From: "Peter Daszak" <daszak@ecohealthalliance.org>
Sent: 04/08/2017 12:38:22 PM (-07:00)
To: "Jonna Mazet" <jkmazet@ucdavis.edu>
Cc: "Dennis Carroll" <dcarroll@usaid.gov>; "Eddy Rubin" <erubin@metabiota.com>; "Elizabeth S Chase" <eschase@ucdavis.edu>; "Brooke Watson" <watson@ecohealthalliance.org>
Subject: Bio for RE: CUGH presentation
Attachments: Peter Daszak Short Bio 2017.doc

Bio attached – please mention that I have a species of centipede and a parasite from the British greenfinch named after me. Also that I named a parasite from a lizard after my wife....

Cheers,

Peter

Peter Daszak
President

EcoHealth Alliance
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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.

From: [redacted] **On Behalf Of** Jonna Mazet
Sent: Saturday, April 8, 2017 3:12 PM
To: Peter Daszak
Cc: Dennis Carroll; Eddy Rubin; Elizabeth S Chase; Brooke Watson
Subject: Re: CUGH presentation

Can you guys also send me your preferred short bios for introductions? I want to highlight your preferred accomplishments.
Thanks,
J

On Saturday, April 8, 2017, Jonna Mazet <jkmazet@ucdavis.edu> wrote:
Here's the working version,
J

CUGH GVP Session.pptx

On Sat, Apr 8, 2017 at 10:45 AM, Peter Daszak <daszak@ecohealthalliance.org> wrote:
I can't – I'll be on the train at 3pm. I also need to see what's in them so I know what to add…

Can you send them by google drive or dropbox link and I'll have a new version with you by the tonight….

Cheers,

Peter

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President

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From: REDACTED **On Behalf Of** Jonna Mazet
Sent: Saturday, April 8, 2017 10:38 AM
To: Peter Daszak
Cc: Dennis Carroll; Eddy Rubin; Elizabeth S Chase; Brooke Watson
Subject: Re: CUGH presentation

I don't think the big file will send from this conference wifi -- can you just send me your section & I'll insert and post the whole thing to google drive and upload. I'd like to upload by today at 3:30.
J

On Saturday, April 8, 2017, Peter Daszak <daszak@ecohealthalliance.org> wrote:
Jonna, everyone – I've got slides to insert into the CUGH deck. Can someone send me the latest version in the right speaker order so I can do this on the train today…?

Look forward to seeing you all in DC

Cheers,

Peter

Peter Daszak
President

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From: [redacted] **On Behalf Of** Jonna Mazet
Sent: Thursday, March 23, 2017 12:01 PM
To: Dennis Carroll; Peter Daszak; Eddy Rubin
Cc: Elizabeth S Chase
Subject: Re: CUGH presentation

Hi again GVPers,
I noticed in Dennis' slides that some of them weren't the most recent versions that we updated in Beijing. In case any of you are looking for those, I've attached them here.
Liz may have already let you know, but I am running our One Health Institute annual meeting today, so I won't be able to join the call (I know, again!). I'll definitely be on the next two calls, though. We can do email and then final coordination for the presentation next week. I know we'll be missing Eddy, but if he has a chance to let us know about his slides before next week's call, we can wrap up that planning.
Have a nice day,
Jonna

On Wed, Mar 22, 2017 at 5:50 PM, Jonna Mazet <jkmazet@ucdavis.edu> wrote:
Hi all,
Just coming back in after a couple of days off. Thanks to Eddy for sending in slides. That request was just to allow them to assign Continuing Medical Education units for our session. Eddy's submission should work just fine for that.
We can use what Dennis has provided for a starting point for this one. I had proposed to the organizers that each of us would present for about 15 mins and then have a discussion with Q&A. I will do introductions of each of you as the moderator. So please do look at Dennis' set and suggest any numbers you think you would like to covers d/or how many slides you might add for your part. We will then discuss order & flow.
Thanks to all,
Jonna

What I originally submitted for the session included

On Wednesday, March 22, 2017, Peter Daszak <daszak@ecohealthalliance.org> wrote:
All sounds good to me. Maybe I could show a few slides at the end on the modeling work we've just done trying to target the GVP to deliver the biggest bang at a much-reduced cost…?

