nodes" for spillover of zoonotic threat and the behaviors and practices that enable spillover identified

Surveillance for Priority Zoonotic Diseases and Pathogens

PREDICT supported the Government of Bangladesh (GoB) by participating in a One Health investigation (February 16-24, 2016) of a suspected H5 influenza outbreak in crows. PREDICT sampled crows and other wild birds in Rajshahi and Natore Districts to better understand which, if any, influenza viruses were in circulation, to identify potential transmission pathways and sources of domestic bird infection, and to help elucidate the risk of disease spillover into people. Analysis of results is underway. The GoB Outbreak Team also conducted a comprehensive follow-up investigation that included sampling domestic birds at a live bird market and human surveillance. Samples from wild birds are being tested at the Bangladesh Livestock Research Institute (BLRI) under the Ministry of Livestock and Fisheries, using specific PREDICT Influenza protocols.

Also upon GoB request, PREDICT participated in a suspected Leptospira outbreak in people in Shibpur Upazilla of Narsingdi, Bangladesh (December 14-23, 2015). Using a One Health approach to investigate epidemiological links between animal and human infection, the team collected 200 biological samples from rodents, 20 biological samples from domestic animals and 18 water samples at different human-animal interfaces. Additionally, PREDICT's behavioral science team conducted an observational study of people at the same sites to evaluate behaviors and practices that could be associated with disease transmission and to identify potential risk mitigation strategies.

In collaboration with GoB partners, PREDICT collected biological samples from dromedary camels from an urban farm and market for viral screening (serology and PCR for MERS Coronavirus) and viral family testing targeting coronaviruses along with other priority viral families of public health concern. This activity is helping to increase our understanding of urban livestock markets as a high-risk interface for zoonotic disease evolution and transmission.

PREDICT collects biological specimens from camels at a seasonal livestock market in Dhaka. Photo: PREDICT/Bangladesh

This year as part of planned surveillance activities, PREDICT collected a total of 9,170 biological samples from rhesus macaques at sites where people and macaques are in close contact; 5,830 samples were collected during the winter season (January to April 2016) and 3,340 during the summer season (July to August 2016).

Goats and macaques share feed provided by a local community member, a type of contact that may lead to disease spillover and that PREDICT is evaluating through human, livestock, and wildlife focused surveillance activities.
Photo: PREDICT/Bangladesh

Also this year, PREDICT collected a total of 2,864 biological samples from 282 small bats, 920 biological samples from 90 dromedary camels, and 2,279 biological samples from 214 rodents. These samples were collected from animals in and around households, animal production facilities, and agricultural fields as part of efforts to assess how viral diversity in key wildlife species and the risk of zoonotic disease emergence change through time and space in human-altered landscapes.

PREDICT's behavioral sciences team completed a total of 73 ethnographic interviews and three focus group discussions to understand hunting practices and the wildlife value chain within local communities and the risk of disease spillover. The team also transcribed and translated the ethnographic interviews in preparation for analysis and conducted preliminary reviews of data for insight into risks for viral transmission. As a proof of concept for PREDICT's strategic use of behavioral investigations to characterize risks for viral spillover, amplification, and spread at the country level, insights from these ethnographic interviews were used to identify communities in Faridpur, Rajbari, Magura, Madaripur, Shariatpur, and Jessore – districts that hunt and consume bats. Some members of these communities consume bats year-round, with highest demand in the winter season (December to April). This behavior may create opportunities for spillover of bat-borne zoonotic viruses, such as Nipah virus, and as a result, surveillance and monitoring for viral transmission has been proposed for a subset of these communities to further investigate these risks.

PREDICT/Bangladesh conducted an anthropological investigation to observe hunting behavior and assess the wildlife value chain in 'Shardar Communities' of Faridpur District. Above, a woman is skinning a bat for consumption; children playing with dead bats that hunters collected; and a hunter killing a bat without any protection against exposure to bodily fluids that may contain Nipah virus or other pathogens.

To prepare for a community-based surveillance pilot project to help track zoonotic disease transmission at the community level, PREDICT mapped community health providers in Charmuguria (Madaripur) and Sadar Upazilla (June 2016). A total of 48 community medical practitioners, pharmacies, and traditional healers were identified through the mapping.

To help better understand and identify zoonotic disease transmission risks in the transboundary animal value chain (with India). PREDICT and FAO also mapped areas and visited animal markets in Bangladesh's seven northwestern and southwestern border districts. Team anthropologists observed human, domestic animal, and wildlife interactions at the markets, conducted key informant interviews, and recorded market GPS locations.

PREDICT and FAO partners conduct a rapid assessment of livestock markets. Livestock markets are part of the transboundary value chain in districts of Bangladesh that border India.
Photos: PREDICT/Bangladesh

Zoonotic Disease Action Package

Milestones: Develop and operationalize shared vision among national leadership and key stakeholders of importance of multi-sectoral coordination mechanism for zoonotic disease prevention

Multisectoral Coordination to Support Mechanisms for Responding to Zoonotic Diseases

- PREDICT joined in and provided technical expertise during a consultative GHSA workshop organized by IEDCR and the US CDC (March 10, 2016) to collaboratively evaluate the Joint External Evaluation Tool - International Health Regulations (IHR-JEE; 2005), a tool designed to assist countries in assessing their readiness to face public health security threats.
- PREDICT continued to coordinate with all GHSA and USAID EPT-2 partners, attending meetings organized by USAID/Bangladesh and providing updates to US CDC, FHI 360, Save the Children, FAO, P&R, and other conservation-

and health-oriented groups to discuss synergies and identify opportunities for collaboration and to ensure there is no duplication of effort and that the programs are complimentary

- PREDICT contributed expertise to a consultative GHSA workshop at IEDCR (May 8-10, 2016) organized with the US CDC and designed to evaluate the GHSA under the Prevent, Detect, and Respond Activity, including the 19 Action Packages undertaken in Bangladesh.
- PREDICT also contributed to a GoB-FAO Technical Planning Workshop to develop activities necessary to implement the GHSA program in-country and met with FAO to discuss the work plans and FAO engagement with other EPT-2 partners.
- PREDICT contributed technical expertise to the consultative workshop "Operational Aspects of One Health Institutionalization in Bangladesh," which was organized by IEDCR and P&R. Partners included WHO, US CDC, GoB FD, DLS, DoH, BLRI, USAID Mission, FAO, IEDCR, P&R, and icddr,b.
- PREDICT's experienced One Health professionals provided expertise to an extended meeting of the "National Coordination Committee of One Health Bangladesh" hosted by IEDCR (August 18, 2016). The purpose of the meeting was to advance the development of inter-ministerial meetings and the One Health coordination of ministries, pursue the establishment of a One Health Secretariat, discuss the Annual One Health Conference, and review ongoing One Health activities in Bangladesh.
- PREDICT participated in a Collaborative Workshop for Anthrax Prevention in Bangladesh organized by the Institute for Epidemiology, Disease Control and Research (IEDCR) and the Department of Livestock Services (DLS).
- PREDICT contributed to a workshop on the Assessment of Animal Health Surveillance and Information Systems in Bangladesh organized by FAO and the DLS.
- The PREDICT team engaged in a stakeholder workshop on zoonoses control and behavioral adaptations in poultry trading and farming systems in Bangladesh organized by Chittagong Veterinary and Animal Sciences University (CVASU), IEDCR, and the Royal Veterinary College, London.
- Team members also contributed to a Consultative Workshop to revise the National Action Plan for the National Influenza Center (NIC), Bangladesh.
- PREDICT met with the new Conservator of Forest in the Wildlife and Nature Conservation Circle of the Bangladesh Forest Department (FD) in February 2016 to brief the Conservator on project activities and progress.
- Team members engaged scientists from BLRI (March 2016) to discuss collaboration on the testing of domestic animal samples collected under EPT-2 and to improve capacity development.
- PREDICT participated in the "Guidelines for Integrating Geographic Information Systems (GIS) in M&E Workshop" at the American Club, Dhaka (February 29, 2016) organized by USAID/India with partners from WHO,

World Food Programme, FAO, and Development Alternatives Incorporated (DAI), as well as several health and conservation organizations.

- PREDICT joined a consultative expert members' meeting organized by the Bangladesh Forest Department on the functioning and biosafety level of Bangladesh's wildlife forensic laboratory.
- The Bangladesh team engaged in an array of stakeholders' workshops and events this period, beginning with the Annual Scientific Conference of Chittagong Veterinary and Animal Sciences University, Chittagong (April 2-3, 2016); partners present at this meeting included the Department of Livestock Services (DLS), FAO, IEDCR, and Bangladesh Agricultural University (BAU), as well as several educational institutions.
- Team members participated in the "National Consultation Workshop on Zoonotic Disease Control at Community: Opportunities and Challenges." This event, which was organized by Relief International, was designed to enhance awareness for zoonoses control at the community level and to develop a locally functional joint coordination and surveillance mechanism to combat zoonotic diseases. Key stakeholders at this meeting included FAO, IEDCR, DLS, Department of Health (DoH), local government representatives, P&R, and Sher-e-Bangla Agricultural University (SAU), April 2016.
- In June 2016, PREDICT participated in an FAO organized training on participatory livestock value chain assessment tools at large livestock markets.
- The PREDICT team also provided expertise in a workshop for a "National Dialogue on the Future of Animal Health Services in Bangladesh" (August 2016) organized by the Department of Livestock Services and FAO..
- On August 16th, the project country coordinator met with the new director of IEDCR to share updates on recent project activities and to explore opportunities for collaboration on work at human hospitals and in community-based surveillance to detect novel pathogens and improve emerging infectious disease response.

Lab Strengthening Systems Action Package

Milestones: Map laboratory capabilities, including antimicrobial resistance testing, and develop trainings and collaborations to strengthen laboratories in Bangladesh; Identify gaps in national laboratory capability to conduct core tests; Capacity buildup of National Reference laboratory to expand core testing of extended agreed number of pathogens and also to detect novel pathogens

Laboratory Testing for Detection of Priority Diseases

PREDICT provided technical expertise to a Zika virus planning meeting at IEDCR (January 2016) to strategically review the national virus diagnostic plan and to provide the project's flavivirus primers and protocols in support of preparedness efforts; PREDICT is also helping IEDCR obtain multiplex real-time assay primer/probes and controls for Zika, West Nile, and Dengue viruses so that the Institute can establish a national platform for viral detection of these diseases.

PREDICT's global lead for viral detection activities visited Bangladesh to assist in the advancement of cooperative in-country laboratory relationships and, together with the country coordinator, visited with IEDCR's and icddr,b's laboratory scientists to discuss laboratory protocols for viral detection, the primers and reagents needed for conducting the work, the plan for testing human and animal samples, and plans for capacity strengthening across animal and human sector labs to optimize detection and discovery activities for known and emerging viral threats. Discussions were also held with partners at the Bangladesh Livestock Research Institute (BLRI) laboratory about plans strengthening viral testing capabilities for livestock and avian influenza samples. Outcomes of these discussions were shared with the Conservator of Forest (FD) and P&R's One Health Coordinator and One Health Advisor.

PREDICT's partner lab at the icddr,b maintained capacity for testing wildlife and livestock samples for five viral families representing priority zoonotic diseases of public health concern (corona-, flavi-, henipa-, influenza, and paramyxoviruses). This year, PREDICT tested 60 camel samples using both qPCR and MERS-CoV serology and coronavirus family PCR assays using project protocols; confirmatory testing of samples is underway at partner labs, and any confirmed results will be reported to the GoB when available.

PREDICT also conducted testing of *Pteropus medius* samples collected in 2012 and 2014 during outbreak investigations using a henipavirus assay; further characterization of suspected positive bat samples is ongoing at icddr,b lab.

Workforce Development Action Package

Milestone: Identify/implement training courses/opportunities to enhance workforce capacity

Strengthening the One Health Workforce

This year, PREDICT contributed to an in-country workshop introducing One Health to young professionals. PREDICT/Bangladesh also conducted a seven-day field training (April 27 to May 3, 2016) on zoonotic diseases, biosafety, and field-based methods for disease surveillance, including safe anesthesia and sampling of rhesus macaques in Gazipur, Bangladesh. During the training, Government of Bangladesh forestry officers, veterinarians, and post-graduate students from Chittagong Veterinary and Animal Sciences University gained critical hands-on experience conducting safe animal capture and sampling techniques, collecting 120 biological samples from the macaques.

PREDICT/Bangladesh demonstrates the use of personal protective equipment (left) and macaque capture techniques (right) as part of a training course on safe macaque capture and disease surveillance for Government of Bangladesh wildlife staff. Photos: PREDICT/Bangladesh

Training Summary

A total of **100 individuals**, including **80 men** and **20 women**, have been trained in Bangladesh since the start of PREDICT-2 activities in 2014. **Of those trained, 23 were governmental personnel and 76 were students**. A number of individuals completed trainings in more than one subject.

Training Events by Topic*

Topic	Total Trainings	# Trainings by Government Personnel	# Trainings by Women	# Trainings by PREDICT staff	# Trainings by Students
Avian Sampling	5	1		4	
Basic Laboratory Safety	4	1	1	3	
Bat Sampling	3			3	
Biosafety and PPE	11	6	1	4	1
Bushmeat Sampling	2			2	
CITI Biomedical Research	2			2	
CITI Social Behavioral	4	1	1	3	
Emergency Preparedness	5	1	1	4	
Implementing Cold Chain for Safe Sample Transport	10	5		5	
Livestock Sampling	3			3	
Non-Human Primate Sampling	6	1		5	
One Health Approach	69		13		67
Outbreak Response	2	1		1	
Packing and Shipping Biological Samples	3			3	
Policies and Plans	4			4	
Qualitative Research and Data Collection	24	18	6	4	8
Rodent Sampling	4			3	1
Safe Animal Capture and Sampling	5	1		4	
Safe Sample Transport and Storage	2			1	1
Small Carnivore Sampling	3			3	
Totals	**171**	**36**	**23**	**61**	**78**

*Some individuals were cross-trained in multiple topics. Individuals may be represented in multiple rows per column and multiple columns.

USAID | PREDICT FROM THE AMERICAN PEOPLE   Global Health Security Agenda

SUPPORTING THE GLOBAL HEALTH SECURITY AGENDA IN INDIA

Zoonotic Disease: While preparing for training and launch of activities providing proof-of-concept for One Health application to successful Zoonotic Disease management, PREDICT worked with government partners in India to prioritize high-risk interfaces for zoonotic disease transmission and spread that will strengthen India's surveillance system by integrating sampling of wildlife and livestock (with FAO support) with behavioral risk investigations among at-risk human communities. This year, **PREDICT** engaged the **Sanjay Gandhi Postgraduate Institute of Medical Sciences (SGPGIMS)** as the primary implementing partner **and, together with federal and state-level partners, initiated activities to map high-risk human-animal interfaces and characterize sites.** Scoping visits to Maharajgani District, Uttar Pradesh near India's border with Nepal, an area with history of severe outbreaks of acute encephalitis, validated plans to include this site in surveillance activities.

A map highlighting the area where PREDICT is proposing sites for surveillance activities. The Maharajganj District, Uttar Pradesh is at the border with Nepal. There have been severe outbreaks of acute encephalitis syndrome in the district, along with identified high-risk human-animal interfaces.

Lab Strengthening Systems: PREDICT is working with state and federal-level government partners in India to identify opportunities that directly strengthen capabilities for detection of priority zoonotic disease threats in animal and human laboratories and that contribute to operationalization of a One Health laboratory network. This year, **PREDICT worked with SGPGIMS,** our implementing lab partner, **and the National Institute of Virology (NIV) to develop plans for capacity strengthening, viral detection activities, and advanced pathogen characterization** that enable more rapid detection of both known and novel zoonotic disease threats. As a result,

PREDICT's SGPGIMS lab initiated viral detection training and developed plans for launch of viral testing in December 2016.

Workforce Development: A well-trained and equipped workforce is critical for health security and for emergency and disaster management and response. **This year, PREDICT developed plans for the launch of One Health skills trainings in India**; capacity strengthening will intensify in 2016-2017.

Additional details and highlights from PREDICT's 2015-2016 activities in India are provided below and linked to corresponding GHSA Road Map Action Packages and milestones.

Zoonotic Disease Action Package

Milestones: Emerging zoonoses highest risk transmission pathways and drivers assessed; Framework developed for characterizing risk and predicting spillover of high consequence zoonotic diseases; High risk pathways characterized for spillover, amplification, and spread of zoonotic threats and the behaviors and practices that enable spillover identified

Surveillance for Priority Zoonotic Diseases and Pathogens

PREDICT developed One Health partnerships to enable successful surveillance and viral detection activities by engaging the Sanjay Gandhi Postgraduate Institute of Medical Sciences (SGPGIMS) as the project implementing partner and by appointing SGIPGMS's chief of microbiology as the country coordinator. PREDICT also established a country management team that includes representatives from the Public Health Foundation India and former members of WHO SEARO.

Together with the project's new One Health team, PREDCT conducted the first site scoping and characterization trip to assess high-risk transmission pathways and drivers of viral emergence. The team visited a potential surveillance site in Maharajganj District, Uttar Pradesh State, a border region between India and Nepal that has long experienced severe outbreaks of acute encephalitis syndrome (AES) and that features transboundary livestock movement (see map above). In Maharajganj, the team characterized the site and human-animal interfaces for suitability for zoonotic disease surveillance, noting a heavily altered landscape; an abundance of domestic and peri-domestic animals, with livestock seen within households; and the presence of key wildlife reservoir species, including fruit bats, Rhesus macaques, and Hanuman langurs. Priority high-risk interfaces identified by the team for follow-up include interactions between non-human primates and local community members and regular transboundary movements of people and livestock, as reported by locals and local government officials. Surveillance activities are planned to begin in 2016-2017.

Zoonotic Disease Action Package

Milestone: Shared vision built among national and state leadership and key stakeholders of importance of a multi-sectoral coordination mechanism for zoonotic disease prevention

Multisectoral Coordination to Support Mechanisms for Responding to Zoonotic Diseases

- PREDICT engaged with central and state-level stakeholders in India, including potential institutional partners, such as federal reference laboratories in both human and animal health sectors, which may serve to provide additional genomic analysis and characterization of viruses detected at the project laboratory.
- The new PREDICT team conducted outreach to federal reference labs and discussed establishing potential mechanisms for additional characterization and analysis of viral sequences identified by the program.
- PREDICT met with and continues to engage with the Ministry of Agriculture, Ministry of Forest, Environment, and Climate Change, and the Ministry of Health and Family Welfare, as well as the Indian Council for Medical Research (ICMR, Delhi), Wildlife Institute of India (Dehradun), and the School of Tropical Medicine (Kolkata).
- Team members debriefed the USAID/India in Delhi (February 11, 2016) on recent activities and held discussions with the FAO Regional Deputy Director and the FAO National Coordinator on the outcomes of PREDICT-1 during meetings held with FAO in West Bengal and Uttar Pradesh. During the debrief, the team agreed with FAO to continue the close and cooperative coordination of government agency engagement efforts and concurrent human, wildlife, and domestic animal surveillance activities.
- PREDICT staff contributed to an FAO-organized federal and state stakeholder meeting (May 2016) for GHSA and EPT-2 coordination in Kolkata and presented a project overview and held specific discussions with potential state and federal partners, including the School of Tropical Medicine, the Indian Veterinary Research Institute, the National Institute of Virology, and the Indian Council for Medical Research.
- PREDICT met with senior scientist from the Wildlife Institute of India (February 2016) to discuss approval processes for wildlife sampling in prioritized project sites and gained critical insights into effective ways to approach and liaise with local and central agencies and on appropriate mechanisms for securing operational permissions. As a result, the Wildlife Institute of India offered assistance in navigating these processes.
- The project team visited the School of Tropical Medicine (STM) in Kolkata, West Bengal (February 12, 2016), a state-run institution where interest in engagement

with PREDICT was high and where existing partnerships are maintained with key scientific bodies on acute encephalitis surveillance and GHSA activities. Discussions are ongoing, as the STM hospital currently receives acute encephalitis patients from around West Bengal, which could potentially facilitate PREDICT's syndromic surveillance for novel zoonoses in humans on-site.

- PREDICT met with an FAO India representative at a federal anti-microbial resistance (AMR) meeting (February 26, 2016) and discussed a coordinated strategy for joint meetings in West Bengal to meet state stakeholders and identify potential field sites. In addition, partners discussed future stakeholder meetings and agreed on an approach to build capacity for zoonotic disease surveillance and AMR detection with state-level and federal stakeholders in West Bengal.
- The team joined in and contributed to bi-monthly coordination calls with the USAID/India, USAID/Washington, and FAO to plan for effective workplan implementation and stakeholder engagement strategies.
- In April 2016, PREDICT and FAO held multiple coordination discussions on a consultation planned for Kolkata, West Bengal to inform delegates from state agencies representing human, livestock, and wildlife health, as well as other high-level officials from federal agencies in Delhi and Bhopal about the EPT-2 program.
- Upon the request of the Director of the School of Tropical Medicine in Kolkata, the team developed and shared a document describing the project for onward submission to the Department of Health, West Bengal. PREDICT also met with USAID/India, the EPT/GHSA point of contact, the FAO regional director, and the Indian Council on Medical Research to discuss the project and the consultation in Kolkata. The consultation was planned to inform delegates from state agencies representing human health, livestock health, and wildlife, as well as some high-level officials from federal agencies in Delhi and Bhopal about the EPT program, helped initiate the state-level approval process for PREDICT and FAO activities, and helped to facilitate participation of state representatives.
- PREDICT met with the Director of the Indian Veterinary Research Institute (IVRI) and senior leaders within the Indian Council of Agricultural Research (ICAR). IVRI has agreed, in principle, to partner with the project as the counterpart to NIV, serving as a reference laboratory for further characterization or confirmatory testing of domestic animal and wildlife samples sent by SGPGIMS.

Lab Strengthening Systems Action Package

Milestones: Capacities and gaps identified in targeted animal health surveillance systems, including use of data; Longitudinal synchronized livestock, wildlife, and at-risk human population viral zoonoses surveillance continued in up to 10 states

Laboratory Testing for Detection of Priority Diseases
PREDICT team members led a series of strategic meetings (early February 2016) with in-country laboratories identified as potential candidates for collaboration to introduce GHSA, EPT-2, and PREDICT; tour laboratory facilities; and guide detailed discussions on the nature of the work and current capacities for conducting project surveillance and viral detection activities.

Team members also met with the director of the National Institute of Virology (NIV) and senior scientists in Pune to discuss collaborative activities in Uttar Pradesh (July 27 and September 7, 2016). Specifically, PREDICT presented an overview of the EPT-2 program and requested NIV's partnership as a reference laboratory that could further characterize viral sequences detected by the project lab. The NIV director expressed interest in supporting project activities by participating as a member of a technical advisory group (to be formed) and agreed that NIV could perform confirmatory testing or advanced characterization of samples sent by the SGPGIMS project lab. This partnership forges an alliance with India's national laboratory system through a key link with federal agency in addition to existing state-level partners.

To lay the groundwork for lab capacity strengthening, team members attended the PREDICT-FAO organized Asia Regional Laboratory Training in Bangkok, Thailand (May 17-19, 2016): "Regional Workshop on Utilization and Harmonization of PREDICT Protocols in the Animal Health Sector in Bangkok, Thailand." The workshop brought together veterinary laboratory personnel from Bangladesh, Cambodia, India, Indonesia, Lao PDR, Mongolia, Nepal, Thailand, and Viet Nam, with FAO's Asia Regional Laboratory Coordinator and PREDICT's virology co-lead. Attendees were trained in sample preparation and PCR protocols for priority viral families; presented on specimen collection, selection for testing, and sample handling and testing; reviewed PREDICT's SOPs for priority virus identification, analysis, and reporting; and strategized on FAO-PREDICT collaborative sample collection in livestock.

In addition, PREDICT initiated steps to establish in-country lab capability for viral detection activities, by transferring lab protocols and reagents for viral discovery to SGIPMS, the project implementing lab. Testing is planned to begin in December 2016.

SUPPORTING THE GLOBAL HEALTH SECURITY AGENDA IN INDONESIA

Zoonotic Disease: While training and providing proof-of-concept for One Health application to successful zoonotic disease management, PREDICT targeted high-risk interfaces for zoonotic disease transmission and spread and worked to enhance Indonesia's surveillance system by integrating sampling of wildlife with behavioral risk investigations among at-risk human communities and continued work testing samples from hospitalized patients for emerging viral threats. This year, **PREDICT/Indonesia collected samples from 418 wild animals** (383 bats and 35 rodents) **along with 500 samples from livestock through FAO support** at high-risk human-animal interfaces for zoonotic disease transmission **and continued testing samples for known and emerging viral threats**. **PREDICT also conducted behavioral risk investigations** targeting the wildlife trade a particularly high-risk for viral spillover and spread **and completed 47 ethnographic interviews** with hunters, collectors, transporters, and vendors in traditional markets.

A live animal market in Minahasa District, North Sulawesi where PREDICT is conducting surveillance for viral threats along with behavioral risk investigations Photo: PREDICT/Indonesia

Lab Strengthening Systems: PREDICT is working to directly strengthen capacity for detection of priority zoonotic disease threats in animal and human laboratories and to contribute to operationalization of a One Health laboratory network in Indonesia by fostering communication and coordination between human and animal partner laboratory facilities and ministries. This year, PREDICT's partner labs at the Institute for Primate Research, Bogor and Eijkman Institute for Molecular Biology, our implementing lab partners, **provided critical support towards strengthening the national laboratory system, leading trainings for government lab staff and conducing additional viral testing in support of multiple public health outbreak investigations**.

Workforce Development: A well-trained and equipped workforce is critical for health security and for emergency and disaster management and response. PREDICT investments are making an impact on Indonesia's One Health workforce though the provision of in-service training to health professionals in the human and animal health sectors from the district to national levels. This year, PREDICT conducted a number of trainings in Indonesia, including **multiple trainings in lab safety and viral detection for national lab staff at Disease Investigation Centers**, making critical contributions to strengthening the One Health workforce for improved global health security. To date, **31 individuals have received training in zoonotic disease surveillance and viral detection skills** in Indonesia, including 18 government personnel, part of the current national One Health workforce.

Additional details and highlights from PREDICT's 2015-2016 activities in Indonesia are provided below and linked to corresponding GHSA Road Map Action Packages and milestones.

Zoonotic Disease Action Package

Milestones: High risk human/animal interfaces (i.e. "value chains," land use change, etc.) and their interfaces mapped; High risk "nodes" identified for spillover of zoonotic threats and the behaviors and practices that enable spillover identified

Surveillance for Priority Zoonotic Diseases and Pathogens

PREDICT successfully conducted wildlife field surveillance activities (March 2-12, 2016), at four sites, two in the Province of Gorontalo (Tilamuta and Paguyaman Pantai) and two in the Province of North Sulawesi (West Dumoga and Modoinding). Over 1,000 oral swab, rectal swab, urine, and blood specimens were collected from 102 bats and 27 rodents to better understand the circulation of viruses in species involved in the wildlife value chain and to provide samples and data from the wet season; additional rodent tissue specimens were collected to enable genetic identification; all specimens were safely transported to Bogor Agricultural University for laboratory analyses.

PREDICT also sampled bats in Bogor Botanical Garden (June 2016), a potential interface with ecotourists. The team collected a total of 52 specimens and transferred them to the lab for analysis.

PREDICT conducted scoping visits to potential surveillance sites in Central, West, and South Sulawesi Provinces (July 2016), to better understand and map the wildlife value chain and specific natural source populations for wildlife sold in traditional markets around North Sulawesi Province. Scoping visits were also conducted in February, 2016, in Tomohon and Kawangkoan, North Sulawesi, to observe live animal markets and discuss potential collaborations with local government and communities on animal sampling and human behavioral risk investigations. In September 2016, the project wildlife team completed a surveillance trip to these provinces and safely collected samples from a total of 68 *Pteropus alecto* bats; all specimens were safely transported to Bogor Agricultural University for laboratory analyses.

PREDICT conducted wildlife field surveillance in Gorontalo and North Sulawesi provinces (September 1-9, 2016), collecting specimens from eight rodents and 187 bats from the following species: *Pteropus alecto*, *Acerodon celebensis*, and *Dobsonia exoleta*.

PREDICT received permission from the Ministry of Health to conduct behavioral risk investigations (ethnographic interviews and focus groups) with individuals involved in the wildlife value chain including hunters, collectors, transporters, and vendors in the traditional markets. Following approval, the project behavioral risk team conducted 47 ethnographic interviews in Tomohon, Minahasa, South Minahasa, Bolaang Mongondouw, and North Minahasa districts in North Sulawesi province. Interviews were transcribed and translated and prepared for analysis.

As part of preparations for human surveillance activities, PREDICT conducted capacity assessments at four health care facilities in Kawangkoan, Langowan, and Bitung, North Sulawesi (April, 2016). These visits also identified behavioral factors influencing the risk of viral spillover, such as wildlife hunting and trading.

Following the initial visits, PREDICT and collaborators from the Medical Faculty of Sam Ratulangi University (FK UNSRAT) then conducted further assessments at two of these sites (Puskesmas Kawangkoan and Noongan Hospitals, Langoan). The team met with the Vice-Dean of the Medical Faculty Sam Ratulangi University and worked to determine patient flow, identify key personnel to implement human surveillance activities, and develop the workflow plan for hospital-based human biological and behavioral sampling at each site. These two hospitals in North Sulawesi were selected for implementation of syndromic surviellance and behavioral risk investigations, and the project team formed partnerships with hospital staff and local communities to begin planning for project launch. A local research team was also assembled to assist with the study, consisting of a medical doctor, an epidemiologist, a health sociologist, and a public health community practitioner.

In addition, PREDICT completed translation of project human surveillance protocols into Bahasa Indonesia and submitted a proposal for ethcnial clearance to the Institutional Review Board at EIMB; the team anticipates launch of syndromic surveillance in 2017.

Zoonotic Disease Action Package

Milestones: Updated strategy among national leadership and key stakeholders of centrality/importance of need for multisectoral coordination mechanism for zoonotic disease prevention; Options for multi-sectoral coordination assessed and strengths, weaknesses, gaps and government priorities identified

Multisectoral Coordination to Support Mechanisms for Responding to Zoonotic Diseases

- PREDICT met with the deputy regional manager of FAO/ECTAD in Bangkok, the FAO-ECTAD Indonesia team leader, and PRC-IPB staff in Bogor (February 24, 2016) to discuss future training at Indonesian Disease Investigation Centers (DICs), with particular emphasis on utilization of project laboratory protocols and technology to analyze poultry and livestock samples at DIC labs; partners agreed that the Primate Research Centre-Institut Pertanian Bogor (PRC-IPB) will serve as a referral laboratory in this process.
- Project staff contributed to the Training for Trainers for Biosafety Implementation and Biorisk Analyses organized by Ministry of Health and WHO Indonesia (February 24-26, 2016) and subsequently participated in the Laboratory Partners' Meeting at the National Institute of Health Research and Development (NIHRD), MoH, also organized by WHO, with USAID/Indonesia, PREDICT, FAO, the Biosecurity Engagement Program of the US Embassy, and US CDC in attendance; at the meeting partners shared updates on strengthening laboratory capacity in-country and identified collaboration opportunities.
- PREDICT attended a Partners' Coordination Meeting, organized by FAO and the Ministry of Agriculture (MoA) in Jakarta (February 29 – March 1, 2016), designed to review recent information on studies and surveillance activities that have been, and are currently being carried out on migratory birds and wild animals. The meeting aimed to identify specific animal targets for surveillance and to assess environmental aspects likely to influence the evolution and spread of zoonotic and emerging infectious diseases. Meeting participants included the MoA, FAO, USAID, Udayana University and Airlangga University partners, the Indonesian Research Centre for Veterinary Science (IRCVS/Bbalitvet), Indonesian Institute of Sciences (LIPI), Yayasan Burung Indonesia, National Commission for Zoonosis Control, and the Ministry of Environment and Forestry (MoEF).PREDICT's country coordinator participated in a coordination meeting for "Triangulated Surveillance and Livestock Sampling" held by Directorate General of Livestock and Animal Health Services, Ministry of Agriculture, at Aston Priority Simatupang Hotel and Conference Center, Jakarta (April 2016).
- PREDICT conducted a coordination meeting (April 2016) with Tabanan Hospital and Warmadewa University in Bali, regarding the potential for collaboration on surveillance of respiratory diseases of likely zoonotic origin.

- The project team contributed data and briefings on surveillance and behavioural risk activities along with updates on laboratory capacity building activities at the Medical Faculty Sam Ratulangi University during the Country Partners' Meeting held by WHO Indonesia (May 20, 2016) at the MoH, Jakarta. Participants included USAID, FAO, WHO, CDC, and Association of Public Health Laboratory (APHL). The purpose of the meeting was to share updates relating to partners' accomplishments in strengthening and supporting infectious disease laboratories in-country.
- PREDICT provided zoonotic disease surveillance expertise at the Emerging Infectious Disease and Zoonotic Risk Mapping meeting, organized by the Ministry of Agriculture and FAO's Emergency Centre for Transboundary Animal Diseases (June 2016) in Jakarta. The meeting aimed to identify high-risk areas of emerging infectious disease and zoonoses as part of a national surveillance plan and led to the identification of risk factors for the emergence of infectious diseases, such as land conversion for agriculture and infrastructure, wild animal consumption, and climate change. Meeting participants included Ministry of Agriculture, FAO ECTAD, USAID, PREDICT, Airlangga University, the Indonesian Research Centre for Veterinary Science (IRCVS/BBalitvet), Indonesian Institute of Sciences (LIPI), National Zoonosis Committee of Indonesia, Indonesian Agency for Meteorology, Climatology and Geophysics (BMKG), and Ministry of Environment and Forestry.
- The project country coordinator led a session on "Nipah Disease and New Paradigm in Surveillance to Conduct EID Detection" at a meeting for the Directorate General of Livestock and Animal Health Services, Ministry of Agriculture in coordination with FAO ECTAD, held in Central Java Province (May 2016).
- The team led a session on PREDICT activities in a workshop of "Risk Mapping of Targeted New EIDs and Zoonosis in Wildlife and Livestock Animal" held by Directorate General of Livestock and Animal Health Services, Ministry of Agriculture, in coordination with FAO ECTAD, in Jakarta, June 2016.Project staff contributed to the EPT-2 Indonesia Annual Work Planning and Coordination Meeting for EID and Zoonosis Control held by USAID in coordination with Ministry for Culture and Human Development (June 2016) in Jakarta.
- PREDICT shared achievements and experiences from the past year and work plans for 2016-2017, contributing to multisectoral communication and collaboration at the Annual EPT-2 Meeting in Jakarta (June 2016). Participants included FAO, WHO, One Health Workforce (OHW), and Preparedness and Response (P&R), as well as representatives from the Ministry of Health, the Ministry of Agriculture, and the Ministry of Environment and Forestry.

- Additionally, PREDICT staff briefed representatives from OHW, P&R, FAO, WHO, CDC, Biosecurity Engagement Program (BEP), and the US Department of Foreign Affairs on plans for hospital and community-based human surveillance to be conducted in North Sulawesi in the upcoming year (August 3 and September 14, 2016).
- Project staff provided technical expertise and briefings through a presentation for the Workshop of Competency Building and Development in "Identification Method of *Campylobacter jejuni* Bacteria and Identification of Rat Meat in Animal-Based Consumption Ingredients by using Polymerase Chain Reaction (PCR) Technique". The workshop was held by DIC Denpasar-DGLAHS-MoA, Bali (July 2016) and included participants from Animal Disease Investigation Centers (DICs) and representatives from veterinary and public health labs at provincial and district levels.
- The project country coordinator participated in a forum led by the Director of Biodiversity Conservation at the MoEF (March 2016) and organzied to foster dialogue on activities within the MoEF scope pertaining to zoonoses. In attendance, were the Director of Animal Health at MoA, Indonesia Veterinary Medical Association, Primate Research Center at Bogor Agricultural University, Eijkman, Faculty of Veterinary Medicine at Bogor Agricultural University, the Director of Zoonosis Control at the Ministry of Health, and the National Commission of Zoonosis Control.

Lab Strengthening Systems Action Package

Milestones: Measureable improvement in diagnostic capacities of labs against agreed upon list of priority zoonotic diseases completed; Continued strengthening of diagnostic capacities of labs against agreed upon list of priority zoonotic diseases

Laboratory Testing for Detection of Priority Diseases

PREDICT's collaborating lab provided ciritical support to the national laboatory system by testing human samples using project viral family protocols during outbreak investigations:

-In repsonse to tests requested by the local district health office through a local collaborator, Medical Faculty and Health Science Warmadewa University, Bali, PREDICT tested 28 samples from 15 patients with fever of unknown origin in Bali. The samples were screened for filo-, influenza, paramyxo-, corona-, enterovirus, herpes-, hanta-, henipa-, seadorna-, arena-, and lyssaviruses.

- At request of the Ulin Hospital and Medical Faculty Lambung Mangkurat University, PREDICT tested 11 samples from children from Banjarmasin (South Kalimantan) with an unknown respiratory illness for influenza, paramyxo-, entero-, and herpesviruses..

- Also at the request of Ulin Hospital, PREDICT tested 13 samples from Hand, Foot, and Mouth Disease (HMFD)-suspect cases from Banjarmasin (South Kalimantan). In addition to enterovirus protocol, lab staff also performed tests for influenza, paramyxo, and herpesviruses to investigate etiological agent causing the disease in enterovirus-negative samples.

This year, PREDICT performed a total of 1,065 PCR tests when completing testing on 219 rectal swab specimens of bat samples collected during the first phase of the project (2009-2014). Samples from Olibuu, Tomohon, Bersehati Market, Paku Ure, and Tinjil Island were tested using project protocols for coronaviruses (219 samples), paramyxoviruses (219 samples), astroviruses (219 samples), henipaviruses (103 samples), flaviviruses (48 samples), Nipah virus (93 samples), influenza A virus (116 samples), and rhabdoviruses (48 samples). Results are pending.

In collaboration with the US CDC, PREDICT continued to support human sampling activities by providing specimen collection material (swabs, VTM, and collection tubes) and other laboratory consumables to local collaborators in North Sulawesi for ongoing studies.

PREDICT reported to the National Institute of Health Research and Development at the Indonesian Ministry of Health (NIHRD at MoH) about laboratory findings from human archived-specimens tested from November 2015 to March 2016. The team is awaiting approval from the Ministry of Health for approval for public release of data. PREDICT worked to strengthen and extend in-country field and lab cold chain capacity by providing liquid nitrogen and a -20°C freezer to local laboratory collaborators in North Sulawesi.

In collaboration with FAO-ECTAD Indonesia, PREDICT conducted several trainings to strengthen laboratory capacity and give hands-on practice in implementing project assays for livestock specimen analysis and to support planned triangulated surveillance of humans, wildlife, and livestock.

PREDICT led training exercises at PRC-IPB (February 15-23, 2016) with four laboratory staff from the Animal Disease Investigation Centers from Medan, North Sumatera (two women), and Denpasar, Bali (two men), enabling the technicians to implement viral detection protocols using family level primers on livestock and poultry specimens and extending the project's viral detection toolkit to additional lab faciliites in Indonesia's national lab system. PREDICT also trained the four laboratory staff in analysis of virus sequence results and interpretation of laboratory findings (21-22 March 2016). In addition, plans were developed for reporting of laboratory test results to the Director of Animal Health, Directorate General of Livestock and Animal Health Services, MoA.

PREDICT also conducted a specific training focused on implementation and quality control for the the project universal positive control for the DIC Maros, South Sulawesi (one woman), DIC Denpasar, Bali (one man) and FAO staff (one man) on September 19-23, 2016.

PREDICT staff conducted trainings for 14 individuals (seven men and seven women) from the Medical Faculty Sam Ratulangi University on best laboratory practices in molecular virology studies (April 2016), covering theory and practice of biological sample collection, specifically cerebrospinal fluid, specimen handling and labelling, specimen storage, cold chain implementation and management, and specimen packaging and shipment.

A project laboratory QAQC coordinator visited the partner laboratory at the Eijkman Institute in Jakarta to review and assess field site selection criteria, sample collection protocols, sample transport logistics, and lab workflow. In order to improve diagnostic capacities and for quality assurance purposes, strategic sample selection was executed while implementing new project testing protocols, and existing data were reviewed. Staff also reviewed data management and Geneious software for sequence data analysis.

PREDICT lab staff participated in the FAO Asia Regional Workshop "Utilization and Harmonization of PREDICT Protocols in Animal Health Sector" in Bangkok, Thailand (May 17-19, 2016), to share lessons learned in capacity building and laboratory training between PREDICT and FAO.

Project staff also attended the BSL-3 Workshop "Biosafety for Emerging Viruses: Policy and Practice" (March 2106), organized by the Eijkman Institute and US CDC Fort Collins and structured to increase the knowledge of participants from various high containment (BSL-3) facilities across Asia on proper practices and policies to operate and maintain BSL-3 facilities.

Workforce Development Action Package

Milestones: Pre-service/ in-service training opportunities related to surveillance, research, and lab testing identified; Animal and human health professionals in provincial disease control programs receive in-service training in requisite one health skills

Strengthening the One Health Workforce
PREDICT provided pre-service training to a student from the University of Indonesia on viral detection using molecular methods and data analysis. In addition, PREDICT contributed to the Global Health True Leaders (GHTL) Batch 8 workshops in Bali (August 2016) organized by the Indonesia One Health University Network (INDOHUN) and sponsored by USAID. This event aimed to strengthen the One Health platform by training students and young professionals from Indonesia, Malaysia, Thailand, and Viet Nam to approach health problems (especially zoonotic diseases) with a multi-sectoral and collaborative approach. Those in attendance had backgrounds in medicine, public health, veterinary science, pharmacy, nursing, health economics, dentistry, and biomedical science.

PREDICT staff completed all core trainings on project methods and protocols for safe zoonotic disease surveillance and viral detection activites, in part through participation in PREDICT School (October 2015), an event held in the US and brining together staff from both Africa and Asia-based project teams fostering a One Healath-oriented learning exchange by health professionals from veterinary and medical health sectors. The trainings covered best practices for data management, reporting, laboratory and field techniques, workplan development, and implementation of project activities.

PREDICT led a training on cold chain management to be applied to specimens collected in the field, in the Field Surveillance Stakeholders Coordination Meeting and Training on Triangulated Surveillance and Livestock Sampling, held by Directorate General of Livestock and Animal Health Services, Ministry of Agriculture in coordination with FAO ECTAD in North Sulawesi Province (April 2016).

PREDICT Indonesia's new laboratory technician participated in In-House Training on Biosafety and Security, and Occupational Health and Safety (June 7, 2016) at Primate Research Center-IPB.

Project staff attended the 13th Hong Kong University-Pasteur Virology Course: "Bats and viruses," in July. This training included practical workshops to address the dynamics of viral evolution and current strategies for molecular surveillance, as well as broadening the approach to viruses of bat origin to include virology, immunology, public health systems, sociology, and anthropology. The PREDICT team plans to share acquired knowledge with government partners and students over time through continuing capacity strengthening activities.

Training Summary

A total of **31 individuals**, including **16 men, 14 women**, and one individual of undeclared gender, have been trained in Indonesia since the start of PREDICT-2 activities in 2014. Eighteen governmental personnel and one student have received training from PREDICT. A number of individuals completed trainings in more than one subject.

Training Events by Topic*

Topic	Total Trainings	# Trainings by Government Personnel	# Trainings by Women	# Trainings by PREDICT staff	# Trainings by Students
Basic Laboratory Safety	23	8	10	10	
Bat Sampling	4	1			
Biosafety and PPE	26	14	12	7	
Bushmeat Sampling	3				
CITI Biomedical Research	2	2			
CITI Social Behavioral	2	2			
Emergency Preparedness	16	5	7	6	
GIS and Spatial Analysis	2	2			
Human Biological Sampling	8	5	4	3	
Human Syndromic Surveillance	4	1	4	3	
Implementing Cold Chain for Safe Sample Transport	15	4	7	6	
Information Management	3	3			
Lab Protocols and Diagnostics	16	15	6		1
Non-Human Primate Sampling	3				
One Health Approach	4	4			
Other	22	20	9	4	
Outbreak Response	7	4	4	3	
Packing and Shipping Biological Samples	17	6	7	6	
Policies and Plans	14	4	6	6	
Qualitative Research and Data Collection	9	6	4	3	
Rodent Sampling	3				
Safe Animal Capture and Sampling	3				
Total	**206**	**106**	**80**	**57**	**1**

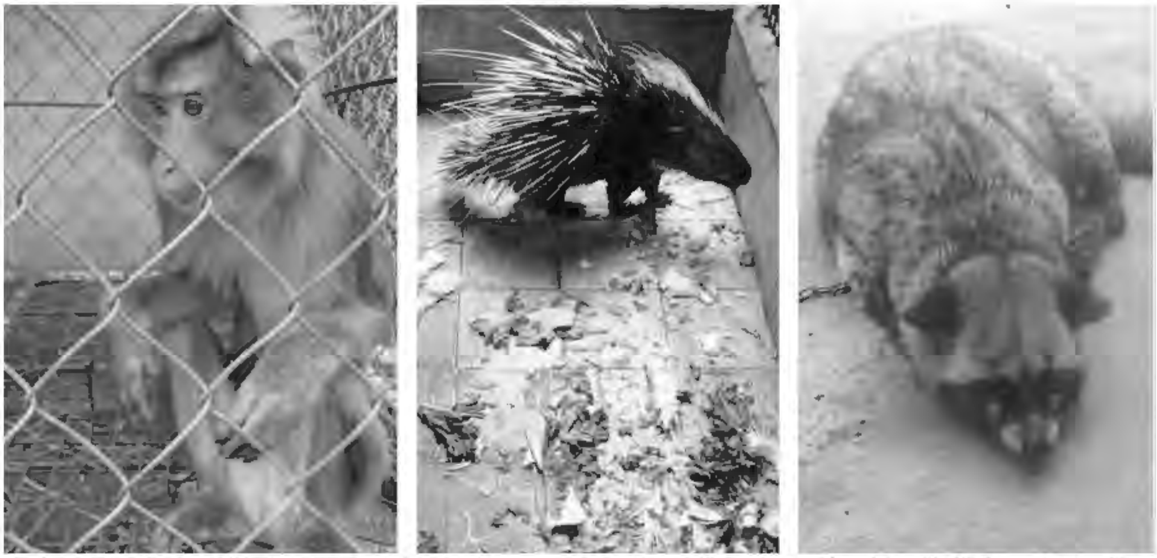
*Some individuals were cross-trained in multiple topics. Individuals may be represented in multiple rows per column and multiple columns.

Other Activities:

- PREDICT staff published a manuscript entitled “Detection and identification of Coxsackievirus B3 from sera of an Indonesian patient with undifferentiated febrile illness,” in the *Journal of Infection in Developing Countries* on August 31, 2016 (*See Section 6 – Publications Summary for details*).

SUPPORTING THE GLOBAL HEALTH SECURITY AGENDA IN VIET NAM

Zoonotic Disease: While training and providing proof-of-concept for One Health application to successful zoonotic disease management, **PREDICT provided assistance for the initiation of the Viet Nam One Health Partnership for Zoonoses and towards the development of the Integrated National One Health Plan**. PREDICT in collaboration with GHSA, USAID EPT-2 partners, and government collaborators, contributed to the **design and launch of the Longitudinal Influenza Surveillance Network (LISN) initiative designed to strengthen influenza surveillance** along Viet Nam's international borders. Project staff worked with LISN's multisectoral team to select interfaces, sampling sites, and populations for surveillance. Also this year, **PREDICT collected samples from 59 wild animals** at high-risk human-animal interfaces in the wildlife trade **and continued working with partners in the national lab system to test samples for known and emerging viral threats.** PREDICT also worked with FAO partners on plans for viral testing of 185 samples collected from swine as part of LISN activities.