I'm sure they'll allow us to add some slides and give them an updated slide deck closer to the date…

Cheers,

Peter

Peter Daszak
President

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From: Dennis Carroll [mailto:dcarroll@usaid.gov]
Sent: Sunday, March 19, 2017 11:41 PM
To: Eddy Rubin; Jonna Mazet; Peter Daszak
Subject: CUGH presentation

Eddy, we can divide the presentation up like we did at Pasteur. Attached is the version I gave at UCSF - why don't you all edit to carve out your space per Pasteur.

d

Dr Dennis Carroll
Director, Emerging Threats Program
U.S. Agency for International Development
Office: (202) 712-5009
Mobile: REDACTED

Begin forwarded message:

> **From:** Dennis Carroll <dcarroll@usaid.gov>
> **To:** DCarroll <dcarroll@usaid.gov>, Dowen Carroll REDACTED
> **Subject: GVP.UCSF**

--

Dr. Dennis Carroll
Director, Emerging Threats Program
Bureau for Global Health
U.S. Agency for International Development

Office: 202-712-5009
Mobile: REDACTED

Dr. Peter Daszak, Ph.D

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's research has been instrumental in identifying and predicting the impact of emerging diseases across the globe. His achievements include identifying the bat origin of SARS, identifying the underlying drivers of Nipah and Hendra virus emergence, producing the first ever global emerging disease 'hotspots' map, developing a strategy to find out how many unknown viruses exist that could threaten to become pandemic, identifying the first case of a species extinction due to disease, and discovering the disease chytridiomycosis as the cause global amphibian declines.

Dr Daszak is a member and Chair-elect of the National Academy of Sciences, Engineering and Medicine's Forum on Microbial Threats. He is a member of the NRC Advisory Committee to the US Global Change Research Program, the Supervisory Board of the One Health Platform, the One Health Commission Council of Advisors, the CEEZAD External Advisory Board, the Cosmos Club, the Advisory Council of the Bridge Collaborative; has 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 has advised the Director for Medical Preparedness Policy on the White House National Security Staff on global health issues. Dr. Daszak is a regular advisor to WHO, OIE and FAO, and is actively involved in the WHO Expert group on Public Health Emergency Disease Prioritization.

Dr Daszak won the 2000 CSIRO medal for collaborative research on the discovery of amphibian chytridiomycosis, is the EHA institutional lead for USAID-EPT-PREDICT, is on the Editorial Board of *Conservation Biology*, *One Health*, and *Transactions of the Royal Society of Tropical Medicine & Hygiene*, and is Editor-in-Chief of the journal *Ecohealth*. He has authored over 300 scientific papers, and his work has been the focus of extensive media coverage, ranging from press articles in The New York Times, The Wall Street Journal, The Economist, The Washington Post, US News & World Report and broadcast appearances on 60 Minutes, CNN, ABC, NPR's Talk of the Nation, Morning Edition, and Fresh Air with Terry Gross.

From: predict-request@ucdavis.edu on behalf of "Anna Willoughby" <willoughby@ecohealthalliance.org>
Sent: 04/15/2018 5:14:51 PM (-07:00)
To: "David J Wolking" <djwolking@ucdavis.edu>
Cc: "Peter Daszak" <daszak@ecohealthalliance.org>; "Molly Turner" <turner@ecohealthalliance.org>; "Kevin Olival" <olival@ecohealthalliance.org>; "Ava Sullivan" <sullivan@ecohealthalliance.org>; "Evelyn Luciano" <luciano@ecohealthalliance.org>; "Corina Grigorescu Monagin" <cgmonagin@ucdavis.edu>; "predict@ucdavis.edu" <predict@ucdavis.edu>
Subject: [predict] Re: Action required: P2 2018 Semi-annual report - due to HQ April 13, 2018
Attachments: M&A_SAR2018_15April2018-Final.docx, M&A M&E_SAR 2018_15April2018.xlsx, Y4SA_M&E1.1b_M&A_15April2018-Final.pdf

Hi David,

Please find our M&A documents for the semi-annual. I am also providing a dropbox link for the M&E appendix ppt if this needs editing, as this is rather large. Let us know if you have any questions or need anything else.

https://www.dropbox.com/s/75y0ikifkwhsi9z/Y4SA_M%26E1.1b_M%26A_15April2018-Final.pptx?dl=0

Best,
Anna

On Fri, Apr 13, 2018 at 5:52 PM, David J Wolking <djwolking@ucdavis.edu> wrote:
Thanks for the heads up and enjoy the weekend!

On Fri, Apr 13, 2018 at 8:54 AM, Anna Willoughby <willoughby@ecohealthalliance.org> wrote:
HI David,

We are actively working on the M&A portion of the semi-annual report and M&E. It is now with Peter for final edits, which he will circulate to everyone before Monday morning. I apologize for the delay, but PD hadn't had a chance to look at it yet with the Napa meeting and travel, but everything will get in by the weekend.

Hope this is okay, and let me know if you have any questions.

Best,
Anna

On Tue, Mar 20, 2018 at 5:07 PM, Kevin Olival <olival@ecohealthalliance.org> wrote:
> Thanks David. My favorite time of year!
>
> Received, will comply.
>
> Kevin
>
> > On Mar 20, 2018, at 2:54 PM, David J Wolking <djwolking@ucdavis.edu> wrote:
> >
> > Hey Peter and Kevin,
> >

> It's Semi-annual Report time!
>
> I'm attaching your section from the AR 2017 for reference and to update as the SAR 2018 template. Feel free to scrap or retain what you like from this as you update the content from your activities to cover the this report's period of performance (October 1, 2017-March 31, 2018).
>
> Our deadline for submission back to HQ is April 13, 2018. Since EIDITH submissions are in pretty good shape and the report is cast in the same mold as the annual report (or even abbreviated for the semi-annual period), hopefully this is enough time.
>
> I'm also including the M&E components for the Behavior Risk team here with instructions (see below). If you have questions on the M&E stuff, reach out to me and Corina (she's just now back from leave).
>
> Thanks,
>
> David
>
>
> M&E Guidance:
>
> Please see attached for your relevant M&E indicator reference sheets and template for data entry. The templates have not changed from last year's annual report. Most instructions are included on the template itself but please refer to the indicator reference sheet if you have questions. If applicable, we included cumulative data so that you may add onto this (there is only one cumulative indicator) The data call is from October 1, 2017 – March 31, 2018.
>
> Additional information below:
>
>
> M&A (Peter/Kevin):
>
> 1.1b: #, list of viral, bacterial, or other disease risk pathway models or maps developed and/or refined (consult with Lab and Surveillance teams).
>
>
>
> <M&A M&E_SAR 2018.xlsx>
> <M&A_AR2017_final.docx>