Animals in the wildlife trade, a high-risk human-animal interface prioritized by GHSA partners for zoonotic disease surveillance activities due to risks for viral spillover and spread. PREDICT has been sampling animals in the wildlife trade including wildlife farms, restaurants, and markets. Photos: PREDICT/Viet Nam

Lab Strengthening Systems: PREDICT is working to directly strengthen capacity for detection of priority zoonotic disease threats in animal and human laboratories and to contribute to operationalization of a One Health laboratory network in Viet Nam by fostering communication and coordination between human and animal partner laboratory facilities and ministries. This year, **PREDICT supported the expansion zoonotic disease detection capacity**

among LISN partners **in Viet Nam's national laboratory system by providing technology and training support.** Also this year, PREDICT's partner labs, all part of the national lab system, **continued strengthening capabilities for zoonotic disease detection, acquiring technologies and skills and testing samples from wildlife and livestock for viral threats**.

Workforce Development: A well-trained and equipped workforce is critical for health security and for emergency and disaster management and response. PREDICT investments are making an impact on Viet Nam's One Health workforce though the provision of in-service training to health professionals from the district to national levels. This year, **PREDICT conducted a number of trainings in Viet Nam covering biosafety, zoonotic disease surveillance, lab safety and viral detection for national lab staff in animal and human sectors,** making critical contributions to strengthening the capacity for improved global health security. To date, **102 individuals have received training** in Viet Nam, **including 71 governmental personnel**, part of the current national One Health workforce.

Additional details and highlights from PREDICT's 2015-2016 activities in Viet Nam are provided below and linked to corresponding GHSA Road Map Action Packages and milestones.

Zoonotic Disease Action Package

Milestones: Wildlife farming demographics and risks characterized; Strengthened country commitment for cross-border epizone coordination on zoonotic diseases; Strengthened technical and biosafety capacity for animal health and human health laboratories to conduct diagnostic investigation of zoonotic diseases

Surveillance for Priority Zoonotic Diseases and Pathogens

This year, PREDICT contributed to the design and launch of the Longitudinal Influenza Surveillance Network (LISN) initiative in Viet Nam in collaboration with GHSA, USAID, EPT-2 partners, and government collaborators from the Department of Animal Health (DAH), Ministry of Agriculture and Rural Development (MARD), and the General Department of Preventive Medicine (GDPM), Ministry of Health (MoH). LISN was designed to promote triangulated surveillance and data analysis in wildlife, humans, and domestic animals, with an emphasis on influenza and respiratory pathogens. Through a series of stakeholder meetings and workshops taking place between January and July 2016, the provinces of Quang Ninh and Dong Thap were selected for LISN activities as key provinces for strengthening influenza surveillance along Viet Nam's international borders. Dong Thap Province, which borders Cambodia in the Mekong Delta Region of Viet Nam, and Quang Ninh Province in northern Viet Nam, bordering China, are both important nodes in transboundary animal value chains in the region. WHO-supported Severe Acute Respiratory Illness (SARI) surveillance, FAO/DAH influenza surveillance in swine and poultry, and PREDICT surveillance activities were coordinated closely across these LISN provinces with PREDICT staff contributing expertise in identifying high-risk interfaces for zoonotic pathogen transmission to select specific sampling sites and populations for LISN surveillance. Also this year, project staff supported the expansion zoonotic disease detection capacity by transferring the technology and knowledge needed to screen samples for new and emerging viruses to LISN partners in Viet Nam's national laboratory system. PREDICT provided Viet Nam's National Influenza Centers at the Pasteur Institute-Ho Chi Minh City (PI-HCM) and the National Institute of Hygiene and Epidemiology (NIHE) in Hanoi, with viral detection protocols and the project Universal Control, and provided training and the technical support that will be needed to confirm results and analyze collected triangulated surveillance data.

This year, PREDICT's surveillance team focused on the GHSA priority wildlife trade and farming interface and collected 44 samples from nine individual pangolins (seven Sunda pangolins and two Chinese pangolins) confiscated from the illegal wildlife trade in Thanh Hoa, Nghe An, and Ninh Binh provinces. The pangolins were confiscated from traders as the animals were being transported north along Viet Nam's main highway to Hanoi. The final intended destination of these pangolins was presumed to be markets in China. Additionally, PREDICT collected 93 samples from 41 individual animals (three birds, four carnivores, three wild boar, 30 rodents, and one rabbit) that were confiscated from the illegal wildlife trade at a restaurant and warehouse in Dak Nong Province. Dak Nong Province, which borders Cambodia, is considered a major transit point for wildlife moving between Cambodia and Viet Nam, and is an important node in the wildlife trade value chain in the region. Finally, three additional carnivores (one leopard cat, one Owston's civet, and one masked palm civet) confiscated from the illegal wildlife trade were sampled as part of project activities. The carnivores were delivered to a rescue center in Ninh Binh Province in northern Viet Nam and their origin is unknown.

PREDICT collaborated with FAO and DAH to identify and transfer 185 nasal swabs collected from swine to the project lab for viral family level testing. The samples were collected from farms in Dong Thap Province as part of Viet Nam's LISN program.

This year, PREDICT provided technical support in three investigations of morbidity and mortality in non-human primates housed at a rescue center in Ninh Binh Province involving white-cheeked gibbons and black-shanked douc langurs. Samples were collected from six individuals with full necropsy exams performed on two of the animals. Results of screening for viral pathogens are pending, but the presence of an outbreak situation was ruled out through the investigations and normative diagnostics.

PREDICT completed a series of site assessments with personnel from NIHE, the project's human health sector partner agency in Viet Nam, to prepare for triangulated surveillance in wildlife, livestock, and human populations. Ethical clearance for human surveillance activities was received from NIHE's Institutional Review Board in July 2016, though NIHE's decision remained under review with official approval granted in November 2016. Human sampling is planned to begin in 2017.

PREDICT made progress towards the launch of behavioral risk investigations at priority human-animal interfaces for disease transmission, receiving ethical clearance Ha Noi School of Public Health in March 2016 and initiating training in behavioral risk methods (ethnographic interviews and focus groups), including pilot tests of data collection tools.

Zoonotic Disease Action Package

Milestones: Zoonotic disease threats for Vietnam prioritized (human and animal); Zoonotic Disease Action Package (ZDAP) international conference convened and Annual Plan developed; National multi-sectoral "One Health" coordination mechanism established and functioning; Updated Integrated National Operational Program on AI, Pandemic Preparedness and emerging Infectious Diseases

Multisectoral Coordination to Support Mechanisms for Responding to Zoonotic Diseases

- PREDICT participated in the Viet Nam One Health Partnership for Zoonoses (OHP) launch in Viet Nam with the signing of the OHP Framework. The launch meeting was co-chaired by the Vice Ministers of MARD and MoH, the UN Resident Coordinator, and the US Ambassador to Viet Nam. Twenty-seven delegates representing the UN organizations (FAO, WHO, UNDP), US Government Partners (USAID, US CDC, DTRA), the Ministry of Environment and Natural Resources, multi-lateral organizations (World Bank, ADB), Vietnamese academic and research institutions, and national and international NGOs outlined their commitment to the partnership and signed the OHP agreement.
- PREDICT also contributed to the development of the Viet Nam Integrated National One Health Plan for the period 2016-2020 by providing expertise in a formal stakeholder consultation process organized by MARD and OHP. PREDICT's contributions included highlighting downstream interfaces for zoonotic disease transmission, such as wildlife trade, land use change, and agricultural system intensification, which must be addressed to control and prevent infectious disease emergence.
- PREDICT held regular meetings with FAO and DAH to prepare for the initiation of the livestock component of triangulated surveillance activities. Sample collection and data collection protocols were agreed upon at the national level and training workshops will be scheduled in 2017 with provincial level DAH personnel who will perform the sample and data

collection, thereby strengthening national capacity for zoonotic surveillance.

- Work continued this year on a pilot study applying PREDICT viral testing protocols to archived swine samples, previously collected by FAO and DAH under the USAID EPT+ program. These samples were collected concurrently (by district and season) with PREDICT surveillance and sampling activities targeting rodents and bats from 2009-2014 and is nearing completion with national lab partners conducting all tests.
- PREDICT held a local partner meeting in Dong Nai Province to present the results of the project wildlife farm surveillance conducted between 2009-2014 and to discuss cooperation for triangulated surveillance under PREDICT-2. Participants at the meeting included the Vice Director of the Dong Nai Forest Protection Department and the Head of the Epidemiology Division of the Sub-Department of Animal Health. The Dong Nai government agencies agreed to continue cooperation with PREDICT in conducting surveillance on wildlife farms. They welcomed the addition of livestock and human sampling and the inclusion of behavioral risk investigations.

Lab Strengthening Systems Action Package

Milestones: Core lab tests and priority pathogens identified; National standardized testing algorithms and SOPs developed for selected core tests and pathogens of concern

Laboratory Testing for Detection of Priority Diseases

PREDICT joined the informal public health laboratory system support group organized by WHO Viet Nam that includes GHSA and EPT-2 partners from USAID, US CDC, DTRA, FAO, WHO, Nagasaki University, and Oxford University Clinical Research Unit (OUCRU). The group meets quarterly to share information among development partners to optimize coordination of activities and utilization of resources in support of the Ministry of Health's five-year plan to strengthen Viet Nam's public health laboratory capacity. There was significant interest in PREDICT's laboratory capacity-building activities and project's viral detection tools that have capability for detecting both known and emerging viral threats. Partners also discussed safely distributing the project's standardized positive control material.).

This year, the project's collaborating animal health laboratory in southern Viet Nam, Regional Animal Health Office No. 6 (RAHO6), completed extraction and PCR screening of 185 swine swab samples for corona-, filo-, flavi-, influenza, and paramyxoviruses; PCR products were approved for export for confirmatory sequencing at the global reference laboratory.

Also this year, PREDICT's collaborating animal health laboratory in northern Viet Nam, the Viet Nam National University of Agriculture (VNUA), commenced analysis of 186 wildlife samples collected from pangolins, civets, gibbons, langurs, and leopard cats confiscated from the illegal wildlife trade. The samples will be screened for five viral families (corona-, filo-, flavi-, influenza, and paramyxoviruses).

In collaboration with partners, project staff completed detailed laboratory assessments at NIHE (PREDICT human health sector partner) and PI-HCM (LISN partner). Project viral detection protocols and the Universal Control were delivered and one-on-one training was initiated and will continue into 2017.

PREDICT exported 42 original samples and additional RNA-extraction products collected during the first phase of the project (2009-2014) to the project's global reference laboratory for deep sequencing and further characterization.

PREDICT received permission from government partners to release test results from 1,804 samples from 1,131 rodents and five carnivores collected from wildlife farms and live animal markets during the first phase of the project (2009-2014). Results include the identification of five known coronaviruses and one new rhabdovirus; more information on these results and other findings from the project is available at http://data.predict.global.

Workforce Development Action Package

Milestones: Critical needs for epidemiological training in both human and animal health defined; Program for short course training revised and implemented at provincial and district level

Strengthening the One Health Workforce

This year, PREDICT/Viet Nam staff completed core trainings in biosafety, zoonotic disease surveillance, behavioral risk investigations, laboratory safety, and viral detection and continued working with government partners to advance national capacity through investments targeting improved detection for known and emerging viral threats in the national laboratory system and for improved influenza surveillance across animal and human sectors as part of the LISN initiative.

Training Summary

A total of **102 individuals** (72 men and 30 women), **including 71 governmental personnel** have been trained in Viet Nam since the start of PREDICT-2 activities in 2014. A number of individuals completed trainings in more than one subject.

Training Events by Topic*

Topic	Total Trainings	# Trainings by Government Personnel	# Trainings by Women	# Trainings by PREDICT staff	# Trainings by Students
Avian Sampling	6	2	3	3	
Basic Laboratory Safety	12	4	8	3	
Bat Sampling	6	2	3	3	
Biosafety and PPE	6	2	3	3	
Bushmeat Sampling	6	2	3	3	
CITI Biomedical Research	2		2	2	
Emergency Preparedness	6	2	3	3	
Implementing Cold Chain for Safe Sample Transport	6	2	3	3	
Non-Human Primate Sampling	4		3	3	
One Health Approach	91	68	22	2	
Other	90	68	21	1	
Packing and Shipping Biological Samples	6	2	3	3	
Policies and Plans	1		1	1	
Qualitative Research and Data Collection	6		5	5	
Rodent Sampling	6	2	3	3	
Safe Animal Capture and Sampling	6	2	3	3	
Safe Disposal of Carcasses and Infectious Waste	5	2	2	2	
Safe Sample Transport and Storage	1		1	1	
Small Carnivore Sampling	4		3	3	
Total	**270**	**160**	**95**	**50**	**0**

*Some individuals were cross-trained in multiple topics. Individuals may be represented in multiple rows per column and multiple columns.

USAID | PREDICT
FROM THE AMERICAN PEOPLE

Global Health Security Agenda

SUPPORTING THE GLOBAL HEALTH SECURITY AGENDA IN CAMBODIA

Zoonotic Disease: Through the GHSA, Cambodia has the opportunity to build on previous achievements by working to strengthen multisectoral coordination across animal and human health sectors for improved zoonotic disease surveillance. This year, PREDICT contributed to the national Zoonotic Technical Working Group and **worked with government and FAO partners to coordinate the project's first concurrent surveillance operation, collecting samples from wildlife, livestock, and people** and launching behavioral risk investigations in a bat guano farming community to learn more about factors potentially associated with zoonotic disease transmission within this high-risk interface. Together, project staff and government partners **collected a total of 1,629 wild animal and 1,026 livestock samples, while trained medical staff and interviewers obtained samples and behavioral risk data from 95 people**.

PREDICT and partners collect bat urine and feces at a bat guano farm in the Kang Meas district of Kampong Cham Province, Cambodia during the project's first One Health surveillance operation targeting wildlife, livestock, and people. Photo: PREDICT/Cambodia

Lab Strengthening Systems: PREDICT is working to directly strengthen capacity for detection of priority zoonotic disease threats in animal and human laboratories and to contribute to operationalization of a One Health laboratory network in Cambodia by fostering communication and coordination between human and animal partner laboratory facilities and ministries. This year, **PREDICT, through the project lab at the Institute Pasteur du Cambodge (IPC), worked with national laboratory partners at the National Veterinary Research institute (NaVRI) and National Institute for Public Health (NIPH),** to identify opportunities for capacity strengthening to enable more rapid detection of both known and novel zoonotic disease threats. **IPC staff also continued actively testing samples for known and emerging viral threats while**

providing concurrent in-service training to government animal and human health laboratory staff.

Workforce Development: A well-trained and equipped workforce is critical for health security and for emergency and disaster management and response. PREDICT investments are making an impact on Cambodia's One Health workforce though the provision of in-service training to health professionals in the human and animal health sectors from the district to national levels. This year, **PREDICT conducted a number of trainings in Cambodia, including pre-service trainings for university students and in-service trainings for government health professionals**, making critical contributions to strengthening the One Health workforce for improved global health security. To date, **10 individuals have received training** in Cambodia.

Additional details and highlights from PREDICT's 2015-2016 activities in Cambodia are provided below and linked to corresponding GHSA Road Map Action Packages. *As a Phase 2 GHSA country, the Road Map for Cambodia with specific milestones has not been publicly released.*

Zoonotic Disease Action Package

Surveillance for Priority Zoonotic Diseases and Pathogens

Together with government partners from National Veterinary Research Institute (NaVRI), Cambodian Communicable Disease Control Department (CDC), the Forestry Administration (FA), the Department of Animal Health and Production (DAHP), and students from Royal University of Agriculture (RUA) and University of Health Sciences (UHS), PREDICT conducted two field sampling trips (wet and dry season) targeting bats and domestic animals at and around bat guano farms in Kang Meas district, Kampong Cham province. Samples were collected from bats, including 600 fecal and urine samples from under farm roosts along with samples from 264 livestock (poultry, cattle, pigs, horses, and dogs).

During one of these trips and with excellent cooperation between national livestock, wildlife, and human health sectors (including both central and local government departments, staff from local health centers, and village chiefs), PREDICT launched the first concurrent field sampling event of humans, wildlife, and domestic animals. The multisectoral One Health surveillance team sampled bats, their guano and urine, rodents, domestic animals, and people, and trained interviewers completed behavioral questionnaires with community members to help understand zoonotic disease transmission risk. A total of 95 participants from 32 households located on and around the bat farms provided samples and responses to surveys, which also served as an opportunity for capacity strengthening, as epidemiology students from the Royal University of Phnom Penh received training in behavioral risk investigations and survey implementation from project staff.

Together with partners from the NaVRI, CDC, FA, students from RUA, and local district veterinarians from the DAHP, PREDICT coordinated the concurrent sampling of rodents and domestic animals at the cross-border rodent trade field site in Chrey Thom, Koh Thom district, Kandal province, bordering Vietnam. PREDICT conducted two sampling trips (dry season and wet season) and sampled a total of 306 rodents during the two trips with specimens transferred to the project lab in advance of viral testing. In addition, the team sampled a total of 501 domestic animals, including 270 poultry, 123 cattle/ buffalo, and 60 pigs. Swine sampling was performed at a small-scale abattoir where pigs from nearby houses are taken for slaughter. Poultry samples were collected from flocks on small farms and from those reared around houses.

PREDICT made progress towards launch of syndromic surveillance activities in-country, obtaining approvals to move forward with surveillance activities in two district hospitals adjacent to the field surveillance sites in Kampong Cham and Kandal Provinces. In addition, team members commenced coordination with the Kantha Bopha pediatric hospital in Phnom Penh, which receives sick children from around the country, to establish syndromic surveillance of children with Severe Acute Respiratory Illness (SARI).

Multisectoral Coordination to Support Mechanisms for Responding to Zoonotic Diseases

- PREDICT, together with FAO partners made considerable progress in working across animal and human health sectors and to provide opportunities for One Health surveillance of animals and humans at priority high-risk human-animal interfaces for zoonotic disease transmission. Project surveillance activities, including field sampling of wildlife, domestic animals, and humans were conducted alongside staff from NaVRI, the Forestry Administration (FA), and the Cambodian Communicable Disease Control Department (CDC). In addition, PREDICT coordinated with FAO to organize concurrent sampling of domestic animals with veterinarians from the Department of Animal Health and Production DAHP.
- PREDICT contributed technical assistance and provided surveillance plans and updates at national Zoonotic Technical Working Group meetings (participants included NaVRI, FA, CDC, USAID, USCDC, WHO, FAO, NIPH, and IPC).
- Project team members provided monthly written activity reports and briefings to the USAID/Cambodia and USAID/RDMA, the US CDC, non-governmental partners, and governmental partners at the Cambodian CDC, FA, and NaVRI.

Lab Strengthening Systems Action Package

Laboratory Testing for Detection of Priority Diseases

This year, PREDICT met with relevant NaVRI, FA, and National Institute for

Public Health (NIPH) government partners to plan for laboratory training and joint diagnostic testing using project viral detection protocols that can detect zoonotic diseases of public health concern, including plans for future viral testing at the government animal health laboratory NaVRI.

PREDICT continued to work with the collaborating partner lab at the IPC, which continued actively testing project samples using viral detection protocols, while providing concurrent in-service training to government animal and human health laboratory staff. The project lab at IPC maintains capability for testing of 10 viral families.

This year the technicians at the IPC lab extracted RNA from 771 samples for viral family testing, including oral and rectal swabs from 195 rodents and 109 bats and 210 bat fecal samples collected in 2014-2015. The lab completed viral family testing for corona-, alpha-, paramyxo-, flavi- and influenza viruses on these 771 samples though sequencing of positives is ongoing. Testing on these 771 samples is also continuing for a further five viral families (filo-, bunya-, rhabdo-, hanta-, and picornaviruses).

PREDICT obtained coronavirus spike protein (cell receptor binding protein) sequences from deep sequencing of selected samples performed at the project global reference lab to further our understanding of receptor binding properties, and viral host range; analyses are ongoing.

Workforce Development Action Package

Strengthening the One Health Workforce

PREDICT continued to advance the capacity of Cambodia's One Health workforce by conducting pre-service trainings with final year university students (veterinary and medical students) and in-service trainings with government personnel from the agriculture, wildlife, and human health sectors (NaVRI, the Department of Wildlife and Biodiversity - DWB; part of the Forestry Administration, and the Cambodian CDC). These trainings incorporated learning and knowledge acquisition with field-based practicums in biosafety, field sampling and surveillance techniques, laboratory safety, and viral detection.

PREDICT staff participated in the Cooperative PREDICT-FAO Asia Regional Laboratory Training (May 17-19, 2016) in Bangkok Thailand, which brought together veterinary laboratory representatives from across Southeast Asia. Attendees participated in hands-on training on sample preparation and Polymerase Chain Reaction (PCR) protocols for priority viral families; gave presentations on specimen collection, selection for testing, and sample handling and testing; reviewed philosophies behind priority virus identification, analysis, and reporting; and strategized on FAO-PREDICT collaborative sample collection in livestock. Additionally, PREDICT laboratory representatives shared key insights to successful field sampling and laboratory analysis gained through experience working under the first phase of the project.

Training Summary

A total of **ten individuals**, including **eight men** and **two women,** have been trained in Cambodia since the start of PREDICT-2 activities in 2014. Three governmental personnel and two students have received training from PREDICT. A number of individuals completed trainings in more than one subject.

Training Events by Topic*

Topic	Total Trainings	# Trainings by Government Personnel	# Trainings by Women	# Trainings by PREDICT staff	# Trainings by Students
Basic Laboratory Safety	10	3	2	5	2
Bat Sampling	10	3	2	5	2
Biosafety and PPE	10	3	2	5	2
Human Biological Sampling	10	3	2	5	2
Human Syndromic Surveillance	1			1	
Implementing Cold Chain for Safe Sample Transport	10	3	2	5	2
Livestock Sampling	10	3	2	5	2
Non-Human Primate Sampling	10	3	2	5	2
Rodent Sampling	10	3	2	5	2
Safe Animal Capture and Sampling	10	3	2	5	2
Safe Sample Transport and Storage	10	3	2	5	2
Small Carnivore Sampling	10	3	2	5	2
Totals	**111**	**33**	**22**	**56**	**22**

*Some individuals were cross-trained in multiple topics. Individuals may be represented in multiple rows per column and multiple columns.

Other Activities*:*

- This year, project staff submitted two papers entitled “Diversity of bat astroviruses in Lao PDR and Cambodia” and “Genetic diversity of coronaviruses in bats in Lao PDR and Cambodia Infection, Genetics and Evolution” for publication in the journal Infection, Genetics and Evolution; both papers have now been accepted.

SUPPORTING THE GLOBAL HEALTH SECURITY AGENDA IN THE LAO PEOPLE'S DEMOCRATIC REPUBLIC

Zoonotic Disease: Through the GHSA, the Lao People's Democratic Republic (PDR) has the opportunity to build on previous achievements by working to strengthen multisectoral coordination across animal and human health sectors for improved zoonotic disease surveillance. This year, **PREDICT worked with government and FAO partners to conduct scoping visits to potential surveillance sites at high-risk interfaces in wildlife markets and subsistence hunting communities.** Following the visits, PREDICT **officially launched concurrent animal sampling activities, collecting samples from 153 animals (19 bats and 134 rodents), while FAO-supported teams sampled livestock.**

An insectivorous bat caught at an animal-human interface, where people capture bats to process for their use in traditional medicines. Here, a bat expert from the National University of Laos demonstrates methods for identifying bat species based on the number and placement of teeth. Photo: Dave McIver, PREDICT/Lao PDR

Lab Strengthening Systems: PREDICT is working to directly strengthen capacity for detection of priority zoonotic disease threats in animal and human laboratories and to contribute to operationalization of a One Health laboratory network in Lao PDR by fostering communication and coordination between human and animal partner laboratory facilities and ministries. This year, **PREDICT worked with the National Animal Health Laboratory (NAHL) and the National Center for Laboratory and Epidemiology (NCLE),** our implementing lab partners for animal and human surveillance activities, to identify opportunities for capacity strengthening to enable more rapid detection of both known and novel zoonotic disease threats. **NAHL staff received training and**

maintained capacity for testing wildlife and livestock samples for viral families using techniques that can detect priority zoonotic diseases of public health concern, such as MERS-Coronavirus, Zika virus, and Ebola viruses.

Workforce Development: A well-trained and equipped workforce is critical for health security and for emergency and disaster management and response. PREDICT investments are making an impact on Lao PDR's One Health workforce though the provision of in-service training to health professionals in the human and animal health sectors from the district to national levels. This year, PREDICT conducted a number of trainings in Laos, including **a field-based training for project and government staff in methods for zoonotic disease surveillance**, making critical contributions to strengthening the One Health workforce for improved global health security. To date, **19 individuals have received training** in Laos PDR, including 15 government personnel, part of the national One Health workforce.

Additional details and highlights from PREDICT's 2015-2016 activities in the Lao PDR are provided below and linked to corresponding GHSA Road Map Action Packages. *As a Phase 2 GHSA country, the Road Map for Lao PDR with specific milestones has not been publicly released.*

Zoonotic Disease Action Package

Surveillance for Priority Zoonotic Diseases and Pathogens

PREDICT conducted a scoping visit in Champasak Province between (October 31 - November 7, 2015) in southern Lao PDR, with representatives from the FAO, the Department of Livestock and Fisheries (DLF), the National Animal Health Laboratory (NAHL), and the National Center for Laboratory and Epidemiology (NCLE). This visit included investigations of multiple wildlife markets and identification of subsistence-hunting communities and potential surveillance sites along wildlife, human, and domestic animal interfaces.

The PREDICT team conducted a second visit to Na Pa Kieb village, the selected surveillance site in Champasak Province, alongside representatives from NAHL and NCLE (January 20-22, 2016) to assess the Soth Village Cluster healthcare center, visit the Khong District Hospital, and engage the Na Pa Kieb community in preparation for future concurrent human and animal sampling.

During three field trips to priority surveillance sites (Na Pa Kieb village and the Kilometer 14 wildlife market) conducted since May 2016, PREDICT collected 807 samples from 134 rodents and 19 bats. In addition, in Na Pa Kieb village, FAO partners collected livestock samples from buffalo, poultry, and swine concurrently with PREDICT, representing the official launch of joint animal surveillance activities designed to explore risks of zoonotic disease transmission between animal populations.

Plans for human surveillance were also advanced this year, as PREDICT completed development of a Lao PDR-specific human behavioral and biological sampling protocol (September 2016), currently being finalized for submission for ethical clearance by the NCLE.

Multisectoral Coordination to Support Mechanisms for Responding to Zoonotic Diseases

- During a field scoping visit (November 2015), PREDICT liaised with provincial department partners, including the Provincial Office of Agriculture and Forestry (PAFO), the Provincial Health Office (PHO), and the Provincial Office of Natural Resources and Environment (PONRE), to explain the project and facilitate future field work in Champasak Province.
- PREDICT worked with the Department of Livestock and Fisheries to create a Memorandum of Understanding, which was submitted to the Ministry of Agriculture and Forestry and the Ministry of Planning and Investment and signed by the Lao PDR Government on May 9, 2016, allowing the official launch of PREDICT in Lao PDR.
- Team members gave a presentation on EPT-2 and PREDICT to the Ministry of Planning and Investment (February 10, 2015) and obtained their support for project implementation.
- PREDICT staff met with partners from the DLF, Department of Communicable Disease Control, NAHL, and NCLE to discuss data management and sharing (September 5, 2016). Following the meeting, NAHL, NCLE, and DLF agreed to use the project database and associated data collection tools for both wildlife and human biological samples, and data sharing agreements were subsequently signed – a critical step towards enabling data sharing and reporting across animal and human health sectors.

Lab Strengthening Systems Action Package

Laboratory Testing for Detection of Priority Diseases

PREDICT convened a meeting (March 7, 2016) with the Director of NAHL, the NAHL point of contact for the project, and the lead of FAO Lao PDR to discuss project lab protocols, standard laboratory tests for animal and human samples, and to plan a training event to be held in Vientiane.

PREDICT completed laboratory training (August 22-26, 2016), in Vientiane at NAHL. Ten staff from NAHL and NCLE were trained on nucleic acid extraction and cDNA synthesis, using the project universal control, viral detection protocols, gel electrophoresis, interpretation of results, and optimization of PCR protocols with control plasmids. As a result, NAHL is well prepared to continue testing wildlife and livestock samples for viral families that can detect priority zoonotic diseases of public health concern (corona-, filo-, flavi-, influenza, and paramyxoviruses).

Workforce Development Action Package

Strengthening the One Health Workforce

PREDICT conducted a large-scale classroom and practical field training session, focusing on key One Health skills for zoonotic disease surveillance (July 24 - August 6, 2016) in Champasak Province, with support from PREDICT global and Cameroon staff. Bat and rodent experts from the National University of Lao PDR, Faculty of Environmental Science, also presented to trainees on species identification and capture techniques and assisted in the capture of rodents and bats during field training. This training strengthened the capacity of the PREDICT/Lao PDR team and local government health professionals to safely conduct animal capturing and sampling and to manage data. Participants included representatives from the Provincial Office of Agriculture and Forestry, Provincial Office of Natural Resources and Environment, technical staff from the Khong District Office of Agriculture and Forestry, as well as personnel from the National Animal Health Laboratory and the National Centre for Laboratory and Epidemiology.

Opening ceremonies at a training event with government partners from NCLE, NAHL, the Provincial Forestry and Agriculture Office, the National University of Laos, and PREDICT's Lao PDR and Cameroon teams. Photo: Dave McIver, PREDICT/Lao PDR

Training Summary

A total of **19 individuals (17 men** and **two women), including 15 governmental personnel** have been trained in the Lao PDR since the start of PREDICT-2 activities in 2014. A number of individuals completed trainings in more than one subject.

Training Events by Topic*

Topic	Total Trainings	# Trainings by Government Personnel	# Trainings by Women	# Trainings by PREDICT staff	# Trainings by Students
ACU 101	1			1	
Avian Sampling	1			1	
Basic Laboratory Safety	13	9	4	4	
Bat Sampling	13	9	4	4	
Biosafety and PPE	13	9	4	4	
Bushmeat Sampling	13	9	4	4	
CITI Biomedical Research	1			1	
Emergency Preparedness	13	9	4	4	
Implementing Cold Chain for Safe Sample Transport	13	9	4	4	
Lab Protocols and Diagnostics	9	9	3	1	
Livestock Sampling	1			1	
Non-Human Primate Sampling	1			1	
Outbreak Response	4	2	2	4	
Packing and Shipping Biological Samples	1			1	
Policies and Plans	4	2	2	4	
PREDICT School	2			2	
Qualitative Research and Data Collection	1			1	
Rodent Sampling	13	9	4	4	
Safe Animal Capture and Sampling	11	7	2	3	
Safe Disposal of Carcasses and Infectious Waste	13	9	4	4	
Safe Sample Transport and Storage	1			1	
Small Carnivore Sampling	1			1	
Total	**143**	**92**	**41**	**55**	**0**

*Some individuals were cross-trained in multiple topics. Individuals may be represented in multiple rows per column and multiple columns.

Other Activities:

- On March 23, 2016, a collaboratively written PREDICT and PREVENT project manuscript from EPT-1, "Wildlife Trade and Human Health in Lao PDR: An Assessment of the Zoonotic Disease Risk in Markets," was published in the journal *PLoS ONE (See Section 6 – Publication Summaries for details)*.
- The project country coordinator presented at the One Health Symposium held by the Lao PDR government (September 21-22, 2016), in cooperation with the US CDC, Defense Threat Reduction Agency (DTRA), WHO, and FAO and attended by participants from the Provincial Agriculture and Forestry Office and the Provincial Health Office, as well as NGOs working in zoonotic disease surveillance. The meeting objective was to share results from zoonotic surveillance activities and to discuss methods to increase understanding of the One Health concept by high ranking government officials. The presentation included an overview of the success of PREDICT-1 in Lao PDR, the components of the USAID Emerging Pandemic Threats-2 program, coordinated surveillance efforts by PREDICT and FAO, human syndromic surveillance, and an overview of hospitals that will participate in human syndromic surveillance in Laos.

USAID | PREDICT
FROM THE AMERICAN PEOPLE

Global Health
Security Agenda

SUPPORTING THE GLOBAL HEALTH SECURITY AGENDA IN MALAYSIA

Zoonotic Disease: Through the GHSA, Malaysia has the opportunity to build on previous achievements by working to strengthen multisectoral coordination across animal and human health sectors for improved zoonotic disease surveillance. This year, **PREDICT/Malaysia worked with government partners to launch triangulated surveillance activities in the Orang Asli community,** an at-risk community with frequent contact with wildlife through subsistence hunting, **collecting samples from wildlife, domestic animals (dogs and chickens), and people.** In addition, **at the request of government partners, PREDICT provided technical assistance during multiple wildlife die-off events and disease investigations.** This year, **PREDICT** teams and collaborating government partners in Peninsular Malaysia and Sabah **sampled over 400 wild animals, 160 domestic animals, and 170 people,** offered multiple in-service training opportunities to in-country partners, and through the Deep Forest project, continued to explore the dynamics of land use change on viral spillover and emergence.

Lab Strengthening Systems: PREDICT is working to directly strengthen capacity for detection of priority zoonotic disease threats in animal and human laboratories and to contribute to operationalization of a One Health laboratory network in Malaysia by fostering communication and coordination between human and animal partner laboratory facilities and ministries. This year, **PREDICT continued working with government lab partners at the project collaborating labs PERHILITAN National Wildlife Forensic Laboratory (Peninsular Malaysia) and the Sabah Wildlife Department's Wildlife Health, Forensics, and Genetics Laboratory**, both of which continued advancing capacity for viral testing of animal samples. Also this year, **PREDICT worked to strengthen capabilities** to enable more rapid detection of both known and novel zoonotic disease threats in people **at the National Public Health Laboratory (Peninsular Malaysia) and the Kota Kinabalu Public Health Laboratory (Sabah)**. Trainings and preparations with these labs are well underway, and viral testing is scheduled to begin in 2017.

Workforce Development: A well-trained and equipped workforce is critical for health security and for emergency and disaster management and response. PREDICT investments are making an impact on Malaysia's One Health workforce though the provision of in-service training to health professionals in the human and animal health sectors from the district to national levels. This year, PREDICT conducted a number of trainings in Malaysia, including **field and lab-based trainings for project and government staff covering methods for zoonotic disease surveillance** and viral detection. To date, **74 individuals have received training** in Malaysia, 71 of whom are government personnel, making critical contributions to strengthening the national One Health workforce for improved global health security.

Additional details and highlights from PREDICT's 2015-2016 activities in Malaysia (separated by Peninsular Malaysia and Sabah) are provided below and linked to corresponding GHSA Road Map Action Packages. *As a Phase 2 GHSA country, the Road Map for Malaysia with specific milestones has not been publicly released.*

PENINSULAR MALAYSIA

Zoonotic Disease Action Package

Surveillance for Priority Zoonotic Diseases and Pathogens
PREDICT held meeting with Department of Orang Asli Development (JAKOA) and Orang Asli village leaders from Kuala Lipis, Gua Musang, and Kuala Kangsar to inform village leaders of surveillance activities and plans for sampling animals and people and to set dates for community meetings. The Orang Asli villages targeted for surveillance are remote rural communities with frequent wildlife contact, including through subsistence hunting. Village leaders reiterated their support for the project and for PREDICT plans to sample humans, wildlife, and livestock. Community meetings were held with around 220 individuals at Pos Lenjang, Gua Musang, and Kuala Kangsar to provide information about the aims of the project and about plans for human, wildlife, and livestock sampling. The team also provided information on zoonotic diseases and transmission risk, along with prevention and risk mitigation options, for example through carcass disposal and practices for safe hunting.

PREDICT also met with the Ministry of Health and PERHILITAN (Department of Wildlife and National Parks) to coordinate human, wildlife, and livestock sampling in the Orang Asli villages. Following these meetings, the first sampling trip to communities near Kuala Lipis occurred in May 2016, led by a collaborative sampling team, including Ministry of Health, District Health, and PERHILITAN staff. After the launch of surveillance in Kuala Lipis, PREDICT and government partners completed the initial round of concurrent human, wildlife, and livestock surveillance in all three Orang Asli communities, enrolling 171 people for sampling and behavioral risk surveys and collecting 1,302 samples.

This year, PREDICT conducted a total of four animal surveillance and sampling events in Peninsular Malaysia (including sampling events at the Orang Asli villages) during which 2,454 samples were collected from 227 animals at high-risk human-animal interfaces: 20 bats, 15 rodents, 27 non-human primates (one a pet), one carnivore (also a pet), 87 dogs, and 77 chickens.

Multisectoral Coordination to Support Mechanisms for Responding to Zoonotic Diseases

- PREDICT attended the Roundtable on Sustainable Palm Oil (RSPO) Annual Meeting in Kuala Lumpur (November 17-19, 2015) as part of a new engagement with the oil palm industry and extractive industries in-country. At the meeting, PREDICT displayed three posters: "The Economics of Pandemic Prevention: New Strategies to Mitigate Disease Emergence at Source" (showing an economic analysis of disease prevention versus outbreak response); "Bat species and viral diversity across different anthropogenic disturbance gradients in Kinabatangan, Sabah, Malaysia" (describing findings that low-disturbance sites may host animals with a lower number of viruses); and "Assessing viral diversity within non-human primates of Peninsular and Bornean Malaysia" (which detailed findings of measles virus and human Adenovirus G RNA in macaques).

- PREDICT met with the new director and new deputy director of the Department of Wildlife and National Parks, Peninsular Malaysia (PERHILITAN; December 11, 2015) to provide an update on work to date. At the meeting, both confirmed their continued support for the project.
- In addition, PREDICT conferred with the newly confirmed director of the Department of Veterinary Services (DVS; January 14, 2016), to discuss project activities and renew engagement with the Veterinary Research Institute (VRI).
- The team coordinated with the Malaysia One Health University Network (MyOHUN) to assist Wildlife Disease Risk Analysis Training (April 2016). PREDICT also made plans and preparations to give a talk at a MyOHUN colloquium in April 2016 on PREDICT and the USAID-funded Infectious Disease Emergence and Economics of Altered Landscapes (IDEEAL) project activities.
- PREDICT gave an invited talk at the Asia-Pacific Biosafety Association's 11th Annual Biosafety Conference, "Strength in Unity: Partnerships in Biosafety & Biosecurity," held in Siem Reap, Cambodia (May 31-June 3, 2016).
- The team continued to collaborate with government partners at PERHILITAN with regard to samples collected through the Wildlife Disease Surveillance Program (WDSP) and opportunities for additional viral testing.
- PREDICT/Malaysia's country coordinator shared expertise on zoonotic disease risk analysis with partners at the One Health Workforce - One Health Risk Analysis Training (April 21, 2016) through a talk titled "The Emerging Pandemic Threat PREDICT Program and Implications for Risk Analysis".
- PREDICT continued developing plans with the Faculty of Veterinary Medicine, Universiti Putra Malaysia (UPM) with regard to incorporating the project's viral detection protocols for the testing of domestic animal and livestock samples, a collaboration that will strengthen PREDICT and OHW partnerships through MyHOUN.
- The project country coordinator shared expertise and experiences working in One Health and zoonotic disease surveillance activities with students at the Faculty of Applied Sciences at UCSI University, Kuala Lumpur in a talk entitled "Conservation through One Health & Zoonotic Disease Surveillance: The PREDICT & IDEEAL Projects in Malaysia" (September 19, 2016).

Lab Strengthening Systems Action Package

Laboratory Testing for Detection of Priority Diseases

This year, PREDICT engaged National Public Health Laboratory (NPHL) representatives and Kuala Lipis District Health Officers to discuss workflow, biosafety, and administrative needs in preparation for the launch of viral testing. The NPHL laboratory, part of Malaysia's national laboratory network, will be the main collaborating lab for testing of human samples collected as part of triangulated surveillance activities in the at-risk Orang Asli community. PREDICT held regular meetings with MoH and NPHL and made plans to initiate viral testing in October 2016. As part of efforts to prepare the lab for launch, PREDICT coordinated a new laboratory inspection with biosafety consultant and improved cold chain for sample storage by installing a temperature monitoring system for the ultra-low temperature freezer. Training for lab staff has also commenced and will continue through in-service viral detection training as the lab initiates activities.

PREDICT met with the director general of the Department of Veterinary Services (DVS - May 16, 2016) and made plans to move lab equipment from the Veterinary Research Institute (VRI) to the Faculty of Veterinary Medicine (FVM) Universiti Putra Malaysia and the project lab at PERHILITAN. Livestock testing will now be conducted at the FVM Virology and Bacteria lab (planned to begin in December 2016) with wildlife testing continuing at the PERHILITAN National Wildlife Forensic Laboratory.

PREDICT transferred project equipment (MiniMag, laminar cabinet, -20C freezer, 4C refrigerator, ultra-low freezer, and CO2 back-up systems, and other consumables) from the old diagnostic laboratory to PERHILITAN's planned Bio-Safety Level (BSL) 2 disease diagnostic lab. In addition, PREDICT installed two biosafety cabinets at the new PERHILITAN laboratory and hosted biosafety consultants to review progress and provide feedback on improvements needed for BSL2 certification. Consultants identified a few issues that will be resolved by December 2016 thereby enabling certification and initiation of viral detection activities.

Workforce Development Action Package

Strengthening the One Health Workforce

PREDICT conducted meetings and training with 34 MoH District Health Offices to prepare for Orang Asli community sampling. Training covered lab safety and biosafety and proper use of PPE along with surveillance implementation, including eligibility criteria, enrolment, pre-test counseling; how to consent participants; how to administer the behavioral risk questionnaire; how to fill in appropriate forms for the study; and safe collection of nasal and oropharyngeal swabs.

PREDICT also conducted training for seven government staff (four PERHILITAN staff and three Wildlife Health Unit staff) on biosafety, PPE use, safety for wildlife and domestic animal handling, specimen collection, cold chain maintenance, and setting up small mammal and bat traps

Training Summary

A total of **31 individuals** (16 men and 15 women), including 31 governmental personnel have been trained in **Peninsular Malaysia** since the start of PREDICT-2 activities in 2014. A number of individuals completed trainings in more than one subject.

Training Events by Topic (Peninsular Malaysia)*

Topic	Total Trainings	# Trainings by Government Personnel	# Trainings by Women	# Trainings by PREDICT staff	# Trainings by Students
Basic Laboratory Safety	11	11	4		
Biosafety and PPE	31	31	15		
Other	42	42	19		
Total	**84**	**84**	**38**	**0**	**0**

*Some individuals were cross-trained in multiple topics. Individuals may be represented in multiple rows per column and multiple columns.

Other activities

- PREDICT's country coordinator gave a talk at the Asia-Pacific Biosafety Association 11th Annual Biosafety Conference on "One Health Networks & Zoonotic surveillance: The PREDICT Project in Malaysia" in Siem Reap, Cambodia (June 2, 2016).
- Two abstracts submitted by PREDICT/Malaysia team members were accepted for poster presentations at the One Health, Ecohealth conference in Melbourne (December 2016): "Assessing viral diversity in non-human primates and bats of Peninsular and Bornean Malaysia" and "Zoonotic Viruses Surveillance for the Confiscated Pangolins in Malaysia".

SABAH MALAYSIA

Zoonotic Disease Action Package

Surveillance for Priority Zoonotic Diseases and Pathogens

This year, PREDICT supported government partners, providing field and lab-based technical assistance during multiple animal die-off and disease investigations. In May, Sabah Wildlife Department (SWD) requested assistance with elephant death investigation, and PREDICT with WHU partners conducted necropsies and collected samples as part of an outbreak investigation capacity building exercise. At the request of the Malaysian Wildlife Health Unit, PREDICT opportunistically collected feces from wild orangutans found in Sepilok forest (November 8, 2015) and screened the samples for viruses prior to the relocation of these animals to the Sepilok Orangutan Rehabilitation Centre. Finally, after a gibbon died suddenly of flu like symptoms in May 2016 at the Rescue Centre, Kota Kinabalu, SWD requested PREDICT support with an investigation. Project staff conducted a necropsy at the Rescue Centre, sampled one animal, and collected 24 samples.

PREDICT received approval in February 2016 to work in Wilmar Ribubonus oil palm planation and conducted a visit to the site in March 2016 to characterize the plantation for surveillance and sampling activities.

In July 2016, PREDICT held a meeting with Sabah State Health Department (SSHD) to develop plans with staff from KKPHL and Queen Elizabeth and Likas hospitals for syndromic surveillance activities to begin in 2017. The team also commenced trainings in project human surveillance activities with SSHD staff.

This year, PREDICT teams completed a total of nine surveillance events, collecting 401 samples from 40 animals (one wild boar, 11 non-human primates, 24 pangolins, and three elephants). Details on the surveillance events and sample collections are provided below.

- Sampled proboscis monkeys (*Nasalis larvatus*) in Kota Belud (19-20 October) and Kota Belud (February 2016) with SWD. These animals are being evaluated for translocation due to wildlife-human conflict.
- Collected 37 specimens from four long-tailed macaques (December 2015) at the human-wildlife conflict interface and collected 52 samples from four rescued gibbons (December 2015); viral screening will inform a management plan.
- Sampled two wild orangutans (January 2016) and collected a total of 21 specimens prior to their translocation to the Sepilok Orangutan Rescue Centre.
- Collected 134 samples from 23 pangolins at Sepilok Orangutan Rehabilitation Centre (February 2016); the animals were confiscated from smuggler during transportation. Pangolin are of interest due to high prevalence in transboundary illegal trade (value chain).
- Sampled two proboscis monkeys and collected 27 samples near the Segama River- Lahad Datu (March 2016). This is a wild population near a human community, resulting in frequent conflict. This population may be relocated and so were provided a genetic screen and health check prior to relocation. In addition, the team sampled an additional six proboscis monkeys and collected 76 samples in April 2016.
- Sampled a pangolin at Lok Kawi Wildlife Park's clinic (June 2016) and collected 11 samples. The animal was confiscated from a smuggler during transportation.
- Sampled a proboscis monkey near Sugut – Sabah (August 2016) and collected 15 samples. The proboscis monkey population near Sugut is a wild population near a human community, resulting in frequent conflict. This population may be relocated and so were provided a genetic screen and health check prior to relocation.
- Also sampled two proboscis monkeys in Beluran – Sabah, collecting 30 samples. This is also a wild population near a human community, resulting in frequent conflict. This population may also be relocated and so were provided a genetic screen and health check prior to relocation.
- Collected three bushmeat samples at the WHGFL from wild boar meat sourced from a restaurant located at Penampang, Kota Kinabalu.

As part of Deep Forest Project, activities to sample wildlife along a deforestation gradient and investigate the potential impact of anthropogenic change on viral diversity and disease emergence continue, PREDICT received ethical approval (December 2015) to conduct a second round of behavioral risk investigations using the Human Animal Contact Survey (HACS) at Telupid. The team conducted a visit to Telupid District in October 2015 to evaluate potential sites for Deep Forest sampling and to identify communities for a second round of PREDICT's HACS. PREDICT held community meetings with 76 individuals in July 2016 living near Deep Forest sites at Kampungs Buis, Ansuan, Baba, and with staff on the Wilmar Ribubonus plantation in Telupid. The meetings were held to inform the community about the project and the HACS. The survey was launched in July in these communities, and a total of 450 people were interviewed.