--

Anna Willoughby
Research Assistant

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--

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Research Assistant

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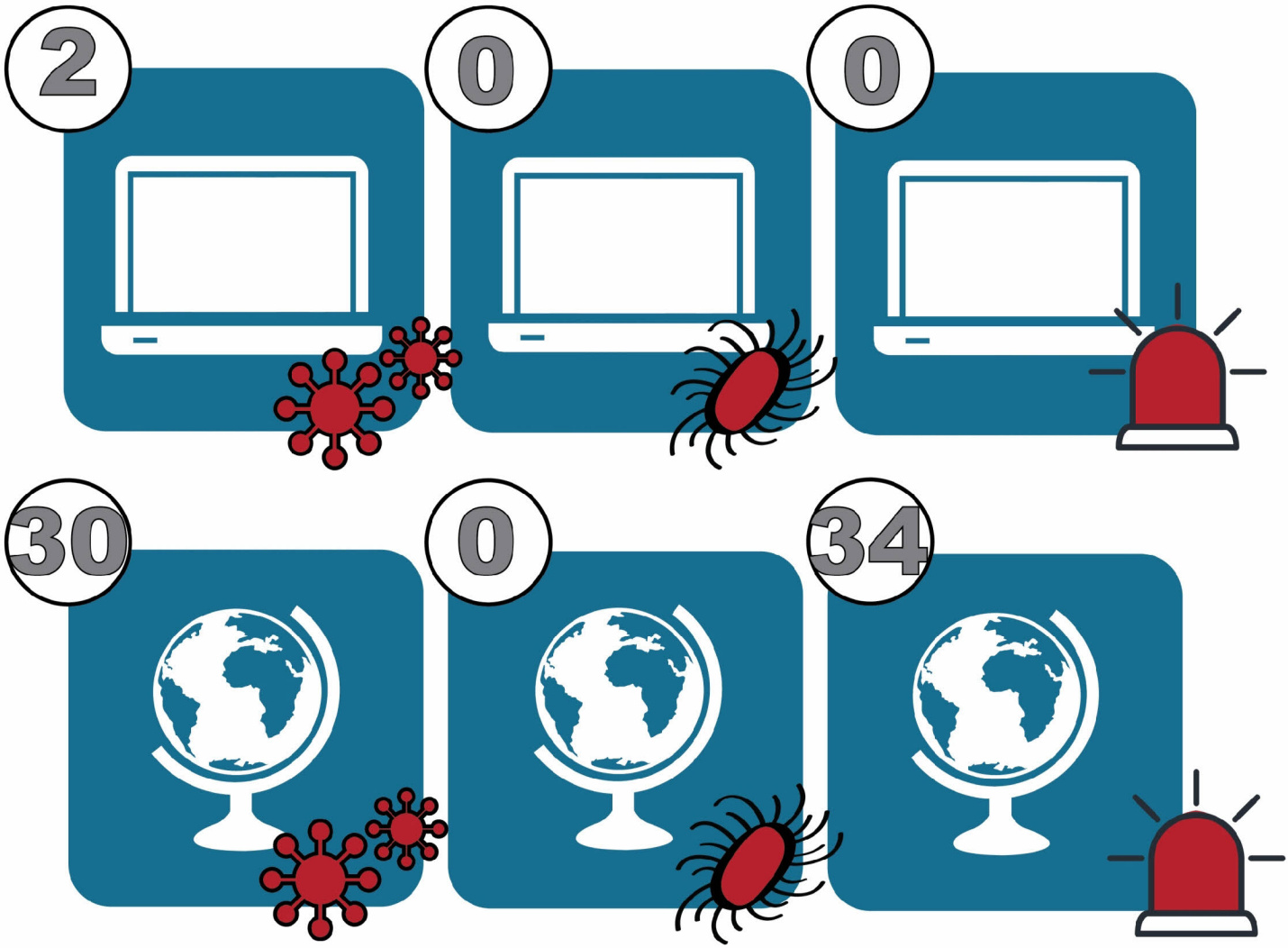
PREDICT Year 4 Semi-Annual M&E
M&E 1.1b Maps & Models



Infographic: Number of viral (left), bacterial (center) and risk characterization (right) models (top) and maps (bottom) developed or refined between 10/01/17-3/31/18.

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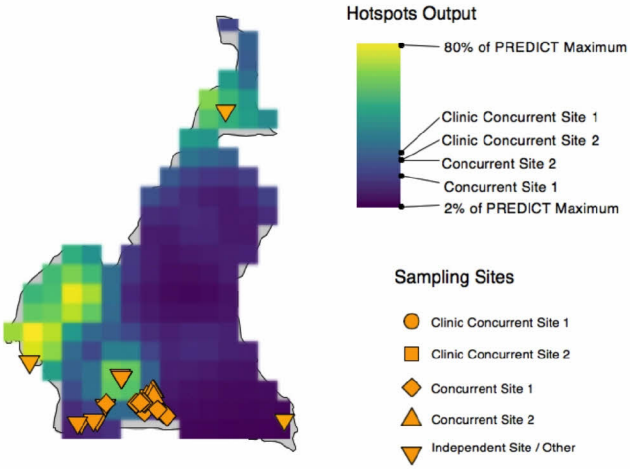
Emerging Threats Program 2 (EPT-2)

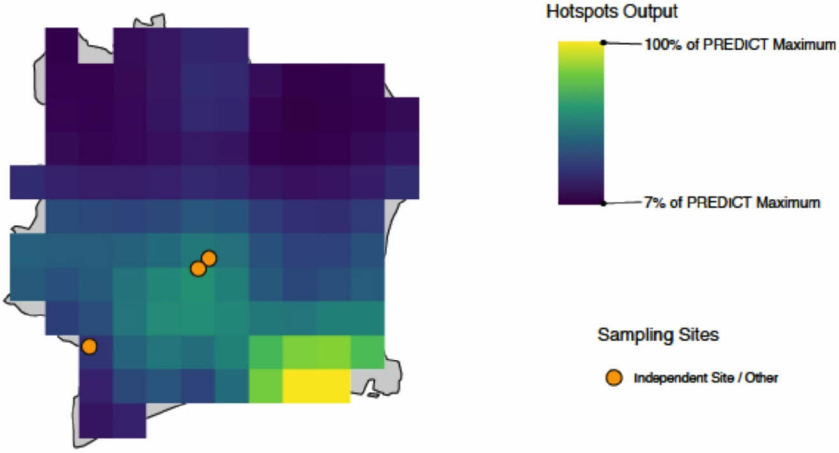
1-4 West Africa

Country-Level EID Risk Maps

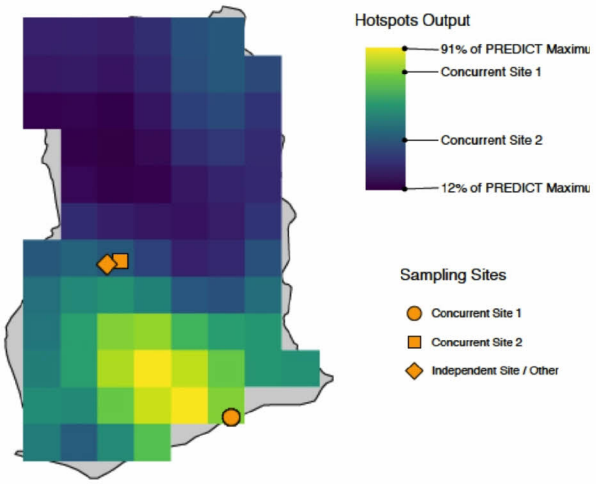
1. Cameroon



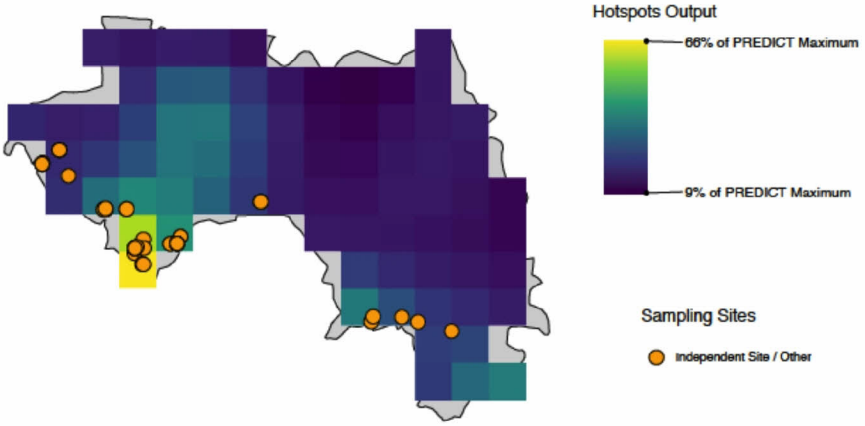
2. Cote d'Ivoire



3. Ghana



4. Guinea



1-30. Country level relative EID risk maps. As part of the country reports presented at the Brussels PREDICT meeting in January, we created per-country relative spatial risk maps of novel zoonotic pathogen spillover, based on the PREDICT Hotspots 2.0 model, a global model fit to 224 new disease emergence events reported globally.