As part of continuing Deep Forest project sampling, PREDICT completed sampling events at four sites: Semi Disturbed 3 (SD3), SD1, SD2 and Pristine 2. A total of 129 animals were sampled (36 rodents and tree shrews, two other mammal, six carnivores, and 85 bats), and 1,064 samples were collected.

An additional 10 Deep Forest sampling trips were completed in two rounds, including visits to Semi-disturbed sites 1 and 3 and Disturbed sites 1, 2, and 3. PREDICT teams collected a total of 3,056 biological specimens from 331 animals (180 bats, 143 rodents and tree shrews, six carnivores, and two other mammals).

Multisectoral Coordination to Support Mechanisms for Responding to Zoonotic Diseases

- PREDICT was invited to join Sabah Zoonotic Diseases Committee semiannual meetings with Sabah State Health Department (SSHD), DVS Sabah, SWD, and staff from Universiti Malaysia Sabah (UMS). PREDICT provided information on viral findings along with results from the Deep Forest Project's Human Animal Contact Survey.
- Project staff met with the former Infectious Disease Adviser for the State of Sabah to discuss the strategy for engaging the Department of State Health Sabah (DSHS) regarding disease findings from PREDICT and IDEEAL models.
- The team met with the Forest Sustainability Manager for Wilmar International (November 19, 2016) and the Sustainability Manager for Wilmar's Sabah plantations to discuss PREDICT sampling on the plantations and potential surveillance in clinics that provide medical care for staff and workers.
- PREDICT met with the British High Commissioner and Economic Counsellor from the British High Commission (December 9, 2016) and discussed the local implementation of project activities.
- The project lab manager presented on project work at the MyOHUN colloquium, Kuching, Sarawak (April 14, 2016).

Lab Strengthening Systems Action Package

Laboratory Testing for Detection of Priority Diseases

PREDICT continued working with the Sabah Wildlife Department's Wildlife Health, Genetic, and Forensic Laboratory (WHGFL), the collaborating project lab, which maintains capacity for viral detection of known and emerging threats including arena-, corona-, filo-, flavi-, hanta-, herpes-, and influenza viruses.

This year, PREDICT successfully recruited a laboratory manager for SWD's WHGFL to meet the lab's re-certification requirements for 2016-2017. In addition, project staff trained the new lab manager on general management tasks and lab operations, lab safety, PPE, sample collection and storage, introduction to the project and Deep Forest activities, along with viral testing and molecular techniques (April 2016).

PREDICT also worked with WHGFL on recertification (May 2016), including lab inspection and discussion of how to improve lab management and safety. The team also provided training for nine individuals covering lab drills and training for lab staff and WHU rangers on biosafety, PPE, and glow-germ test.

In preparations for next year's syndromic surveillance in Sabah, PREDICT led trainings with seven Kota Kinabalu Public Health Laboratory (KKPHL) staff, our collaborating partner for testing of human samples, on viral detection protocols, including use of the MiniMag extraction system for sequencing.

PREDICT continued ongoing laboratory analysis of samples collected for the Deep Forest project this year, testing 94 specimens (including 27 urine, 50 throat, and 17 rectal specimens) from 50 animals (49 bats and one civet) for corona-, filo-, paramyxo-, influenza, and herpes-viruses; results are pending.

In addition, the lab tested 188 Deep Forest 2 samples (100 animals) for filo, corona, paramyxo, influenza, and herpesviruses. Cloning and plasmid preparations have been completed, and confirmatory sequencing is underway. Results will be shared with government partners for approval when available.

The lab team also extracted 697 Deep Forest samples (lysis buffer duplicates of samples preserved in Viral Transport Media previously tested in 2013) and tested the samples for corona-, filo-, paramyxo-, arena-, hanta-, and herpesviruses for comparison.

An additional 143 Deep Forest samples from 59 animals were tested for filo-, corona-, paramyxo-, influenza, and herpesvirues; results are pending interpretation and approval by government partners for release.

Finally, 697 Deep Forest samples from 411 animals were screened for filo-, corona-, paramyxo-, influenza, herpes-, hanta-, and arenaviruses; results are pending and will be shared with government partners for approval.

Workforce Development Action Package

Strengthening the One Health Workforce

PREDICT provided refresher training on safe capture, handling, and sampling of wildlife for zoonotic disease surveillance to a Malaysian Wildlife Rescue Unit (WRU) ranger.

PREDICT also trained a masters student from the Biotechnology Research Institute, UMS on molecular techniques and viral detection protocols this year. Following training, the student joined the PREDICT team in September as a project laboratory technician.

Additional trainings are covered above under Lab Strengthening Systems.

Traning Summary

A total of **43 individuals** (37 men and 6 women), including 40 governmental personnel have been trained **in Sabah, Malaysia** since the start of PREDICT-2 activities in 2014. A number of individuals completed trainings in more than one subject.

Training Events by Topic (Sabah, Malaysia)*

Topic	Total Trainings	# Trainings by Government Personnel	# Trainings by Women	# Trainings by PREDICT staff	# Trainings by Students
Avian Sampling	1		1	1	
Basic Laboratory Safety	37	35	3	2	
Bat Sampling	1		1	1	
Biosafety and PPE	38	36	3	2	
Bushmeat Sampling	1		1	1	
CITI Biomedical Research	1		1	1	
CITI Social Behavioral	1		1	1	
Emergency Preparedness	2		2	2	
Human Biological Sampling	1		1	1	
Implementing Cold Chain for Safe Sample Transport	1		1	1	
Livestock Sampling	1		1	1	
Non-Human Primate Sampling	2	1	1	1	
Other	39	37	5		
Packing and Shipping Biological Samples	1		1	1	
Policies and Plans	1		1	1	
Qualitative Research and Data Collection	1		1	1	
Rodent Sampling	1		1	1	
Safe Animal Capture and Sampling	33	32	2	1	
Safe Sample Transport and Storage	35	35	1		
Small Carnivore Sampling	4	3	1	1	
Total	**202**	**179**	**30**	**21**	**0**

*Some individuals were cross-trained in multiple topics. Individuals may be represented in multiple rows per column and multiple columns.

Other Activities this Period

- The team hosted a journalist from a British independent newspaper in the field (October 4-6, 2016), resulting in two articles describing PREDICT and the Deep Forest project and featuring novel viruses found in Sabah.
- PREDICT's country coordinator, lab manager, and field manger were interviewed by RTM 1 about the project, Deep Forest, and collaboration with Malaysian Government to build capacity for zoonotic disease surveillance. The program is scheduled to air in late 2016 or early 2017.

USAID | PREDICT
FROM THE AMERICAN PEOPLE

Global Health Security Agenda

SUPPORTING THE GLOBAL HEALTH SECURITY AGENDA IN THAILAND

Zoonotic Disease: Through the GHSA, Thailand has the opportunity to build on previous achievements by working to strengthen multisectoral coordination across animal and human health sectors for improved zoonotic disease surveillance. This year, **PREDICT provided sample collection and lab support to government partners during an investigation into a bat die-off event.** PREDICT also worked with government and FAO partners to coordinate and **launch joint surveillance of wildlife and livestock populations** at high-risk interfaces for disease transmission, collecting 159 samples from macaques and 394 samples from pigs (through FAO's collaboration with the Department of Livestock Development). PREDICT also continued to sample wildlife at key pathways for zoonotic disease emergence, **collecting samples from 301 bats (with an additional 50 non-invasive bat specimens) and 56 rodents**. Samples continue to be tested for 10 viral families at the project lab, a key national and regional resource for viral detection and discovery.

Measuring bat body length and collecting a swab sample from a Lyle's flying foxes (Pteropus lylei) during triangulated wildlife-domestic animal surveillance in Chonburi Province. Photos: PREDICT/Thailand

Lab Strengthening Systems: PREDICT is working to directly strengthen capacity for detection of priority zoonotic disease threats in animal and human laboratories and to contribute to operationalization of a One Health laboratory network in Thailand by fostering communication and coordination between human and animal partner laboratory facilities and ministries. **This year, PREDICT's laboratory**, the WHO Collaborating Centre for Research and Training on Viral Zoonoses at Chulalongkorn University **provided critical viral detection support during multiple events of public health concern, including confirming cases of MERS-Coronavirus, supporting Zika virus surveillance, and by investigating a suspected Ebola case**. In addition, **lab staff continued to provide training opportunities for national lab staff both in Thailand and in the Asia region,**

helping to advance laboratory networks and improve global health security through advances in viral detection.

Workforce Development: A well-trained and equipped workforce is critical for health security and for emergency and disaster management and response. PREDICT investments are making an impact on Thailand's One Health workforce though the provision of in-service training to health professionals in the human and animal health sectors from the district to national levels. To date, **27 individuals have received training** in Thailand with PREDICT providing a number of training opportunities this year, including **core trainings for project staff, biosafety and zoonotic disease surveillance training for government staff**, **and viral detection training for national lab staff in Thailand and the Asia region**.

Additional details and highlights from PREDICT's 2015-2016 activities in Thailand are provided below and linked to corresponding GHSA Road Map Action Packages. *As a Phase 2 GHSA country, the Road Map for Thailand with specific milestones has not been publicly released.*

Zoonotic Disease Action Package

Surveillance for Priority Zoonotic Diseases and Pathogens

In partnership with the Department of National Parks, Wildlife and Plant Conservation (DNP), PREDICT investigated the cause of death of more than 1,000 bats in Kanchanaburi Province, (November 2015). As part of the investigation, the team sampled more than 53 bats in the field and tested the samples for the presence of RNA from six viral families at the project laboratory including corona-, paramyxo, influenza, lyssa-, rhabdo-, and filoviruses (additional funding for laboratory assays was provided by FAO). Seven coronaviruses in fecal samples and four paramyxoviruses in urine specimens were identified; these results were confirmed by genetic sequencing. There is no evidence at this time to suggest these viruses pose a threat to human health or caused the bat die-off. All results were reported to government partners as part of the surveillance and outbreak investigation. It was concluded that the mortality event was likely due to weather (flooding within the cave) and not a viral pathogen.

PREDICT collected samples from a total of 199 bats along the land conversion pathway including 99 bats from Khao Chakan, Sa Kaeo Province and 100 bats from Pha-Ya cave, Loei Province. Samples were also collected from 56 rodents in Loei Province. All samples will be tested in-country at the project laboratory (the WHO Collaborating Centre for Research and Training on Viral Zoonoses Laboratory, Chulalongkorn University Lab).

Also this year, PREDICT collected samples from 102 *Pteropus lylei* bats from Wat Luang Temple, Chonburi Province along the intensifying of animal production systems pathway.

PREDICT coordinated with FAO, the Department of Livestock Development (DLD), and DNP partners during a meeting at the USAID/RDMA office in Thailand (March 4, 2006) and developed action plans for triangulated surveillance of livestock, wildlife, and human populations. Partners agreed to focus surveillance activities on two provinces in the central region of Thailand for coordinated sampling, which will be conducted three times per year. The first joint sampling activity took place in May 2016 where PREDICT collected samples from 159 macaques in Chonburi Province. In collaboration with FAO, DLD also collected samples from a total of 394 pigs. Bat and macaque samples were transferred to the project lab for viral testing, while pig samples are planned for testing at the National Institute of Animal Health laboratory.

In preparation for launch of human surveillance activities in 2017, PREDICT submitted proposals for ethical clearance to the Chulalongkorn University Institutional Review Board and Loei hospital committee, both of which approved the protocol. Project staff have developed plans for trainings and enrollment of patients.

Multisectoral Coordination to Support Mechanisms for Responding to Zoonotic Diseases

- PREDICT assisted the Government of Thailand in Zika virus readiness measures by participating in the National Zika Virus Preparedness and Response Meeting at the MOPH in Nonthaburi, Thailand (January 2016).
- Also this year, PREDICT contributed expertise to a workshop in Nonthaburi (February 2016) held to conceptualize and prepare the action plan for coordinated One Health activities in Thailand. Eight organizations, including MOPH, Ministry of Agriculture and Cooperatives, Ministry of Natural Resources and Development, Ministry of Education, Ministry of Social Development and Human Security, Ministry of Interior, Ministry of Labor, and the Thai Red Cross Society, ultimately agreed to collaborations under a conceptual and functional One Health umbrella. On January 27, 2016, PREDICT's country coordinator participated in the One Health Memorandum of Understanding (MOU) signing ceremony at the Prince Mahidol Award Conference.

PREDICT/Thailand's country coordinator (seated, far left) at the One Health MOU signing ceremony in Bangkok (January 2016). Photo: PREDICT/Thailand

The PREDICT team provided technical knowledge and expertise to government partners and other national stakeholders multiple times this year through workshops, meetings, and seminars. Notable contributions are provided in brief below.

- Presentation on “Surveillance for Encephalitis” at Thailand Partners’ Meeting in Nonthaburi and at the National Epidemiology Meeting in Khon Kaen (December 2015).
- Presentation on “How to collect the human specimens for rabies diagnostics?” at the National Rabies Meeting in Bangkok (December 2015).
- Presentation at the “Emerging and re-emerging diseases: from experiences towards future preparedness” seminar on The Viral Lab Network for EID Preparedness, organized by the Ministry of Science and Technology, Bangkok (March 2016).
- Presentation on “Bat Ecology and Emerging Infectious Diseases’ at the Thai Department of National Parks, Wildlife, and Plant Conservation’s Protected Area Committee meeting (March 7, 2016). In addition to the presentation, PREDICT provided guidance on how to reduce the risk of infection by bat pathogens. Attendees included monks, a local municipal president, local administrative officers, teachers, DNP staff, and bat guano miners.
- Contributions to the Identification of One Health Core Competencies of the Current Workforce Workshop, organized by the Thailand One Health University Network (March 23-25, 2016).
- Presentation on success stories of PREDICT’s first five years (2009-2014) in Thailand, including novel coronavirus discovery and support to the Thai government on active pathogen surveillance in macaques, along with an overview of the scope of PREDICT-2 activities under the One Health concept at the Indo-U.S. Workshop on Building Regional Capacity to Tackle Challenges of Emerging Infections and Global Health Safety, organized by United States National Academy of Sciences in Seychelles (May 2016).
- Presentation on “Emerging Infectious Diseases from Bats” at the Prevention of Vector Borne and Infectious Diseases Workshop, organized by the Department of Medical Science in Chonburi (June 2016).

Lab Strengthening Systems Action Package

Laboratory Testing for Detection of Priority Diseases

At the request of the Thai Ministry of Public Health (MOPH), PREDICT provided technical assistance for viral detection for a number of noteworthy infectious disease investigations this year. In January and February, through work at the project’s Chulalongkorn University lab, PREDICT confirmed the second imported human case of MERS-CoV in Thailand. More than 200 subsequent specimens from the index case and contact persons were tested, but there was no evidence of secondary infection from this patient. In addition, the MOPH engaged to confirm the third imported MERS-CoV human case in Thailand. More than 100 specimens from index cases and contact persons were tested and again there was no evidence of secondary infection from this patient. In March 2016, the project lab was called upon by the MOPH to assist by testing patient specimens from a region of the country where Zika virus cases had been detected. PREDICT obtained Zika viral sequences to facilitate confirmation of laboratory results and to allow genetic characterization for strain identification. The project lab conducted whole genome sequencing of Zika virus from patient specimens using Next Generation Sequencing. Also in March, PREDICT supported the MOPH by analyzing laboratory samples from a patient from a high-risk country under investigation for Ebola virus infection; test results were negative. Finally, PREDICT tested specimens from patients with Dengue-like illness at the request of MOPH using the PREDICT flavivirus PCR protocol to identify the cause of infection.

As part of ongoing efforts providing technical expertise to national and regional laboratory capacity system strengthening, PREDICT/Thailand participated in the International Training Workshop on Laboratory Diagnosis for Zika, organized by Taiwan CDC in collaboration with US-CDC in Taipei, Taiwan (April 13-15). At the meeting, PREDICT shared its experience with Zika virus detection using real-time PCR.

In addition, the PREDICT/Thailand team jointly conducted a “Regional workshop on utilization and harmonization of PREDICT protocols in the animal health sector” with FAO in Bangkok. The hands-on training in PREDICT PCR assays was held at Chulalongkorn University Lab (May 17, 2016), with participants from government and academic livestock disease laboratories from around the region, including national lab staff from multiple GHSA member countries. Twelve participants from animal sector labs (Laos, Thailand, Cambodia, Nepal, Bangladesh, Indonesia, and Viet Nam) and new PREDICT partners (Mongolia and India) were trained on project viral detection protocols. During the workshop PREDICT/Thailand team members also shared their expertise in sample collection methods and ways to optimize assays.

PREDICT and FAO during hands-on training for the use of viral detection protocols at Chulalongkorn University. This training provided hands-on experience for animal laboratory technicians from nine countries.
Photo: PREDICT/Thailand

Project lab staff continued work to advance viral characterization capabilities in-country and to further characterize viral findings from the first phase of the project (2009-2014). Seven bat fecal samples that previously tested positive for coronavirus were tested using PCR and high-throughput sequencing to sequence the entire coronavirus spike gene.

This year, the project lab continued to test wildlife samples for known and emerging viral threats. A total of 99 rectal swab samples collected from bats at

Khao Chakan in Sa Kaeo Province were tested for coronaviruses; results are pending approval for public release.

In addition, the lab tested samples collected from 102 *Pteropus lylei* bats at Wat Luang Temple in Chonburi Province for paramyxoviruses (oral swabs), corona- and influenza viruses (rectal swabs), filoviruses and flavivirus (plasma), and specific PCR for Nipah virus (oral swabs). All results are pending approval for public release.

Also this year, the lab tested 50 pooled urine samples collected from *Pteropus lylei* bats at Wat Luang Temple in Chonburi Province for paramyxoviruses and for Nipah virus; results are pending approval for public release.

Project lab staff tested samples collected from 100 bats at Pha-Ya cave in Loei Province at Chulalongkorn University Lab for corona- and Influenza viruses (rectal swab and feces) and paramyxo-, filo-, and flaviviruses (whole blood); results are pending confirmatory sequencing and approval for public release.

In addition, the lab tested samples collected from 159 macaques at Royal Thai Marine Corps in Chonburi Province for herpes-, influenza, and coronaviruses (148 oral swabs), and paramyxo-, flavi-, and filoviruses (156 serum specimens). Results are being confirmed and will be shared with government partners for public release.

Finally, the lab tested 33 archived cerebrospinal fluid specimens from human patients with encephalitic symptoms and history of animal contact (collected by MOPH during 2015-2016). Results are pending approval for public release.

This year, PREDICT's country coordinator and lab team provided expertise and technical assistance during multiple international and national-level workshops and meetings helping to expand the knowledge base for viral detection in Thailand and the greater Southeast Asia region. Notable contributions are included below.

- Presentation at the "Workplan of a three-year project on Lab Network" at the National EID Knowledge Management and Research Development Meeting in Bangkok (February 2016) to advocate for the use of PREDICT viral family protocols as tools for capacity building for viral detection and discovery.
- Presentation "Molecular diagnosis of viral infections" at the From Fundamental Virology to Emerging Viral Diseases Workshop, organized by the Thai Virology Association in Bangkok (April 2016).
- Presentation on "Next-generation sequencing (NGS) of the spike gene of bat coronaviruses from biological samples" at the Pathogen Identification Regional Meeting hosted by the US Army Medical Directorate's Armed Forces Research Institute of Medical Sciences in Bangkok (April 2016).
- Presentation "Rabies laboratory diagnosis" at the One Health Network Capacity Strengthening for Rabies and Leptospirosis Control Workshop, organized by Department of Diseases Control in Songkhla. (June 2016)
- Presentation "Laboratory diagnosis of Zika infection: The role of medical technologist" at the Case Conference in Medical Technology and Laboratory Diagnosis", organized by Chiangmai University in Chiangmai (July 2016).

- Presentation "Laboratory diagnosis for Encephalitis" at the Achievement from Laboratory Surveillance Project Workshop in Chonburi, organized by Department of Diseases Control in Chonburi (July 2016).
- Presentation "Laboratory diagnosis of Zika virus infection" at the Chulalongkorn Medical Congress 2016 in Bangkok, organized by the Faculty of Medicine, Chulalongkorn University (August 2016).
- Presentation "Laboratory diagnosis of rabies virus infection" at the Workshop on Rabies Control and Prevention at the Special Economic Province in Chiang Rai Province, organized by Department of Diseases Control, MOPH. (August 2016)

Workforce Development Action Package

Strengthening the One Health Workforce

This year, all PREDICT staff completed core trainings for safe conduct of project activities, including topics in ethics, biosafety, safe animal capture and sampling, safe sample transport and storage, laboratory safety, and viral detection. In addition, PREDICT conducted biosafety training in bat and rodent sampling for local government staff from the DNP who will be working alongside PREDICT staff in Loei Province. Finally, PREDICT/Thailand made significant contributions to improving the capabilities of the national laboratory system in Thailand and the greater Asia region, hosting workshops (with FAO partners) in viral detection methods and through numerous in-country events detailed above.

Conducting training in biosafety, bat, and rodent sampling for collaborating DNP staff in Loei Province (July 18, 2016). Photo: PREDICT/Thailand

Training Summary

A total of **27** individuals, including three men, eight women, and 16 individuals of undeclared gender, have been trained in Thailand since the start of PREDICT-2 activities in 2014. A number of individuals completed trainings in more than one subject.

Training Events by Topic*

Topic	Total Trainings	# Trainings by Government Personnel	# Trainings by Women	# Trainings by PREDICT staff	# Trainings by Students
Avian Sampling	1		1		
Basic Laboratory Safety	22		4	5	
Bat Sampling	17		9	12	
Biosafety and PPE	32		11	14	
Bushmeat Sampling	1		1		
Emergency Preparedness	22		4	5	
Implementing Cold Chain for Safe Sample Transport	22		4	5	
Non-Human Primate Sampling	2		1	1	
Packing and Shipping Biological Samples	22		4	5	
Qualitative Research and Data Collection	4		2	1	
Rodent Sampling	16		2	3	
Safe Animal Capture and Sampling	28		9	12	
Small Carnivore Sampling	1		1		
Total	**190**	**0**	**53**	**63**	**0**

*Some individuals were cross-trained in multiple topics. Individuals may be represented in multiple rows per column and multiple columns.

Other Activities*:*

- Published an article in the journal *Emerging Infectious Diseases* (December 2015) entitled “Surveillance for Ebola Virus in Wildlife, Thailand” (See Section 5 – Publication Summaries).
- Presented “Surveillance of novel emerging infectious diseases and unknowns: Is region prepared for novel EIDs and unknowns?” at the 2015 Regional Animal Health Laboratory Technical Advisory Group Meeting, organized by FAO in Chiang Mai, Thailand.
- Presented at the Joint International Tropical Medicine Meeting 2015 Conference in Bangkok (December) on “Surveillance for and Diversity of Coronaviruses in Bats from Eastern Thailand.”

II. COOPERATIVE AGREEMENT GLOBAL INFORMATION

COOPERATIVE AGREEMENT GLOBAL INFORMATION

Objective 1. Managing and Coordinating Operations

Establish and maintain collaborative and adaptive management of program operations and ensure compliance with agency policies and procedures.

- Successfully organized and held the first PREDICT-2 All-Country Meeting (February 2-4, 2016) with participants from 26 project countries and representatives from USAID and the United Nations Food and Agriculture Organization (FAO). The three-day meeting brought together global and in-country project staff for presentations, training, and workshops covering a number of topics including best practices for implementation and rollout of surveillance and behavioral risk characterization activities. The meeting also provided a forum to coordinate global planning and implementation for the upcoming years along with opportunities for country coordinators and key personnel from around the world to network, resulting in a number of regional initiatives and plans for surveillance and capacity strengthening.
- Fully-executed subawards with domestic and international partners for engagement in Bangladesh, China, Cote d'Ivoire, Egypt, Ethiopia, Ghana, Jordan, Kenya, Liberia, Sierra Leone, and Tanzania and continued subaward approval processes with partners in multiple new and existing countries.
- Completed a subaward with Oxford University collaborators to enable an investigation of select Zika virus cases in Brazil using next generation sequencing and phylogenetic and molecular clock analyses. This work led to a publication in the journal *Science* (See Section 5 – Publication Summaries).
- Provided subawardees guidance on administration and ensured compliance with all federal guidelines and regulations.
- Held technical working meetings with EPT-2 partners in October and December 2015, including representatives from USAID, FAO, One Health Workforce (OHW), and Preparedness & Response (P&R) to establish a Monitoring & Evaluation (M&E) working group and draft the EPT-2 M&E framework and indicators.
- Continued to participate in regular monthly calls with the M&E working group on planning and coordination.
- Attended M&E working group meetings in Rome, Italy in April 2016 to refine draft indicators.
- Worked collaboratively with the M&E working group to develop Project Indicator Reference Sheets (PIRS) to contextualize M&E indicators and targets, define key terms, identify data sources available for tracking, and set timelines for reporting.
- Developed project-specific M&E indicators, tracking, and reporting plans.
- Continued managing and facilitating international travel approvals and authorizations with domestic and international partners.

- Shared travel calendar with EPT-2 partners to improve coordination.
- Maintained global and in-country staff contact information spreadsheet to facilitate communication and coordination among EPT-2 partners at all levels and updated and maintained the EPT-2 partner contact list with input from FAO, OHW, and P&R.
- Submitted equipment approval requests for surveillance activities in Cambodia, Democratic Republic of Congo, Indonesia, Jordan, Lao PDR, Liberia, Republic of Congo, Sierra Leone, and Thailand.
- Worked with implementing partners and USAID on solutions to Value Added Tax (VAT) exemptions.
- Maintained communications among Management Team and Executive Board members and facilitated information flows with operational teams and implementing partners.
- Responded to all requests for information and reports from USAID Emerging Threats Division (ETD), USAID Missions, and EPT-2 and GHSA partners.
- Maintained Environmental Management and Monitoring Plans and reporting obligations with all consortium and implementing partners.
- Developed and submitted monthly and quarterly Global Health Security Agenda (GHSA) technical reports, and shared financial reports, quarterly accruals, and responses to all information requests on budgets and finances.
- Completed and updated country implementation plans (CIPs) to provide ETD and Mission staff additional tools to facilitate improved EPT-2 operational planning and coordination.
- At request of ETD and select Missions, maintained monthly briefings on project progress and upcoming plans and customized communications to suit USAID needs.
- Considered and responded to all coordination concerns from USAID, FAO, WHO, and other partners and stakeholders; adapted workplans as appropriate, in particular the 2016-2017 workplans for GHSA Phase 1 countries.
- Held consultations with all country partners on human subjects research to facilitate in-country ethical committee applications and approvals at local and global levels and secured approvals for conduct of human subjects research in nine countries (see 2.1 below for details).
- Developed procedures and guidelines to ensure compliance among all sites engaged in human subjects research at local and global levels.
- Completed annual renewal and reporting on behavioral risk activities to the UC Davis Institutional Review Board.
- Consolidated animal sampling data from all countries actively conducting wildlife and/or domestic animal surveillance activities and produced reports for UC Davis Institutional Animal Care and Use Committee's (IACUC) Animal Tracking System.
- Refined project communications strategy, updated project website (http://predict.global), and launched new social media platforms on Twitter

(@predictproject) and Research Gate (https://www.researchgate.net/project/USAID-PREDICT-Project).

Objective 2: Characterizing Biological and Ecological Risk

Identify the biological and ecological drivers and host-pathogen dynamics at high-risk interfaces within three critical pathways of disease emergence and spread in Asia and Africa.

Activity 2.1. Targeted monitoring for zoonotic viruses with pandemic potential at specific high-risk interfaces

- Held biweekly consortium-wide surveillance calls with operational leads and regional surveillance leads to provide support for standardized surveillance operations across Asia and Africa and received regular updates on activities in all 31 countries.
- Presented overall surveillance strategy and guidelines for targeting risk-based human and animal surveillance activities to detect viral sharing across species at the PREDICT All-Country Meeting. Held regional breakout sessions on operationalizing surveillance with regional leads and partners to encourage cross-border coordination, shared surveillance targets, and activities along common epizones.
- Developed and shared details on country-specific surveillance activities, locations, in-country partnerships, and upcoming plans for all countries in preparation for regional meetings and EPT-2 Summer Jams in East Africa, West Africa, and Asia.
- Presented plans for surveillance activities and shared surveillance strategy at USAID regional meetings (including Summer Jams in East Africa, West Africa, and Asia) and country-level partner planning meetings.
- Refined and optimized surveillance data collection strategy and tools for risk characterization based on field application and in-country feedback including: 1) site and event characterization with data on animal-human contact, landscape change, and animal and human host ecology; 2) animal information with data on animal contact with people and condition at sampling; 3) sample data, including sample type and condition; and 4) human questionnaire data, including information on occupations, travel, medical history, and animal contact to be collected along with human biological samples.
- Engaged with FAO and WHO counterparts on surveillance coordination, both broadly in EPT-2 partner meetings and via regional and local meetings, including FAO rollout meetings in Africa, to develop opportunities for collaboration, plan systematic and standardized data collection, and synchronize surveillance activities across wildlife, livestock, and humans.
- Communicated with local Ministries, in partnership with FAO where appropriate, to prioritize site and animal targets along high-risk disease emergence pathways and to coordinate joint surveillance activities and reporting frameworks for surveillance data and policy development.

- Shared surveillance plans and protocols with FAO and other EPT-2 partners to enhance collaboration, including PREDICT's strategy for targeting high-priority disease emergence pathways, sites for concurrent sampling, and high-risk taxa for focused surveillance activities, as well as diagnostic testing plans and designated laboratories in 31 countries.
- As a proof-of-concept for integrating longitudinal surveillance of viruses beyond influenza into existing human and animal surveillance systems coordinated by WHO and FAO, participated in development of a pilot program Longitudinal Influenza Surveillance Network (LISN) in Viet Nam. Planning is ongoing for coordinated surveillance at existing WHO-SARI site(s) and areas with intensive animal production and animal value chain, including wildlife farms. Held preliminary coordination meetings to discuss potential for implementation of LISN in China.
- Added flaviviruses to surveillance strategy wherever feasible as an additional target viral family to inform on potential new animal hosts of Zika and other related viruses with focus on several target host species.
- Developed a filovirus targeted surveillance strategy and initiated sampling activities to investigate reservoir and spillover hosts in post outbreak areas in the three countries most affected by the West Africa Ebola outbreak (Guinea, Liberia, and Sierra Leone).
- Established a strategy for concurrent sampling to detect anti-microbial resistance (AMR) patterns shared between humans and animals in Nepal as a pilot for coordinated surveillance.
- Developed a comprehensive protocol and received approval from the University of California, Davis Institutional Review Board (IRB) for human subjects research in all countries and sites under a Master Protocol; this global approval enabled country teams to prepare ethical clearance applications for approval at the country level.
- Completed translations of IRB research protocols and questionnaires for submission to in-country regulatory agencies; to date protocol materials and questionnaires have been translated into six languages.
- To date, nine countries have received in-country ethical board approval for human biological and behavioral surveillance, including Cambodia, China, Democratic Republic of Congo, Egypt, Ghana, Nepal, Rwanda, Uganda, and Tanzania. Drafted and shared our first comprehensive human syndromic surveillance guide and human sampling protocol, detailing the collection of biological samples and behavioral risk characterization for patients in clinics and hospitals.
- Developed a new Institutional Animal Care and Use Committee (IACUC) protocol for safe and ethical animal sampling activities to integrate consortium partner activities in all countries under a single protocol and to update all methods and procedures to better align with PREDICT-2 surveillance plans and targets; received approval from the UC Davis IACUC in April.
- Maintained or renewed national and local permits for wildlife sampling.

- Implemented plans for longitudinal and concurrent surveillance at highest priority sites targeting sampling opportunities for wildlife in contact with people and livestock, livestock in contact with people (coordinated with FAO as appropriate), humans at high occupational risk for zoonotic spillover at sites where wildlife and livestock were proposed for sampling, and humans presenting with undiagnosed syndromes at collaborating clinics/hospitals.
- Specifically, we initiated:
  1) Wildlife sampling activities targeting high-risk wildlife taxa in 25 countries (Bangladesh, Cambodia, Cameroon, China, DRC, Egypt, Ethiopia, Ghana, Guinea, Indonesia, Jordan, Kenya, Lao PDR, Liberia, Malaysia, Mongolia, Myanmar, Nepal, RoC, Rwanda, Sierra Leone, Tanzania, Thailand, Uganda, Viet Nam).
  2) Domestic animal and livestock sampling activities in six countries: Bangladesh, Jordan (with FAO), Kenya, Malaysia, Sierra Leone, and Uganda.
  4) Concurrent wildlife and livestock sampling at sites with FAO partners in seven countries: Cambodia, Egypt, Guinea, Lao, Indonesia, Thailand, and Viet Nam.
- 3) Human biological sampling and surveys using PREDICT's human questionnaire in three countries: Cambodia, Egypt, and Nepal. Updated table for tracking surveillance, behavioral risk, and laboratory testing activities and shared with USAID Management Team on a monthly or as needed basis.

Activity 2.2. Characterizing Risk

- Conducted weekly Modeling and Analytics (M&A) staff meetings to address ongoing analyses and prioritize activities and overarching goals.
- Held monthly PREDICT-wide M&A team conference calls to prioritize project-wide analyses.
- Established standardized template and online distribution platform for PREDICT "Emerging Disease Insights" short reports to highlight and summarize new analyses from the M&A team (See Section 6 - Featured Products)
- Finalized and distributed five "Emerging Disease Insights", including: MERS-CoV Surveillance in Africa; Distribution and Seasonality of Potential Bat Ebola Reservoirs; Market Size and Avian Influenza Strain Spillover Risk; Simulating Outbreak Scenarios: Novel Bat Coronavirus from Guano Harvest; and Mapping Hotspots of Emerging Diseases (See Section 6 - Featured Products).
- Hosted a Modeling & Analytics Workshop at the PREDICT All-Country Meeting to open communication and identify in-country avenues for M&A support (new analyses, available datasets, and potential collaborations or training opportunities).
- Established PREDICTmodeling@ecohealthalliance.org email point of contact to streamline communication with in-country partners and partnering organizations (FAO and P&R).

- Continued to coordinate EPT-2 related risk modeling with FAO; including during June 28-30, 2016 "Working meeting on risk modeling and assessment" in Rome.
- Finalized database of all known mammal virus-host association; paper in review and data will be made publicly available online early in 2016-2017.
- Revised analysis of host and viral traits to predict the number of total zoonotic viruses in mammals and developed maps of the predicted distribution 'missing viruses' and 'missing zoonoses' in wild mammal species to guide surveillance (Figure 1).

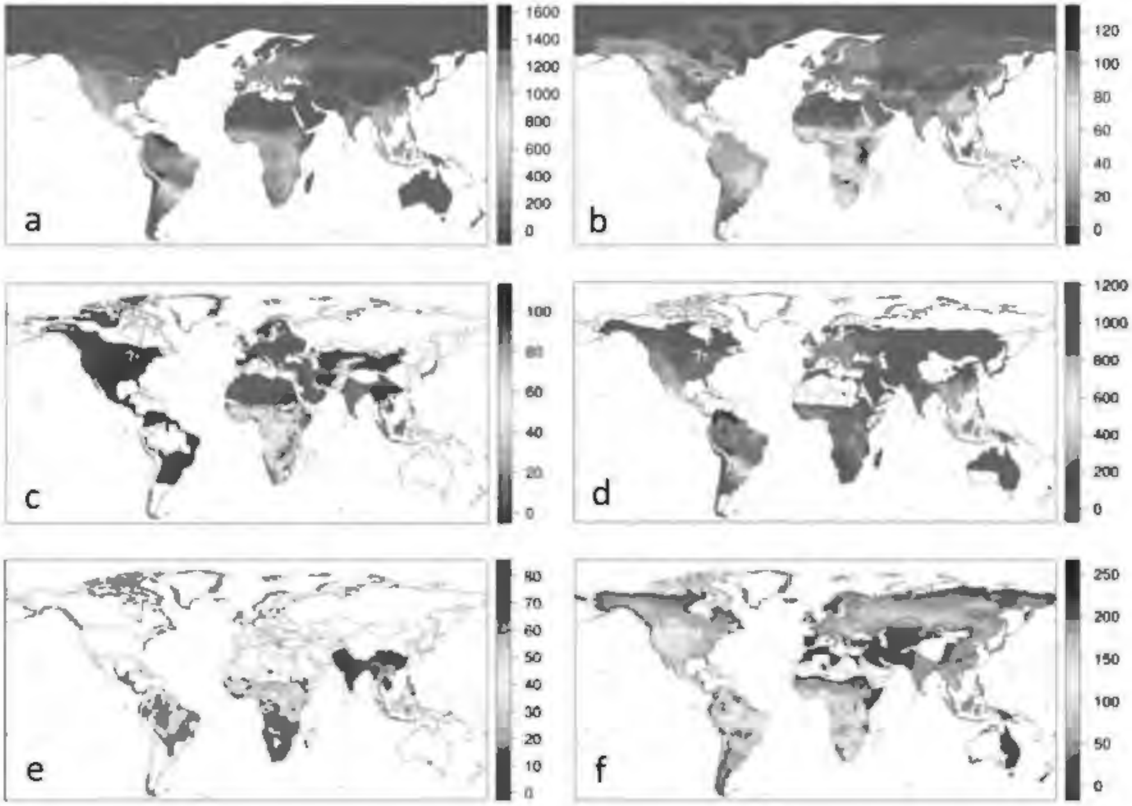


Figure 1. Global distribution of the predicted number of 'missing zoonoses' for **a)** all wild mammals (n=584 spp.), **b)** carnivores (Order Carnivora, n=55), **c)** even-toed ungulates (Order Cetartiodactyla, n=70), **d)** bats (Order Chiroptera, n=157), **e)** primates (Order Primates, n=73), and **f)** rodents (Order Rodentia, n=183). Warmer colors highlight areas predicted to be of greatest value for discovering novel zoonotic viruses. (Olival et al. *In Review*).

- Developed preliminary susceptible-infected-recovered (SIR) model to assess seasonality of bat viral shedding, and tested with field data from Nipah virus and Ebola virus serology in Bangladesh.
- Developed SIR model, parameterized with data from literature, to assess MERS-CoV dynamics in camel populations; shared model framework with FAO (Figure 2).

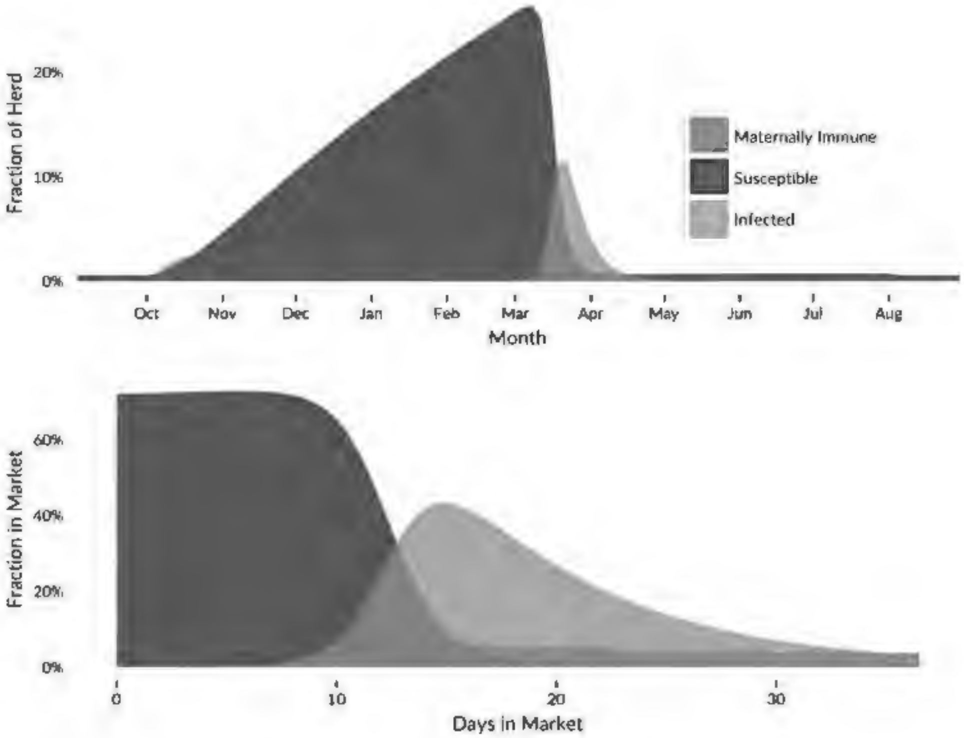


Figure 2. Model of MERS-CoV dynamics in a camel herd. Indicates that the fraction of juveniles infected with MERS will spike shortly after the calving season (Oct-Feb, top), when enough naive juveniles have been born to cause small epidemics within herds. These dynamics are highly sensitive to herd size, however, and will vary depending on husbandry practices. When young camels are brought to market (bottom), the high proportion of susceptibles in this group can lead to large, fast outbreaks and many infectious camels. These dynamics are sensitive to the age of camels brought to market and the time of year.

- Refined framework to conduct ‘hotspots’ analysis with emerging antimicrobial resistance events and identify drivers for these EIDs; analysis ongoing.
- Finalized and submitted manuscript for Hotspots II model of wildlife-origin zoonotic EIDs, Allen et al. "Global Correlates of Emerging Zoonoses." Updates to the model include a natural language processing tool to correct for research bias globally and improved machine learning and resampling methodologies to quantify uncertainty in the model. (Figure 3).

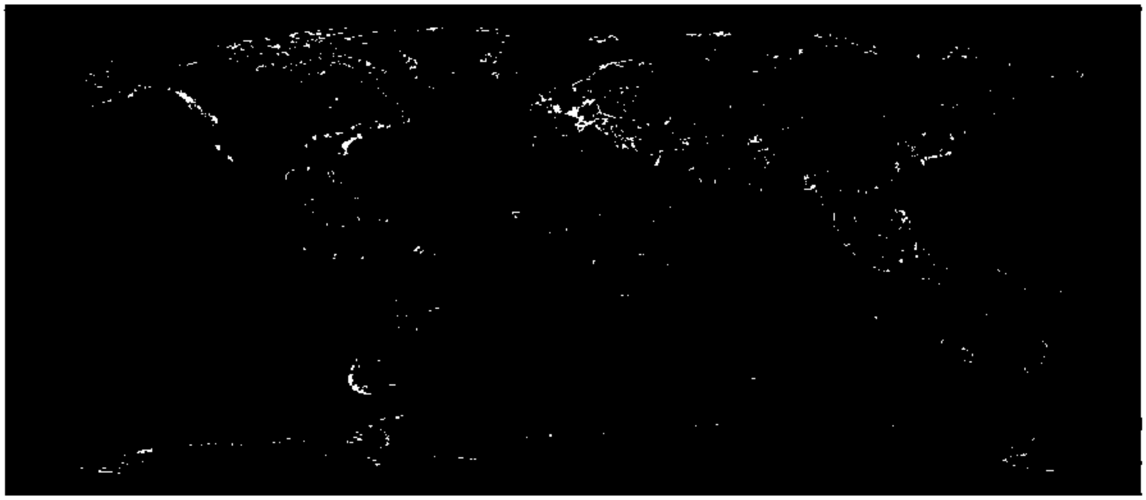


Figure 3. Global distribution of disease reporting effort with a correction for human population density (PubCrawler). This spatial layer was used to more accurately correct for bias in the Hotspots II model. (Allen et al. *In Review*).

- Completed analysis on the biogeography of human infectious diseases; results show that human diseases present similar biogeographic clusters at global scale, reminiscent of zoogeographic patterns.
- Continued biodiversity analysis of Deep Forest data and combined Deep Forest testing results data for analysis to understand change in host and virus communities across a land use gradient.
- Identified, compiled, and developed temporal and spatial datasets on land use change; ecological, socioeconomic, and other demographic changes; and climate variability to apply to disease and epizone maps; and used GIDEON human outbreak data in global map of biogeographic patterns in viral EID epizones (EIDR).
- Collated global datasets on wildlife populations; livestock production systems; livestock antimicrobial use; wild animal farming, market, and value chains; and human health infrastructure to inform modeling of animal value chain and animal production disease pathways.
- Continued geospatial modeling for the Africa Sustainable Livestock 2050 (ASL 2050). Specifically, local and global regressions are being used to identify underlying EID drivers for different biogeographic regions and continents; results will then be used to model hotspots of disease emergence with a focus on Africa (Ethiopia specifically).
- Initiated dynamic modeling analyses for ASL 2050 and developed the first version of a dynamic simulation model to examine the role of livestock intensification on disease emergence in the African context, to be parameterized with data being generated by FAO partners. Initial work has focused on Avian Influenza in chicken flocks and MERS-CoV in camel herds.

- Identified ecological, animal, and health capacity data available to model hypothesized drivers of AMR emergence and spread.
- Developed metrics and identified datasets needed to estimate host species range for zoonotic viruses and model outbreak parameters for spread of zoonotic viruses based on public health infrastructure, capacity, and governance indices.
- Developed a comprehensive database of mammal and bird hosts and known vectors for all recognized flaviviruses.
- Conducted phylogenetic and nucleotide selection analysis of flaviviruses using multiple genes to assess potential genetic markers of zoonotic potential.
- Updated database of all known avian viruses and the bird host species they infect.
- Completed phylogeographic analysis and species distribution modeling of *Pteropus* sp. from Bangladesh to better understand Nipah virus spread, evolution, and spillover risk.
- Conducted phylogenetic analysis of Beta- and Alpha-CoVs in China to better understand the spatio-temporal diffusion, evolution, and host switches of bat CoVs in China.
- Identified geographic areas in PREDICT countries at increased risk of zoonotic outbreak by mapping mammal biodiversity, *Anatidae* family waterfowl diversity, hotspot risk, and predicted missing zoonoses (Figure 4).

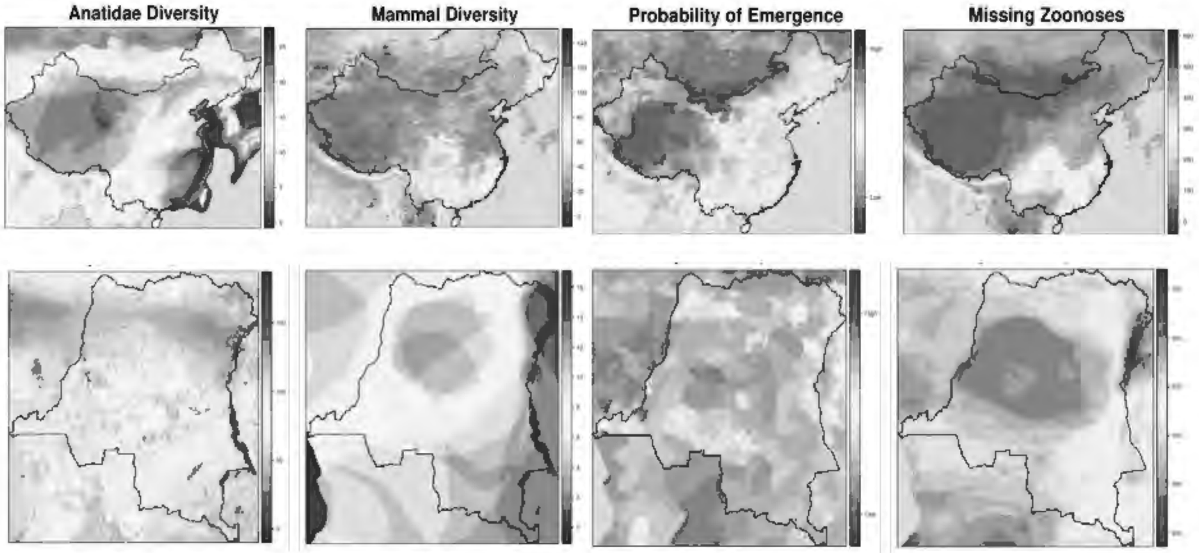


Figure 5. Output from spatial analyses to better understand viral diversity in China (top) and Democratic of Congo (bottom). High resolution analysis of these high diversity countries revealed that both mammalian biodiversity and missing zoonoses tended to be clustered in high density areas (e.g. Southwest China), suggesting potential targets for more efficient sample collection.

- Established datasets needed to estimate wild and domestic animal host species ranges, vectors, and transmission dynamics for yellow fever virus, Zika virus, and relevant flaviruses.
- Collaboratively developed datasets and transmission dynamics parameters to estimate the spread of MERS and other target zoonotic viruses based on public health infrastructure, health capacity, and governance indices.
- Initiated analyses to evaluate sampling effort across the spectrum of human-animal interfaces, anthropogenic activities at sites, and habitats at PREDICT-1 sites.

Activity 2.3. Viral detection and discovery and longitudinal monitoring of viruses to track changes in geographic and host distribution, genetic sequences, transmissibility, infectivity, and viral evolution

- Met monthly with Laboratory Implementation Team to provide guidance on laboratory partner selection and testing and to resolve problems to ensure consistency for sample handling, testing, and viral detection, as well as to provide feedback and new information to labs.
- Continued development of new cPCR assays including assays for filoviruses, flaviviruses orthobunyaviruses, arenaviruses and hantaviruses.
- Provided guidance to field and lab teams to prioritize samples for PREDICT-2 testing.
- Screened 6,396 archived wildlife samples (blood, rectal, oral) from Brazil for Zika virus, using the PREDICT consensus broadly reactive flavivirus genus assay and a Zika-specific real-time PCR assay. All samples tested by consensus PCR and specific real-time PCR were negative.
- Further characterized a MERS-like virus detected in a bat from Uganda. Completed full genome sequence, and results showed high sequence identity to MERS in many parts of the genome. Performed 3-D structural modeling of the spike protein to assess the likelihood of this virus using human DPP4 (the MERS receptor) for cell entry. Sequence variation in the spike (due to a recombination event) suggests reduced affinity for human DPP4 and low risk of zoonotic spillover. In-vitro experiments using a reverse-engineered infectious clone show that this MERS-like virus is of low risk to humans. Manuscript has been submitted for publication.
- Continued to complete full-genome sequences for PREDICT coronaviruses to: 1) understand their evolution and 2) develop primer sets for in-country PCR characterization of spike proteins.
- Completed study of the PREDICT-1 global coronavirus data and submitted the manuscript for publication.
- Began genome of sequencing of PREDICT-1 paramyxoviruses for further characterization.
- Begin finalizing influenza genomes from PREDICT-1 samples collected in Brazil, Bolivia, Tanzania, Uganda, and Vietnam.
- Began to interpret test result data as they were submitted to EIDITH.
- Started to develop a new strategy for test result interpretation to include input from the livestock and human health sectors.

- Furthered development of a protein and peptide-based ELISA assay to detect Ebola group and Ebola Zaire-specific antibodies for evaluation in animal samples (dogs, cats, pigs, bats, goats, rodents, and non-human primates).
- Tested samples from 175 bats from Liberia using the new cPCR filovirus assay and compared to three published Ebola Zaire-specific assays. All samples were negative.
- Started sequencing an Ebola host receptor (NPC1) from bats and using protein-binding assays to identify which species are likely to be hosts of Ebola.

Activity 2.4 Advancing pathogen characterization through refinement and development of new diagnostic tools and mainstreaming of testing protocols

- Completed deep sequencing of samples from 250 acute patients (FUO/ILI) from Bangladesh, data analysis is ongoing.
- Continued comparison of viral detection technologies used for testing samples, specifically comparing virus capture procedures with traditional unbiased high throughput sequencing approaches. Evaluating the performance of each of human and wildlife samples.
- Continued to compare flavivirus genus consensus PCR with a Zika virus-specific assay to begin to understand assay detection limits and capabilities.
- Continued to assess current global serologic capacity for Ebola virus antibody detection for input into PREDICT diagnostic development needs for analysis of samples from a wide range of potential animal hosts. Initiated discussions with FAO for coordinated effort in assay development and positive controls.
- Began development of a reverse genetics system for further characterization of paramyxoviruses to evaluate viral pathogenicity and host range.

Activity 2.5. Assisting host country partners in outbreaks

- Engaged EPT-2 partners, including WHO and FAO, at international and regional in-country meetings to build partnerships and increase synergies for outbreak response planning, preparedness, reporting, and data sharing.
- Engaged host country governments and relevant national ministries to provide guidance on PREDICT's availability for assistance in outbreak investigations and response activities during outbreaks with undiagnosed causes of illness in humans.
- Developed outbreak involvement guidance document containing guiding principles during outbreaks; roles, responsibilities, and activities during a disease outbreak, including an outbreak rapid report and response timeline; outbreak assistance checklist; in-country outbreak contact worksheets; and a decision tree outlining the chain of command for informing and reporting outbreaks to USAID and PREDICT leadership (See Section 6 – Featured Products).

- Shared global and in-country staff contact information with EPT-2 partners to facilitate communication and coordination in the event of an outbreak.
- Upon request from host country governments, assisted with outbreak investigations in six countries (Bangladesh, Cameroon, DRC, Mongolia, Rwanda, and Thailand) for ongoing preparedness and training purposes by providing expertise, and when appropriate field assistance for animal sampling.
- Tailored syndromic surveillance activities in Malaysia to assist with undiagnosed acute encephalitis cases in humans following request from the host country government.
- Participated in a yellow fever technical planning meeting with the Rwanda One Health Steering Committee (ROHSC) to discuss the current resurgence of yellow fever cases in East-central Africa and the preventive measures that can be put into place to minimize the spread of the disease and other vector-borne diseases (e.g., West Nile, dengue, chikungunya, and Zika viruses) into Rwanda.
- Conducted MERS and Zika diagnostic testing in humans in Thailand to assist with detection of imported diseases of international concern.
- In response to public health emergency associated with outbreak of Zika virus in Brazil, developed and implemented plan for additional testing of PREDICT-1 animal samples from Brazil for Zika virus to evaluate potential for Zika virus circulation in animal hosts prior to disease emergence in humans (see Section 2.3 above for description of results).
- In the Democratic Republic of Congo, facilitated laboratory diagnosis of samples from suspected cases of yellow fever and joint field investigation by teams from DRC government and US CDC at sites where suspected cases had been reported. Additionally, PREDICT enabled nationwide vaccination campaigns that were conducted in Kinshasa and in six other provinces and helped procure a new mobile laboratory that will be deployed for follow-up surveillance in the Haut-Katanga Province at the border with Angola.

Objective 3: Characterizing Behavioral Risk

Characterize contact among people, livestock, and potential wildlife reservoirs; investigate the correlation of human behavior and zoonotic disease risk to understand the behavioral mechanisms of high-risk pathways for disease emergence and spread; identify potential control points and behavior change targets.

Activity 3.1. Standardizing approaches to study human behavioral risk

- Conducted 425 ethnographic interviews and 32 focus groups with 273 individuals in seven countries (Bangladesh, Cameroon, China, DRC, Indonesia, Nepal, and Uganda).
- Prioritized additional countries for further behavioral risk investigations, likely in Viet Nam, Republic of Congo (ROC), Tanzania, Cote d'Ivoire, and

Laos and received approval for work in Viet Nam and Tanzania. IRB protocols for remaining countries are currently under review.

- Continued transcription and translation of qualitative data in all active countries; standardized methods for coding, expanded coding dictionary and added definitions for coding standardization across sites, and developed a qualitative database to facilitate analytics. Translated transcripts are being coded and site-specific results (when obtained) used to support and refine surveillance priorities and 2016-2017 behavioral strategy.
- Conducted preliminary data analysis on available qualitative observational field notes, focus group discussions, and ethnographic interviews from pilot sites.
- Continued qualitative data coding and structured analysis of zoonotic disease exposure, risk behavior, and significant attitudes and beliefs associated with highly-exposed risk behavior according to key risk pathways.
- Presented preliminary behavioral risk insights at the All-Country Meeting.
- Trained country behavioral teams in all IRB-approved countries in preparation for implementation of country behavioral work plan (See Section 4 – Overall Training Summary for details).
- Expanding on EPT-1 PREVENT research of longitudinal wildlife market conditions and practices in ROC and DRC, designed and launched (in DRC) additional behavioral risk investigations into the wildlife value chain to compliment evolving surveillance and sampling of hunted, traded, and consumed wildlife. Trained local DRC interviewers in behavioral data analysis.
- Completed preliminary analysis of Deep Forest Human Contact survey data to analyze relationships between land use change and human-animal contact from sites in Brazil, Malaysia, and Uganda.
- In coordination with consortium operational teams, continued planning and development of methods to integrate behavioral risk data collection into biological data collection protocols and training materials.
- Developed a distinct Ebola Host Project questionnaire for human handlers of wildlife and domestic animals to capture behavioral risk factors and practices pre- and post-Ebola (See Section 6 – Featured Products).

Objective 4: Improving Global Surveillance Networks

Strengthen internal data storage and sharing platforms to improve the ease of collection, synthesis, storage, access, and dissemination of relevant animal and human, spatially explicit epidemiological and ecological data.

Activity 4.1. Standardizing data collection

- Expanded the reach of PREDICT's hard-copy/paper-based Human Questionnaire Optical Mark Recognition (OMR) forms by translating the forms into six languages (French, Swahili, Indonesian Bahasa, Arabic, Khmer, Mandarin).

- Released the Hospital & Clinic modules and OMR forms for human sampling at clinics and hospitals.
- Developed an application enabling the integration of human OMR forms into the database.
- Continued to develop the EIDITH database structure and developed a module to accommodate serologic test results (currently in Beta testing).
- Released the PCR test result data entry dashboard in the data collection application. Continued to improve the user interface in the data collection application by developing tools to import data through Excel templates, including templates for uploading animal, specimen, and test result data.
- Added country-level reports to help with analysis and with data quality assurance.
- Refined the online interface to improve user experience for data review, extraction, and report generation.
- Optimized the training application for improved tracking and monitoring of project staff and trainee status and to generate customized reports for USAID (Section 4 – Overall Training Summary) and M&E needs.

Activity 4.2. Synthesizing global data

- Completed phase one of development of a respiratory pathogens database (AIRWAYS) by conducting extensive literature review and an alpha version of the website.
- HealthMap's digital disease detection system collected 40,115 alerts lines in PREDICT countries (1 Oct 2015-30 September 2016); top diseases generating alerts were Dengue, Influenza (avian and human), Zika, and Chikungunya.

Activity 4.3. Disseminating global data

- Distributed surveillance and digital disease detection data through the open access public site: http://data.predict.global.
- Continued to submit PREDICT sequences to the Genbank database, which are distributed through the PREDICT bioproject (https://www.ncbi.nlm.nih.gov/bioproject/270892); to date paramyxovirus, astrovirus, coronavirus and hantavirus sequences have been submitted; submission of sequences from other viral families will follow.

Objective 5: Validating One Health Approaches

Conduct a systematic and dedicated effort to validate and evaluate the utility of One Health approaches using all available evidence.

Activity 5.1. Promoting policies and practices that reduce the risk of virus evolution, spillover, amplification, and spread

- Compiled and printed One Health 'Lessons Learned' document, disseminating to EPT partners (Section 6 - Featured Products).

- In collaboration with EPT-2 partners, gathered and integrated input on the 'One Health in Action' case study booklet for policy makers (Section 6 - Featured Products), and initiated French translation. Began compiling examples of One Health success stories for a second edition.
- Appointed as International Member of the European Union (EU) Cost Action Network for the Evaluation of One Health (NEOH) and participated in NEOH Working Group 2 meeting on One Health Evaluation to promote cross-project synergies. Co-authored a draft chapter on One Health governance for the NEOH handbook.
- Appointed to serve on the GHSA Consortium Steering Committee; the Consortium serves as the mechanism for private sector and other non-governmental sector partner engagement in the GHSA.
- In collaboration with P&R, updated the Audit Tool and Planning Checklist for extractive industries and discussed priorities for additional key industries where targeted guidance may be needed.
- Developed parameters for categorizing One Health interventions, intermediate indicators, and outcome indicators.
- Drafted and refined economic analysis strategy with input from health economics and cost-effectiveness experts.
- Compiled list of index cases from all human Ebola virus outbreaks to assess policy options for risk mitigation strategies and drafted scenarios for Ebola virus intervention and outcomes for One Health cost-effectiveness analyses.
- Highlighted PREDICT approaches at GHSA, FAO, and OIE meetings.
- Through the OFFLU Wild Bird/Wildlife Technical Activity, developed a concept note for a global strategy for tracking viral diversity in wild birds.
- Attended the OFFLU Steering Committee meeting and provided an update on PREDICT influenza surveillance activities.
- Highlighted One Health and pandemic and epidemic prevention strategies in the health module of the United Nations Environment Programme's (UNEP) Massive Online Open Course on Ecosystem Approaches (non-PREDICT).
- Presented on PREDICT models of One Health surveillance, data sharing, and risk mitigation techniques at the UNEP Convention on Biological Diversity 19th meeting of the Subsidiary Body on Scientific, Technical, and Technological Advice (non-PREDICT).
- Presented a poster on One Health evaluation at the Consortium of Universities for Global Health conference (Section 6 – Featured Products).
- Analyzed and synthesized findings of a systematic literature review of quantitative and qualitative outcomes reported in >1,800 One Health articles to inform a systematic approach to One Health data collection. The findings were submitted to the *One Health* journal in paper titled "One Health: Are we Demonstrating Effectiveness?" (co-authored with P&R).
- Compiled an exploratory brief comparing Lassa fever, Ebola, and Avian Influenza outbreaks in Nigeria and their potential One Health efficiencies.
- Served on the Expert Review Group for the development of the Checklist for the One Health Epidemiological Reporting of Evidence.

- Through the American Public Health Association Veterinary Public Health Group, submitted input on One Health integration into the U.S. Council on Education for Public Health curriculum criteria.
- Assisted OIE in preparation of the "Guidelines for Wildlife Disease Surveillance: An Overview", now published online.
- With P&R, reviewed the World Bank's draft environmental and social safeguards and provided edits and background justification consistent with EPT-2 best practices. Also provided input for a potential update of the General IFC Environmental, Health, and Safety Guidelines.
- Held planning meetings to establish and refine objectives and agenda for a 2016-2017 meeting on the economics of One Health in follow up to the 2012 World Bank *People, Pathogens and Our Planet* report.
- Presented on zoonotic disease prevention policy lessons from PREDICT at the American Public Health Association meeting in November.
- Served on the GHSA External Assessment Team for Tanzania (non-PREDICT activity) to pilot the GHSA evaluation tool.
- Provided information on simplified solutions for international movement of emergency diagnostic specimens under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) to assist early detection of wildlife disease threats.

Activity 5.2. Improving cross-sectoral collaboration and coordination with EPT-2 partners

- Maintained frequent communication (coordination calls, emails) with P&R, OHW and FAO.
- Discussed opportunities for cross-project coordination at the EPT-2 Partners Meeting in Rome.
- Drafted document for sharing One Health Collaboration best practices from PREDICT with P&R.
- Held phone calls and meetings with P&R to identify key audiences and case examples for a One Health case study booklet, coordinate One Health data collection, and promote policy synergies.
- Led the OFFLU Technical Group on Wildlife and Wild Birds conference call to compile updates on global influenza surveillance findings.
- Coordinated sharing of PREDICT protocols with FAO, including viral family protocols that were also shared with national veterinary laboratories for testing of livestock samples.
- Participated on the FAO Laboratory Technical Advisory group for the Association of Southeast Asian Nations (ASEAN). Held meetings and phone calls with World Bank colleagues to coordinate PREDICT and REDISSE activities.
- Provided an overview of EPT-2 and an update on emerging disease issues at the Steering Committee meeting of the Global Framework for the Progressive Control of Transboundary Animal Diseases meeting, organized by the FAO and OIE in October.

- Provided input on PREDICT surveillance and testing protocols and findings at FAO Technical Meetings on filoviruses and MERS in January and at regional and country-specific meetings throughout the year.

Objective 6: Strengthening Capacity

Add depth and scope to transdisciplinary One Health platforms using a systems approach to classify and track biological surveillance and behavioral risk characterization advances, thereby strengthening surveillance system capacities.

Activity 6.1. Systems approach to capacity building for wildlife, livestock, and human surveillance

- Held monthly global Capacity Team coordination meetings to help standardize approaches to training and assure best practices in implementation of project guidelines, protocols, and methods for safe operationalization of project activities across all partners and sites.
- Updated training guides and quizzes related to safety, animal handling, field operations, laboratory operations, syndromic surveillance, and outbreak support to better prepare in-country teams and implementing partners for the scope of project activities.
- Assembled all complete training guides, master protocols, and capacity strengthening resources into an e-Book format intended for training PREDICT staff and implementing personnel. The e-Book includes sections on: ethical considerations; permissions, permits, and protocols; general field sampling station set-up; safe animal capture and sampling for many host taxa; general data collection; safe disposal of carcasses and infectious material; qualitative research and data collection for behavioral risk investigations; syndromic surveillance; implementing a cold chain for safe sample transport and storage; basic laboratory safety; data policies and plans and data collection for surveillance; biosafety and PPE use; emergency preparedness; outbreak support; and spatial analysis using QGIS software (Section 6 – Featured Products).
- Made all training guides and resources from the e-Book available to the PREDICT in-country teams during the All-County Meeting in February 2016.
- Translated training guides and quizzes into French, and prepared the first set of English and French training guides for posting online (http://publications.predict.global; also highlighted in Section 6 – Featured Products) thereby enabling public access by the global community of health professionals.
- Conducted and tracked in-country trainings using e-Book protocols and quizzes, as well as ethics training via the UC Davis Institutional Animal Care and Use module and the online Collaborative Institutional Training Initiative (CITI) module for human subjects research.
- Continued to provide technical support to in-country laboratories.
- Supported assessment of and provided guidance for the selection of new laboratory partners.

- Continued to assess baseline serologic capacity of new collaborating laboratories to support the development of appropriate technologies for PREDICT activities.
- Continued to strengthen regional One Health networks by conducting multiple trainings of PREDICT and in-country personnel, where teams from a new PREDICT country or less experienced field/lab team would travel to work closely with the more experienced team (or vice versa) for up to two weeks in order to learn new skills and optimize field, laboratory, and data procedures involved with surveillance activities.
- Hosted the first PREDICT Modeling and Analytics International Research Fellow for five weeks to develop, refine, and produce a country-specific risk model for Nipah virus in Thailand.
- Hosted a Generalized Additive Model workshop at the Ecological Society of America Conference.

Activity 6.2. Coordinating capacity development across EPT-2 projects

Support the training of the next generation of the One Health professionals through coordinated activities with EPT-2 and inter-agency partners.

- Continued discussions with FAO and began training of national reference laboratories and sharing of PREDICT viral family protocols. Completed joint regional training in the Southeast Asia region and provided protocols and controls for PREDICT viral family testing to animal health laboratories for testing of livestock samples.
- Furthered collaborations with One Health Workforce to provide pre-service training opportunities to students in One Health university networks, such as OHCEA and SEAOHUN, and initiated student training through a One Health fellowship program in Uganda where a One Health fellow began working with PREDICT to learn technical skills in field settings with animal sampling teams along with methods for behavioral risk investigations.

Objective 7: Assisting Organization of USAID ETD Annual Data Review Meetings

In close coordination with USAID and other EPT-2 projects and partners (including FAO, CDC, WHO, etc.), organize annual data reviews to optimize and refine ongoing and future activities.

- Coordinated data review meeting dates, goals, venue, and logistics, including location cost comparison.
- Held the first Annual Data Review Meeting in August 2016 in New York City, USA, with participation from P&R, FAO, WHO, and USAID, and engaged partners in agenda planning and follow-up. The meeting reviewed the goals of the EPT-2 program, data collection and analyses conducted or anticipated by partners, and potential applications (e.g., policy decisions).
- Drafted and distributed the Annual Data Review Meeting report.
- In collaboration with FAO, determined the minimum data fields for reporting.

- Identified project focal points to promote strong cross-project collaboration.
- Identified key stakeholders for data collection and use, in particular for influenza and other respiratory viruses.
- Established a recommendation for use of a shared data platform (EIDITH) for wildlife and livestock data, with support from FAO (pending decision by country ministries).
- Established an Evidence for Policy Making Working Group.
- Determined preliminary priorities for the 2016-2017 meeting.

III. NON-GHSA EPT-2 COUNTRY REPORTS

EGYPT

Highlights and Success Stories

- In support of strengthening regional One Health networks and capacity for surveillance of emerging disease threats, two members of the PREDICT/Egypt team traveled to Jordan to receive training in biosafety and biosecurity, safe animal capture and handling, wildlife sampling, cold chain, and safe sample transport in July 2016. This in-service training featured members of the PREDICT/Jordan team and PREDICT's global experts in a mix of both classroom instruction and hands-on field experience with wild, cave-dwelling bat colonies. Following training, the PREDICT/Egypt team returned home and launched wildlife surveillance activities, safely and successfully sampling 93 bats near important human-camel interfaces.
- PREDICT/Egypt launched viral detection activities at the National Health Centre laboratory, testing samples from 93 bats collected by the surveillance team for Middle East Respiratory Syndrome (MERS) Coronavirus, other coronaviruses, and filoviruses. The lab team also performed MERS serology on collected sera. Final interpreted results will be shared with the government partners for approval of public release.

A bat captured during the training with the PREDICT/Jordan team in Ajloun, Jordan. PREDICT/Egypt field staff participated in the training. Photo: Patrick Dawson.

PREDICT/Egypt receiving training on bat capture and sampling techniques in Ajloun, Jordan in July 2016. Photo: Patrick Dawson.

Summary of Surveillance and Field Activities for the Period Oct. 2015-Sept. 2016:

- Sampled a total of 93 bats between July and September 2016 near important human-camel interfaces.
- Continued coordinating with FAO partners and the Egyptian Ministry of Agriculture and Land Reclamation's General Organization for Veterinary Services on livestock surveillance exploring camel populations and other livestock sharing the same environment as camels.
- Obtained Institutional Review Board (IRB) approval for human subjects research both at the global level and from a local Egyptian IRB committee in August 2016 and initiated preparations for interviewing and sampling humans with camel exposure in various settings including abattoirs, farms, and quarantines beginning in October 2016.

Summary of Laboratory Development/Testing for the Period Oct. 2015-Sept. 2016

- Tested 93 sera from bats for MERS antibodies at Egypt National Research Center for Scientific Excellence in Influenza Viruses; all results were negative.
- Continued working with the National Research Center, the implementing laboratory for wildlife and human surveillance, to test rectal and oral swab samples from bats for corona- and filoviruses and to perform MERS serology. In addition, the team continued to make preparations for testing human sera for

MERS antibodies, planned to begin with the launch of human sampling activities in October 2016.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2015-Sept. 2016:

- Established subaward with implementing partner, Human Link; secured animal ethics approval in July 2016 for the wildlife sampling of bats; and officially launched field activities in July 2016.

Other Activities this Period

- Conducted all necessary trainings with laboratory and field teams to ensure compliance with project policies and procedures and conducted several online and teleconference training courses throughout June 2016 on protocols and guidelines for sample collection and transport, fieldwork, data collection, occupational health and safety, and ethics. Received training on the project's integrated bio-surveillance information management system and successfully launched systems for data collection and management using tablet computers and project applications.

Training Summary

A total of **22 individuals**, including **14 men** and **8 women**, have been trained in Egypt since the start of PREDICT-2 activities in 2014. All of these individuals are governmental personnel. A number of individuals completed trainings in more than one subject.

Training Events by Topic*

Topic	Total Trainings	# Trainings by Government Personnel	# Trainings by Women	# Trainings by PREDICT staff	# Trainings by Students
Basic Laboratory Safety	28	28	12	2	
Bat Sampling	14	14	6	2	
Biosafety and PPE	14	14	6	2	
CITI Biomedical Research	15	15	6	1	
CITI Social Behavioral	15	15	6	1	
Emergency Preparedness	14	14	6	2	
Implementing Cold Chain for Safe Sample Transport	14	14	6	2	
Information Management	2	2		1	
Lab Protocols and Diagnostics	16	16	6	1	
Packing and Shipping Biological Samples	4	4	2	1	
Rodent Sampling	12	12	6	1	
Safe Animal Capture and Sampling	14	14	6	2	
Safe Disposal of Carcasses and Infectious Waste	4	4	2	1	
Safe Sample Transport and Storage	2	2		1	
Total	**168**	**168**	**70**	**20**	**0**

*Some individuals were cross-trained in multiple topics. Individuals may be represented in multiple rows per column and multiple columns.

GABON

As a limited engagement country, activities in Gabon over the past year focused on scoping visits to surveillance sites for potential wildlife and human sampling activities maintaining partnerships, and networking with PREDICT teams in the Central Africa region.

Summary of Surveillance and Field Activities for the Period Oct. 2015-Sept. 2016:

- Conducted a scoping visit to evaluate potential sites for surveillance activities in in December and January 2016 in Haut-Ntem Department in Woleu-Ntem Province, L'Ogoulou Department in La Ngounié Province, and L'Ivindo Department in L'Ogooué-Ivindo. The Haut-Ntem site is a densely forested site, parts of which are national park, inhabited by elephants, gorillas, other non-human primates, and bats in a rich wild animal-human interface. The Ogoulou department contains the national park of Mougalaba, animal production, bat caves, and some gold mine exploration. The Ivindo Department contains a hospital, supports an active mining industry, and features hyro-electric dam and agricultural projects.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct 2015-Sept 2016:

- Identified the Institut National Supérieur d'Agronomie et de Biotechnologies and the Université des Sciences de la Santé as key potential in-country partners and held in-country meetings in Libreville in May 2015.
- Held teleconference calls with potential in-country partners and the PREDICT global and Cameroon teams to facilitate workplan development.

Other Activities this Period:

- Held meetings with regional PREDICT teams in Cameroon, Republic of Congo, and Democratic Republic of Congo to synergize workplans and coordinate a regional approach to surveillance.
- Facilitated the training of three individuals from potential partner organizations in Gabon, including the Institut National Supérieur d'Agronomie et de Biotechnologies; all individuals travelled to Cameroon in April 2016 and received in-service and field and lab-based training in biosafety; safe animal capture, handling, and sampling; data management, and laboratory safety and viral detection protocols from the PREDICT/Cameroon team.

Training Summary

A total of **four individuals**, including **three men** and **one woman**, have been trained in Gabon since the start of PREDICT-2 activities in 2014. A number of individuals completed trainings in more than one subject.

Training Events by Topic*

Topic	Total Trainings	# Trainings by Government Personnel	# Trainings by Women	# Trainings by PREDICT staff	# Trainings by Students
ACU 101	1			1	
Basic Laboratory Safety	4		1	4	
Bat Sampling	4		1	4	
Bushmeat Sampling	4		1	4	
Other	8		2	8	
Rodent Sampling	4		1	4	
Total	**25**	**0**	**6**	**25**	**0**

* Some individuals were cross-trained in multiple topics. Individuals may be represented in multiple rows per column and multiple columns.

Future Activities: Note that activities have been discontinued in Gabon to focus resources in higher priority areas.

JORDAN

Highlights and Success Stories

- As part of continuing efforts to strengthen regional One Health networks and surveillance capacity for emerging viral threats, PREDICT's implementing partner, the Jordan University of Science and Technology (JUST), hosted a regional training workshop on safe wildlife capture, handling, and sampling techniques in July 2016. Ten participants from human and animal health sectors in Jordan and Egypt received a mix of classroom and field-based training on biosafety, biosecurity; safe capture, handling, and biological sampling of bats; and maintaining cold chain for samples. The training targeted wild, cave-dwelling bat colonies that are part of PREDICT/Jordan's surveillance plan, further enhancing trainee exposure, as participants also gained experience contextualizing sites and identifying high-risk human-animal interfaces. PREDICT also conducted training for Jordanian and Egyptian partners on the project's integrated bio-surveillance information management system and use of data collection tools and applications. During field training activities, the PREDICT/Jordan team officially launched wildlife surveillance activities, collecting a total of 40 bat samples (oropharyngeal, urogenital, and rectal swabs and whole blood).
- PREDICT provided viral detection and discovery testing protocols and universal positive controls to the implementing laboratory, JUST's Molecular Virology Laboratory and Health Center Diagnostic Laboratory, to enable initiation of viral detection activities targeting coronaviruses, influenza viruses, paramyxoviruses, and filoviruses in both human and wildlife samples. The lab successfully launched viral family testing for known and emerging viral threats in Jordan, testing PREDICT bat samples for the four viral families along with MERS-CoV using a real-time PCR assay. In addition, the lab tested camel samples collected in collaboration with FAO and other in-country partners for MERS-CoV. All results are pending interpretation and/or government approval for public release.

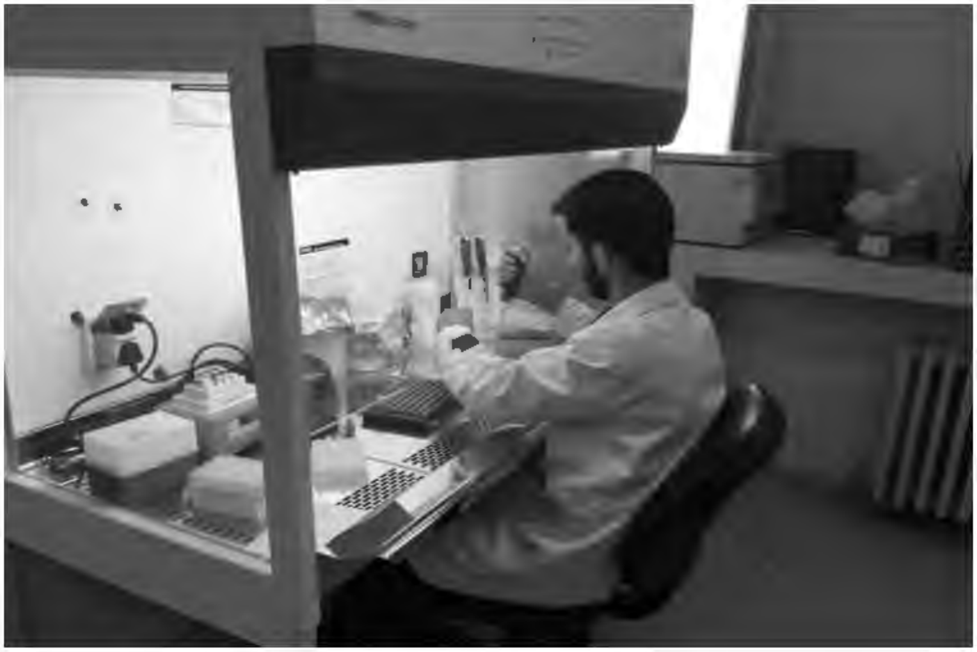
Bat capture and sampling training in Jordan in July 2016. Photo: PREDICT/Jordan.

Summary of Surveillance and Field Activities for the Period Oct. 2015-Sept. 2016:

- Collected a total of 40 bat samples during safe wildlife capture, handling, and sampling traning.
- Coordinated with partners FAO, KSU, and the NIH's Rocky Mountain Laboratories on a sampling operation in May 2016 to collect samples from camels at three sites (Azraq, Ramtha, and Aqaba); a total of 120 samples were collected and transferred to JUST, PREDICT's implementing laboratory partner, for viral testing.

Summary of Laboratory Development/Testing for the Period Oct. 2015-Sept. 2016:

- Initiated viral detection in-country by testing 40 samples collected over the course of field training operations at JUST, PREDICT's in-country implementing laboratory for animal and human surveillance, for MERS-CoV by real-time PCR. The samples were also tested for paramyxoviruses, coronaviruses, filoviruses, and influenza viruses; viral family test results are pending confirmatory sequencing and interpretation, after which they will be shared with government partners for approval of public release.
- Performed laboratory diagnostics at JUST for camel samples collected from three sites (Azraq, Ramtha, and Aqaba) in May 2016. Nasal swab samples were tested for MERS-CoV RNA using real-time polymerase chain reaction (PCR). A total of 120 samples were tested; results are pending interpretation and release by the government partners. An additional 24 camel samples collected from another farm in Ramtha were tested against MERS-CoV using RT-PCR and were found to be negative.



A PREDICT/Jordan team member preparing master mix for conventional PCR. Photo: PREDICT/Jordan.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2015-Sept. 2016:

- PREDICT attended the Meeting of Human and Animal Health Surveillance Stakeholders at the World Health Organization (WHO) Country Office in Amman on August 9, 2016. The purpose of the meeting was to review the status of human and animal health surveillance operations and the integration of epidemiological and laboratory surveillance in Jordan. Participants included representatives from the Jordan Ministry of Health, Jordan Ministry of Agriculture, WHO, FAO, World Organization for Animal Health (OIE), US Defense Threat Reduction Agency, and JUST. At the meeting, PREDICT discussed Middle East Respiratory Syndrome Coronavirus (MERS-CoV) surveillance in bats and camels and debriefed attendees on PREDICT's partnership with FAO. The team agreed to pursue upgrades to the surveillance system at the Ministry of Agriculture and to develop a more formal collaboration with the Ministry of Health and the Ministry of Agriculture for reporting zoonotic diseases.
- PREDICT team members from JUST and FAO conducted a training workshop on laboratory diagnosis of MERS-CoV on different animal species specimens at the Ministry of Agriculture (MOA) Central Veterinary Laboratories for veterinarians and technicians from MOA (September 5-7, 2016). Twelve participants from four different governorates participated in the training.

- PREDICT identified a list of key government points of contact in case of a disease outbreak of potential zoonotic origin, as well as potential areas for intergovernmental coordination. The mechanisms for responding to infectious zoonoses are established and functional in Jordan, and the Ministry of Health's (MOH) Division of Zoonotic Diseases and MOA's Veterinary Services have developed a strong and cooperative relationship across surveillance and laboratory sectors. However, while both MOH and MOA have established priority notifiable disease lists, which are used to strengthen surveillance and laboratory capacities, there had not yet been a collaborative discussion on cross-linking these lists to develop formalized multi-sectoral priorities, particularly with respect to zoonotic diseases.
- PREDICT assisted the Jordan MOA in defining national One Health workforce needs and strategies and made plans to support the government of Jordan in developing a One Health workforce through training in core competencies and skills for preventing, controlling, detecting, and responding to zoonotic diseases.
- On April 25, 2016, PREDICT participated in the first EPT-2 Partners' Meeting in Jordan at the USAID Mission to coordinate activities and ensure alignment with GHSA and USAID goals. The team met with Director of Population and Family Health of the USAID/Jordan for a briefing meeting and project coordination discussion. Meeting participants included the FAO Representative in Jordan; FAO EPT-2 Technical Consultant; Ministry of Agriculture Director of Animal Health; and JUST School of Veterinary Medicine Dean, who is the PREDICT/Jordan country coordinator.
- PREDICT continuously updated PREDICT-2 project liaison at USAID/Jordan Mission regarding activities and events.
- On September 26, 2016, PREDICT met with the USAID/Jordan office, along with representatives from USAID/Washington, at the US Embassy in Amman to discuss the progress and updates of PREDICT-2 in Jordan. The Jordan team also met with the Director of Communicable Diseases and Head of Surveillance Department at the Ministry of Health (MOH) to introduce the project, particularly regarding proposed human surveillance activities. Following, the group visited a camel farm together. They also met with FAO representatives in Jordan on September 28th, and provided a briefing about PREDICT-2 goals and objectives.

Other Activities this Period

- Held a workshop in collaboration with Rocky Mountain Lab (National Institutes of Health) and Kansas State University (KSU) in May 2016 to introduce the bat catching and sampling approach to veterinarians of the Jordan Ministry of Agriculture. PREDICT gave lectures on sampling techniques and use of GPS in the field.

- Conducted several online and teleconference training courses throughout June 2016 with partner staff at JUST to ensure competency and compliance with protocols and procedures for fieldwork, sample transport, and data collection, as well as occupational health and safety and ethics policies.
- PREDICT/Jordan team members received training in safe bat capture and sampling techniques from the Jordan Royal Society for Nature Conservation in May 2016 at an underground cave in the Ajloun Governorate in northern Jordan.

Training Summary

A total of **seven individuals**, including **six men** and **one woman**, have been trained in Jordan since the start of PREDICT-2 activities in 2014. Two governmental personnel and one FAO representative have received training from PREDICT. A number of individuals completed trainings in more than one subject.

Training Events by Topic*

Topic	Total Trainings	# Trainings by Government Personnel	# Trainings by Women	# Trainings by PREDICT staff	# Trainings by Students
Bat Sampling	6	2	1	3	
Biosafety and PPE	7	2	1	4	
Emergency Preparedness	6	2	1	3	
Implementing Cold Chain for Safe Sample Transport	6	2	1	3	
Information Management	6	2	1	3	
Packing and Shipping Biological Samples	7	2	1	4	
Safe Animal Capture and Sampling	6	2	1	3	
Safe Disposal of Carcasses and Infectious Waste	7	2	1	4	
Safe Sample Transport and Storage	7	2	1	4	
Total	**58**	**18**	**9**	**31**	**0**

* Some individuals were cross-trained in multiple topics. Individuals may be represented in multiple rows per column and multiple columns.

REPUBLIC OF CONGO

Highlights and Success Stories:

- Following approval from the Comité d'Ethique de la Recherché en Sciences de la Santé (CERSSA), PREDICT initiated preparations for an in-depth human behavioral study investigating risk of viral spillover associated with the animal value chains in Republic of Congo and neighboring Democratic Republic of Congo. PREDICT recruited staff with social science backgrounds for behavioral risk investigations, specifically two individuals who supervised USAID's PREVENT project bushmeat market characterization study in Brazzaville and Dolisie during EPT-1. The team also conducted observational research in a community surrounding the Sibiti hospital, a planned site for human surveillance activities that includes a bushmeat market and surrounding restaurants, as well as in Brazzaville bushmeat markets, prior to finalizing an integrated behavioral and wildlife sampling plan. The team plans to initiate interviews, focus groups, and sampling in these markets in the first quarter of 2016-2017.

Summary of Surveillance and Field Activities for the Period Oct. 2015-Sept. 2016:

- Conducted a three-day practical training session on bat and rodent sampling for two staff from the Laboratoire de Diagnostique Vétérinaire de Brazzaville in Kintele (December 18-20, 2015). A total of 222 samples were collected from 50 bats and four rodents and sent for testing to the PREDICT lab at Institut National de Recherche Biomédicale in neighboring Kinshasa, Democratic Republic of Congo.
- Launched exploratory field visits (January 20-24, 2016) in Cuvette-Ouest to identify new sampling sites where the risk of virus transmission between wildlife, livestock, and humans is high. PREDICT completed an evaluation of potential sites and selected two sites for sample collection: Ouesso (Sangha Department) and Sibiti (Lékoumou Department). The PREDICT team established positive working relationships with officials in these communities, and both sites are suitable for concurrent animal and human surveillance with risk pathways for viral emergence identified.
- Conducted wildlife surveillance activities in Ouesso, in the Sangha Department from June 25 to July 5, 2016. A total of 356 samples were collected from 49 bats, 28 rodents, and one non-human primate. Samples were sent to INRB to be tested for priority viral families.
- Conducted wildlife surveillance activities in Sibiti, in the Lekoumou Department from July 18-28, 2016. A total of 509 samples were collected from 65 bats, 59 rodents, and two bushmeat and sent to INRB to be tested for PREDICT priority viral families.
- In Ouesso and Sibiti areas, PREDICT staff identified potential bushmeat markets and health facilities for surveillance. The team performed capacity assessments of Ouesso and Sibiti hospitals in preparation for the implementation of the human syndromic surveillance study.

- September 10-15, 2016, PREDICT/RoC staff attended training held at the Sibiti hospital alongside medical personnel considered for PREDICT human syndromic surveillance at this site. The participants of the human surveillance training included the director of the Sibiti hospital, the major in charge of the inpatient department, a triage nurse, the laboratory director, as well as two community leads. This training session led by the PREDICT global team detailed the project's human surveillance approach, including analysis of patient load and workflow to determine suitability of the Sibiti hospital as a surveillance site.

Summary of Laboratory Development/Testing for the Period Oct. 2015-Sept. 2016:

- The Republic of Congo Laboratoire National de Santé Publique (LNSP) (National Laboratory for Public Health) and the Democratic Republic of Congo Institut National de Recherche Biomédicale (INRB), located in Kinshasa, renewed their collaborative agreement to facilitate testing of PREDICT samples from RoC at the project lab in DRC.
- Laboratory assessment and capacity-building efforts have been ongoing throughout the year, with testing expected to begin in the PREDICT lab at LNSP in 2017. As part of these efforts, a member of the PREDICT/RoC team travelled to INRB in December 2015 to work with the PREDICT/DRC team on laboratory analysis and project work plans.

Other Activities this Period:

- Obtained a scientific animal capture permit from the Ministry of Agriculture and Livestock to enable animal sampling.
- Participated in the World Health Organization (WHO) International Health Regulations (IHR) meeting on January 19, 2016, with EPT consortium members, the General Directorate of Epidemiology and the Fight against Disease (DGELM), and the Directorate of Public Health and Health Promotion (DHPPS). The PREDICT team chaired the first quarterly session, during which the Director of Public Hygiene and Health Promotion introduced the International Health Regulations documents to members and participants were brought up to date with ongoing public health concerns.
- Participated in a meeting organized by the General Directorate of Epidemiology and the Fight against Disease (DGELM) on March 14, 2016, to discuss cases of yellow fever in neighboring Angola and five suspected cases in Pointe-Noire, RoC.
- Attended a meeting organized by the General Directorate of Epidemiology and Fight against Disease (DGELM) on April 26, 2016, to approve the 2016 operational action plan of the Directorate. During this meeting, PREDICT staff delivered a presentation on project activities and achievements and continued to promote the One Health concept.

Training Summary

A total of **eight individuals**, including **six men** and **two women**, have been trained in the Republic of the Congo since the start of PREDICT-2 activities in 2014. Six of these individuals are governmental personnel. A number of individuals completed trainings in more than one subject.

Training Events by Topic*

Topic	Total Trainings	# Trainings by Government Personnel	# Trainings by Women	# Trainings by PREDICT staff	# Trainings by Students
Avian Sampling	5	4	1	3	
Basic Laboratory Safety	8	6	1	6	
Bat Sampling	7	6	1	5	
Biosafety and PPE	8	6	2	5	
Bushmeat Sampling	7	6	1	5	
CITI Biomedical Research	5	4	1	4	
CITI Social Behavioral	2			2	
Emergency Preparedness	6	4	1	4	
Implementing Cold Chain for Safe Sample Transport	4	3	1	2	
Non-Human Primate Sampling	7	6	1	5	
Other	4	4	1	2	
Packing and Shipping Biological Samples	3	3	1	1	
Qualitative Research and Data Collection	4	3	1	2	
Rodent Sampling	7	6	1	5	
Safe Animal Capture and Sampling	7	6	1	5	
Safe Disposal of Carcasses	1			1	
Safe Sample Transport and Storage	1	1		1	
Small Carnivore Sampling	6	5	1	4	
Use of EIDITH Training App	2	2		2	
Total	**94**	**75**	**16**	**64**	**0**

*Some individuals were cross-trained in multiple topics. Individuals may be represented in multiple rows per column and multiple columns.

SOUTH SUDAN

As a limited engagement country, activities for South Sudan focused on testing of archived specimens, setting up and obtaining permission for human behavioral surveys, and maintaining partnerships. Implementation of in-country activities was delayed by political issues, which resulted in lack of travel approval for South Sudan.

Summary of Surveillance and Field Activities for the Period Oct. 2015-Sept. 2016:

- Developed the 2016-2017 workplan and selected potential sites for zoonotic disease surveillance.
- Worked towards implementation of behavioral risk investigations by arranging for questionnaire translations to local languages (now complete for Zande with Bari translations in process) and applying for and receiving clearance from the South Sudan Research Ethics Board for study activities. In addition, identified a local community worker as a candidate for implementing the surveys.

Summary of Laboratory Development/Testing for the Period Oct. 2015-Sept. 2016:

- Conducted analysis of vial diversity of 258 archived (previously exported) specimens from 2011-2015 at the Bucknell University laboratory. These specimens were used to help establish baseline data for viral diversity. Archived samples were comprised of specimens from 228 bats (one Emballonurid (tomb bat); 15 Hipposiderids (horseshoe bats); 67 Molossids (free-tailed bats); three Nycterids (slit-faced bats); 110 Pteropids (Epauletted fruit bats); 10 Rhinolophids (nose-leaf bats); 22 Vespertilionids (plain faced bats); and 30 rodents (species undeclared).
- Host identity was confirmed by morphological analysis of museum specimens from which samples were collected and by barcoding of tissue samples.
- Liver tissue (spleen in a few cases) was surveyed for filo-, paramyxo, and coronaviruses using viral family protocols; results are pending interpretation and will be shared with government partners for approval for public release.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2015-Sept. 2016:

- Drew upon established relationships in South Sudan to continue developing partnerships to implement project activities.
- Interfaced with local and state stakeholders, including governmental officials and traditional tribal leaders. At the level of the central government in Juba, interfaced with heads of the Ministry for Wildlife Conservation in Tourism and Ministry of Health and the Environment.
- Interfaced with WHO officials and regularly monitored South Sudan weekly disease bulletins.
- Held discussions with the NGO Caritas Internationalis in Western Equatoria State (Gbudue State) regarding the development of livelihood programs in areas of high human-wildlife interface.

- Continued to monitor ministry points-of-contact and regional governmental officials due to recent changes in government and evaluate political and security conditions to determine if activities could be planned for future implementation.

Future Activities: Note that activities have been discontinued in South Sudan to focus resources in higher priority and more secure areas.

CHINA

Highlights and Success Stories

- This year the members of the PREDICT/China team published the article "Fugong virus, a novel hantavirus harbored by the small oriental vole (Eothenomys eleusis) in China" in the *Virology journal*. In the article, the authors led by X.Y. Ge describe results from characterizing one full-length genomic sequence of a novel virus, which they named fugong virus, obtained from a small oriental vole *(Eothenomys eleusis)*, and show that the virus is most closely related to hantavirus LX309, a virus found in another vole species from the same genus (Hantavirus, some members of which are known to cause hemorrhagic fever with renal syndrome in Eurasia and hantavirus pulmonary syndrome in the Americas). See Section 6 – Publication Summaries for more details.
- Following approval from the School of Public Health of Wuhan University and Guangdong Center for Disease Control and Prevention Institutional Review Board committees, PREDICT/China launched behavioral risk investigations in three provinces: Guangdong, Guangxi, and Yunnan. The team completed 157 ethnographic interviews and seven focus group discussions exploring behavioral factors that may be associated with viral transmission and spread. Data collection is complete, and results informed PREDICT's human questionnaire development, which is now being rolled-out globally in other PREDICT countries through human surveillance activities. Analysis of China behavioral risk data and manuscript preparation are in process. In addition, PREDICT initiated implementation of community-based and syndromic surveillance activities for emerging zoonotic disease threats in high-risk communities identified for concurrent surveillance; activities are now active in Guangdong, Guangxi, and Yunnan Provinces.
- Forty-two bat samples tested at Wuhan Institute of Virology were positive for coronaviruses, 36 of which were bat CoV/SC2013, a lineage C betacoronavirus related to MERS-CoV.

Summary of Surveillance and Field Activities for the Period Oct. 2015-Sept. 2016:

- Collected 1,084 oral and rectal samples from 542 individual bats belonging to 21 species along the animal value chain across Yunnan, Guangdong, and Guangxi Provinces. All samples were transported to Wuhan Institute of Virology for viral detection.

*Nutrias (*Myocastor coypus*) in a wild animal farm in Guangxi Province. Photo: Guangjian Zhu, PREDICT/China*

- Completed 154 ethnographic interviews and seven focus group discussions in Guangdong, Guangxi, and Yunnan Provinces in collaboration with Guangdong Institute of Public Health (GDIPH), Guangdong CDC, Guangdong Entomological Institute (GDEI), and Yunnan Institute of Endemic Diseases Control and Prevention. Audio recordings of all interviews and focus groups have been transcribed and translated, and coding and analysis are in process. In addition, PREDICT shared a Qualitative Data Analysis Progress Report with GDIPH in May 2016.
- Continued developing plans for concurrent livestock/wildlife/community sampling around large pig farms in Guangdong with FAO and South China Agricultural University partners. PREDICT shared protocols for animal handling and sampling with the university and worked to coordinate livestock surveillance activities at sites in the Shantou region of Guangdong Province. Partners are working on specific site selection for concurrent sampling that will include wildlife around large farms, livestock, people with high levels of animal contact, and hospital cases originating from the area.

Domestic and wild poultry birds at a local wet markets; pigs at a local livestock farm in Shantou, Guangdong where PREDICT, FAO, and South China Agricultural University partners are planning concurrent surveillance activities. Photos: Jason Euren/PREDICT.

Summary of Laboratory Development/Testing for the Period Oct. 2015-Sept. 2016:

- Tested 700 bat rectal swab samples collected during PREDICT-1 at Wuhan Institute of Virology for filovirus, influenza virus, and bunyavirus; all samples tested negative.
- Tested 128 rectal swab samples from *Vespertillio superans* bats collected in PREDICT-1 for corona-, paramyxo- and mammalian orthoreoviruses at Wuhan Institute of Virology. Forty-two positive samples for coronavirus were detected, 36 of which were infected with bat CoV/SC2013, a lineage C betacoronavirus related to MERS-CoV.
- Tested 352 oral samples collected during PREDICT-1 from residents who reside near bat caves for mammalian orthoreovirus at Wuhan Institute of Virology; results are pending interpretation and approval by government partners for public release.
- Enhanced sample transport, establishing both intra-Yunnan and intra-Guangdong cold chain systems. As a result, prefecture CDCs and hospitals may now rapidly deliver project samples from field sites to laboratories while maintaining appropriate cold chain and documentation.
- Shared the latest laboratory protocols and universal controls with Wuhan Virology Institute and Guangdong CDC laboratory teams. The Wuhan Institute of Virology maintains capacity for testing paramyxo-, corona-, flavi-, bunya-, orthomyxo-, reo-, picorna-, and filoviruses. Training and capacity strengthening activities continue with lab partners at the Institute of Pathogenic Microbiology, Guangdong CDC.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2015-Sept. 2016:

- A human surveillance kick-off meeting was held in Dongguan in January 2016 with members of PREDICT, GDCDC, GDIPH, Tungwah Hospital, and Shantou University.
- PREDICT/China global leads met with PREDICT's human surveillance coordinator in Wuhan (January and February) and personnel from the Yunnan Provincial Center for Disease Control, Yunnan Disaster and Emergency Response, as well as Infectious Disease Department Teams from the Kunming Third People's Hospital and The Dali Hospital, to plan field and laboratory activities.
- PREDICT/China coordinator continued to meet regularly with officials from China Central CDC and the State of Forestry Administration, FAO China staff, and relevant conservation and public health NGOs in China to share project findings and promote One Health collaborations.

Other Activities this Period

- *Publications*
  - Ge, X. Y., Yang, W. H., Pan, H., Zhou, J. H., Han, X., Zhu, G. J., ... & Zhang, Y. Z. (2016). Fugong virus, a novel hantavirus harbored by the small oriental vole (Eothenomys eleusis) in China. *Virology journal*, *13*(1), 1. (See Section 5 – Publication Summaries).
  - Serological and behavioral risk survey of workers with wildlife contact in China. Submitted to *Emerging Infectious Diseases* in August 2016.
  - Serological surveillance and antibiotic susceptibility of Group B Streptococcus serotypes in pregnant women in Dongguan, China. Submitted to *Scientific Reports* in August 2016. This is a collaborative publication between PREDICT-2 and partners at the Tungwah Hospital, in Dongguan, Guangdong.

- *Meetings and Presentations*
  - In April 2016, attended the 'Wildlife and Public Health Workshop' hosted by China CDC, the State Administration of Forestry, and EcoHealth Alliance in Beijing, to share PREDICT research findings with different Chinese governmental departments.

The PREDICT China Team exchanges knowledge with the experts from Chinese government departments of health, forestry, and agriculture at the Wildlife and Public Health Workshop in Beijing. Photo: PREDICT/China.

  - Participated in the 'Stakeholder Consultative Workshop to Strengthen the Influenza Surveillance Networks' during September 2016 in Guangzhou. As a result, PREDICT plans to provide technical support to the development and implementation of a coordinated, multi-sectoral (human-animal health) surveillance and disease outbreak response program, coordinated by FAO and Chinese federal and provincial agencies.

- *Trainings and Capacity Strengthening*
  - Trained 20 field and laboratory team members in qualitative research for behavioral risk surveillance and characterization in Guangdong, Yunnan, and Wuhan.
  - Completed ethics training for implementation of human surveillance activities; all PREDICT/China team members involved in human surveillance activities completed the Social and Behavioral Responsible Conduct of Research certificate courses in the Collaborative Institutional Training Initiative (CITI) Program.
  - Completed all required project trainings using protocols and guidelines in PREDICT's eBook; all PREDICT/China team members, including 28 individuals from the human surveillance team, wildlife surveillance team, and laboratory team, are now trained and prepared for implementation of project work.
  - In June 2016, PREDICT China's lab coordinator from the Wuhan Institute of Virology, China Academy of Sciences traveled to New York City to receive training in advanced modeling and analytics methods and to work with the PREDICT Modeling and Analytics Team on PREDICT-1 coronavirus sequence data.

Training Summary

A total of **40 individuals**, including **21 men** and **19 women**, have been trained in China since the start of PREDICT-2 activities in 2014, including **29 governmental personnel and six students**. A number of individuals completed trainings in more than one subject.

Training Events by Topic*

Topic	Total Trainings	# Trainings by Government Personnel	# Trainings by Women	# Trainings by PREDICT staff	# Trainings by Students
ACU 101	1			1	
Avian Sampling	3	1	1	3	
Basic Laboratory Safety	20	12	12	16	3
Bat Sampling	3	1	1	3	
Biosafety and PPE	21	12	13	17	3
Bushmeat Sampling	3	1	1	3	
CITI Biomedical Research	11	4	4	5	3
CITI Social Behavioral	11	4	4	5	3
Emergency Preparedness	21	12	13	17	3
Human Syndromic Surveillance	17	12	10	15	2
Implementing Cold Chain for Safe Sample Transport	21	12	13	17	3
Livestock Sampling	1			1	
Non-Human Primate Sampling	3	1	1	3	
Other	2	1	2	1	
Outbreak Response	6	3	4	5	
Packing and Shipping Biological Samples	21	12	13	17	3
Policies and Plans	15	10	10	14	2
Qualitative Research and Data Collection	31	24	14	15	4
Rodent Sampling	3	1	1	3	
Safe Animal Capture and Sampling	3	1	1	3	
Safe Disposal of Carcasses and Infectious Waste	9	4	6	8	
Small Carnivore Sampling	3	1	1	3	
Totals	**229**	**129**	**125**	**175**	**29**

*Some individuals were cross-trained in multiple topics. Individuals may be represented in multiple rows per column and multiple columns.

MONGOLIA

Highlights and Success Stories

- On September 8, 2016 during field surveillance activities targeting migratory birds in Mongolia as part of PREDICT efforts to understand the dynamics of transmission and spread of influenza viruses, the PREDICT-2 team detected a Greater Flamingo *(Phoenicopterus roseus)* at Doitiin Tsagaan lake of Arkhangai province. The species was first sighted in Mongolia in 1947 at Khar Us lake of Zavkhan province, and ours was the nation's second sighting after 69 years. This sighting was an exciting encounter because our observation of this healthy bird feeding with a swan flock was ~2,500 km west of its range. We suspect the flamingo might have followed the swans out of its usual migratory range. Its presence at this location indicates that migratory patterns may be changing, possibly as a consequence of climate variability. If a pattern with other species emerges, there may be implications for pathogen movements into new areas, as well.

Summary of Surveillance and Field Activities for the Period Oct. 2015-Sept. 2016:

- Identified an initial set of PREDICT surveillance sites in Central, Northern, and Eastern Mongolia. Site selection was informed by input from key avian influenza surveillance stakeholders in the environmental, agricultural, and public health sectors. Spring and fall field missions resulted in the collection of 1,195 community wild bird fecal samples and samples from seven dead birds comprised of three Mongolian gulls, two rock doves, one steppe eagle, and one Pallas's gull. These samples will be tested with PREDICT influenza protocols at the State Central Veterinary Laboratory (SCVL) beginning in November 2016.
- Developed and completed trainings aligned with PREDICT protocols for field surveillance and outbreak response. Key partners were targeted at the provincial level, including nine province laboratory veterinarians, zoonotic disease center biologists, and protected area rangers. A total of 39 professionals were trained successfully at three sites, including two SCVL staff members, 27 province laboratory veterinarians, six local zoonotic diseases experts, and four protected area rangers (25 May - 25 June).
- During fall field surveillance at the end of the fiscal year, PREDICT trained 13 key partners in bird identification, safe sample collection, lake mortality surveys and outbreak investigation. The cohort professional mix was: one SCVL staff member, one Institute of Biology expert, eight province laboratory veterinarians, one zoonotic diseases expert, and two protected area rangers.

Summary of Laboratory Development/Testing for the Period Oct. 2015-Sept. 2016:

- Completed an initial assessment of the SCVL's capacity to implement PREDICT's viral detection and diagnostic protocols. The Transboundary Animal Disease (TAD) Laboratory within the SCVL will be the designated laboratory for all viral detection activities, as this lab contains a BSL-3 facility and is staffed by trained virologists. The lab also conducts molecular diagnostic work and has existing serological capacity. Lab materials and supplies for sample testing with PREDICT influenza protocols were acquired.
- Trained laboratory virologists on the PREDICT protocols for laboratory safety, bio-safety, PPE use, sample collection and storage, and viral detection using the consensus-based viral family protocols. In addition, the SCVL virologist attended FAO training on PREDICT-2 protocols in Thailand in July 2016. SCVL currently has capacity to conduct viral family testing for influenza viruses and is planning to initiate testing of collected wild bird specimens in November 2016.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2015-Sept. 2016:

- Signed a MoU with SCVL, which in addition to WCS is PREDICT's implementing partner in Mongolia. Introduced the project partnership and explored additional opportunities for collaboration with the National Human Influenza Center at the National Center for Communicable Diseases (NCCD) within the Ministry of Health and Sports.
- Hired an avian specialist to lead avian influenza-focused field surveillance in Mongolia in collaboration with SCVL personnel. The avian specialist is a Mongolian biologist with extensive wildlife and avian-focused field research experience. He is enrolled in a graduate program in ornithology at the National University of Mongolia that will integrate PREDICT surveillance data into a Master's thesis project.
- Held a PREDICT Project Launch Workshop in Mongolia in April 2016. National and international stakeholders including the Veterinary and Animal Breeding Agency (VABA) of the Ministry of Food and Agriculture (MoFA); the Ministry of Environment, Green Development and Tourism; the National Center for Communicable Diseases; the National Human Influenza Center; the Institute of Biology; the National University of Mongolia, Field Epidemiology Center; National Center for Zoonotic Diseases; Veterinary and Biotechnology School of the National Agricultural University; WHO; FAO; US Embassy, and the USAID Mission were invited and introduced to the project and its scope of work.
- Engaged and integrated key government stakeholders into spring and fall surveillance and sample collection activities; partners included members from

SCVL, Institute of Biology, eight province laboratory veterinarians, six province zoonotic diseases experts, and three province protected area rangers.

Other Activities this Period:

- On June 16-17th at the One Health 5th International Scientific Symposium held in Ulaanbaatar, Mongolia, the PREDICT country coordinator presented on avian influenza surveillance work in Mongolia over the last decade and the need for a One Health approach and platform within Mongolia to engage all stakeholders related to influenza surveillance and monitoring.

Training Summary

A total of **74 individuals**, including **49 men** and **25 women**, have been trained in Mongolia since the start of PREDICT-2 activities in 2014. **Sixty-one governmental personnel** have received training from PREDICT. A number of individuals completed trainings in more than one subject.

Training Events by Topic*

Topic	Total Trainings	# Trainings by Government Personnel	# Trainings by Women	# Trainings by PREDICT staff	# Trainings by Students
Avian Sampling	39	37	14	2	
Basic Laboratory Safety	1		1	1	
Biosafety and PPE	40	37	15	3	
Emergency Preparedness	40	37	15	3	
One Health Approach	73	58	25	6	
Packing and Shipping Biological Samples	40	37	15	3	
Safe Animal Capture and Sampling	1			1	
Safe Disposal of Carcasses and Infectious Waste	40	37	15	3	
Safe Sample Transport and Storage	37	37	14		
Total	**311**	**280**	**114**	**22**	**0**

*Some individuals were cross-trained in multiple topics. Individuals may be represented in multiple rows per column and multiple columns.

MYANMAR

Highlights and Success Stories:

- Following completion of trainings, PREDICT/Myanmar successfully launched wildlife surveillance activities collecting the first set of non-invasive bat samples in April 2016. During the event, PREDICT also provided in-service training, and an opportunity for University of Yangon students to gain field-based experience in safe wildlife sampling. Collected samples were safety secured in cold chain and transferred to storage with PREDICT's implementing partner, the Livestock Breeding and Veterinary Department (LBVD), where they await testing for known and emerging viruses.

A Pteropus bat flying out of a roosting tree in Myanmar. Photo: Suzan Murry/Smithsonian.

Summary of Surveillance and Field Activities for the Period Oct. 2015-Sept. 2016:

- Completed a scoping evaluation (April 2016) and identified three priority sites for surveillance activities targeting non-human primates, bats, rodents, livestock, and humans. Sites include Hpa An, Bagan/Mt. Popa, and areas in Bago region, which were identified as high-risk animal-human interfaces.

- Collected ~18 non-invasive urine/ fecal samples from macaques and 110 samples of bat guano via non-invasive tarp collection method in Hpa An (April 2016); samples will be tested at the Livestock Breeding and Veterinary Department (LBVD) laboratory once infrastructure is in place and training completed.
- As part of the collaboration with FAO, developed plans for concurrent wildlife and livestock sampling and testing and worked to refine site selection.

Summary of Laboratory Development/Testing for the Period Oct. 2015-Sept. 2016:

- Continued working with the Livestock Breeding and Veterinary Department laboratory (LBVD) to establish partnerships and strengthen their capacity for viral detection. LBVD is the planned lab partner for EPT-2 wildlife and livestock surveillance in-country. LBVD has reviewed and signed PREDICT's data sharing agreement and received universal controls and viral family testing protocols.
- Engaged representatives from the Department of Medical Research (DMR), the planned in-country laboratory for human surveillance activities, and continued preparations for capacity strengthening activities to enable launch of viral testing, planned for 2016-2017.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2015-Sept. 2016:

- Maintained active engagements with governmental partners, meeting with the Ministry of Planning, Department of Medical Research, and the Livestock Breeding and Veterinary Department for project start-up, planning, and coordination. In addition, PREDICT engaged Myanmar's Ministry of the Environment, Conservation, and Forestry (MOECAF) to discuss appropriate permissions, training of MOECAF personnel, and opportunities for collaboration.
- Held a stakeholders meeting in August 2016 to discuss collaborative opportunities between One Health and government organizations, including FAO and WHO. Both UN organizations expressed interest in holding joint regional training workshops, and PREDICT continued to coordinate with FAO on plans for concurrent livestock and wildlife surveillance activities and surveillance site selection.
- Represented PREDICT at an FAO-organized One Health Strategy Workshop in Spring 2016 designed to strengthen collaborations between veterinary and public health sectors and to expand interdisciplinary communications in key aspects of health care for humans, animals, and the environment.
- Engaged World Wildlife Fund, Wildlife Conservation Society, Fauna & Flora International, University of Yangon, Oikos, and Turtle Survival Alliance members in discussions exploring areas of collaboration and overlap, such as sampling at wildlife markets and identification of illegal trade routes.
- Collaborated with the Myanmar Health and Development Consortium (MHDC) for support in guiding PREDICT through government regulations. PREDICT and the MHDC are also working together to offer internships in public health linked with PREDICT staff and surveillance activities.

Other Activities this Period:

- Attended the Asian Society of Conservation Medicine's 8th International Conference on Conservation Medicine, 'One Health in Asia-Pacific' in October 2015. The conference, held in Naypidaw, brought together One Health and conservation specialists from around the world to discuss issues of urgent environmental and animal health concern.
- Finalized a Letter of Agreement (LOA) with the Livestock Breeding and Veterinary Department laboratory; the LOA is under review with the ministry partners.
- Received pre-approval for the ethical conduct of human surveillance activities; a proposal is now pending final review with Department of Medical Research.
- Stationed a Smithsonian team member in-country to assist with project implementation and to oversee a successful staff transition.
- Hired a new project coordinator/medical surveillance officer, well versed in Myanmar government protocols, research requirements, public health, and international NGO management.
- Hired a new field supervisor/veterinary surveillance officer with an excellent background in zoological medicine and field sampling experience.
- Hired a project advisor to assist with government communication, project administration, staff supervision, and assure compliance and completion of project deliverables.
- Identified a potential collaboration with a local National Institutes of Health study that is also using a One Health approach for surveillance of humans and non-human primate populations and identified synergies to enhance sample size, improve efficiency for sample collection and lab analysis, and share costs across projects.
- Developed plans to collaborate with Smithsonian-based research on pangolin health and identified opportunities to include PREDICT-related viral surveillance, with staff cost-sharing between projects.

Training Summary

A total of **six individuals**, including **three men, three women, and three students** have been trained in Myanmar since the start of PREDICT-2 activities in 2014. A number of individuals completed trainings in more than one subject.

Training Events by Topic*

Topic	Total Trainings	# Trainings by Government Personnel	# Trainings by Women	# Trainings by PREDICT staff	# Trainings by Students
Avian Sampling	1		1	1	
Basic Laboratory Safety	2		1	2	
Bat Sampling	6		3	2	3
Biosafety and PPE	6		3	2	3
Bushmeat Sampling	1		1	1	
CITI Biomedical Research	2		1	2	
Emergency Preparedness	6		3	2	3
Implementing Cold Chain for Safe Sample Transport	1		1	1	
Livestock Sampling	1		1	1	
Non-Human Primate Sampling	1		1	1	
Other	4		2		3
Outbreak Response	1			1	
Packing and Shipping Biological Samples	1		1	1	
Qualitative Research and Data Collection	1		1	1	
Rodent Sampling	1		1	1	
Safe Animal Capture and Sampling	1		1	1	
Safe Disposal of Carcasses and Infectious Waste	1		1	1	
Small Carnivore Sampling	1		1	1	
Total	**38**	**0**	**24**	**22**	**12**

*Some individuals were cross-trained in multiple topics. Individuals may be represented in multiple rows per column and multiple columns.

NEPAL

Highlights and Success Stories:

- After identifying the local Chepang community in the Chitwan region as potentially high-risk for emerging viral threats, PREDICT engaged Chepang community members at a field site, working with local bat hunters to learn about traditional methods of bat capture and bushmeat consumption habits and to explore risks of viral spillover. PREDICT trained two local members of the community as field assistants, providing them with One Health skills in biosafety and PPE use and safe bat capture, handling, and sampling techniques, then worked with the local assistants to trap bats for viral surveillance activities. The team collected samples from a total of 43 bats and stored samples for viral family testing at the project lab in Kathmandu. In addition, to learn more about this community and potential zoonotic disease risks in the Chitwan region, PREDICT launched behavioral risk investigations and conducted observational research and key informant interviews. In September 2016, in Silinge village, PREDICT launched syndromic surveillance at a mobile clinic collecting samples and conducting behavioral interviews with patients presenting with fevers of unknown origin (FUO). The mobile clinic was deployed during an epidemic of fever and rash with unknown origin and provided community members with the opportunity to receive a professional health consultation from certified medical staff. All samples collected from PREDICT/Nepal's first concurrent wildlife-human surveillance event will undergo testing for known and novel viral threats, and behavioral data will be analyzed to learn more about potential risks for spillover along with risk mitigation options and potential intervention strategies.

PREDICT/Nepal's wildlife surveillance team well prepared for sampling bats and processing specimens in the mobile field tent. Photo: PREDICT/Nepal.

Summary of Surveillance and Field Activities for the Period Oct. 2015-Sept. 2016:

- Collected biological samples from 107 rodents and 104 waterfowl at the Kathmandu informal settlements of Teku Dovan and Jadibuti in order to investigate disease transmission in temporary settlements that have expanded in the aftermath of the 2015 earthquake.
- In February, conducted site assessments and pilot sampling of fruit bats (*Rousettus leschenoulti*) at the Silinge, Makwanpur field site in Southern Nepal in a community dependent on bat hunting and consumption.
- Collected biological samples in wet and dry seasons from 43 bats and 102 rodents during the wet season within the Chepang community, Silinge, Makwanpur.
- Collected samples from 148 patients presenting at a mobile clinic in the Silinge village, including samples from 75 patients meeting case definitions for targeted syndromes.
- Collected 304 non-invasive samples (saliva, fecal, and urine samples) in wet and dry seasons from macaques at the ecotourism interfaces at Pashupatinath, Swayambhunath temples in Kathmandu and Daunne Devi temple in Nawalparasi.
- Performed a survey of the macaque population distribution at the Swayambhu and Pashupati temple complexes and surrounding urban areas.
  The surveys revealed average macaque count of (N) = 687 ± 39.50, and (N) = 931 ± 46.30, respectively. Collection of macaque observational behavioral data (n=10/each survey site) was also implemented.
- Conducted behavioral risk investigations with 72 individuals through 40 ethnographic interviews and three focus group discussions in Kathmandu's Jadibuti informal settlement.
- Conducted site assessments and selected three clinics, the Patan Academic Health Center and Kantipur Hospital in Kathmandu and the Chitwan Medical College to conduct syndromic sampling of patients presenting with fevers of unknown origin.

Summary of Laboratory Development/Testing for the Period Oct. 2015-Sept. 2016:

- Conducted testing on saliva samples collected from 304 non-human primates during the wet and dry seasons for corona, paramyxo, influenza, filo, and flaviviruses; confirmation of PCR results is ongoing.
- Conducted testing for corona, paramyxo, influenza, and filoviruses on 148 mallard samples (69 oral and 79 cloacal specimens) and 227 rodent samples (107 oral, 107 rectal, and 13 blood specimens) collected at Jadibuti and Teku Dovan field sites.
- Cross-trained project staff on pipetting techniques, volume concept, concentration calculations, serum separation, and updated laboratory protocols, including biosafety and biosecurity, PPE, waste and bio-hazardous disposal, and viral detection protocols to optimize and increase throughput.

Summary of Stakeholder Engagement and Partner Coordination for the Period Oct. 2015-Sept. 2016:

- Maintained ongoing stakeholder relationships with the Central Veterinary Lab (CVL), FAO Nepal, Walter Reed/AFRIMS Research Unit Nepal (WARUN), WHO Nepal, the Department of National Parks and Wildlife Conservation (DNPWC), and the Patan Academy of Health Sciences (PAHS) for coordination for the implementation of PREDICT sampling activities at priority sampling sites.
- Participated in the Wildlife Disease Research Workshop hosted in Chitwan, Nepal (February 2016) and attended by governmental and non-governmental One Health stakeholders, which provided a forum to effectively and collectively evaluate needs for wildlife health surveillance in the country.

Other Activities this Period:

- Applied and received ethical approval from the Nepal Health Research Council (NHRC) for permission to conduct clinic and community based human syndromic surveillance research activities at selected locations in Kathmandu and Chitwan District.
- Conducted follow-up trainings on project operations, including in-depth training on the implementation of qualitative research at prioritized sites by the behavior team.
- Trained two local community field assistants to build capacity for surveillance of emerging viral threats in at-risk communities. Training covered biosafety, emergency preparedness, and sampling techniques to optimize surveillance and sampling activities.

Training Summary

A total of **24** individuals, including **16 men** and **eight women**, have been trained in Nepal since the start of PREDICT-2 activities in 2014. A number of individuals completed trainings in more than one subject.

Training Events by Topic*

Topic	Total Trainings	# Trainings by Government Personnel	# Trainings by Women	# Trainings by PREDICT staff	# Trainings by Students
Avian Sampling	8		1	8	
Basic Laboratory Safety	9		4	9	
Bat Sampling	6			6	
Biosafety and PPE	17		5	17	
Bushmeat Sampling	2			2	
CITI Biomedical Research	3		1	3	
CITI Social Behavioral	3		1	2	
Emergency Preparedness	8		1	8	
Implementing Cold Chain for Safe Sample Transport	12		3	12	
Lab Protocols and Diagnostics	4		2	4	
Livestock Sampling	4		1	4	
One Health Approach	6		3	6	
Other	5		2	5	
Packing and Shipping Biological Samples	12		4	12	
Policies and Plans	3			3	
Qualitative Research and Data Collection	7		4	7	
Rodent Sampling	8		1	8	
Safe Animal Capture and Sampling	4		1	4	
Safe Sample Transport and Storage	12		3	12	
Total	**133**	**0**	**37**	**132**	**0**

*Some individuals were cross-trained in multiple topics. Individuals may be represented in multiple rows per column and multiple columns.

IV. OVERALL TRAINING SUMMARY

SECTION 5. OVERALL TRAINING SUMMARY

STRENGTHENING THE ONE HEALTH WORKFORCE

Preparing for emerging disease threats requires investments in infrastructure, institutions, and human resources across a broad array of health and social systems to operationalize One Health platforms. In collaboration with country governments, Global Health Security Agenda, and EPT partners, PREDICT is committed to developing the infrastructure and core skills and capabilities required by today and tomorrow's One Health workforce.

Since the start of PREDICT-2 in October 2014, **PREDICT teams around the world have trained 913 individuals** (including **447 governmental personnel**, **329 in-service professionals**, and **137 students**), supporting the development of an extensive network of global One Health professionals prepared to lead and maintain long-term zoonotic disease surveillance efforts. From 2015 to 2016, trainings intensified in preparing for launch of field and lab activities with the number of trained individuals increasing by 169% (from 339 in 2014-2015 to 574 over the past year). Trainings to date covered a variety of One Health skills, including biosafety, ethics, field epidemiology and surveillance, data and information management, laboratory safety and viral detection, social sciences and behavioral risk investigations, and modeling and analytics.

Descriptions of these trainings are provided below; for details on trainings completed in each country please see Section 1 *(GHSA country reports)* and Section 3 *(Non-GHSA EPT-2 country reports)*.

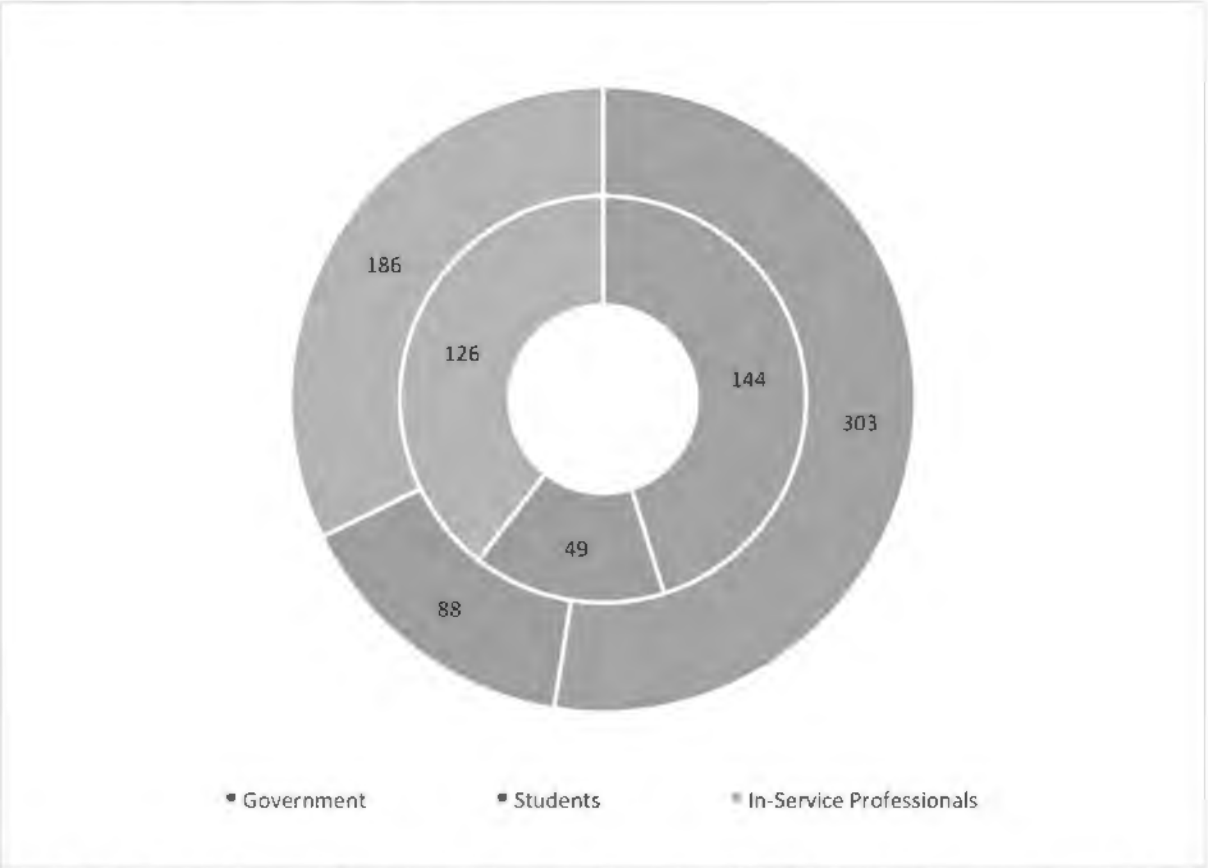
Total Number of Individuals Trained (October 2014 – November 2016)

	Total # of Individuals	Government Personnel	In-service Professionals*	Students
Female	319	144	126	49
Male	577	303	186	88
Undeclared	17		17	
Total to Date	**913**	**447**	**329**	**137**
2015-2016 Total	**574**	**241**	**239**	**94**
Increase from 2014-2015	**169%**	**117%**	**266%**	**219%**

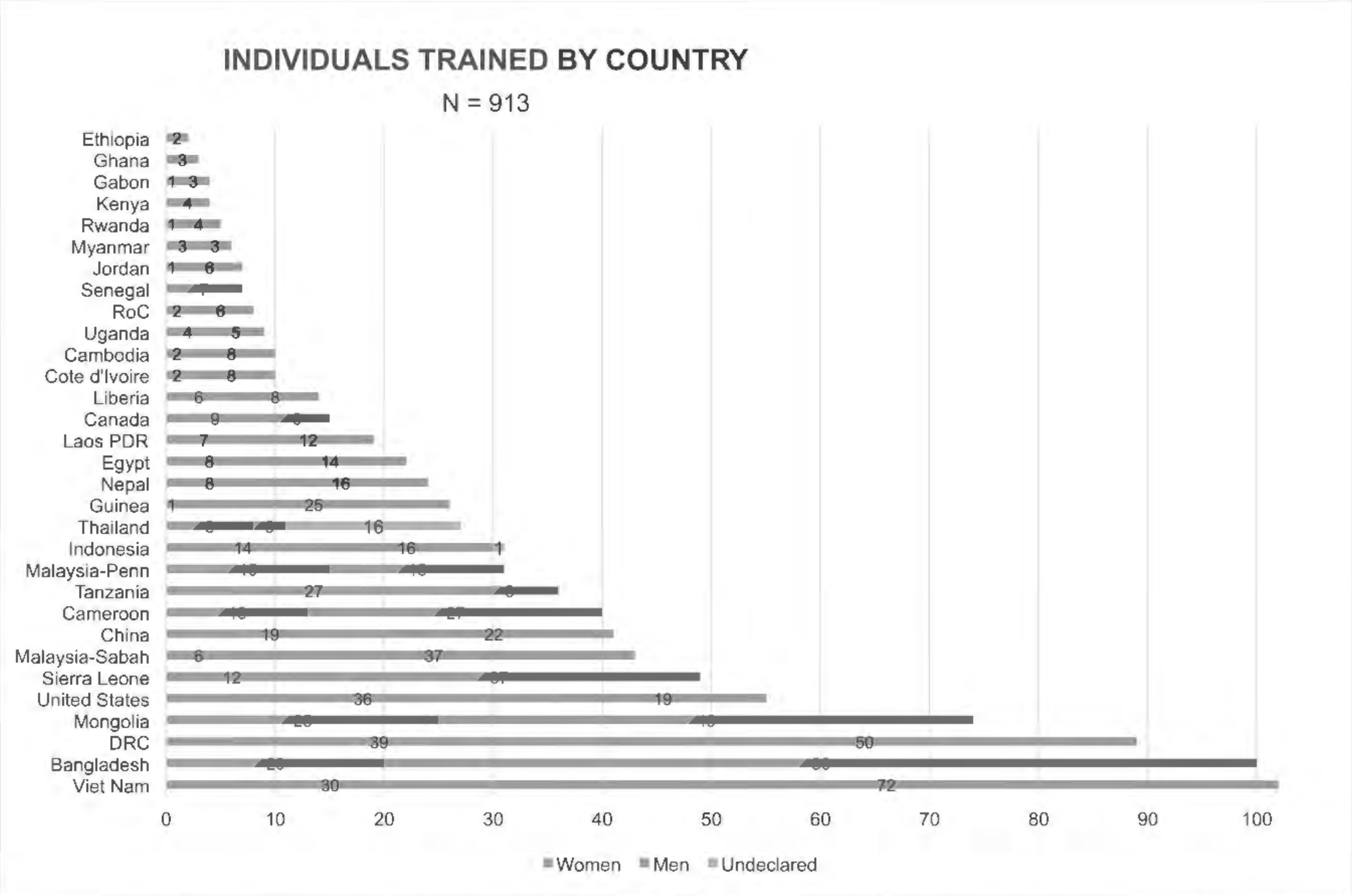
**Includes PREDICT staff.*

Note: Some individuals are represented in more than one category (e.g., Student and In-service Professionals).

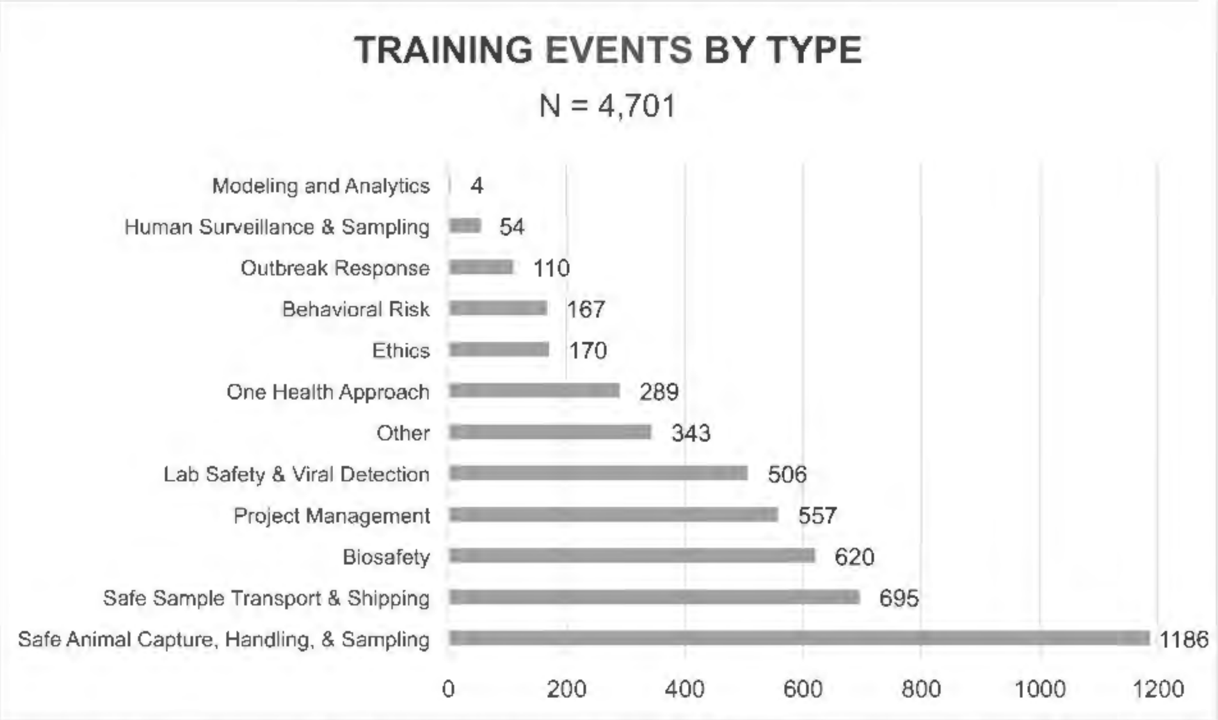
TRAINING BY GENDER AND SECTOR



Number of men (outer ring; N = 577) and women (inner ring; N = 319) trained by sector since the start of PREDICT-2 activities in 2014. Seventeen individuals of undeclared gender, all in-service professionals, are not shown in the figure.



Number of individuals trained by country and separated by gender. As of November 2016, a total of 913 individuals, including 577 men, 319 women, and 17 individuals of undeclared gender have been trained in 30 countries around the world.



Number of trainings completed by category since the start of PREDICT-2 activities in October 2014. A total of 4,701 trainings have been completed by PREDICT staff and local partners (including government staff in national health systems). Many individuals completed trainings in multiple topics.

PREDICT-2 TRAINING EVENTS BY COUNTRY (2014-2016)

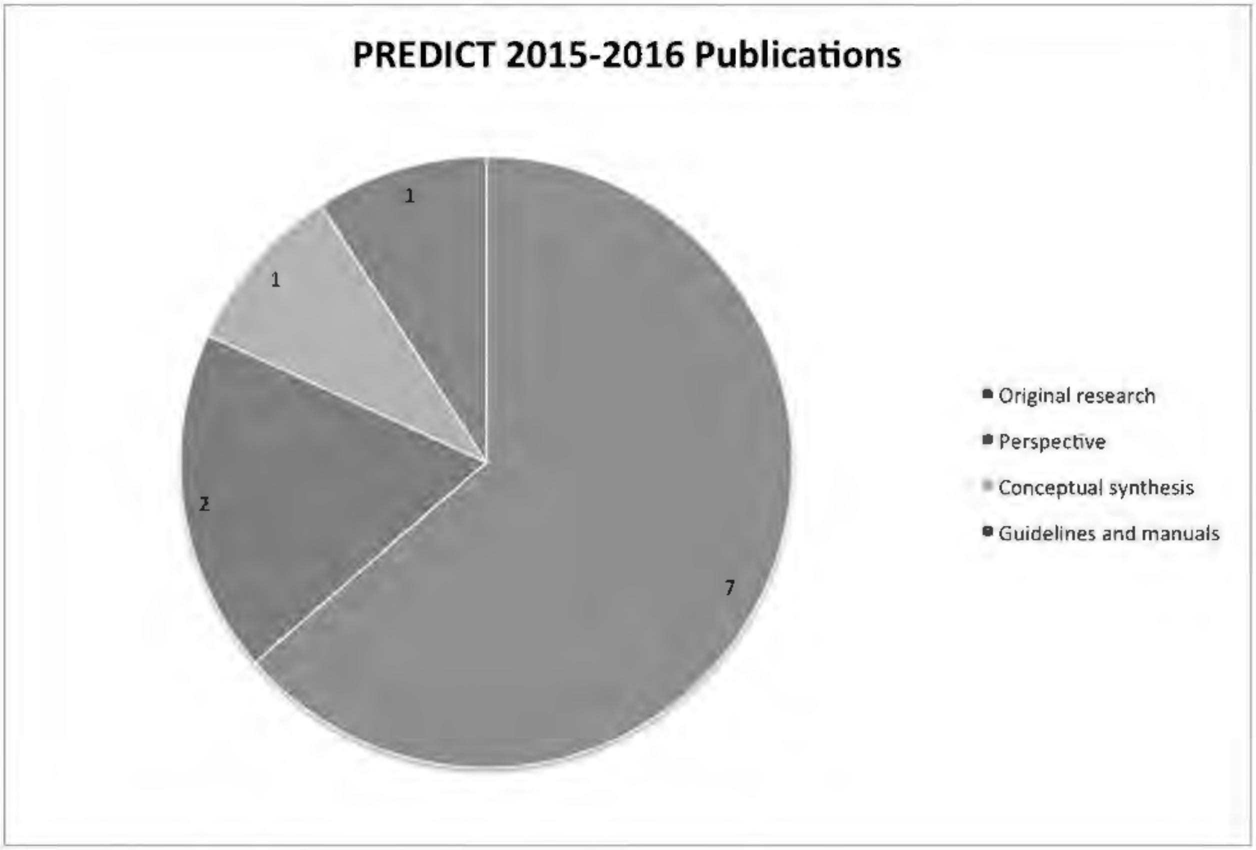
Country	Total # Trainings	# Trainings by Government Personnel	# Trainings by Women	# Trainings by PREDICT staff	# Trainings by Students
Bangladesh	171	36	23	61	78
Cambodia	111	33	22	56	22
Cameroon	228	48	62	90	228
Canada	111		48	109	
China	229	129	125	175	29
Cote d'Ivoire	39	7	2	29	2
Democratic Republic of the Congo	268	134	87	123	27
Egypt	168	168	70	20	
Ethiopia	31			31	11
Gabon	25		6	25	
Ghana	40	40		40	
Guinea	346		3	229	
Indonesia	206	106	80	57	1
Jordan	58	18	9	31	
Kenya	34	43		42	
Laos	143	92	41	55	
Liberia	55		24	30	
Malaysia	286	263	68	21	
Mongolia	311	280	114	22	
Myanmar	38		24	22	12
Nepal	133		37	132	
Republic of the Congo	94	75	16	64	
Rwanda	25		1	23	2
Senegal	6	6			
Sierra Leone	449	149	86	351	
Tanzania	125	5	68	66	33
Thailand	190		53	63	
Uganda	38	1	6	22	15
United States	474	54	289	405	10
Viet Nam	270	160	95	50	

Total number of trainings completed since the start of PREDICT-2 activities in October 2014 (data sourced on November 18, 2016). Individuals may be represented in multiple columns per row.

V. PUBLICATIONS

SECTION 5. PREDICT PUBLICATION SUMMARIES

This past year, PREDICT research led to 11 publications, including seven original research articles, many in top-tier journals like *Science, Emerging Infectious Diseases,* and *PLOS One*. Summaries of highlighted publications are provided below, showcasing practical implications for the scientific, policy, and development sectors. A comprehensive bibliography with all PREDICT publications to date may be found online at publications.predict.global



You can also follow PREDICT on ResearchGate to explore our current work, receive notifications of new publications, and interact with PREDICT's authors and research collaborators.

All summaries appearing herein were developed or reproduced with author permission.

ORIGINAL RESEARCH HIGHLIGHTS

Detection of viruses using discarded plants from wild mountain gorillas and golden monkeys

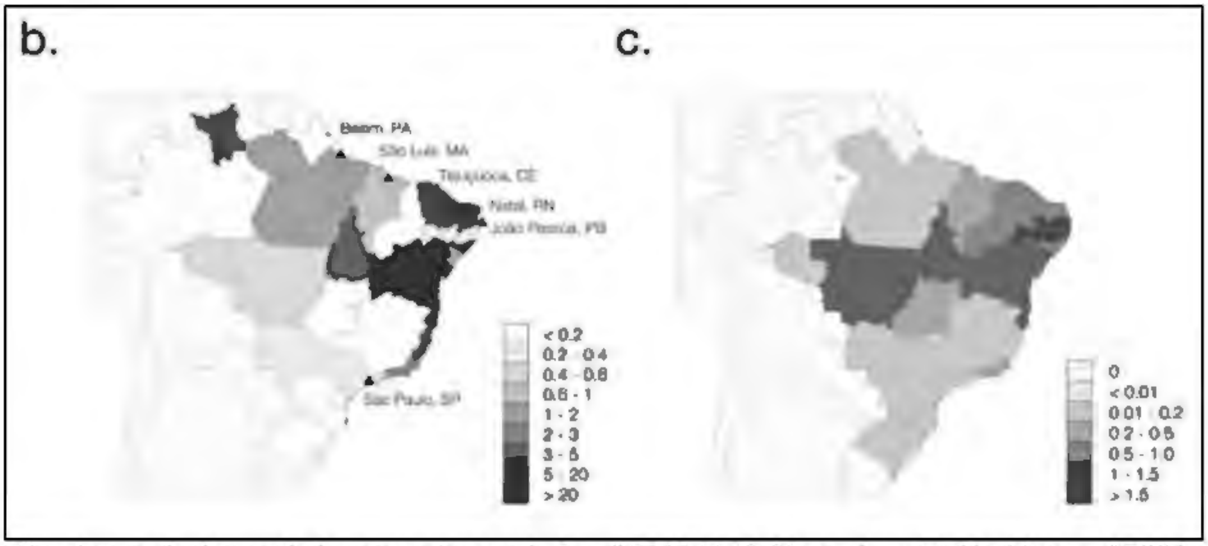
In brief: This study evaluated the potential use of discarded chewed plants from primates as a novel non-invasive biological sampling method to detect viruses that are shed orally. The authors tested plant samples discarded by mountain gorillas (*Gorilla beringei beringei)* and sympatric golden monkeys (*Cercopithecus mitis kandti*) for the presence of mammalian-specific genetic material and two ubiquitous DNA and RNA primate viruses, herpesviruses and simian foamy virus, respectively. The authors successfully recovered mammalian-specific genetic material from all plant species and portions of plant bitten or chewed by gorillas and golden monkeys. They more consistently recovered gorilla herpesviral DNA from plants in which leafy portions were eaten by gorillas. They also recovered simian foamy virus nucleic acid from plants discarded by golden monkeys, which indicates that this method also allows for detection of RNA viruses. This study demonstrated that discarded plants are a useful non-invasive sampling method for detection of viruses that are shed orally in mountain gorillas and sympatric golden monkeys and could potentially also be used in other species. This method offers an innovative sampling alternative that can be combined with collection of feces and urine to evaluate the most common routes of viral shedding in wild primates. Monitoring primate pathogens is important for detection of pathogens that could jump the species barrier, as well as primate population health and endangered species management.

A family of mountain gorillas in Volcanoes National Park, Rwanda. Photo: Tierra Smiley Evans/UC Davis

Citation: Smiley Evans, T., K. Gilardi, P. Barry, B. Ssebide, J. Felix Kinani, F. Nizeyimana, J. Bosco Noheri, D. Byarugaba, A. Mudikikwa, M. Cranfield, J.A.K. Mazet, C.K. Johnson. 2016. Detection of viruses using discarded plants from wild mountain gorillas and golden monkeys. *American Journal of Primatology*. doi: 10.1002/ajp.22576 Available online at: http://onlinelibrary.wiley.com/wol1/doi/10.1002/ajp.22576/full

Zika virus in the Americas: Early epidemiological and genetic findings

In brief: Zika virus (ZIKV) is a single stranded, positive-sense RNA virus in the family *Flaviviridae*, genus *Flavivirus*. It is transmitted among humans by *Aedes* mosquito species. The virus was first isolated in 1947 in Uganda and is classified into two genotypes, African and Asian. The Asian genotype recently caused epidemics in Micronesia (2007) and several Pacific Islands (2013–2014). In May 2015, ZIKV was reported for the first time in Brazil and subsequently in several countries of South and Central America and the Caribbean. In particular, Brazil has experienced an unprecedented ZIKV epidemic with ~30,000 cases reported until April 2016. With autochthonous transmission and high incidence in 22 out of its 27 states, ZIKV is now widespread in Brazil. Infection during pregnancy is thought to cause microcephaly and congenital abnormalities. Between November 2015 and 30th January 2016, 4,783 suspected cases of microcephaly were reported in Brazil. The authors selected 1,118 of these cases for analysis, using next generation sequencing to identify seven Brazilian ZIKV genomes from which they performed phylogenetic and molecular clock analyses. These analyses indicated a single introduction of ZIKV into the Americas, estimated to have occurred between May and December 2013, more than 12 months prior to the detection of ZIKV in Brazil, suggesting this timeframe overlaps with an increase in air passengers to Brazil from ZIKV endemic areas and Pacific Islands with recent or ongoing outbreaks. The failure to identify ZIKV early is attributed to an overlap in symptoms with Chikungunya and dengue fever. The team also showed that ZIKV genomes from Brazil are phylogenetically related to those from other South American and Caribbean countries, suggesting it was first introduced to Brazil and then spread throughout the continent. The data presented here provides an invaluable baseline for future studies of the evolution and molecular epidemiology in the Americas of this emerging virus.



Zika virus and microcephaly reported cases in Brazil 2015-2016. Maps show total incidence of ZIKV cases (b) and suspected microcephaly cases (c) per 100,000 people in each state.

Citation: Rodrigues Faria, N., Azevedo Rdo S, Kraemer MU, Souza R, Cunha MS, Hill SC, Thézé J, Bonsall MB, Bowden TA, Rissanen I, Rocco IM, Nogueira JS, Maeda AY, Vasami FG, Macedo FL, Suzuki A, Rodrigues SG, Cruz AC, Nunes BT, Medeiros DB, Rodrigues DS, Nunes Queiroz AL, da Silva EV, Henriques DF, Travassos da Rosa ES, de Oliveira CS, Martins LC, Vasconcelos HB, Casseb LM, Simith Dde B, Messina JP, Abade L, Lourenço J, Carlos Junior Alcantara L, de Lima MM, Giovanetti M, Hay SI, de Oliveira RS, Lemos Pda S, de Oliveira LF, de Lima CP, da Silva SP, de Vasconcelos JM, Franco L, Cardoso JF, Vianez-Júnior JL, Mir D, Bello G, Delatorre E, Khan K, Creatore M, Coelho GE, de Oliveira WK, Tesh R, Pybus OG, Nunes MR, Vasconcelos PF. 2016. Zika virus in the Americas: Early epidemiological and genetic findings. *Science*. doi: 10.1126/science.aaf5036. Available online at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4918795/

Fugong virus, a novel hantavirus harbored by the small oriental vole (*Eothenomys eleusis*) in China

In brief: Rodents are natural reservoirs of hantaviruses (genus *Hantavirus*, family *Bunyaviridae*). These viruses cause hemorrhagic fever with renal syndrome in Eurasia and hantavirus pulmonary syndrome in the Americas. To date, 23 distinct species of hantaviruses have been identified worldwide, yet the full diversity of these viruses is very likely underestimated. The team sampled 189 animals, including 15 species belonging to 10 genera, 5 families, and 4 orders in Fugong county, Yunnan province, China and found seven positive species for hantavirus: *Eothenomys eleusis* (42/94), *Apodemus peninsulae* (3/25), *Niviventer eha* (3/27), *Cryptotis montivaga* (2/8), *Anourosorex squamipes* (1/1), *Sorex araneus* (1/1), and *Mustela sibirica* (1/2). The full-length genomic sequence was identified as of a novel virus and named fugong virus (FUGV). It is most closely related to hantavirus LX309, a virus found in another vole species. Given the high prevalence and diversity of hantaviruses in the *Eothenomys* genus, additional investigations should be considered.

Citation: Ge, X-Y, W-H Yang, H. Pan, J-H Zhou, X. Han, G-J Zhu, J.S. Desmond, P. Daszak, Z-L Shi, Y-Z Zhang. 2016. Fugong virus, a novel hantavirus harbored by the small oriental vole (Eothenomys eleusis) in China. *Virology Journal, 13*(27). doi: 10.1186/s12985-016-0483-9. Original article available online at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4754816/; Erratum including PREDICT acknowledgement available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4858850/

Wildlife trade and human health in Lao PDR: An assessment of the zoonotic disease risk in markets

In brief: Although the majority of emerging infectious diseases can be linked to wildlife sources, most pathogen spillover events to people could likely be avoided if transmission was better understood and practices adjusted to mitigate risk. Wildlife trade can facilitate zoonotic disease transmission and represents a threat to human health and economies in Asia, as well as a serious threat for biodiversity conservation. To asses the combined impacts of Asian wildlife trade on public health and biodiversity, this work evaluated surveys from markets selling wildlife in Lao PDR (2010 to 2013) and recorded information on volume, form, species, and price of wildlife; market biosafety; and visitor origin. The potential for traded wildlife to host zoonotic diseases was then evaluated at the seven markets with highest volumes of trade. During 21 surveys, 1,937 alive or fresh dead mammals were recorded (approximately 1,009 kg) for sale, including mammals from 12 taxonomic families previously documented to be capable of hosting 36 zoonotic pathogens. Furthermore, to examine the potential conservation impact of trade in markets, the status of 33,752 animals observed during 375 visits to 93 markets was assessed. Of these animals, 6,452 were found listed by Lao PDR as near extinct or threatened with extinction. In these markets, the combination of high wildlife volumes, high-risk taxa for zoonoses, and poor biosafety increases the potential for pathogen presence and transmission. The combined risks of wildlife trade in Lao PDR to human health and biodiversity highlight the need for a multisectoral approach to effectively protect public health, economic interests, and biodiversity.

Wildlife for sale at a market in Lao PDR. Photo: WCS/Zoe Greatorex.

Citation: Greatorex, Z.F., S.H. Olson, S. Singhalath, S. Silithammavong, A.E. Fine, W. Weisman, B. Douangngeun, W. Theppangna, L. Keatts, M. Gilbert, W.B. Karesh, T. Hansel, S. Zimicki, K. O'Rourke, D.O. Joly, J.A.K. Mazet. 2016. Wildlife trade and human health in Lao PDR: An assessment of the zoonotic disease risk in markets. *PLOS One.* doi: 10.1371/journal.pone.0150666 Available online at: http://dx.plos.org/10.1371/journal.pone.0150666

Detection and identification of coxsackievirus B3 from sera of an Indonesian patient with undifferentiated febrile illness

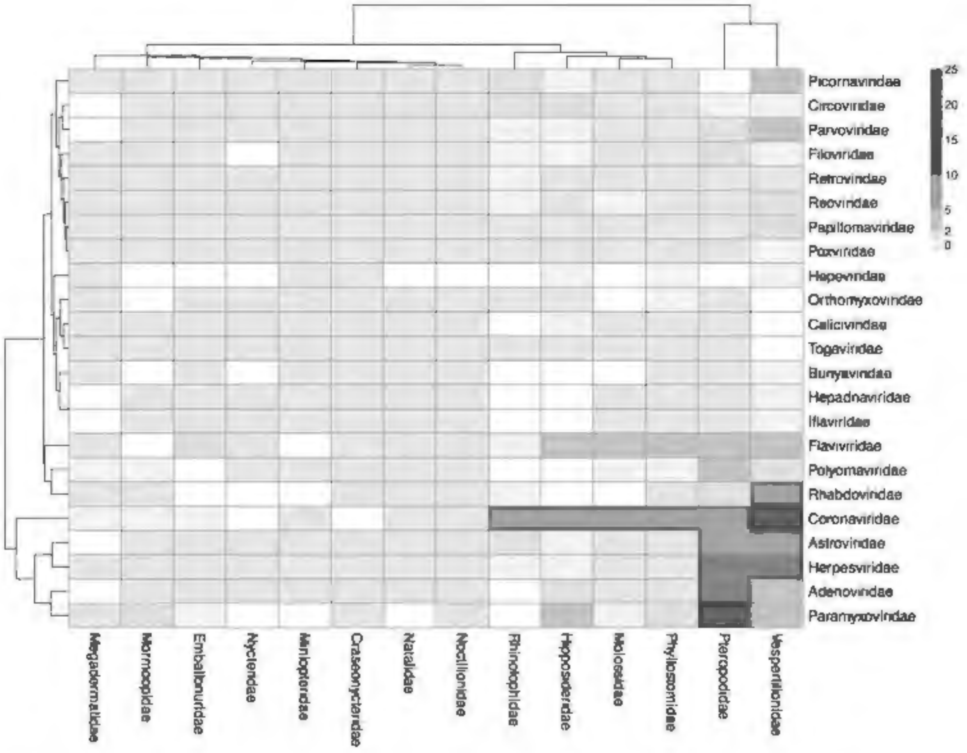
In brief: Coxsackievirus B3 (CVB3) is a non-enveloped single-stranded positive-sense RNA virus of the Picornaviridae family. CVB3 is an important human pathogen and has been associated with type 1 diabetes mellitus, myopericarditis, aseptic meningitis, herpangina, pancreatitis, and hand, foot, and mouth diseases (HFMD). Infections from this virus can be fatal, especially among infants and pregnant women, in whom it may also cause fetal growth retardation and miscarriage. It was identified during a recent outbreak of HFMD in China and France. This publication represents the first-ever detection of a CVB3 infection in Indonesia. Samples from factory workers who displayed symptoms of acute febrile illness were screened via Enterovirus genus-level PCR. In one patient who presented with symptoms of fever, headache, myalgia, and nausea, CVB3 virus exposure was confirmed. The virus found showed 97% homology to a CVB3 virus previously isolated in Taiwan. Further surveillance to characterize CVB3 virus circulation in Indonesia to determine if this was an isolated case or outbreak or if the virus is endemic was recommended.

Citation: Wiyatno, A., U. Antonjaya, C.Nisa Ma'roef, S.F. Riswari, H. Djauhari, I.M. Artika, C. Monagin, B.S. Schneider, K.S. Myint, B. Alisjahbana, D. Safari, H. Kosasih. 2016. Detection and identification of coxsackievirus B3 from sera of an Indonesian patient with undifferentiated febrile illness. *The Journal of*

Infection in Developing Countries, 10(8): 880-883. doi: 10.3855/jidc.7573 Available online at: http://www.jidc.org/index.php/journal/article/view/27580335

Optimizing Viral Discovery in Bats

In brief: While emerging infectious diseases may spillover from various wildlife species, bats have been found to be a primary reservoir for numerous recent zoonoses of global concern, such as Ebola, Marburg, Nipah, and Middle Eastern Respiratory Syndrome (MERS-) and Severe Acute Respiratory Syndrome (SARS)-like coronaviruses. Second only to rodents in numbers of living genera and species, bats comprise one of the most diverse and ecologically important groups of mammals. The team analyzed patterns of viral discovery in bats from 93 peer-reviewed papers published from 2007–2013 to identify the most efficient approach to identifying novel pathogens in this taxa. A total of 60,416 specimens from 44,322 bats (17 families, 110 genera, and 340 species) were collected and tested across all published studies over the time-period examined. Overall, the number of bat species sampled and the number of novel and total viruses found per year have been increasing. Viruses from 24 viral families and 248 putative novel viruses were detected; 9.83% of these positive reports by serology and 2.22% by PCR assays. Major taxonomic gaps in recent bat viral discovery efforts were identified, suggesting ways to improve future viral detection through the design of more efficient and targeted sample collection and screening approaches. The data provided in this study can be used to streamline future bat viral discovery efforts through better study design, the adoption of non-invasive field collection methods, identification of taxonomic gaps in discovery efforts, and focusing of efforts on the host species and specimens most likely to result in detection for pathogens of interest.



Heat map of viral richness by host and viral families, clustered by host and viral families. Source: Young and Olival, 2016 (http://dx.doi.org/10.1371/journal.pone.0149237.g005).

Citation: Young, C.C.W., K.J. Olival. 2016. Optimizing Viral Discovery in Bats. *PLOS One* 11: 2. doi: 10.1371/journal.pone.0149237. Available online at: http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0149237

PERSPECTIVE

Joint China-US call for employing a transdisciplinary approach to emerging infectious diseases

In brief: Despite intensive, high-quality research efforts globally, we are still not able to predict which viruses will become pathogenic to people; which will cause new epidemics in animals; nor where and under what circumstances disease will emerge. To address this pending challenge, the National Science Foundations of both China and the United States convened a small working group of infectious disease experts representing the Chinese Academy of Sciences, academia in both countries, private research institutes, China Centers for Disease Control, and US National Institutes of Health. The need for expanding collaborative, interdisciplinary work was clear. To this extent, the working group agreed that China and the US are well positioned to lead a call for an ambitious and scientifically sophisticated program that yields relevant, high quality science, and sets examples for best practices around the world, through a collaborative and open communication framework. Specifically, the experts further agreed that increasingly collaborative, transdisciplinary attention is needed for a detailed understanding of the drivers of disease emergence and their implications and associated recommendations for infectious disease control. The drivers identified by the group as in most immediate need for increased effort were a) landscape change; b) migration, transportation, and trade; c) economic development and food preferences; and d) climate variability and change. By working more closely together, the world can head off the threat of pandemics with benefits for science, health, ecological integrity, and economic well-being.

Citation: Mazet, J.A.K., Q. Wei, G, Zhao, D.A.T. Cummings, J.S. Desmound, J. Rosenthal, C.H. King, W. Cao, A.A. Chmura, E.A. Hagan, S. Zhang, X. Xiao, J. Xu, Z. Shi, F. Feng, X. Liu, W. Pan, G. Zhu, L. Zuo, P. Daszak. 2015. Joint China-US call for employing a transdisciplinary approach to emerging infectious diseases. *EcoHealth* 12(50). doi: 10.1007/s10393-015-1060-1. Available online at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4700097/pdf/10393_2015_Article_1060.pdf

To cull, or not to cull, bat is the question

In brief: Bats are an extremely diverse group of mammals with over 1300 species, second in diversity only to rodents within the Mammalia. Furthermore, each species has ecological, evolutionary, and life history traits that make it a unique and integral component of the ecosystem in which it is found. Currently, one third of all bat species around the world are considered threatened or lack sufficient data to assess their conservation status. Major recognized threats to bats are habitat destruction and hunting for human food. Moreover, an emerging threat is a call for culling bat populations to mitigate conflict with farmers and reduce zoonotic disease risks. In this paper, culling bats is identified as an inhumane and ineffective way to mitigate conflict with fruit growers and that the ecological disruption of culling would be likely to increase the risk of disease emergence in the human population. The ecosystem services derived from bats, such as crop pollination and insect control, also lead to food security and vector-borne disease control – the lack of which would clearly impact human populations.

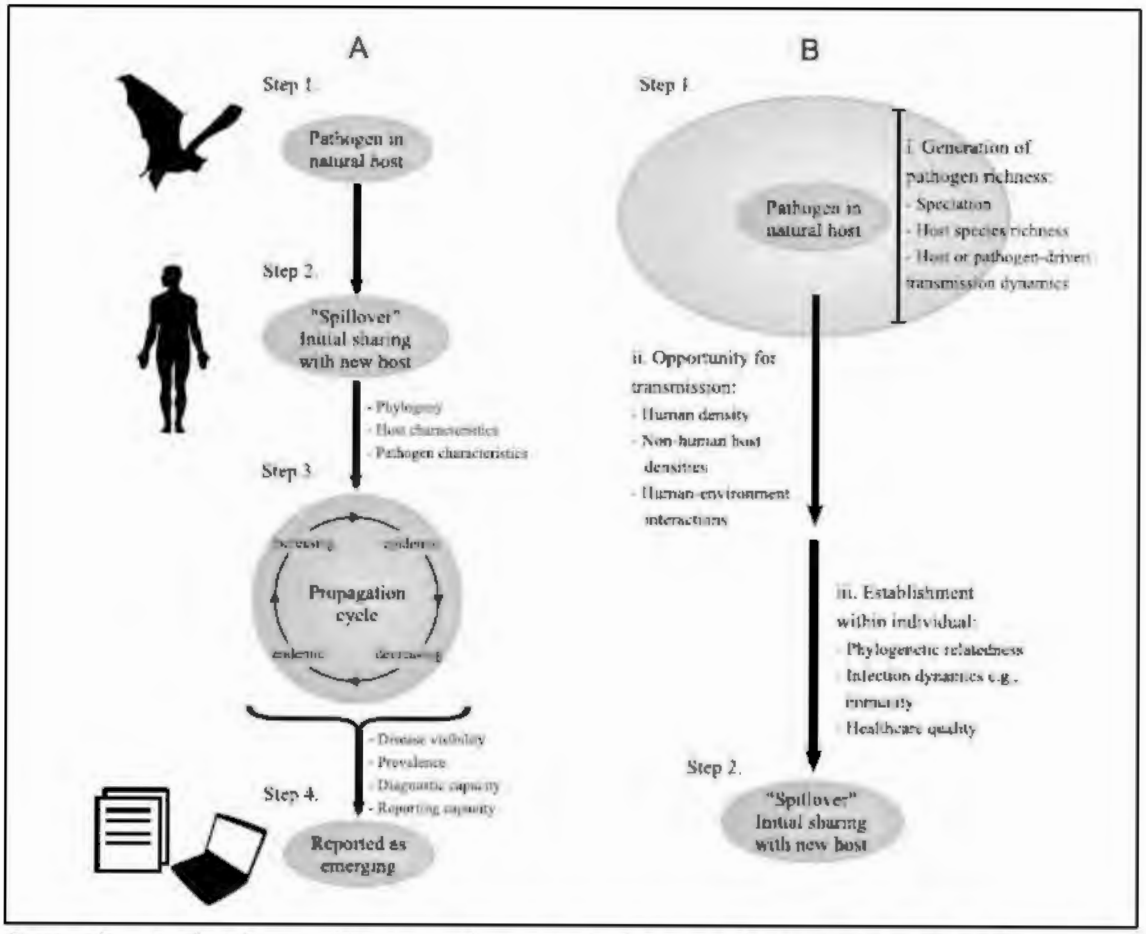
*Fruit bat (*Eidolon helvum*) in a mist net in Tanzania. Photo: PREDICT/Tanzania.*

Citation: Olival, K.J. 2015. To cull, or not to cull, bat is the question. *EcoHealth*, 12. doi: 10.1007/s10393-015-1075-7. Available online at: https://www.ecohealthalliance.org/wp-content/uploads/2016/11/Olival_Cull_EH-2015.pdf

CONCEPTUAL SYNTHESIS

Quantifying global drivers of zoonotic bat viruses: A process-based perspective

In brief: Emergence of zoonotic diseases is often driven by anthropogenic activity, such as travel and land use change. Multiple steps, from initial zoonotic transmission to human-to-human spread, are part of disease emergence frameworks. A process-based framework to analyze components of individual steps in disease emergence was created, focused on early phases of emergence and processes leading to pathogen richness, transmission opportunity, and establishment, each with its own hypothesized drivers. Models were built in a spatial context so priority high-risk regions (hotspots) could be identified and to further understand the biogeographic determinants of these patterns. The synthesis model confirms that drivers of both viral richness (host diversity and climatic variability) and transmission opportunity (human population density, bushmeat hunting, and livestock production) are associated with virus sharing between humans and bats. Beyond basic spatial gradients of pathogen and host diversity, anthropogenic activity is a significant determinant of the global distribution of emerging diseases. The practical recommendation is that high-priority sites for pathogen discovery and surveillance in wildlife (i.e. hotspots of viral richness) may not necessarily coincide with those for public health intervention (i.e. bushmeat regulation and reducing bat-human or bat-livestock contact).

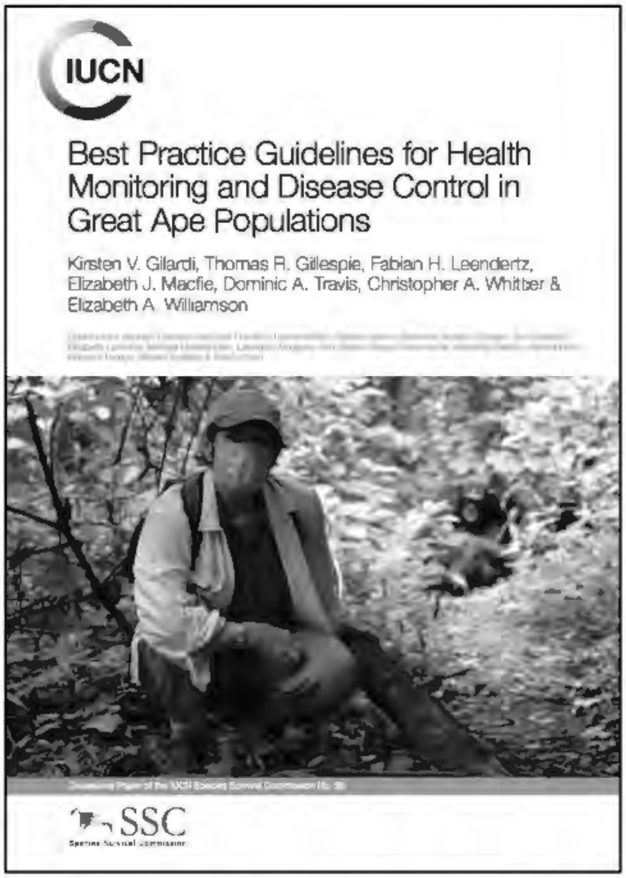


Determinants of pathogen richness and opportunity for transmission and constructed process-based models to better characterize spillover. Source: Brierley et al., 2016.

Citation: Brierley, L., M.J. Vonhof, K.J. Olival, P. Daszak, K.E. Jones. 2016. Quantifying global drivers of zoonotic bat viruses: A process-based perspective. *The American Naturalist, 187*(2). doi: 10.1086/684391. Available online at: http://www.journals.uchicago.edu/doi/10.1086/684391

GUIDELINES AND MANUALS (in addition to PREDICT protocols and guides in the eBook)

IUCN Best Practice Guidelines for Health Monitoring and Disease Control in Great Ape Populations



IUCN

Best Practice Guidelines for Health Monitoring and Disease Control in Great Ape Populations

Kirsten V. Gilardi, Thomas R. Gillespie, Fabian H. Leendertz, Elizabeth J. Macfie, Dominic A. Travis, Christopher A. Whittier & Elizabeth A. Williamson

SSC

In brief: Due to their phylogenetic relatedness, great apes and humans share susceptibility to many diseases. As great ape tourism becomes more popular, great ape research more imperative, and landscape conversion more rampant, the risk that human pathogens will be introduced to immunologically naïve wild populations, leading to catastrophic losses of great apes, becomes greater. Therefore, it is critical that tourism and research projects involving close proximity between great apes and people assess the risks entailed and establish and implement disease prevention and control measures. These guidelines provide governments, policy makers, conservation practitioners, researchers, great ape tourism professionals and funding agencies with recommendations of best practices for great ape health monitoring and disease prevention. Recommendations are primarily aimed at preventing or controlling disease spread. They advise continual monitoring of the health of great apes to improve current knowledge of great ape population health, determine the effectiveness of disease prevention and health management strategies implemented, and provide a basis for conducting responsible and reasonable health interventions when needed.

Citation: Gilardi, K.V., T.R. Gillespie, F.H. Leendertz, E.J. Macfie, D.A. Travis, C.A. Whittier, E.A. Williamson. 2015. *IUCN Best Practice Guidelines for Health Monitoring and Disease Control in Great Ape Populations.* IUCN, 56. ISBN: 978-2-8317-1274-1. Available online at: https://portals.iucn.org/library/sites/library/files/documents/SSC-OP-056.pdf

VI. FEATURED PRODUCTS


ONE HEALTH IN ACTION


USAID FROM THE AMERICAN PEOPLE | EMERGING PANDEMIC THREATS

One Health Lessons from PREDICT: Approaches to support sustained collaborations

Building partnerships to prevent pandemics using a One Health approach.


2016

PREDICT Operating Procedures


EMERGING DISEASE INSIGHTS

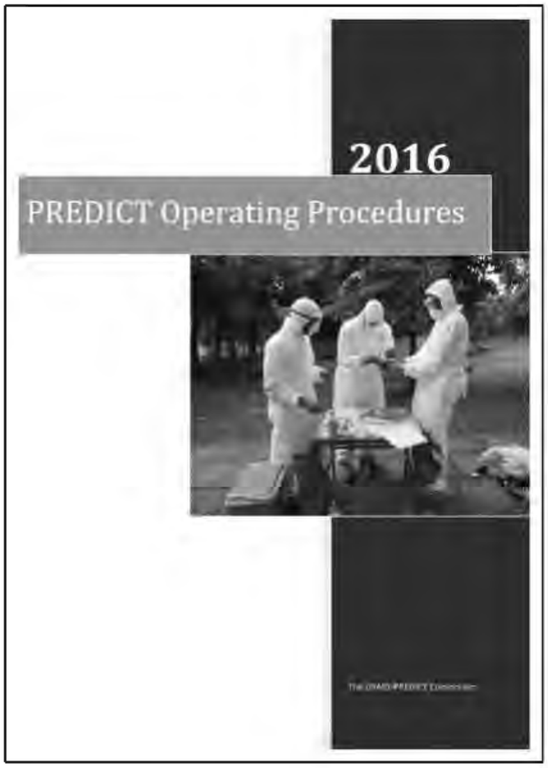
Research from the PREDICT Modeling & Analytics team

SECTION 6. FEATURED PRODUCTS

6.1. Sharing Knowledge and Tools to Conduct Surveillance for Zoonotic Viral Threats

PREDICT continued to expand, refine, and roll out One Health toolkits to conduct surveillance for zoonotic viral threats in 2015-2016, providing staff and health professionals around the world with training guidelines, protocols, and methods to sample animal and human populations, detect high-risk viruses, and identify the human behaviors associated with risks of pathogen spillover, amplification, and spread.

PREDICT's experts in animal field sampling, biosafety, laboratory safety, behavioral risk, and other key fields updated and enhanced project training materials, increasing the total number of project-developed training guides to 30 (at over 600 pages), including French translations for seven guides, providing critical resources to help grow the knowledge base and One Health skillsets for viral surveillance around the world.



PREDICT's Operating Procedures eBook features 30 training guides and provides additional resources to teams developing One Health surveillance and risk mitigation skills around the world. Several are available to the public and can be accessed at http://publications.predict.global

A 16-unit subset of these training guides (including French translations when available) is now available online for the global health and development community at: http://publications.predict.global

PREDICT Public Training Guides

General Information

- Basic Laboratory Safety (English-pdf, French)
- Biosafety and PPE Use (English-pdf, French)
- Emergency Preparedness (English-pdf, French)
- Implementing Cold Chain for Safe Sample Transport and Storage (English-pdf)
- Packing and Shipping Biological Samples (English-pdf)
- QGIS User Guide (English-pdf)

Field Sampling Guides

- Avian Sampling Methods (English-pdf)
- Bat Sampling Methods (English-pdf, French)
- Bushmeat Sampling Methods (English-pdf)
- Livestock Sampling Methods (English-pdf)
- Non-Human Primate Sampling Methods (English-pdf)
- Rodent Sampling Methods (English-pdf)
- Safe Animal Capture and Sampling (English-pdf)
- Small Carnivore Sampling Methods (English-pdf)

Qualitative Research Guides

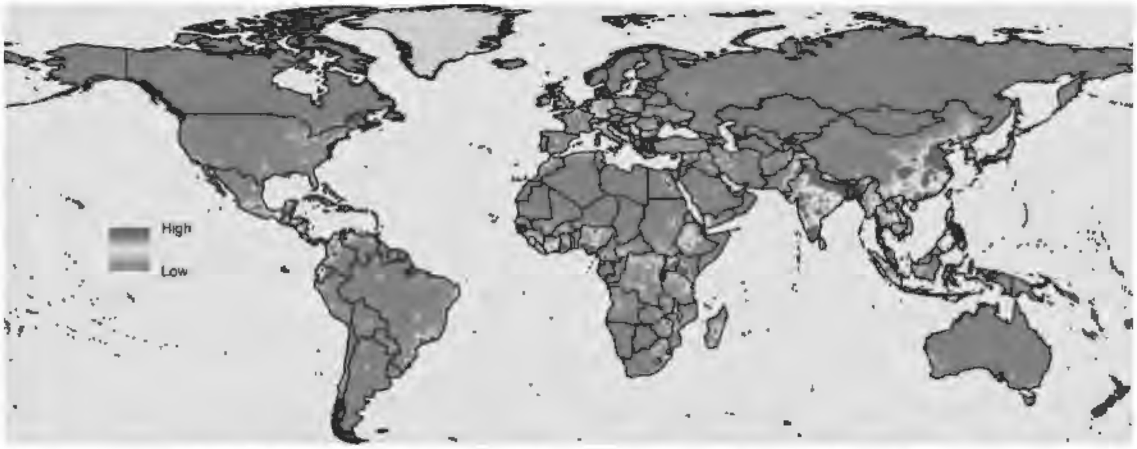
- Qualitative Research: Introduction & Observational Research Methods (English-pdf)
- Qualitative Research: Focus Groups, Ethnographic Interviews, & Data Analysis (English-pdf)

Also this year, PREDICT developed specialized instruments for qualitative research activities in Guinea and Sierra Leone, where project staff will administer questionnaires, perform in-depth ethnographic interviews, and conduct focus groups as part of targeted Ebola Host Project activities. These new tools (provided in the accompanying appendix) ensure that investigations will be systematic, standardized, and strong enough to help bring the Ebola virus' wild animal reservoir host or hosts into focus.

6.2. Emerging Disease Insights: Modeling and analytics for improved understanding of zoonotic disease spillover, amplification, and spread

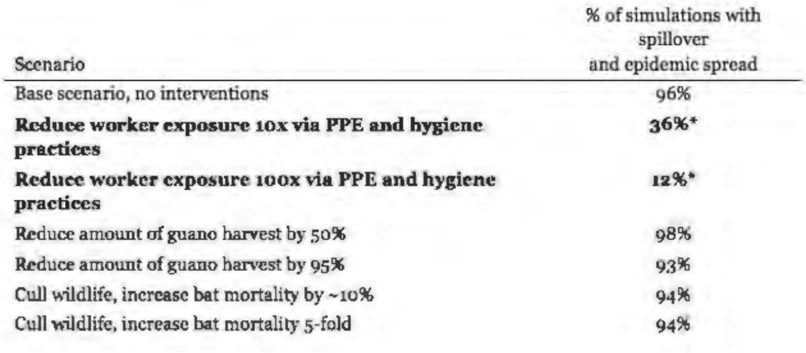
In 2016, PREDICT's Modeling and Analytics team released the results of several analyses intended to improve our understanding of the dynamics of zoonotic disease spillover, amplification, and spread. These five briefs can be found online at the Modeling and Analytics team Live Science page. Key insights and direct links to PDFs of each brief are featured below.

In **Mapping Hotspots of Emerging Zoonoses**, "the PREDICT-2 Modeling & Analytics team advances on previous work, focusing on the mechanisms driving emergence of zoonoses from wildlife (these are the diseases most often responsible for pandemic risk)." In the brief, PREDICT examined "a broader set of potential drivers, used updated and refined data sets, incorporated advanced machine-learning techniques, and developed new ways to estimate and account for reporting bias and uncertainty in the information available." The resulting analysis and "new map of EID hotspots shows that the highest risk of new zoonotic EID emergence is concentrated in tropical regions with high wildlife biodiversity, dense and growing human populations, and rapid land use change. These are the places where the next pandemic is most likely to originate, and therefore most valuable for surveillance in wildlife, livestock or people."



Heat map of predicted relative risk of zoonotic EID events, taking into account bias and under-reporting. Green indicates lowest risk, yellow mid-level risk, and red is the highest. Source: Mapping Hotspots of Emerging Zoonoses: *http://livescience.ecohealthalliance.org/predict/reports/2016-07-11-hotspots2.pdf*

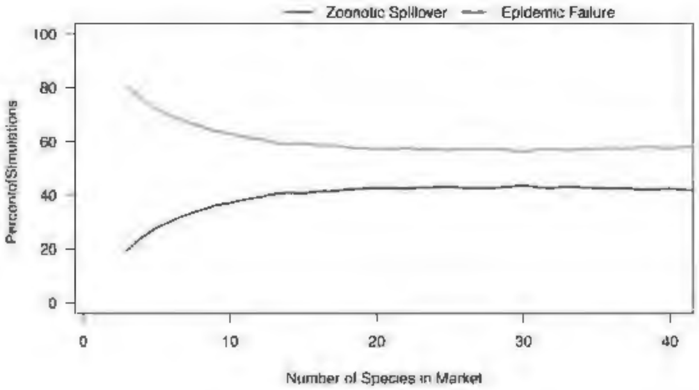
In **Simulating Outbreak Scenarios: Novel Bat Coronavirus from Guano Harvest**, a hypothetical scenario is used to examine "what might occur if one of the viruses discovered through the PREDICT-1 project spilled over into humans. We also examine ways to reduce this risk. In 2013, the PREDICT project discovered a novel beta-Coronavirus in bat guano in Thailand. This virus does not currently pose a known threat to human health, but its presence in bat guano, which is harvested in Thailand for use in fertilizer and in other countries for traditional medicine, highlights a potential pathway for viruses to emerge. This scenario hypothesizes that a different strain or alternate coronavirus with pathogenicity similar to SARS-CoV emerges from bat guano. It allows us to test the efficacy of various intervention strategies, and explore how analysis of air travel networks could be used to anticipate the spread of such a virus."



Scenario	% of simulations with spillover and epidemic spread
Base scenario, no interventions	96%
Reduce worker exposure 10x via PPE and hygiene practices	**36%***
Reduce worker exposure 100x via PPE and hygiene practices	**12%***
Reduce amount of guano harvest by 50%	98%
Reduce amount of guano harvest by 95%	93%
Cull wildlife, increase bat mortality by ~10%	94%
Cull wildlife, increase bat mortality 5-fold	94%

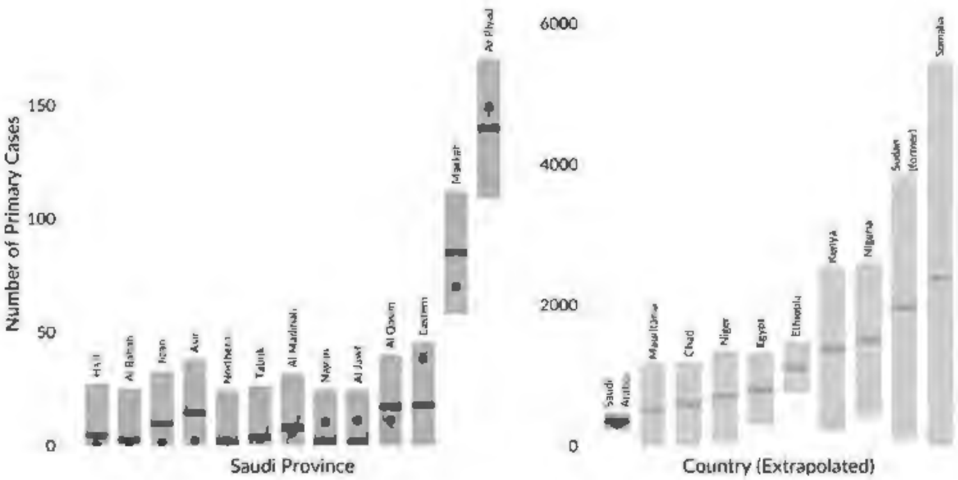
Findings from the brief demonstrate the potential impact an intervention using personal protective equipment and hygiene could have in reducing the risk of viral spillover to workers harvesting and using bat guano. Source: Simulating Outbreak Scenarios: Novel Bat Coronavirus from Guano Harvest: http://livescience.ecohealthalliance.org/predict/reports/2016-07-11-bat-guano-coronavirus.pdf

The brief, **Market Size and Avian Influenza Strain Spillover Risk** uses models to explore how the risk of spillover and the drivers of viral evolution likely change along the animal value chain by modeling a typical live bird market with 500 animals and species diversity from three to 40 animals "compared against the introduction of a novel virus of a single genotype, in one specific host in the 'virtual market'". Scenarios reveal that risk for zoonotic disease spillover increases relative to species diversity at the market, regardless of market size. Findings support existing market studies by showing that targeting surveillance at markets where risk is greatest (e.g., markets where wild birds and poultry comingle near wetlands vs. those with only ducks and chickens) would increase the chances for identifying the origins of future avian influenza pandemics.



A figure illustrating how the risk of zoonotic spillover (in this case avian influenza from animals to people), and epidemic failure (the inability of a novel virus to spread among animals within a market) changes depending on the diversity of species in the market. Source: Market Size and Avian Influenza Strain Spillover Risk: http://livescience.ecohealthalliance.org/predict/reports/2016-07-11-bat-guano-coronavirus.pdf

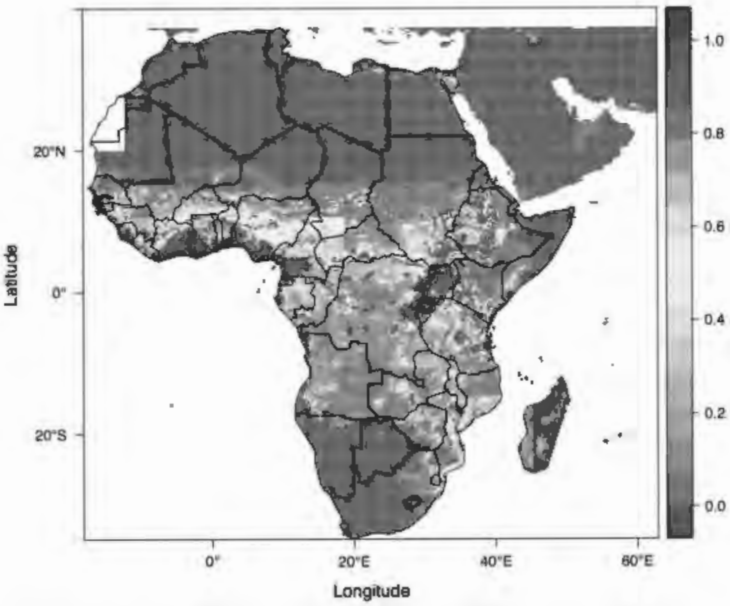
In the brief **MERS-CoV Surveillance in Africa**, PREDICT explores why there have been no human cases of Middle East Respiratory Syndrome (MERS) in Africa despite evidence that MERS Coronavirus has been circulating for several decades in camels. By collating previous evidence of MERS-CoV circulation in camels and data on camel and human population densities, modelers “estimate the potential human MERS burden” in countries where the virus has been detected and “developed a model of MERS-CoV circulation dynamics in camel herds”. Findings reveal that MERS-CoV infections are most likely found in juvenile camels during or immediately after calving season, and along with camel value chain “at markets, trade points, and slaughterhouses where young camels from small herds aggregate.” Model results have important implications for targeting surveillance for MERS-CoV in camels to “more precisely identify the locations, periods, and conditions that result in high spillover risk”.



In this figure “Missing MERS cases in Africa”, a model from Saudi Arabia (left) shows that the number of primary MERS cases can be predicted by the interaction of human and camel populations. These findings are extrapolated to African countries (right) with model findings suggesting MERC-CoV could cause thousands of human cases if the virus behaves in Africa as it has in the Arabian Peninsula. Source: MERS-CoV Surveillance in Africa: http://livescience.ecohealthalliance.org/predict/reports/2016-01-08-mers-cov-in-africa.pdf

The brief **Distribution and Seasonality of Potential Ebola Bat Reservoirs**, highlights results from work conducted to help predict the spatial occurrence of 10 African bat species that have tested positive for Ebola virus exposure and provides recommendations for targeting surveillance. Through a literature review, the team consolidated known information on the bats, their reproductive seasonality, and other life-cycle characteristics and produced ensemble ecological niche models that highlight widespread risk of future Ebola virus spillover across West and Central Africa. These maps also have utility for targeting surveillance, and findings from life history analysis support PREDICT’s existing surveillance approach, which is examining seasonality as viral shedding can vary over time.

Stacked ecological niche models for 10 African bat species that potentially harbor Ebola virus. Source: Distribution and Seasonality of Potential Ebola Bat Reservoirs: http://livescience.ecohealthalliance.org/predict/reports/2016-01-08-ebola-bat-reservoir-distribution.pdf



6.3. Strengthening One Health Networks and Partnerships

On a country basis and at a global level, PREDICT enables and supports implementation of One Health practices. Toward this goal, PREDICT has worked closely with a wide range of government ministries, scientific institutions, local organizations, and other stakeholders to further One Health initiatives.

These initiatives have taken the form of inter-ministerial data sharing and interpretation, interdisciplinary capacity building and surveillance, and coordinated outbreak response activities. Building on these best practices, PREDICT worked with Emerging Pandemic Threats program partners in 2015-2016 to develop an evidence base to demonstrate the value of the One Health approach.

USAID | EMERGING PANDEMIC THREATS
FROM THE AMERICAN PEOPLE

ONE HEALTH IN ACTION

One Health in Action showcases trans-disciplinary collaborative success stories gleaned from PREDICT-1 (2009-2014) and PREDICT-2 events to date.

In ***One Health Lessons from PREDICT: Approaches to support sustained collaborations***, PREDICT and EPT-2 partners offer insights into ways in which One Health efforts may be operationalized at the country level to synergistically build capacity and meet the needs of diverse stakeholders. Available at http://onehealth.predict.global

USAID | EMERGING PANDEMIC THREATS
FROM THE AMERICAN PEOPLE

One Health Lessons from PREDICT: Approaches to support sustained collaborations

Building partnerships to prevent pandemics using a One Health approach.

Beyond Operationalization: The Need for Evaluation in One Health

Authors: Baum, S.E., C. Machalaba, P. Daszak, and W.B. Karesh

“Building a strong evidence base for One Health through program evaluation may provide a greater incentive to change the currently siloed system.” In this research poster presented at the Consortium of Universities for Global Health conference in April 2016, authors examine how One Health is being reported in scientific literature, analyze how interventions are being evaluated, and explore metrics of success. They find that evaluations of One Health interventions are in need of standardized methods and metrics to compare outcomes across interventions. Authors then suggest steps towards mainstreaming evaluation efforts, advancing the evidence base for use of the One Health approach.

Read more about PREDICT’s efforts to strengthen One Health networks and partnerships at http://onehealth.predict.global

6.4. Engaging Stakeholders

Several PREDICT country teams created materials in 2015-2016 to introduce and describe the project, promoting awareness about PREDICT's strategy for viral detection and utility of the One Health approach for disease surveillance. Materials from six PREDICT countries (Cambodia, Indonesia, Jordan, Liberia, Sierra Leone, and Viet Nam) are included in the appendix.

USAID | PREDICT
TỪ NHÂN DÂN MỸ
WCS

CÁC THÔNG TIN CẬP NHẬT DỰ ÁN PREDICT TẠI VIỆT NAM
từ tháng 10/2015 đến tháng 3/2016

A partner update for the October 2015 to March 2016 period from the PREDICT/Viet Nam team.

PREDICT/Nepal also created an informational video this year to highlight the project's local successes and showcase the enhancements to local disease surveillance capacity. This video is available on YouTube:
https://www.youtube.com/watch?v=SrC9pKdEUoQ&feature=youtu.be

6.5. In the Media

PREDICT was featured in a number of films/videos, radio programs, news articles, and press releases this year, further extending the project's global reach.

Film and video

Spillover: Zika, Ebola & Beyond aired on the United States' Public Broadcasting Service (PBS) first on August 3, 2016 and offered viewers insight into the science of infectious zoonoses, the efforts – including those by PREDICT through interviews with several key team members – to detect and prevent zoonotic disease transmission, and the human behaviors that drive humans closer to critical spillover events.

Spillover — Zika, Ebola & Beyond

Premiered August 3, 2016

WHEN TO WATCH

Throughout the last few decades, diseases that spill over from animals to humans have been on the rise. What's behind their increase, and can we do anything to combat these dangerous foes? Join scientists as they investigate the rise of spillover viruses like Zika, Ebola and Nipah, and learn what science can do to anticipate and prevent epidemics around the world.

Spillover: http://www.pbs.org/video/2365815991/

Radio

PREDICT's global director joined the discussion on KCRW's **To The Point** radio show (February 25, 2016). *Tropical Diseases, Global Crisis* took a specific look at the Zika virus outbreak in Latin America, considering the environmental and human-activity links between "mosquitos, public health, water, and women" that are quintessential hallmarks of a One Health approach.

Tropical Diseases, Global Crisis

With the summer Olympics scheduled in August, there's growing concern about an outbreak of the Zika virus in Brazil, the host country. Have world health officials waited too long to find out if the virus really produces the birth defect microcephaly?

To The Point: http://www.kcrw.com/news-culture/shows/to-the-point/tropical-diseases-global-crisis

PREDICT's Modeling and Analytics deputy lead and bat surveillance expert Kevin Olival spoke with **Hawaii Public Radio: The Conversation (**February 25, 2016), describing work the project has done to identify risks for pandemic disease outbreaks and the steps that may be taken to strengthen disease detection, core laboratory capacity, and public health communications to prevent disease outbreaks of significant concern.

The Conversation: http://hpr2.org/post/conversation-thursday-february-25th-2016

News (by publication date)

How Vietnam Mastered Infectious Disease Control. Joanne Silberner. PBS: Nova Next. November 5, 2015. http://www.pbs.org/wgbh/nova/next/body/one-health-vietnam/

Disease prevention a boost to human health and great ape conservation. Elizabeth Devitt. Mongabay: Mongabay Series: Global Palm Oil, Great Apes. April 21, 2016. https://news.mongabay.com/2016/04/disease-prevention-boost-human-health-great-ape-conservation/

The planet's health is essential to prevent infectious disease. Sonila Cook and Oren Ahoobim. The Guardian (US Edition): Global development professionals network. May 15, 2016. https://www.theguardian.com/global-development-professionals-network/2016/may/15/the-planets-health-is-essential-to-prevent-infectious-disease

These scientists are racing to prevent the next Ebola. Adriana Cargill and Lydia Randall. VICE News: Global Health. July 6, 2016. https://news.vice.com/article/these-scientists-are-racing-to-prevent-the-next-ebola

Chew on this new way to detect disease in primates. Julia John. Mongabay: Wildtech. July 28, 2016. https://wildtech.mongabay.com/2016/07/chew-new-way-detect-disease-primates/

Virus Hunting: UC Davis researcher heads global effort to avert the next Ebola or Zika outbreak. Claudia Buck. The Sacramento Bee: Health and Medicine. August 1, 2016. http://www.sacbee.com/news/local/health-and-medicine/article92997847.html

Meet the virus hunters trying to prevent the next Zika. Mackenzie Dawson. New York Post: Entertainment. August 3, 2016. http://nypost.com/2016/08/03/meet-the-virus-hunters-trying-to-prevent-the-next-zika/

How the Zika response is going beyond reactive approaches. Catherine Cheney. Devex: News: Inside Development: Focus on: Global health. August 16, 2016. https://www.devex.com/news/how-the-zika-response-is-going-beyond-reactive-approaches-88448

Press Releases

Risky Business: Practices at wildlife markets in Lao PDR endangering both biodiversity and human health (See Section 6 – Publications Summary for description and details). Wildlife Conservation Society. https://newsroom.wcs.org/News-Releases/articleType/ArticleView/articleId/8665/RISKY-BUSINESS-Practices-at-wildlife-markets-in-Lao-PDR-endangering-both-biodiversity-and-human-health.aspx

Noninvasive health monitoring could help save gorillas. University of California: News. July 11, 2016. https://www.universityofcalifornia.edu/news/noninvasive-health-monitoring-could-help-save-gorillas.

SECTION 6. FEATURED PRODUCTS APPENDIX

1. **Ebola Host Project Behavior Risk Investigation Tools**
    a. Ethnographic interview guide
    b. Focus group guide
    c. Questionnaire

2. **Beyond Operationalizing: The Need for Evaluation in One Health (CUGH Poster)**

3. **Select country information sheets, flyers, partner updates**
    a. Cambodia
    b. Indonesia
    c. Liberia
    d. Sierra Leone
    e. Viet Nam

EBOLA HOST PROJECT ETHNOGRAPHIC INTERVIEW GUIDE

Ebola Host Project Core Themes

1. Human-animal contact
2. Illness, medical care/treatment and death of humans
3. Human movement
4. Biosecurity in human environments
5. Socioeconomics

HUMAN ANIMAL CONTACT

GOAL: To gain knowledge about interactions with animals, animal health and animal perceptions and knowledge

Encourage but don't lead discussion about which animals. Allow respondent to name the animals. If no non-human primates, rodents, or bats are mentioned, follow up by asking specific questions about those species.

Direct contact

- Do you or someone in your household handle live animals? In what context? (e.g., ranching/animal husbandry, hunting, wet markets, work, around dwelling/other building, pets)
- What are the animals that you keep/raise or sell? How many different kinds of animals? How many of each?
- For how long do you have the animals?
- Where do live animals come from? Where is the furthest away an animal comes from?
- Who buys/trades for your live animals? Where do the animals go?
- Have you been bitten, scratched or had bleeding after handling an animal? By a wild animal? What did you do (e.g., visit a doctor, wrap it up, nothing)?
- Where are live animals slaughtered? Butchered? Do people buy or sell parts?
- Do you travel with animals? Explore details of the process, specific routes and encounters (e.g., with other animals, with animal transport supporting industries, such as holding areas, restaurants, hotels) along the way.
- Explore for differences over time in animal handling (e.g., seasonality, legal, religious, animal reproduction).

Indirect contact

- What kind of meat do people in your household eat? How do you get it/where does it come from?
- What is furthest away an animal comes from?
- Is meat dead or alive when you get it? If dead (or prepared), how can you tell if good/fresh?
- If alive, how long are live animals kept before being sold or eaten? How do you get live animals home? Who slaughters it?
- How is meat prepared (Probe about raw/undercooked meta)? Is meat prepared in the same place as other activities (e.g., preparing vegetables, cleaning babies/changing diapers, where other food or drinking water is stored)?
- Do animals come in or near the dwelling? Which animals? How do you know animals are/have been there?

Animal products/rituals

- Other uses of animals (e.g., as pets, medicine, magic, fertilizer, for trading)?
- Rules for children around wild animals as pets, playing with wild animals or dead animals

Animal health

- How do you care for your animals: how are they fed, what do they eat, where do they eat/graze and sleep? Are they segregated or all together? Differences by season? Day/night? Does anyone live or stay with the animals?
- Is there a central area for animal waste? How often are animal cages, stalls, or penned areas cleaned?
- Who cleans them?
- Do the animals get veterinary care? Vaccinations?

- How do you know when an animal is sick? What's the first thing you do about a sick animal?
- Have you seen an animal outbreak or die-off? What happened?
- During the Ebola outbreak, did you ever see domestic, livestock, or wild animals get sick or die? What happened? What did you think of this?

Animal Contact

- During the Ebola outbreak, did you ever see animals come into contact with people who were sick or who had died from Ebola? What happened?

Perceptions and knowledge

- What are the most unusual animals anyone can buy? Seasonal? Expensive? Who buys?
- Are there any animals you avoid eating? Why? Ever heard of anyone eating/selling dead or infected animals?
- Do people ever eat non-domesticated animals/wildlife? Where do they get them?
- Who usually buys wildlife products? Have there been changes over time?
- What do you do when you find a dead animal?
- What laws about animals do you know (e.g., limiting/outlawing hunting, reporting and culling of sick animals)?
- Do you think you can get sick from animals/animal fluids? If yes, how?
    - If yes, what do you do to protect yourself from getting sick?
- Do you think that working with animals is dangerous? If yes, why?
- Do you think that you can get sick from an animal that is sick or dead? Follow up for details.
- If another outbreak happened, what would you do (interviewer can use the following examples to stimulate conversation: avoid public transport, avoid eating or drinking at public places, limit shopping to essential items, take absence from work, keep children out of school (if still open), limit physical contact with friends and family, avoid seeing doctors, go to see doctors or take traditional medicine, stay indoors.
- Has the Ebola outbreak changed the way you think about or interact with animals? If so, in what ways?

ILLNESS, MEDICAL CARE/TREATMENT, DEATH

GOAL: To identify any unusual disease experiences—signs, symptoms and sources

Household illness

- During the Ebola outbreak, that is from 1 June 2013 through 31 March 2016, were you diagnosed with Ebola?
- If yes, what happened (explore when, with what, how did they get sick, who told/consulted, anyone else get sick after, final outcome)?
- What causes this sickness? Where did it come from?
- Who took care of you when you were ill?
- Who else in your household got sick?
- During the Ebola outbreak, was there quarantine in your community and did you leave quarantine for any reason? Tell me about that.
- While someone was sick at your home with Ebola, what (if anything) did you do to try to avoid getting sick with Ebola?

Illness from animals

- While you were sick with Ebola (or if a family member was sick) what was your/their contact with animals?
- Do you believe that Ebola comes from animals? (wild or domestic animals?) Why do you think this?
- Can animals get sick from Ebola?
- How did people Ebola? What happened? How does the animal give the illness to the person?
- Do you think that wild animals can give Ebola to domestic animals? How is it transmitted?

Medical care/treatment

- How sick would you have to feel to stay home and not do your normal routine? Where do you go when you are sick?
- Do you prefer to use traditional medicine, western medicine or a combination?
- What kind of medical care did you seek during the Ebola crisis? What about other family members?

Death

- What is the tradition when someone dies? (Explore if reported to authorities, differ by age or gender, what happens to the body, does the community come together or is it private, burial rituals).
- Did you have family members that did not survive Ebola? What happened?

HUMAN MOVEMENT

GOAL: To understand living environment and 'home range' (e.g., how far people travel and why).

Work

- What kind of work or activities do you do that might cause you to travel?
- How far do household members travel from home and why? (Follow up on animal related travel: shopping, selling/buying/trading, hunting, transport, etc.)
- Please tell me about the kinds of areas you travel to: forest, extractive industry areas, markets, zoos, farms where animals are raised, etc.
- Do you cross national borders when you travel? If so, is this to visit family, buy/sell products, to work, or something else?
- What issues come up when you travel? (Probe on health, security, border crossing issues, quarantine of animals, etc.)
- How do you travel (by foot, bike, cart, truck, plane)? What do you transport?

Observed environment

- Have there been any changes in the environment (e.g., new roads, more boats or ports, fields, buildings, population movement (in or out), land clearing or abandonment, new houses, other new buildings)? If so, when did these changes start?
- Who is responsible for the changes?
- Are the changes good or bad?

BIOSECURITY IN HUMAN ENVIRONMENTS

GOAL: To determine if any sanitation or hygiene factors could play a role in disease spillover

Water and food

- Is there a central source of water? What is the source? (e.g., pond, uncovered well, rainwater, taps, covered well)
- Is there a water source you like better? Why?
- How far away is the water source? Do animals drink from the same source? Was this different during the Ebola outbreak?
- Do you do anything to your drinking water to clean it before you drink it?
- How do you store your food (e.g., open containers, covered, hanging, refrigerate)?
- Do you eat or drink things where you suspect animal contact (e.g., teeth/scratch marks, feces or urine seen or smelled)? Was this different during the Ebola outbreak?
- Do you regularly clean your food prep station/kitchen and tools? How? (Probe about soap use if not mentioned)

Sanitation

- Are there toilets, latrines or other designated areas for human waste? Are these cleaned and used regularly?
- Are butchering and slaughtering areas separate from work or living space? How often are they cleaned and how? Who does the cleaning?
- Are there any official rules or laws about human waste and garbage disposal?
- Are there any animal pest control laws? What do you do to control animal pests around your property?

Hygiene

- When are the best times to wash your hands? Do you use soap? How much does soap cost and where get it?
- Do you wash your hands at home? at work?
- How often and where do you and your household members bathe?

SOCIOECONOMICS

GOAL: To understand a typical day and how money and social standing impact opportunity and risk.

Daily routine

- Tell me about your daily routine (get description of work on a usual day, include purchasing and preparing food, timing of types of meals, responsibilities/duties related to animals, any changes by season).
- How do people in the household contribute to earning money and getting food (and water)?
- Where do the children play? Who takes care of the children when you are at work?

Animal responsibilities

- Describe the animal related jobs and responsibilities for people at every age (i.e., young children, older children, young adults, adults, elderly).
- What are the skills/knowledge needed before moving to the next stage of duties/responsibilities?
- Are there differences in responsibilities between boys and girls, men and women, by ethnicity or class?
- Do animals live in or near the house? Why or why not?
- Who takes care of the animals when they get sick?
- Who slaughters animals for food, sale, or culling?

Education

- How many of your children are currently in school?
- Until what age do your children go to school? (Boys and girls?)
- What is your level of education? Why did you stop school?

Economics

- Are there times of year when you make less money? What happens then?
- Are there times when food is more expensive than others? Tell me about that (e.g., different food availability, seasonal, festival related).
- During the Ebola outbreak, where there any food shortages? What did you do to deal with them?
- Do you think you and your household are better off than most people? Could you do things to make it better?

EBOLA HOST PROJECT FOCUS GROUP GUIDE

The focus group discussion is initiated by naming all of the animals that can be found in the community. The goal of this exercise is to explore animal diversity. The community mapping activity locates where the different kinds of animals can be found relative to the site of the focus group. It should be emphasized that this will not be an 'accurate' map. This exercise is designed to assess the distribution and overlap of animals. Prompts such as 'anywhere else?' should be used. The animal list will contain insects, reptiles and fish. ***Map key taxa (non-human primates, rodents, bats) and domestic species.***

This mapping exercise should be limited to 10-15 minutes. The themes to be explored in the discussion are 1) contact and context, 2) illness in animals and humans, and 3) rules and restrictions. Events such as animal die-offs should be added to the map, if they are discussed.

1) Contact and context

- Which of these animals do you see the most often? The least? (Probe: where, why)
- What animals do you come into physical contact with? (Probe: where, why, how often)
- Which of these animals do you eat? Where do you get them? How are they prepared? Which are for special occasions only?
- What are animals good for other than food? (probe: labor, medicinal, magic, pets, by-product uses)
- Which animals come into buildings or places where people are? Is water shared with animals?
- How are unwanted animals kept out? (probe: which animals, all methods used)
- Who takes care of the animals? (Probe: who, specific jobs, animal movements)
- How did the Ebola outbreak affect these things?
- During the Ebola outbreak, did you ever see animals come into contact with people who were sick or who had died from Ebola? What happened?
- During the Ebola outbreak, were there ever food shortages? How did you deal with them?

2) Illness in animals and humans

Animals

- What happens when animals get really sick? How are the animals cared for? Did this happen during the Ebola outbreak?
- Has this happened recently? Do people try to hide animal sickness?
- Is animal sickness reported to anyone? (probe for differences between wild and domestic animals)
- During the time of Ebola, were any animals destroyed or killed by authorities? Describe.
- What happens to animals when they die? (probe: eaten, buried, left to rot, depends if wild or not)

Humans

- What are the causes of illness or sickness? What about Ebola?
- When Ebola crisis started in your community, did people believe that animals were part of the cause of the outbreak? What happened?
- During the Ebola outbreak, were there quarantines in your community? Tell me about that.
- Do you know anyone who has gotten sick from an animal? What happened?
- What do you know about animals that can give you infections or diseases?

3) Rules and restrictions

- Are there places in the community where you aren't allowed to go? Why not?
- Are there any rules about hunting or trapping animals? (Probe: cultural, legal)
- Are there any animals that you don't eat or that are avoided? Why?
- Are there official rules or laws about garbage disposal? Human waste? Animal waste?
- How did that work during the Ebola crisis?
- Is garbage a problem in this community? What's the problem?
- What is the one thing you learned from the Ebola outbreak? What might you do to prevent it from happening again?

Unique ID:______________________________
Interviewer:________________________________

INTERVIEW CHECKLIST

CORE THEMES

Illness, medical care/treatment and death
- ☐ Household illness
- ☐ Illness from animals
- ☐ Medical care/treatment
- ☐ Death

Human-animal contact
- ☐ Indirect contact
- ☐ Direct contact
- ☐ Animal products/rituals
- ☐ Animal health
- ☐ Perceptions/knowledge

Human movement
- ☐ Home
- ☐ Work
- ☐ Travel
- ☐ Observed environment

Socioeconomics
- ☐ Daily routine
- ☐ Animal responsibilities
- ☐ Education
- ☐ Economics

Biosecurity in human environments
- ☐ Water and food
- ☐ Sanitation
- ☐ Hygiene

Ebola Host Project PREDICT
Human Questionnaire

EIDITH
V 1.0

Add Site and Event Form ID:

Site name: ______________________

(For reference only)

⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

1. Participant ID:______________________ Consent Form Administered & Signed ○ yes ○ no

2. Description of Interview Location - Select all that apply.
(To be completed by interviewer prior to administrative questionnaire.
Prepare and download modules in advance.)

○ Animal Production or Abattoir Site
○ Crop Production Site
○ Extractive Industry Site
○ Market or Value Chain Site
○ Temporary Settlement Site
○ Natural Areas (eg. forest, urban park/garden)
○ Wildlife Restaurant
○ Zoos or Sanctuaries
○ Outbreak Investigation Site
○ Control Site
○ Other:______________________

3. Date of interview ______________________

4. Begin time of interview ________________
(Example: 17:50)

5. End time of interview ________________
(Example: 19:20)

6. Where are you conducting this interview?

Village/Town/City ______________ District ______________ Province/State ______________

Latitude ______________________ Longitude ______________________

Interviewer: Please collect GPS coordinates if administering using paper and pen.

7. Interviewer Observed Gender ○ male ○ female ○ other

INTERVIEW/QUESTIONNAIRE BEGINS

Demographics Section (include observation question 7)

8. How old are you? ________________

If the exact age is unknown, enter the respondent's estimated age.

9. Where do you live?

Village/Town/City ______________ District ______________ Province/State ______________

Latitude ______________________ Longitude ______________________

Interviewer: Probe for landmarks or nearest known site if area unknown.
GPS coordinates to be identified and entered after completion of interview.

10. How long have you lived there?
Select one option.
○ <1 month
○ 1 month - 1 year
○ >1 - 5 years
○ >5 - 10 years
○ >10 years

11. How many other people live in the dwelling where you live? ________
Skip to question 14 if answer is 0.

12. How many in the dwelling are children less than 5 years old? ________

13. How many in the dwelling are male? ________

14. How many rooms are there in the dwelling where you live? ________
(Do not include bathroom or kitchen)

15. Is the dwelling a permanent structure (that cannot be moved)?
○ yes
○ no

Ebola Host Project PREDICT Human Questionnaire

Livelihood Section

Participant ID ____________________
(For reference only)

In this section, I'd like to ask you about education and the kinds of work activities that you have done since this time last year.

1. What is the highest level of education you have completed?
Select one option. (Skip for Cameroon.)
○ primary school
○ secondary school
○ college/university/professional
○ none

2. What is the highest level of education that your mother completed?
Select one option. (Skip for Cameroon.)
○ primary school
○ secondary school
○ college/university/professional
○ none

3. Since this time last year what are the activities you have done to earn your livelihood?
Select all that apply
○ extraction of minerals, gas, oil timber
○ crop production
○ wildlife restaurant business
○ wild/exotic animal trade/market business
○ rancher/farmer animal production business
○ meat processing, slaughterhouse, abattoir
○ zoo/sanctuary animal health care
○ protected area worker
○ hunter/trapper/fisher
○ forager/gatherer/non-timber forest product collector
○ migrant laborer
○ nurse, doctor, traditional healer, community health worker
○ construction (road, housing)
○ other: ____________________

4. If more than one activity was selected, what is the activity on which you spend the most time since this time last year?*
Select one option.
○ extraction of minerals, gas, oil timber
○ crop production
○ wildlife restaurant business
○ wild/exotic animal trade/market business
○ rancher/farmer animal production business
○ meat processing, slaughterhouse, abattoir
○ zoo/sanctuary animal health care
○ protected area worker
○ hunter/trapper/fisher
○ forager/gatherer/non-timber forest product collector
○ migrant laborer
○ nurse, doctor, traditional healer, community health worker
○ construction (road, housing)
○ other: ____________________

5. Which best describes your job position?
Select one option.
○ manager/owner/foreman
○ worker
○ live and work at home independently (If chosen, skip to Medical History Section.)
○ professional
○ other: ____________________

6. Where do you work?

Village/Town/City ______________ District ______________ Province/State ______________

Latitude ____________________ Longitude ____________________

Interviewer: Probe for landmarks or nearest known site if area unknown.
GPS coordinates to be identified and entered after completion of interview.

Ebola Host Project PREDICT Human Questionnaire

Medical History Section

Participant ID ____________________ (For reference only)

In this section, I'm going to ask you about illness and treatment that have occurred in the community.

1. Before the Ebola outbreak, that is before 1 June 2013, where did you usually get treatment for medical problems? Select all that apply.
   - ○ clinic/health center
   - ○ hospital
   - ○ mobile clinic
   - ○ community health worker
   - ○ traditional healer
   - ○ dispensary or pharmacy

2. During the Ebola outbreak, that is from 1 June 2013 through 31 March 2016, where did you usually get treatment for medical problems? Select all that apply.
   - ○ clinic/health center
   - ○ hospital
   - ○ mobile clinic
   - ○ community health worker
   - ○ traditional healer
   - ○ dispensary or pharmacy

3. During the Ebola outbreak, that is from 1 June 2013 through 31 March 2016, did you have an unusual illness with any of the following symptoms? Select all that apply. (READ ONLY SYMPTOMS)
   - ○ fever with headache and severe fatigue or weakness (encephalitis)
   - ○ fever with bleeding or bruising not related to injury (hemorrhagic fever)
   - ○ fever with cough and shortness of breath or difficulty breathing (SARI)
   - ○ fever with muscle aches, cough, or sore throat (ILI)
   - ○ fever with diarrhea or vomiting
   - ○ fever with rash
   - ○ persistent rash or sores on skin
   - ○ no
   - ○ yes, but none of these symptoms-describe: ____________________

4. In your opinion, when you were sick, what caused this sickness? Select all that apply.
   - ○ contact with sick people and/or their bodily fluids
   - ○ contact with wild animals
   - ○ contact with domestic animals and/or excretia
   - ○ bad food or water
   - ○ bad spirits/witchcraft
   - ○ wound or injury
   - ○ contact with a corpse/dead body
   - ○ I don't know
   - ○ other: ____________________

5. During the Ebola outbreak, that is from 1 June 2013 through 31 March 2016, were you diagnosed with Ebola?
   - ○ yes
   - ○ no (Skip to question 7)

6. In your opinion, when you were sick with Ebola, what caused this sickness? Select all that apply.
   - ○ contact with sick people and/or their bodily fluids
   - ○ contact with wild animals
   - ○ contact with domestic animals and/or excretia
   - ○ bad food or water
   - ○ bad spirits/witchcraft
   - ○ wound or injury
   - ○ contact with a corpse/dead body
   - ○ I don't know
   - ○ other: ____________________

IF NO UNUSUAL ILLNESS OR EBOLA DIAGNOSIS, SKIP TO Q21

Medical History Section

Participant ID ____________
(For reference only)

7. When did you first become sick with Ebola (or that unusual illness)? ____________
date

I don't remember the date. ○

8. In total, how many days were you sick after first becoming ill? ____________
days

9. In total, how many days were you sick at home? ____________
days

10. While you were sick at home, did you ever isolate yourself for any period of time?

○ yes, from my family
○ yes, from my animals
○ yes, from both my family and my animals
○ no (skip to question 13)

11. How many days after becoming sick did you first isolate yourself? ____________
days

12. In total, how many days did you isolated yourself? ____________
days

13. What did you do after you first became sick?
Select all that apply.

○ I went to an Ebola Treatment Center - that is, a place specially dedicated to the care and treatment of people sick with Ebola
○ I went to a traditional healer
○ I self-medicated (i.e., took oral hydration fluid or medicine I bought)
○ I isolated myself in the bush/forest
○ other: ____________

If no Ebola Treatment Center, skip to Question 18.

14. Why did you choose to go to an Ebola Treatment Center?
Select all that apply.

○ because I thought it was the right thing to do
○ because I was afraid I was going to die
○ because of proximity
○ because the cost of care would be covered
○ because of the medical resources available
○ because of the expertise of the Ebola Treatment Center staff
○ because I trusted the Ebola Treatment Center
○ because there was no clinical care available near where I live
○ because I was taken there without being asked
○ because the media suggested I go to the nearest health facility
○ other: ____________

15. Where was that Ebola Treatment Center located or what was the name?

____
(Name city/town/zone)

16. How many days were you sick before you went to the Ebola Treatment Center? ____________
days

17. When did you leave the treatment center? ____________
date

(Prompt: Do you have your discharge card? The date should be written there. If you can't remember exactly, give your best guess.)

If answered Question 10, go to Question 19.

18. If no, why did you chose NOT to go to an Ebola Treatment Center? Select all that apply.

○ because of the distance
○ because I thought I wasn't very sick
○ because I didn't think they had the resources I needed
○ because I didn't think they had the necessary expertise
○ because I did not trust the Ebola Treatment Center
○ I was told there was no bed available
○ because I was afraid of getting in the ambulance/fear that it was contaminated
○ because I was afraid of getting sick with Ebola at the Ebola Treatment Center
○ fear of begin stigmatized
○ I was afraid my family would be quarantined
○ fear of dying at the Ebola Treatment Center
○ fear of leaving my family
○ other: ____________

Participant ID ______________________
(For reference only)

19. While you were sick with Ebola (or that unusual illness), did you have any contact with animals?
○ yes
○ no

20. If yes, which taxa? Select all that apply.
For each taxa selected provide the number of days you had any contact with these animals while sick?

rodents/shrews	○	☐
bats	○	☐
non-human primates	○	☐
birds	○	☐
carnivores	○	☐
ungulates	○	☐
pangolins	○	☐
poultry/other fowl	○	☐
goats/sheep	○	☐
camels	○	☐
swine	○	☐
cattle/buffalo	○	☐
dogs	○	☐
cats	○	☐

21. During the Ebola outbreak, that is from 1 June 2013 through 31 March 2016, did anyone living at your home (i.e., children, aunts, uncles, grand-parents) become sick with Ebola?
If no one had any symptoms, skip to the City Section.
○ yes
○ no

22. How many people living at your home became sick with Ebola? ______________________

Ebola Host Project PREDICT Human Questionnaire

Sick Person Matrix

Participant ID________________ (For reference only)

Now I am going to ask you a few questions about each person living at your home who became sick with Ebola. (Complete for each sick person.)

		person 1	person 2	person 3	person 4	person 5	person 6
1. Who was this person that became sick in relation to you? (Select all that apply.)	spouse	○	○	○	○	○	○
	child	○	○	○	○	○	○
	parent	○	○	○	○	○	○
	sibling	○	○	○	○	○	○
	grand-parent	○	○	○	○	○	○
	other: __________	○	○	○	○	○	○
2. When did this person first become sick with Ebola?	date	______	______	______	______	______	______
(If you can't remember exactly, give your best guess.)	don't know	○	○	○	○	○	○
3. In total, how many days was this person sick after first becoming ill?	days	☐	☐	☐	☐	☐	☐
	don't know	○	○	○	○	○	○
4. In total, how many days was this person sick at home?	days	☐	☐	☐	☐	☐	☐
	don't know	○	○	○	○	○	○
5. While this person was sick at home, did he or she ever isolate him or herself for any period of time?	yes, from his or her family	○	○	○	○	○	○
	yes, from his or her animals	○	○	○	○	○	○
	yes, from both his or her family and his or her animals	○	○	○	○	○	○
(If no, skip to question 8.)	no	○	○	○	○	○	○
6. How many days after becoming sick did this person first isolate him or herself?	days	☐	☐	☐	☐	☐	☐
	don't know	○	○	○	○	○	○
7. In total, how many days did this person isolate him or herself?	days	☐	☐	☐	☐	☐	☐
	don't know	○	○	○	○	○	○
8. What did this person do after becoming sick? Select all that apply.	this person went to an Ebola Treatment Center—that is, a place specially dedicated to the care and treatment of people sick with Ebola	○	○	○	○	○	○
	this person went to a traditional healer	○	○	○	○	○	○
	this person self-medicated (i.e., took oral hydration fluid or medicine he or she bought)	○	○	○	○	○	○
	this person isolated him or herself in the bush/forest	○	○	○	○	○	○
[If no Ebola Treatment Center, skip to question 13]	other: __________	○	○	○	○	○	○
9. Why did this person choose to go to an Ebola Treatment Center? (Select all that apply.)	because he/she thought it was the right thing to do	○	○	○	○	○	○
	because he/she was afraid he/she was going to die	○	○	○	○	○	○
	because of proximity	○	○	○	○	○	○
	because the cost of care would be covered	○	○	○	○	○	○
	because of the medical resources available there	○	○	○	○	○	○
	because of the expertise of the Ebola Treatment Center staff	○	○	○	○	○	○
	because he/she trusted the Ebola Treatment Center	○	○	○	○	○	○
	because there was no clinical care available near where he/she lived	○	○	○	○	○	○
	because he/she was taken there without being asked	○	○	○	○	○	○
	because the media suggested he/she go to the nearest health facility	○	○	○	○	○	○
	other: __________	○	○	○	○	○	○

Sick Person Matrix

Participant ID ____________________
(For reference only)

		person 1	person 2	person 3	person 4	person 5	person 6
10. Where was that Ebola Treatment Center located or what was the name?		______ ______	______ ______	______ ______	______ ______	______ ______	______ ______
				(Name, city/town/zone)			
11. How many days was this person sick before he/she went to the Ebola Treatment Center?	days	☐	☐	☐	☐	☐	☐
	don't know	○	○	○	○	○	○
12. When did this person leave the Ebola Treatment Center?	date	______	______	______	______	______	______
Skip to question 14	don't know	○	○	○	○	○	○
13. If no, why did this person chose NOT to go to an Ebola Treatment Center? (Select all that apply.)							
	because of the distance	○	○	○	○	○	○
	because he/she thought he/she wasn't very sick	○	○	○	○	○	○
	because he/she didn't think they had the resources needed	○	○	○	○	○	○
	because he/she didn't think they had the necessary expertise	○	○	○	○	○	○
	because he/she did not trust the Ebola Treatment Center	○	○	○	○	○	○
	he/she was told there was no bed available	○	○	○	○	○	○
	because he/she was afraid of getting in the ambulance/fear that it was contaminated	○	○	○	○	○	○
	because he/she was afraid of getting sick with Ebola at the Ebola Treatment Center	○	○	○	○	○	○
	fear of begin stigmatized	○	○	○	○	○	○
	he/she was afraid his/her family would be quarantined	○	○	○	○	○	○
	fear of dying at the Ebola Treatment Center	○	○	○	○	○	○
	fear of leaving his/her family	○	○	○	○	○	○
	other: ____________	○	○	○	○	○	○
14. Did this person survive Ebola?	yes	○	○	○	○	○	○
	no	○	○	○	○	○	○
15. While someone was sick at your home with Ebola, what (if anything) did you do to try to avoid getting sick with Ebola? Ask 'Anything else?'		______ ______ ______ ______ ______ ______ ______ ______	______ ______ ______ ______ ______ ______ ______ ______	______ ______ ______ ______ ______ ______ ______ ______	______ ______ ______ ______ ______ ______ ______ ______	______ ______ ______ ______ ______ ______ ______ ______	______ ______ ______ ______ ______ ______ ______ ______

Ebola Host Project PREDICT Human Questionnaire

City Section

Participant ID ________________
(For reference only)

In this section, I'm going to ask you about things that happened in your city/town/zone during the Ebola outbreak, that is from 1 June 2013 through 31 March 2016.

1. In your opinion, what do you think caused the Ebola outbreak here in your country? Select all that apply.
   - ○ contact with sick people and/or their bodily fluids
   - ○ contact with wild animals
   - ○ contact with domestic animals and/or excretia
   - ○ bad food or water
   - ○ bad spirits/witchcraft
   - ○ wound or injury
   - ○ contact with a corpse/dead body
   - ○ I don't know
   - ○ or something else? Specify: ________________

[IF NO QUARANTINE ACTIVITY, SKIP TO QUESTION 3]

The next question is about quarantine activities during the Ebola outbreak.
It is not always possible to follow quarantine procedures.

2. During the Ebola outbreak, that is from 1 June 2013 through 31 March 2016, did you leave quarantine for any reason?
   - ○ yes If yes, why? ________________
   - ○ no

[IF NO EBOLA CASES, SKIP TO ANIMAL CONTACT SECTION]

The following questions are about the impact of Ebola on your community.

3. During the Ebola outbreak, that is from 1 June 2013 through 31 March 2016, where did (other community) people (besides you) go for health care?
   - ○ clinic/health center
   - ○ hospital
   - ○ mobile clinic
   - ○ community health worker
   - ○ traditional healer
   - ○ dispensary or pharmacy
   - ○ Ebola Treatment Center
   - ○ other: ________________
   - ○ nowhere

4. During the Ebola outbreak, that is from 1 June 2013 through 31 March 2016, were any animals interacting with dead bodies around Ebola burial sites?
   - ○ yes If yes, which taxa?
   - ○ no
     - ○ rodents/shrews
     - ○ bats
     - ○ non-human primates
     - ○ birds
     - ○ carnivores
     - ○ ungulates
     - ○ pangolins
     - ○ do not use
     - ○ poultry/other fowl
     - ○ goats/sheep
     - ○ camels
     - ○ swine
     - ○ cattle/buffalo
     - ○ dogs
     - ○ cats
     - ○ I don't know

5. During the Ebola outbreak, that is from 1 June 2013 through 31 March 2016, when people in your community were ill with Ebola, did animals ever come into contact with the human excrement, blood, urine, or other bodily fluids of those sick with Ebola?
   - ○ yes If yes, which taxa?
   - ○ no
     - ○ rodents/shrews
     - ○ bats
     - ○ non-human primates
     - ○ birds
     - ○ carnivores
     - ○ ungulates
     - ○ pangolins
     - ○ poultry/other fowl
     - ○ goats/sheep
     - ○ camels
     - ○ swine
     - ○ cattle/buffalo
     - ○ dogs
     - ○ cats

6. During the Ebola outbreak, that is from 1 June 2013 through 31 March 2016, were there times that you or people around you did not have enough food to eat?
(If no, skip to Animal Contact Section)
○ yes
○ no

7. During the Ebola outbreak, that is from 1 June 2013 through 31 March 2016, were animals killed and eaten to help deal with the food shortage?
○ yes
○ no

If yes, which taxa?

○ rodents/shrews
○ bats
○ non-human primates
○ birds
○ carnivores
○ ungulates
○ pangolins
○ poultry/other fowl
○ goats/sheep
○ camels
○ swine
○ cattle/buffalo
○ dogs
○ cats

Ebola Host Project PREDICT Human Questionnaire

Animal Contact

Participant ID ____________________
(For reference only)

In this section, I'm going to ask you about the animals in your life during the Ebola outbreak.
Between 1 June 2013 through 31 March 2016

1. Did anyone you live with have an animal as a pet?

○ yes
○ no

If yes, which taxa? (Select all applicable taxa)

○ rodents/shrews
○ bats
○ non-human primates
○ birds
○ carnivores
○ ungulates
○ pangolins
○ poultry/other fowl
○ goats/sheep
○ camels
○ swine
○ cattle/buffalo
○ dogs
○ cats

2. Did you handle live animals?

○ yes
○ no

If yes, which taxa? (Select all applicable taxa)

○ rodents/shrews
○ bats
○ non-human primates
○ birds
○ carnivores
○ ungulates
○ pangolins
○ poultry/other fowl
○ goats/sheep
○ camels
○ swine
○ cattle/buffalo
○ dogs
○ cats

3. Did you raise live animals?

○ yes
○ no

If yes, which taxa? (Select all applicable taxa)

○ rodents/shrews
○ bats
○ non-human primates
○ birds
○ carnivores
○ ungulates
○ pangolins
○ poultry/other fowl
○ goats/sheep
○ camels
○ swine
○ cattle/buffalo
○ dogs
○ cats

4. Did you share a water source with animals for washing?

○ yes
○ no

If yes, which taxa? (Select all applicable taxa)

○ rodents/shrews
○ bats
○ non-human primates
○ birds
○ carnivores
○ ungulates
○ pangolins
○ poultry/other fowl
○ goats/sheep
○ camels
○ swine
○ cattle/buffalo
○ dogs
○ cats

5. Did you see animal feces in or near food before eating?

○ yes
○ no

If yes, which taxa? (Select all applicable taxa)

○ rodents/shrews
○ bats
○ non-human primates
○ birds
○ carnivores
○ ungulates
○ pangolins
○ poultry/other fowl
○ goats/sheep
○ camels
○ swine
○ cattle/buffalo
○ dogs
○ cats

6. Did you eat food after an animal had touched or damaged it? (For example, chew marks or scratches.)

○ yes
○ no

If yes, which taxa? (Select all applicable taxa)

○ rodents/shrews
○ bats
○ non-human primates
○ birds
○ carnivores
○ ungulates
○ pangolins
○ poultry/other fowl
○ goats/sheep
○ camels
○ swine
○ cattle/buffalo
○ dogs
○ cats

Animal Contact

Participant ID ____________________
(For reference only)

7. Did any animals come inside the dwelling where you live?
○ yes
○ no

If yes, which taxa? (Select all applicable taxa)
○ rodents/shrews
○ bats
○ non-human primates
○ birds
○ carnivores
○ ungulates
○ pangolins
○ poultry/other fowl
○ goats/sheep
○ camels
○ swine
○ cattle/buffalo
○ dogs
○ cats

8. Did you cook or handle meat, organs, or blood from a recently killed animal?
○ yes
○ no

If yes, which taxa? (Select all applicable taxa)
○ rodents/shrews
○ bats
○ non-human primates
○ birds
○ carnivores
○ ungulates
○ pangolins
○ poultry/other fowl
○ goats/sheep
○ camels
○ swine
○ cattle/buffalo
○ dogs
○ cats

9. Did you eat raw, undercooked, or smoked meat, organs or blood?
○ yes
○ no

If yes, which taxa? (Select all applicable taxa)
○ rodents/shrews
○ bats
○ non-human primates
○ birds
○ carnivores
○ ungulates
○ pangolins
○ poultry/other fowl
○ goats/sheep
○ camels
○ swine
○ cattle/buffalo
○ dogs
○ cats

10. Did you eat an animal that you knew was sick?
○ yes
○ no

If yes, which taxa? (Select all applicable taxa)
○ rodents/shrews
○ bats
○ non-human primates
○ birds
○ carnivores
○ ungulates
○ pangolins
○ poultry/other fowl
○ goats/sheep
○ camels
○ swine
○ cattle/buffalo
○ dogs
○ cats

11. Did you find a dead animal and collect it to eat, share, or sell?
○ no
○ yes, eat
○ yes, share
○ yes, sell

If yes to any, which taxa? (Select all applicable taxa)
○ rodents/shrews
○ bats
○ non-human primates
○ birds
○ carnivores
○ ungulates
○ pangolins
○ poultry/other fowl
○ goats/sheep
○ camels
○ swine
○ cattle/buffalo
○ dogs
○ cats

12. Were you scratched or bitten by an animal?
○ yes
○ no

If yes, which taxa? (Select all applicable taxa)
○ rodents/shrews
○ bats
○ non-human primates
○ birds
○ carnivores
○ ungulates
○ pangolins
○ poultry/other fowl
○ goats/sheep
○ camels
○ swine
○ cattle/buffalo
○ dogs
○ cats

Ebola Host Project PREDICT Human Questionnaire

Animal Contact

Participant ID ____________________
(For reference only)

13. Did you slaughter an animal? ○ yes ○ no

If yes, which taxa? (Select all applicable taxa)

○ rodents/shrews
○ bats
○ non-human primates
○ birds
○ carnivores
○ ungulates
○ pangolins
○ poultry/other fowl
○ goats/sheep
○ camels
○ swine
○ cattle/buffalo
○ dogs
○ cats

14. Did you hunt or trap an animal? ○ yes ○ no

If yes, which taxa? (Select all applicable taxa)

○ rodents/shrews
○ bats
○ non-human primates
○ birds
○ carnivores
○ ungulates
○ pangolins
○ poultry/other fowl
○ goats/sheep
○ camels
○ swine
○ cattle/buffalo
○ dogs
○ cats

15. During the Ebola outbreak, that is from 1 June 2013 through 31 March 2016, the last time you were scratched, bitten or cut yourself while butchering or slaughtering, what did you do?

Do not read, but select all that apply.

○ let someone else take over
○ wash wound with soap and water
○ rinse wound with water
○ bandage wound
○ visit doctor
○ nothing - kept working
○ never butcher or slaughter

16. Before the Ebola outbreak, that is before 1 June 2013, were you worried about disease or disease outbreaks in live animals in the local market/area? ○ yes ○ no

17. During the Ebola outbreak, that is from 1 June 2013 through 31 March 2016, were you worried about diseases or disease outbreaks in live animals in the local market/area? ○ yes ○ no

18. Since the Ebola outbreak, that is after 31 March 2016, have you been worried about diseases or disease outbreaks in live animals in the local market/area? ○ yes ○ no

19. During the Ebola outbreak, that is from 1 June 2013 through 31 March 2016, what were the activities you did to earn your livelihood?

Select all that apply.

○ extraction of minerals, gas, oil timber
○ crop production
○ wildlife restaurant business
○ wild/exotic animal trade/market business
○ rancher/farmer animal production business
○ meat processing, slaughterhouse, abattoir
○ zoo/sanctuary animal health care
○ protected area worker
○ hunter/trapper/fisher
○ forager/gatherer/non-timber forest product collector
○ migrant laborer
○ nurse, doctor, traditional healer, community health worker
○ construction (road, housing)
○ other: ________________________________

Participant ID ____________________
(For reference only)

20. During the Ebola outbreak, that is from 1 June 2013 through 31 March 2016, was there a significant change to your activities?

Select all that apply.
○ no change (Skip to End of Section for additional module directions.)
○ activities stopped
○ activities decreased
○ activities increased

21. For how long were your activities interrupted? ________________
in weeks

Additional Module Instructions

If domestic animal production or meat processing on Q19, conduct ANIMAL PRODUCTION Module

If hunter/trapper/fisher on Q19 OR Yes to Q14, conduct HUNTER Module

Ebola Host Project PREDICT
Animal Production or Abattoir Module

EIDITH
V 1.0

⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

Add Human Questionnaire Form ID

Participant ID ____________________
(For reference only)

The following questions are about your work raising or slaughtering animals during the Ebola outbreak.

1. During the Ebola outbreak, that is from 1 June 2013 through 31 March 2016, did you live on site?
○ yes
○ no

2. During the Ebola outbreak, that is from 1 June 2013 through 31 March 2016, to the best of your knowledge, what was the most number of people who worked at this site?
Select one option.
○ <10
○ 10-100
○ 101-1000
○ 1001-10,000
○ >10,000

3. Before the Ebola outbreak, that is before 1 June 2013, which animals did you raise there?
Select all that apply.
○ rodents/shrews
○ bats
○ non-human primates
○ birds
○ carnivores
○ ungulates
○ pangolins
○ poultry/other fowl
○ goats/sheep
○ camels
○ swine
○ cattle/buffalo
○ dogs
○ cats

These next questions are about your work raising or slaughtering animals BEFORE the Ebola outbreak.

4. Before the Ebola outbreak, that is before 1 June 2013, how were live animals stored at night?
Select all that apply.
○ multiple species in one enclosure
○ individual species in one enclosure
○ both multiple and individual species in enclosures

5. Before the Ebola outbreak, that is before 1 June 2013, was there a quarantine period for new animals?
○ yes
○ no

6. Before the Ebola outbreak, that is before 1 June 2013, did you have special protective equipment (eg. shoes, masks, gloves) only worn at work?
○ yes
○ no

7. If yes, which protective equipment?
Select all that apply.
○ shoes/boots
○ mask
○ clothes
○ gloves
○ gown/apron

8. If yes, before the Ebola outbreak, that is before 1 June 2013, when did you use protective equipment?
Select all that apply.
○ handling animals
○ slaughter
○ butcher
○ always on at work
○ other:____________________

9. Before the Ebola outbreak, that is before 1 June 2013, did you use disinfectant to clean?
○ yes
○ no

10. If yes, did you use disinfectants to clean the following:
Select all that apply.
○ animal enclosures
○ food bins
○ counter tops
○ slaughtering/butchering equipment
○ hands
○ special protective equipment
○ floors

11. Before the Ebola outbreak, that is before 1 June 2013, when slaughtering/butchering animals, what happened to the viscera (blood, organs, skin, sinews, etc)?
Select all that apply.
○ sell
○ throw into refuse bin
○ throw into the street/gutter
○ take home to eat
○ feed to animals
○ no onsite slaughter

12. Before the Ebola outbreak, that is before 1 June 2013, how often were the animal enclosures cleaned?
Select one option.
○ daily
○ weekly
○ monthly
○ as needed
○ never

13. Before the Ebola outbreak, that is before 1 June 2013, was there a designated area for the disposal of animal waste?
○ yes
○ no

14. If yes, did people use the dedicated area for animal waste?
○ yes
○ no

15. Before the Ebola outbreak, that is before 1 June 2013, did the animals receive veterinary care?
○ yes
○ no

16. Before the Ebola outbreak, that is before 1 June 2013, did an animal health official inspect your animals?
○ yes
○ no

These next questions are about your work DURING the Ebola outbreak.

17. During the Ebola outbreak, that is from 1 June 2013 through 31 March 2016, how were live animals stored at night?
Select all that apply.
○ multiple species in one enclosure
○ individual species in one enclosure
○ both multiple and individual species in enclosures

18. During the Ebola outbreak, that is from 1 June 2013 through 31 March 2016, was there a quarantine period for new animals?
○ yes
○ no

19. During the Ebola outbreak, that is from 1 June 2013 through 31 March 31 2016, was it possible to buy bush meat/wild animal meat on or near the site?
○ yes
○ no

20. During the Ebola outbreak, that is from 1 June 2013 through 31 March 31 2016, did you have special protective equipment (eg. shoes, masks, gloves) only worn at work?
○ yes
○ no

21. If yes, which protective equipment?
Select all that apply.
○ shoes/boots
○ mask
○ clothes
○ gloves
○ gown/apron

22. If yes, during the Ebola outbreak, that is from 1 June 2013 through 31 March 2016, when did you use protective equipment?
Select all that apply.
○ handling animals
○ slaughter
○ butcher
○ always on at work
○ other:________________________

23. During the Ebola outbreak, that is from 1 June 2013 through 31 March 2016, did you use disinfectant to clean?
○ yes
○ no

24. If yes, did you use disinfectants to clean the following:
Select all that apply.
○ animal enclosures
○ food bins
○ counter tops
○ slaughtering/butchering equipment
○ hands
○ special protective equipment
○ floors

25. During the Ebola outbreak, that is from 1 June 2013 through 31 March 2016, how often were the animal enclosures cleaned?
Select one option.
○ daily
○ weekly
○ monthly
○ as needed
○ never

26. During the Ebola outbreak, that is from 1 June 2013 through 31 March 2016, when slaughtering/butchering animals, what happened to the viscera (blood, organs, skin, sinews, etc)?
Select all that apply.
○ sell
○ throw into refuse bin
○ throw into the street/gutter
○ take home to eat
○ feed to animals
○ no onsite slaughter

27. During the Ebola outbreak, that is from 1 June 2013 through 31 March 2016, was there a designated area for the disposal of animal waste?
○ yes
○ no

28. If yes, did people use the dedicated area for animal waste?
○ yes
○ no

29. During the Ebola outbreak, that is from 1 June 2013 through 31 March 31 2016, what did you do when an animal got sick?
Select all that apply.
○ kill the animal and dispose of the carcass
○ kill the animal and sell it
○ sell the live animal for discounted price
○ nothing different
○ get veterinary care
○ report to authorities
○ other:________________________________

30. During the Ebola outbreak, that is from 1 June 2013 through 31 March 2016, did the animals receive veterinary care?
○ yes
○ no

31. During the Ebola outbreak, that is from 1 June 2013 through 31 March 2016, did an animal health official inspect your animals?
○ yes
○ no

32. During the Ebola outbreak, that is from 1 June 2013 through 31 March 2016, did anyone quarantine or destroy your animals because of infection or disease?
○ yes
○ no

33. If yes, which animals? Select all that apply.
○ rodents/shrews
○ bats
○ non-human primates
○ birds
○ carnivores
○ ungulates
○ pangolins
○ poultry/other fowl
○ goats/sheep
○ camels
○ swine
○ cattle/buffalo
○ dogs
○ cats

34. During the Ebola outbreak, that is from 1 June 2013 through 31 March 2016, was there a disease outbreak among any raised animals or livestock?
○ yes
○ no

35. If yes, which animals? (Indicate the percentage that died during the outbreak.) Select all that apply.

	1-25%	26-50%	51-75%	76-100%	don't know
rodents/shrews	○	○	○	○	○
bats	○	○	○	○	○
non-human primates	○	○	○	○	○
birds	○	○	○	○	○
carnivores	○	○	○	○	○
ungulates	○	○	○	○	○
pangolins	○	○	○	○	○
poultry/other fowl	○	○	○	○	○
goats/sheep	○	○	○	○	○
camels	○	○	○	○	○
swine	○	○	○	○	○
cattle/buffalo	○	○	○	○	○
dogs	○	○	○	○	○
cats	○	○	○	○	○

36. During the Ebola outbreak, that is from 1 June 2013 through 31 March 2016, did any animals raid food supplies?
○ yes
○ no

37. If yes, what animals? Select all that apply.
○ rodents/shrews
○ bats
○ non-human primates
○ birds
○ carnivores
○ ungulates
○ pangolins
○ poultry/other fowl
○ goats/sheep
○ camels
○ swine
○ cattle/buffalo
○ dogs
○ cats

Ebola Host Project PREDICT
Hunter Module

EIDITH
V 1.0

○ 0	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6	○ 7	○ 8	○ 9
○ 0	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6	○ 7	○ 8	○ 9
○ 0	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6	○ 7	○ 8	○ 9
○ 0	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6	○ 7	○ 8	○ 9
○ 0	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6	○ 7	○ 8	○ 9
○ 0	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6	○ 7	○ 8	○ 9

Add Human Questionnaire Form ID

Participant ID ______________________
(For reference only)

1. During the Ebola outbreak, that is from 1 June 2013 through 31 March 2016, what animals did you hunt?
Select all that apply.
   - ○ rodents/shrews
   - ○ bats
   - ○ non-human primates
   - ○ birds
   - ○ carnivores
   - ○ ungulates
   - ○ pangolins

2. During the Ebola outbreak, that is from 1 June 2013 through 31 March 2016, what methods did you use to hunt/trap animals?
Select all that apply.

○ snare	○ knife
○ bow	○ net
○ hands	○ cage
○ gun	○ trap
○ machete	○ other: ______________

3. During the Ebola outbreak, that is from 1 June 2013 through 31 March 2016, what was the purpose of your trapping or hunting?
Select all that apply.

	for consumption at home	for use of animal products at home	for sale for consump -tion	for sale alive at market	for sale of animal products	live trapping of nuisance animals for translocation	culling of nuisance animals
rodents/shrews	○	○	○	○	○	○	○
bats	○	○	○	○	○	○	○
non-human primates	○	○	○	○	○	○	○
birds	○	○	○	○	○	○	○
carnivores	○	○	○	○	○	○	○
ungulates	○	○	○	○	○	○	○
pangolins	○	○	○	○	○	○	○

During the Ebola outbreak, that is from 1 June 2013 through 31 March 2016, when you hunted or trapped:

4. Were you exposed to blood? ○ yes ○ no

5. Were you scratched or bitten? ○ yes ○ no

6. During the Ebola outbreak, that is from 1 June 2013 through 31 March 2016, did you see an outbreak of dead wild animals? ○ yes ○ no

7. If yes, which wild animals?
Select all that apply.
   - ○ rodents/shrews
   - ○ bats
   - ○ non-human primates
   - ○ birds
   - ○ carnivores
   - ○ ungulates
   - ○ pangolins

8. During the Ebola outbreak, that is from 1 June 2013 through 31 March 2016, what did you do when you found an animal dead (not in a trap or shot by another hunter)?
Select all that apply.
   - ○ touch it to see if it is still fresh
   - ○ butcher in the forest
   - ○ smoke or cook in the forest
   - ○ take home to prepare
   - ○ bury it
   - ○ report it to authorities
   - ○ take it to sell it
   - ○ nothing
   - ○ other: ____________

9. During the Ebola outbreak, that is from 1 June 2013 through 31 March 2016, how did you transport a dead animal, if you took it?
Select all that apply.
   - ○ not wrapped
   - ○ wrapped in leaves or other natural material
   - ○ wrapped in plastic
   - ○ in a bag
   - ○ in a basket

10. During the Ebola outbreak, that is from 1 June 2013 through 31 March 2016, did you have special protective equipment (eg. shoes, masks, gloves)?
   - ○ yes
   - ○ no

11. If yes, which protective equipment?
Select all that apply.
   - ○ shoes/boots
   - ○ mask
   - ○ clothes
   - ○ gloves
   - ○ gown/apron

12. During the Ebola outbreak, that is from 1 June 2013 through 31 March 2016, when did you use protective equipment?
Select all that apply.
   - ○ handling animals
   - ○ slaughter
   - ○ butcher
   - ○ always on at work
   - ○ other: ____________

Beyond Operationalizing:
The Need for Evaluation in One Health

EcoHealth Alliance

S.E. Baum[1,2], C. Machalaba[1,3], MPH, P. Daszak[1], PhD, and W.B. Karesh[1], DVM

[1]EcoHealth Alliance, New York, NY, [2]Barnard College, New York, NY, [3]City University of New York School of Public Health, New York, NY

Background

What is One Health? :

Many global health challenges have ecological or animal origins. Some of these include:

- •HIV/AIDS
- •Lyme Disease
- •Rift Valley Fever
- •Antimicrobial Resistance from food production practices
- •West Nile Virus
- •Ebola Virus
- •Avian Influenza
- •Severe Acute Respiratory Syndrome (SARS)

Recognizing that the health of animals, humans, and the environment are interdependent, One Health calls for multidisciplinary and cross-sectoral approaches to address health risks through these channels. While most often applied to mitigating the threat of zoonotic diseases, its scope has expanded to incorporate food security, poverty, gender equality and health systems strengthening.

Current State of One Health: From concept to implementation

Since the formal introduction of the term in 2003, One Health has gained notable attention. In 2010, the Food and Agriculture Organization (FAO), World Organisation for Animal Health (OIE), and World Health Organization (WHO) formed a tripartite agreement to share and coordinate international activities to address health risks at the animal, human, and ecosystem level. Regional implementation of One Health, such as the Mekong Basin Disease Surveillance (MBDS) networks, One Health Alliance of South Asia (OHASA), and South African Center for Infectious Disease Surveillance (SACIDS) have contributed to One Health's transition from concept to intervention.

Despite the broad recognition by many One Health champions around the world (such as practitioners, policy stakeholders, funders, NGOs alike), the overall culture and systems are not supportive nor conducive to One Health operations. Building a strong evidence base for One Health through program evaluation may provide a greater incentive to change the currently siloed systems.

Objectives

1. See how One Health is being reported in current scientific literature
2. Analyze whether or not interventions are being evaluated
3. Report the types of metrics (if any) used to measure indicators and targeted outcomes

Methods

A systematic literature review was conducted using the search term ('One Health') restricting publication date from year 2003 (based on the formal introduction of the term) until May 26, 2015, when the literature review was first started. References from Scopus, PubMed, and Web of Science were extracted into EndNote citation manager and screened in various stages:

I. **Primary Screening**: Articles were separated into 'Topical'- whether One Health was referred to as a concept, 'Non-Topical'- One Health was not referred to as a concept or if the article was printed in a language other than English. If an abstract could not be found, articles were categorized by title.

II. **Secondary Screening**: 'Topical' abstracts were screened to determine whether an article should be included in a full-text review based on whether it referenced specific One Health research, intervention, or case studies of One Health in practice. If no full- text could be located, articles were excluded.

III. **Full-Text Review**: Articles were screened for topic, sectors involved, metrics used (if any), policy and regulations implemented, challenges posed, and best practices (if any suggested).

Results

- 3858 articles were found: 1333 from Pub Med, 1172 from Web of Science, and 1353 from Scopus
- After removing 2019 duplicates, 1839 unique papers were included in the primary screening
- 807 were identified as 'Topical' articles if they referred to One Health as a concept
- 73 of these 'Topical' articles were included for full-text review because they referenced One Health research, an intervention or case study
- 39 articles detailed a specific One Health intervention (such as collaboration between sectors, integrated surveillance or control program across the animal-human-ecosystem interface)
- 15 articles evaluated the approach, of which seven used quantitative metrics (i.e. DALYs, cost savings, livestock productivity) to report outcomes

Figure 1: Flow chart of systematic review of One Health literature

How 'One Health' was applied in the literature was often unclear

•Majority of the literature base called for One Health approaches, but did not identify how interventions would influence linkages betweens animals, humans and the environment

•Interventions were often limited to a single phase of the disease transmission process (i.e. prevention or control)

•Interventions were usually limited to a single discipline or certain type of analysis (i.e. economic, epidemiological) with environmental drivers often excluded from the implementation

•Reported metrics did not represent the integrated nature of One Health (i.e. DALYs averted, livestock productivity, impact on ecosystem services)

Table 1: Summary of quantitative evidence found in One Health literature

	Country	Disease	Intervention	Outcome Metric(s)	Outcome	Reference
Intermediate Indicators	Mexico	Chagas	• Window installation program	• Cost • # windows installed	• Average cost spent on Chagas increased from $US 32 to $US 35 • Number of windows installed increased to 822 windows installed into 1606 homes	Waleckx (2015)
	Tanzania	Bovine Tuberculosis Brucellosis	• Testing wildlife, livestock and water sources for zoonotic pathogens • Monitoring water quality and use • Evaluating livestock and human disease impact on pastoral livelihoods • Zoonoses training	• Identification of pathogens • Local perceptions of disease transmission	• Identified BTB and Brucellosis in livestock and wildlife • More than 2/3 of participating pastoral households do not believe that illness can be contracted from livestock and 1/2 believe the same of wildlife	Mazet et al. (2009)
	Ghana	NA	• Field epidemiology and lab training	• Number of disease outbreaks • Number of disease surveillance investigations	• 23 disease outbreak investigations were conducted by GFELTP residents between 2007 and 2011 • 31 evaluations of various disease surveillance systems were conducted between 2008 and 2011	Wurapa et al. (2011)
Outcome indicators	Chad	Trypanosomiasis	• Insecticide footbath	• Vector prevalence	• Total tsetse catches decreased by 80% by end of 6-month footbath treatment	Ndeledje et al. (2013)
	India	Rabies	• Vaccination and post-exposure prophylaxis	Incidence in animal bite and exposure	• Reduced animal bite and exposure cases reported by 30%	Mauthi et al. (2014)
	Sri Lanka	Rabies	• Vaccination and dog sterilization campaign	• DALYs • Social impact • Cost • Case load	• 738 DALYs averted • Increased acceptance of dogs roaming in society (5.68 mean acceptance score) • Increased net cost to society by US $1.03 • Caseload decreased from an average of 43 per year to 2 in first six months	Hasler et al. (2014)
	Thailand	Opisthorchiasis	• Community education curriculum • Praziqantel treatment	• Vector prevalence	• Reduced liver fluke infection rate from 67% to 16% • 9 schools certified as liver fluke free schools • Fish species showed less than 1% prevalence compared to 70%	Sripa et al. (2015)

Discussion

Evaluation of One Health interventions is not widely employed

- Articles referenced effectiveness of One Health approaches without citing measured outcomes
- Reported outcomes are often based on modeled projections

When interventions were evaluated, assessments rarely followed a systematic methodology

- •Effectiveness was often assumed without supporting evidence
- •Efficacy was usually determined subjectively through stakeholder perceptions

A small sample of papers did conduct systematic evaluations of their approach, however, different metrics were usually reported making it difficult to compare outcomes across interventions

Towards Mainstreaming Evaluation

Determine a set of target metrics that demonstrate outcomes across the One Health continuum to identify best practices and entry points for intervention

- May allow for comparability within and between interventions highlighting best-practices
- Incorporate metrics that are standard across sectors and relevant to stakeholders involved or have a vested interest in related issues

Distinguish components of evaluation in terms of the intermediate inputs required to capture desired outputs

- Proactively inform how data is collected and compared, specifically when measured One Health outcomes can be compared to baseline data

Incorporate evaluation protocols into the design and planning of intervention strategy

- May identify where contributions are being made in other parts of the public health system from more systematic One Health approaches

Acknowledgements

This study was made possible by the generous support of the American people through the United States Agency for International Development (USAID) Emerging Pandemic Threats PREDICT project. The contents are the responsibility of the authors and do not necessarily reflect the views of USAID or the United States Government. Internship and travel funding was generously provided through the Shirley Estabrook Wood Fund and the Tow Foundation Public Service Program and Special Professional Opportunities Fund of Barnard College.

References

Hasler, B., E. Hiby, W. Gilbert, N. Obeyesekere, H. Bennani and J. Rushton (2014). "A One Health Framework for the Evaluation of Rabies Control Programmes: A Case Study from Colombo City, Sri Lanka." PLoS Neglected Tropical Diseases 8(10).

Mauthi, N. R. R., D. H. A. Narayana, P. Kulkarni, Gangaboraiah and A. Belludi (2014). "Epidemiology and prevention of animal bite and human rabies in a rural community-One health experiment." Asian Pacific Journal of Tropical Disease 4(S1): S488-S490.

Mazet, J. A., D. L. Clifford, P. B. Coppolillo, A. B. Deolalikar, J. D. Erickson and R. R. Kazwala (2009). "A "one health" approach to address emerging zoonoses: the HALI project in Tanzania." PLoS Med 6(12): e1000190.

Ndeledje, N., J. Bouyer, F. Stachurski, P. Grimaud, A. M. G. Belem, F. Molélé Mbaindingatoloum, Z. Bengaly, I. Oumar Alfaroukh, G. Cecchi and R. Lancelot (2013). "Treating Cattle to Protect People? Impact of Footbath Insecticide Treatment on Tsetse Density in Chad." PLoS ONE 8(6).

Sripa, B., S. Tangkawattana, T. Laha, S. Kaewkes, F. F. Mallory, J. F. Smith and B. A. Wilcox (2015). "Toward integrated opisthorchiasis control in northeast Thailand: the Lawa project." Acta Trop 141(Pt B): 361-367.

Waleckx, E., J. Camara-Mejia, M. J. Ramirez-Sierra, V. Cruz-Chan, M. Rosado-Vallado, S. Vazquez-Narvaez, R. Najera-Vazquez, S. Gourbiere and E. Dumonteil (2015). "An innovative ecohealth intervention for Chagas disease vector control in Yucatan, Mexico." Transactions of the Royal Society of Tropical Medicine and Hygiene 109(2): 143-149.

Wurapa, F., E. Afari, C. Ohuabunwo, S. Sackey, C. Clerk, S. Kwadje, N. Yebuah, J. Amankwa, G. Amofah and E. Appiah-Denkyira (2011). "One Health concept for strengthening public health surveillance and response through Field Epidemiology and Laboratory Training in Ghana." The Pan African medical journal 10 Supp 1: 6.

USAID | PREDICT

FROM THE AMERICAN PEOPLE

Historically, attempts to control deadly viruses, such as SARS and MERS coronaviruses, influenza, and Ebola, have been almost entirely reactionary. In recognition of the costs of emerging infectious diseases (EID), in both lives lost and dollars spent on treatment and control, and the need for a more proactive paradigm, USAID initiated the PREDICT project in 2009, which conducted the most comprehensive zoonotic pathogen and EID surveillance and capacity building program in the world to date. A risk-based surveillance strategy was used in regional "hotspots" for emerging diseases with the aim of targeting efforts toward early detection and response to potentially high-consequence animal viruses before they become significant public health threats.

During the first phase of PREDICT in Cambodia (2009-2014), 3,887 animals were sampled including 300 nonhuman primates, 552 rodents, and 2,503 bats, and other animals hunted, consumed, and traded commonly by local people, such as wild pigs, deer, and civets. Wildlife-human interfaces targeted for surveillance included: wildlife hunting; wildlife trade by middle-men; crop raiding by wild animals; wildlife rescue centers; markets and restaurants selling wildlife; bat guano farms; religious and ecotourism sites; and rodents around human dwellings and traded to Vietnam for food. Polymerase Chain Reaction (PCR) screening for 16 viral families and additional pathogens of regional concern at the Institute Pasteur Cambodia detected 17 known and 31 novel viruses.

Cambodian government veterinarian and PREDICT team training students in PREDICT protocols for sampling hunted wildlife

Phase two of PREDICT in Cambodia, led by the University of California Davis and the Institute Pasteur Cambodia (IPC), further focuses surveillance and interventions at the source of pathogen emergence, amplification, and spread in human populations and forecasts risk from viruses before they emerge through:

- Expanded characterization of pathogens of known epidemic and unknown pandemic potential and their dynamics among hosts:
  - Further characterizing potential pathogens detected in the first phase (Coronavirus, Arenavirus, Flavivirus, Enterovirus families) and any novel viruses identified in the next phase.
  - Expanding testing of syndromic surveillance samples to identify novel agents associated with Influenza Like Illness (ILI), Sudden, Acute, Respiratory Infection (SARI), Fever of Unknown Origin (FUO), hemorrhagic fever and encephalitis
  - Conducting viral family testing on animal and human samples for 10 families using PREDICT protocols at IPC with concurrent training and transfer of PREDICT protocols to the National Institute of Public Health (NIPH), and National Veterinary Research Institute (NaVRI)

- Building on global One Health initiatives for effective collaboration across disciplines and geographic borders
  - Engaging with Zoonotic Technical Working Group & veterinary and human health university faculties

- Documenting pathogen sharing between wildlife, domestic animals, and people:
    - Simultaneous sampling of wildlife, domestic animals and humans at high-risk interfaces for disease emergence with the Forestry Administration (FA), NaVRI, Communicable Disease Control Department, Cambodia (CDC), and veterinary and medical students

- Targeting surveillance at high-risk pathways for disease emergence, spillover & spread to identify social and ecological drivers and to determine appropriate targets for intervention:

A bat guano farm demonstrating woman collecting guano from netting under artificial bat roosts

- Intensifying Animal Production: Bat guano trade

(Kampong Cham Province)

- Targeting wildlife (bats, rodents), livestock (coordinated with FAO) and humans (farmers, family, guano transporters)
- Simultaneous collection of data on human behavior, movements, practices & ecological conditions

- Market Value Chain: Rodent trade

(Kandal Province, border with Viet Nam)

- Targeting wildlife (rodents), livestock (in coordination with FAO) and humans (trappers, drivers, middle men, children assisting with handling)
- Simultaneous collection of data on human behavior, movements, practices & ecological conditions

Syndromic SARI/ ILI surveillance of humans:

- Kampong Cham district hospital
- Kandal district hospital
- Phnom Penh, Kantha Bopha Children's Hospital

<u>PREDICT Partners and Responsibilities</u>

- University of California, Davis: PREDICT lead and implementing partner
- IPC: Coordination of PREDICT 2 in Cambodia, including wildlife, human & livestock surveillance; diagnostics and viral characterization
- Ministry of Health (MOH): CDC in human field surveillance & NIPH for diagnostics
- NaVRI (Department of Animal Health and Production of MAFF) and FAO: livestock surveillance & diagnostics
- FA (MAFF) and Wildlife Conservation Society for wildlife surveillance
- Royal University of Agriculture (RUA) and University of Health Sciences (UHS) for training of veterinary and medical students

Contact information:

Dr. Veasna Duong

Institute Pasteur Cambodia, 5
Preah Monivong Blvd (93),
Phnom Penh, Cambodia

Email: dveasna@pasteur-kh.org

Institut Pasteur du Cambodge

USAID FROM THE AMERICAN PEOPLE | UCDAVIS VETERINARY MEDICINE One Health Institute | WCS | EcoHealth Alliance | METABIOTA | Smithsonian Institution

USAID | INDONESIA
FROM THE AMERICAN PEOPLE

April 2016

EPT-2 PREDICT Indonesia: Working to prevent, detect, and respond to diseases from wildlife to humans

Building an early warning system to reduce the threat of potential zoonotic disease through partnerships with scientific and government institutions.

Roasted bats are sold together with other basic needs in a traditional market in North Sulawesi (Photo by PREDICT Indonesia Team).

PREDICT Indonesia staff collecting bat and rodent specimens for viral testing in North Sulawesi and Gorontalo provinces (Photo by PREDICT Indonesia Team).

Partners:
Food and Agriculture Organization, World Health Organization, U.S. Centers for Disease Control & Prevention, EPT-2 One Health Workforce, EPT-2 Preparedness & Response

Locations of Local Partners:
Universities and hospitals in the Provinces of Gorontalo, North Sulawesi, Central Sulawesi, South Sulawesi, South Kalimantan, East Kalimantan, Bali, and West Java.

Period of Performance:
Five years: 2014-2019

Country Coordinator:
Joko Pamungkas
jpi-pssp@indo.net.id
Tel: (62251) 8320417

CHALLENGE

Emerging infectious diseases pose a significant burden on human and animal health and global economies. Conventional approaches to epidemic control have most often been reactive. However, explosive human population growth, dramatic changes in land use, and increased global trade and travel require a shift toward a proactive, predictive approach. The PREDICT project aims to prevent, detect, and rapidly respond to the spillover of novel infectious pathogens from wildlife to humans.

INITIATIVE

In Indonesia, PREDICT-2 is a collaborative effort of the Primate Research Center at Bogor Agricultural University (PRC-IPB), the Eijkman Institute for Molecular Biology (EIMB), EcoHealth Alliance, Metabiota, and the Smithsonian Institution, in coordination with the Ministries of Health, Agriculture, Environment and Forestry, the Indonesian Institute of Science (LIPI), the National Commission for Zoonosis Control, and in close collaboration with other partners from local universities and hospitals.

Increasing contact between wildlife and humans, due to expanding animal trade and rapid ecological changes, leads to greater risk of human exposure to new and previously known pathogens. Development of early zoonotic disease warning systems and collaboration between government agencies and research and academic institutions are urgently needed to better serve and protect the public. The threat of emerging pandemic diseases is facilitated by the interaction of wildlife, domestic animals, and humans (the human-animal interface). PREDICT Indonesia implements field and laboratory activities to enable the early detection and characterization of viruses across these high-risk, human-animal interfaces, and will conduct human behavioral studies to determine which human behaviors and practices are associated with potential disease spillover, and identify which risk mitigation measures may be the most effective.

EXPECTED RESULTS

1. Support the government of Indonesia in the surveillance of viral families with zoonotic disease potential in high-risk wildlife, domestic animals, and human populations.
2. Conduct human behavioral research to better understand the behaviors, beliefs and practices that may increase zoonotic disease risk from wildlife.
3. Strengthen networking, collaboration, and diagnostic capacity through training and implementation of PREDICT laboratory protocols and technology within the human and animal health national laboratories in Indonesia.

Contact at USAID Jakarta:
Jonathan Ross
jross@usaid.gov

USAID partners to end extreme poverty and promote resilient, democratic societies while advancing our security and prosperity

Bambang Heryanto
bheryanto@usaid.gov
Tel: (6221) 3435 9465

USAID | LIBERIA
FROM THE AMERICAN PEOPLE

PREDICT-2

A Project of USAID's Emerging Threats Program-EPT-2

PHOTO: The PREDICT team measuring and sampling a bat, which will be tested for Ebola virus.

SNAPSHOT

Life of Activity: 2016–2019

Goal:
IDENTIFY EBOLA ANIMAL RESERVOIRS; ENHANCE SURVEILLANCE AND DETECTION OF NOVEL ZOONOTIC VIRUSES WITH PANDEMIC POTENTIAL; AND TO INVESTIGATE BEHAVIORS, PRACTICES AND CONDITIONS ASSOCIATED WITH VIRAL SPILLOVER, AMPLIFICATION AND SPREAD.

Lead Organization: EcoHealth Alliance-EHA

Lead Administrator: Jonathan Epstein

Country Coordinator:
James Desmond (interim)
Tel: +231776147565
Email: desmond@ecohealthalliance.org

Implementing Partner:

Society for Conservation of Nature of Liberia (SCNL)

Government Partners:
MINISTRY OF HEALTH (MOH)
FOREST DEVELOPMENT AUTHORITY (FDA)
MINISTRY OF AGRICULTURE
LIBERIAN INSTITUTE FOR BIOMEDICAL RESEARCH (LIBR)
Other EPT Partners: FAO, Preparedness and Response (DAI)

Activity Overview

The Ebola Host Project (EHP), a sub-project of PREDICT-2, will be the primary focus of PREDICT activities in Liberia. EHP activities are also being conducted in Guinea and Sierra Leone. Its main objective is to identify the animal reservoir for Ebola virus and to determine whether any 'spillback' events may have occurred during the epidemic where Ebola may have been transmitted from humans to domestic animals. The PREDICT team will target bats and domestic animals in the search for Ebola virus. In addition, there is a social science component of the project that aims to better characterize human/animal interactions and how human behavior contributes to potential spillover events.

Current Activities

The EHP field team was recently assembled and a first training conducted in July 2016 in Yekepa, Nimba County at the Arcelor Mittal mining site.

75 bats were sampled as part of field team training in Yekepa. Two more field expeditions are planned for September 2016.

PREDICT has established an office in Congo Town with its implementing partner, the Society for Conservation of Nature of Liberia.

Planned Outcomes

Identify the animal reservoir for Ebola virus and gain a better understanding of transmission dynamaics.

Determine whether any 'spillback' events may have occurred during the recent West African Ebola epidemic where Ebola may have been transmitted from humans to domestic animals.

Build capacity in the fields of biosurveillance and molecular diagnostics by training personnel in proper field and laboratory techniques.

Updated August 2016

USAID | PREDICT
FROM THE AMERICAN PEOPLE

Sierra Leone: PREDICT's goal in Sierra Leone is to identify animals that may act as reservoirs or transmission hosts for Ebola virus to develop targeted prevention measures that reduce the risk of spillover from animals to people.

Background

The PREDICT-2 project, part of USAID's Emerging Pandemic Threats-2 program (EPT- 2), is developing a global early warning system to detect, track, and predict the emergence of new zoonotic pathogens from animals that could pose a threat to human health. In Sierra Leone, PREDICT is implemented by Metabiota Inc., in cooperation with the Ministry of Health and Sanitation (MOHS), the Ministry of Agriculture, Forestry, and Food Security (MAFFS), and the University of Makeni (UNIMAK), as well as local stakeholders, and communities.

In Sierra Leone, Guinea and Liberia, PREDICT is implementing the Ebola Host Project (EHP) to identify the animals that may act as reservoirs or transmission hosts for Ebola and other filoviruses; to enhance surveillance and detection of novel zoonotic viruses with pandemic potential; and to investigate human behaviors, practices, and conditions that may be associated with viral spillover, amplification, and spread. This comprehensive, three-year effort is designed to sample a broad range of possible animal hosts for Ebola virus and other filoviruses that can cause severe infections in humans and non-human primates.

Ebola virus (*Zaire ebolavirus*) is suspected to be present in animal populations in West Africa. Rapid control of any future spillover event, is dependent on a number of factors, including the strength of infectious disease surveillance and response capacity in the region, and understanding which animals are natural reservoirs and potential intermediate hosts for the virus so that preventive measures can be put in place to prevent another protracted high-impact outbreak. Because people in West Africa (and elsewhere) have routine contact with multiple types of animals including wildlife, livestock, and companion animals (e.g. cats, dogs) – identifying which of these animals may act as transmission hosts for the Ebola virus is critical for developing targeted prevention measures to reduce the risk of Ebola virus spillover from animals to people. The project is focused on three critical factors: geographic distribution, seasonality, and distribution of filovirus infection among host species.

Zoonotic Disease Surveillance

EHP focuses on identifying animal reservoir(s) and novel hosts for Ebola virus through surveillance in four domestic species (dogs, cats, domestic pigs, and goats) and three broad wildlife taxa (rodents, non-human primates, and bats). PREDICT will conduct routine, longitudinal collection and analysis of samples from these seven animal targets across Sierra Leone.

Operational Districts and Communities

PREDICT is being implemented in five districts in Sierra Leone (***Bombali, Western Area, Kono, Kambia and Koinadugu)*** with more than 20 communities involved as targeted animal sampling sites. Prior to conducting surveillance activities, PREDICT engages local communities in these districts and sites by holding meetings to discuss intended activities and promote project ownership with key district and community stakeholders at the national, district and chiefdom levels.

Photo: Community engagement meeting in Yeli Sande, Bombali District. Credit: James Bangura, PREDICT Sierra Leone

Capacity Strengthening

PREDICT works with the MOHS and MAFFS district-level staff (through the oversight of District Medical Officers) and with the Livestock and Forestry leads of the Ministry of Agriculture when engaging local communities and during livestock and wildlife sampling. PREDICT is also training local teams in safe collection and handling of domestic and wildlife animal samples, working to strengthen laboratory capacity for detection of novel and known health threats like Ebola, and enhancing scientific capabilities for data analysis and risk mapping.

Photo: PREDICT team performing safe animal sampling in Yeli Sande, Bombali District. Credit: James Bangura, PREDICT Sierra Leone

Contact

Professor Aiah Gbakima
(gbakimaaa2009@gmail.com)
PREDICT Sierra Leone Country
Coordinator
53 Byrne Lane, Drive 5
Freetown, Sierra Leone

http://predict.global

USAID | PREDICT
TỪ NHÂN DÂN MỸ

WCS

CÁC THÔNG TIN CẬP NHẬT DỰ ÁN PREDICT TẠI VIỆT NAM
từ tháng 10/2015 đến tháng 3/2016

Dự án **PREDICT-1** đã thu thập gần 7.000 mẫu từ hơn 2.000 cá thể động vật hoang dã. Hơn 16.300 phản ứng PCR đã được thực hiện tại các phòng thí nghiệm trong và ngoài nước để sàng lọc các virus trong 13 chi/họ virus (Arena, Flavi, Paramyxo, Hanta, Bunya, Corona, Henipa, Filo, Herpes, Alpha, Seadorna, Influenza và Rhabdoviruses). Các mẫu dương tính được xác nhận bằng phương pháp nhân dòng và giải trình tự để phát hiện virus.

Tại Việt Nam, trong 5 năm đầu tiên, dự án đã phát hiện 24 virus mới (trong đó có 2 Corona-, 5 Paramyxo-, 2 Herpes- và 15 Rhabdoviruses) và 3 virus đã biết (1 Corona-, 1 Paramyxo- và 1 Influenza-) (*Xem bảng 1*)

PREDICT-2: Mở rộng quan hệ đối tác

Các đại biểu cấp cao từ các cơ quan đối tác Chính phủ Việt Nam, bao gồm Viện Vệ sinh Dịch tễ Trung ương (NIHE); Cục Thú y (DAH); Học viện Nông nghiệp Việt Nam (VNUA) và Cơ quan Thú y vùng VI (RAHO6) đã tham dự và đóng góp tích cực tại cuộc họp giữa tất cả các nước thực hiện dự án PREDICT diễn ra tại Dubai, Các Tiểu Vương quốc Ả Rập Thống nhất vào tháng 2 năm 2016.

Virus	Đã biết/Mới	Động vật	Địa điểm
Herpes viruses	2 virus mới	Cầy vòi hương và Gấu ngựa	Cầy tại nhà hàng và Gấu tại trung tâm cứu hộ được tịch thu từ hoạt động buôn bán
Influenza A	1 virus đã biết	Dúi	Được bán tại nhà hàng
Paramyxo viruses	1 virus đã biết & 5 virus mới	Chuột, Dơi	Được bán tại nhà hàng, chợ, trong hoặc gần khu vực sinh sống của con người
Rhabdo viruses	15 virus mới	Dúi, Chuột, Dơi và Linh trưởng	Được bán tại nhà hàng; trong hoặc gần khu vực sinh sống của con người và trang trại gây nuôi ĐVHD
Corona viruses	2 virus mới	Dơi	Chùa; trong hoặc gần khu vực sinh sống của con người

Bảng 1: Các virus phát hiện được trong dự án PREDICT-1 tại Việt Nam

* Ảnh trang bìa: Thịt động vật hoang dã được mua, bán tại các nhà hàng là nguồn lây nhiễm bệnh dịch từ động vật sang con người.

Từ trái qua phải: Thịt lợn rừng, thịt đồi/nhen, thịt nhím, thịt dúi. Ảnh: WCS Việt Nam

Hoạt động giám sát và hoạt động ngoài thực địa

- Hồ sơ nghiên cứu định tính của dự án PREDICT-2 đã được Hội đồng đạo đức của trường Đại học Y tế Công cộng Hà Nội phê duyệt vào ngày 24 tháng 3 năm 2016. Theo đó, dự án PREDICT có thể bắt đầu thực hiện giám sát hành vi của con người tại Việt Nam trong những tháng tới.
- Dự án PREDICT-2 đã thu thập 28 mẫu từ 7 cá thể tê tê tại Chương trình bảo tồn thú ăn thịt nhỏ và tê tê - Vườn Quốc gia Cúc Phương và 93 mẫu từ 41 cá thể động vật (trong đó bao gồm 3 cá thể chim, 4 cá thể thú ăn thịt, 3 cá thể lợn rừng, 29 cá thể gặm nhấm, 1 cá thể thỏ và 3 cá thể đồi/nhen) tịch thu được từ hoạt động buôn bán trái phép ĐVHD tại tỉnh Đắk Nông.
- Dự án PREDICT-2 đã phối hợp với NIHE – Cơ quan đối tác của dự án PREDICT trong lĩnh vực nhân y để tiến hành đánh giá địa điểm giám sát tại 2 tỉnh ở miền Bắc (Hà Nội và Lạng Sơn)

Nhóm đánh giá địa điểm hoạt động thực địa chuẩn bị và sử dụng trang thiết bị bảo hộ cá nhân (PPE) trước khi vào thăm hang dơi tại tỉnh Lạng Sơn. Các thành viên trong nhóm bao gồm các đại diện của NIHE, WCS và Trung tâm Y tế dự phòng tỉnh Bắc Giang. Ngày 19 tháng 10 năm 2015. Ảnh: Trần Vũ Phong.

WCS Việt Nam tham gia ký kết Khung đối tác Một sức khỏe Phòng chống dịch bệnh từ động vật sang người. Ngày 01 tháng 03 năm 2016. Ảnh: Ban thư ký Đối tác Một sức khỏe.

Nâng cao năng lực

Từ khi bắt đầu các hoạt động của dự án PREDICT-2 năm 2014, tổng số 34 cá nhân (bao gồm 25 nam và 9 nữ) đã được tập huấn về định hướng Một sức khỏe và Giám sát Bệnh truyền nhiễm tại các địa điểm có sự tương tác giữa người và ĐVHD có nguy cơ cao tại Việt Nam.

Thông tin thêm xin liên hệ:

Tiến sĩ Amanda E. Fine
Hiệp hội Bảo tồn Động vật
hoang dã (WCS)
P. 1302, 57 Láng Hạ,
Q. Ba Đình,
Hà Nội, Việt Nam
SĐT: +84 4 35149750
Email: afine@wcs.org

Đối tác PREDICT tại Việt Nam:

- Cục Thú y (DAH), Bộ Nông nghiệp và Phát triển nông thôn (MARD)
- Viện Vệ sinh Dịch tễ Trung ương (NIHE), Bộ Y tế (MOH)
- Học viện Nông nghiệp Việt Nam (VNUA)
- Cơ quan Thú y Vùng VI (RAHO6)

Họp với khoa Côn trùng và Động vật y học để giới thiệu các hoạt động của dự án PREDICT và thảo luận hợp tác giữa PREDICT và Viện Vệ sinh Dịch tễ Trung ương. Ngày 21 tháng 4 năm 2015. Ảnh: Trần Vũ Phong

Hoạt động phòng thí nghiệm/chẩn đoán

- Dự án PREDICT-2 tiến hành chẩn đoán chuyên sâu những virus được phát hiện trong dự án PREDICT-1 và chuẩn bị chẩn đoán mẫu của dự án PREDICT-2.
- Hoàn thành đánh giá chi tiết phòng thí nghiệm tại NIHE, nơi được lựa chọn là phòng thí nghiệm chẩn đoán mẫu trên người, nhằm xác định năng lực phòng thí nghiệm và độ sẵn sàng để thực hiện các quy trình chẩn đoán của dự án PREDICT.

Đơn vị đối tác và các bên liên quan

- WCS ký kết thỏa thuận với NIHE để hỗ trợ “Phối hợp điều tra nghiên cứu và ứng phó với bệnh truyền nhiễm của các đại dịch có thể xảy ra tại những địa điểm có sự tương tác giữa ĐVHD và con người có nguy cơ cao tại Việt Nam, Dự án PREDICT – Một hợp phần của Chương trình Các mối đe dọa Đại dịch mới nổi của USAID tại Việt Nam”, từ đó đã chính thức hóa cam kết của dự án với cơ quan đối tác là Bộ Y tế tại Việt Nam.

- WCS ký kết thỏa thuận hợp tác với Học viện Nông nghiệp Việt Nam về “Điều tra bệnh dịch trên động vật hoang dã tại các khu vực có sự tương tác giữa người, vật nuôi và động vật hoang dã” đã hợp tác từ dự án PREDICT-1 và tiếp tục phối hợp trong các hoạt động của dự án PREDICT-2 tại Việt Nam.

- PREDICT-2 tham dự hội thảo đa phương về xây dựng Mạng lưới giám sát Cúm theo chiều dọc (LISN) tại Việt Nam, góp phần vào việc lập kế hoạch thực hiện giám sát Cúm và các tác nhân gây bệnh đường hô hấp đồng thời ở trên các quần thể người, ĐVHD và động vật nuôi. Các đối tác của mạng lưới LISN bao gồm Cơ quan Phát triển Quốc tế Hoa Kỳ (USAID), Tổ chức Y tế Thế giới (WHO), Tổ chức Lương thực và Nông nghiệp Liên Hiệp Quốc (FAO), NIHE, Viện Pasteur TP. Hồ Chí Minh (PI-HCM), DAH, Trung tâm Kiểm soát và Phòng ngừa dịch bệnh Hoa Kỳ (US CDC), Cục Y tế dự phòng (GDPM) và các cơ quan, Viện nghiên cứu khác.

- Cán bộ dự án PREDICT tham dự lễ ra mắt và ký kết khung đối tác Một sức khỏe Phòng chống dịch bệnh từ Động vật sang người. PREDICT cung cấp các thông tin cho việc triển khai Kế hoạch Một sức khỏe Quốc gia tổng thể tại Việt Nam giai đoạn 2016-2020 thông qua các cuộc phỏng vấn và tham gia các cuộc họp tham vấn chính thức cho kế hoạch 5 năm được tổ chức tại Hà Nội vào ngày 24 tháng 03 năm 2016

USAID | PREDICT
FROM THE AMERICAN PEOPLE

WCS

VIET NAM UPDATE
October 2015 - March 2016

PREDICT-1 collected nearly 7,000 samples from over 2,000 wild animals. Over 16,300 consensus PCR assays were implemented in national and international laboratories to screen for viruses from 13 viral families/ genus (Arena, Flavi, Paramyxo, Hanta, Bunya, Corona, Henipa, Filo, Herpes, Alpha, Seadorna, Influenza and Rhabdoviruses). The positive suspect samples were confirmed by cloning and sequencing to identify the viruses.

In Viet Nam, during 5 years of the project, 24 novel viruses (2 Corona, 2 Herpes, 5 Paramyxo and 15 Rhabdoviruses) and 3 known viruses (1 Corona, 1 Paramyxo and 1 Influenza) were detected (Table 1).

PREDICT-2 : Expanding partnerships in Viet Nam

Senior representatives from Viet Nam Government partner agencies, including the National Institute of Hygiene and Epidemiology (NIHE); the Department of Animal Health (DAH); Viet Nam National University of Agriculture (VNUA); and the Regional Animal Health Office No. 6 (RAHO6), showed their support for PREDICT-2 by attending and actively contributing to working sessions at the PREDICT All-Country Meeting in Dubai, UAE, February 2016.

Viral Family/ Genus	Known/Novel	Animal	Interface
Herpes viruses	**2 novel**	Common Palm Civet and Asiatic Black Bear	Civet in restaurant; bear rescued from trade in wildlife rescue center
Influenza A	**1 known**	Rhizomyinae subfamily of bamboo rats	For sale in restaurant
Paramyxo viruses	**1 known & 5 novel**	Rats,bats	For sale in restaurant, for sale in the large market or near human dwellings
Rhabdo viruses	**15 novel**	Rhizomyinae subfamily of bamboo rats, rats, bats and non-human Primate	For sale in restaurant, in or near human dwellings and Wildlife farms
Corona viruses	**2 novel**	Bats	Contact during religious activities, in or near human dwellings

Table 1: Viruses detected during PREDICT-1 in Viet Nam

** Cover photo: Wildlife meat sold and consumed in restaurants represents a pathway for zoonotic disease transmission. From left to right: wild boar, treeshrew, porcupine and bamboo rat confiscated from the illegal wildlife trade in Viet Nam. Photo credit: WCS Viet Nam*

Surveillance and Field Activities

- The PREDICT-2 qualitative research package received local IRB approval from the ethics committee at the Ha Noi School of Public Health on 24th March 2016, opening the door to PREDICT to begin human behavioral surveillance operations in Viet Nam in the coming months.
- PREDICT-2 collected 28 samples from 7 pangolins at Carnivore & Pangolin Conservation Program (CPCP) in Cuc Phuong National Park, and 93 samples from 41 animals (3 birds, 4 carnivores, 3 wild boar, 29 rodents, 1 rabbit, and 1 tree shrew) confiscated from the illegal wildlife trade in Dak Nong Province.
- PREDICT-2 conducted surveillance site assessments in two northern provinces (Ha Noi and Lang Son) of Viet Nam in collaboration with NIHE, PREDICT's human health sector partner agency.

The field site assessment team prepared and wearing Personal Protection Equipment (PPE) before entering a bat guano cave in Lang Son Province. The field team participants included representatives of NIHE, WCS and Bac Giang Provincial Preventive Medicine Center. October 19, 2015. Photo credit: Tran Vu Phong.

WCS Viet Nam signed the Viet Nam One Health Partnership for Zoonoses Framework. March 1, 2016. Photo credit: One Health Partnership Secretariat.

Capacity Building

A total of 34 individuals, including 25 men and 9 women, have been trained in the One Health approach and Infectious Disease Surveillance at high risk interfaces between humans and wildlife in Viet Nam since the start of PREDICT-2 activities in 2014.

Contact information:

Amanda E. Fine, VMD, PhD
Wildlife Conservation Society
Room 1302, 57 Lang Ha Street,
Ba Dinh District,
Hanoi, Viet Nam
Tel: +84 4 35149750
Email: afine@wcs.org

PREDICT partners in Viet Nam:

- Department of Animal Health, Ministry of Agriculture and Rural Development (MARD)
- National Institute of Hygiene and Epidemiology (NIHE), Ministry of Health (MoH)
- Viet Nam National University of Agriculture (VNUA)
- Regional Animal Health Office No. 6 (RAHO6)

Meeting with the Medical Entomology and Zoology Department to introduce PREDICT project activities and discuss the cooperation between PREDICT and the National Institute of Hygiene and Epidemiology. April 21, 2015. Photo credit: Tran Vu Phong.

Laboratory Development/Testing

- PREDICT-2 engaged in further characterization of viruses indentified during PREDICT-1 and prepared for PREDICT-2 testing.
- A detailed laboratory assessment at NIHE, the designated PREDICT human health laboratory in Viet Nam, was completed to determine the institution's capacity and readiness to implement PREDICT protocols.

Stakeholder Engagement and Partner Coordination

- WCS signed a Memorandum of Understanding with NIHE to support "Collaborative Investigation and Response to Infectious Diseases of Pandemic Potential at High Risk Wildlife/Human Interfaces in Viet Nam, as part of the USAID Emerging Pandemic Threats Program – PREDICT-2 Project, Viet Nam" thereby formalizing the project's engagement with a Ministry of Health (MoH) partner in Viet Nam.

- WCS signed an Agreement of Collaboration with the Viet Nam National University of Agriculture on "Investigating wildlife diseases at the human/livestock/wildlife interface" continuing collaboration under PREDICT-1, to carry out PREDICT-2 activities Viet Nam.

- PREDICT-2 participated in a multi-stakeholder workshop on developing the Longitudinal Influenza Surveillance Network (LISN) in Viet Nam, contributing to plans to implement concurrent surveillance in human, wildlife and livestock populations for influenza and respiratory pathogens. LISN partners include USAID, WHO, FAO, NIHE, PI-HCM, DAH, US CDC, GDPM, and other agencies and research institutions.

- PREDICT staff participated in the Viet Nam One Health Partnership for Zoonoses (OHP) launch in Viet Nam with the signing of the OHP Framework. PREDICT provided input into the development of the Viet Nam Integrated National One Health Plan for the period 2016-2020 through interviews and participation in the formal consultation meeting for the five-year plan held in Ha Noi, March 24th 2016

USAID FROM THE AMERICAN PEOPLE
UC DAVIS VETERINARY MEDICINE One Health Institute
WCS
EcoHealth Alliance
METABIOTA
Smithsonian Institution

From: (b)(6)
Sent: Mon, 15 Jul 2019 19:45:11 +0000
To: (b)(6)
Cc: Peter Daszak
Subject: (b)(5); (b)(5) - Deliberative Process Privilege
Attachments: (b)(5); (b)(5) - Deliberative Process Privilege
(b)(5); (b)(5) - Deliberative Process Privilege

Dear (b)(6) and Peter,

(b)(5); (b)(5) - Deliberative Process Privilege

Please feel free to share this to our Thai colleagues if they are still interested to participate. I know it may be too late, but it's good to keep them informed.

Cheers,
(b)(6)

(b)(6)

EcoHealth Alliance
460 West 34th Street, (b)(6)
New York, NY 10001

(b)(6) (U.S. mobile)
(b)(6) (Skype)
(WeChat)

EcoHealth Alliance leads cutting-edge research into the critical connections between human and wildlife health and delicate ecosystems. With this science, we develop solutions that promote conservation and prevent pandemics.

On Mon, Jun 24, 2019 at 4:52 PM (b)(6) @ecohealthalliance.org> wrote:

Hi (b)(6)

Great to hear the good news about the Thai VP. Likewise, our Chinese colleagues have been asking about the Thai VP, and would be interested to know more.

The July meeting in Harbin will mainly focus on discussing a plan to (b)(5); (b)(5) - Deliberative Process Privilege (b)(5); (b)(5) - Deliberative Process Privilege I haven't heard a clear message (b)(6) from either (b)(6) or the lead scientists I am working with. If you think it's helpful to have a meeting between the representatives of China and Thailand at this stage, there shouldn't be any problem to get an invitation sent from the conference or one of the lead institutes.

(b)(5); (b)(5) - Deliberative Process Privilege

BTW, I did receive requests for technic advice on the virome database (EHA colleagues (b)(6) and (b)(6) provided useful information), and am helping map out the countries where China work with for EIDs research, another group is working on the lab techniques, we are finalizing the agenda to share in early July.

Cheers,

(b)(6)

On Mon, Jun 24, 2019 at 1:50 AM (b)(6) @usaid.gov> wrote:
Peter and (b)(6) I've just finished sitting in on the Thai VP core group meeting where they laid out s calendar of next steps that lead to field operations. There was much interest in understanding how the CVO will be organized. (b)(5) - Deliberative Process Privilege
(b)(5) - Deliberative Process Privilege
Thoughts? If you agree, do you think we could get an invite? I can forward the contact info for the lead person for the TVP core group. With the invitation they can decide who they would send

(b)(6)
Sent from my iPhone

Page 3 of 5

Withheld pursuant to exemption

(b)(5) ; (b)(5) - Deliberative Process Privilege

of the Freedom of Information and Privacy Act

Page 4 of 5

Withheld pursuant to exemption

(b)(5) ; (b)(5) - Deliberative Process Privilege

of the Freedom of Information and Privacy Act

Page 5 of 5

Withheld pursuant to exemption

(b)(5) ; (b)(5) - Deliberative Process Privilege

of the Freedom of Information and Privacy Act