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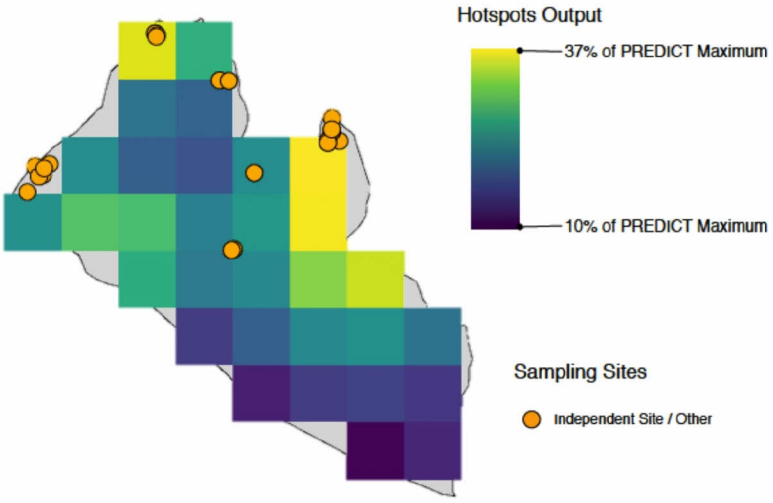
Emerging Threats Program 2 (EPT-2)

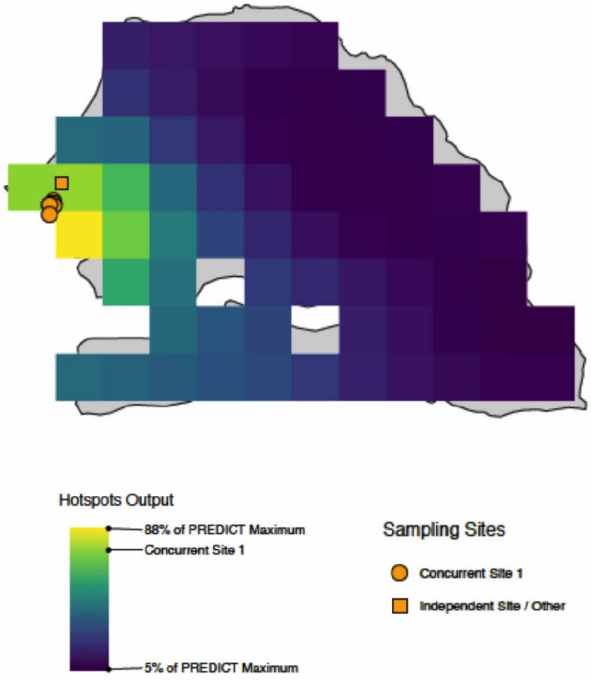
5-7 West Africa

Country-Level EID Risk Maps

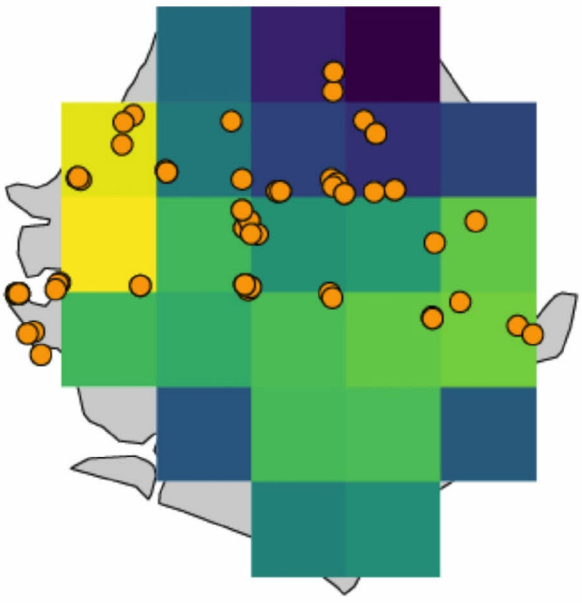
5. Liberia



6. Senegal



7. Sierra Leone



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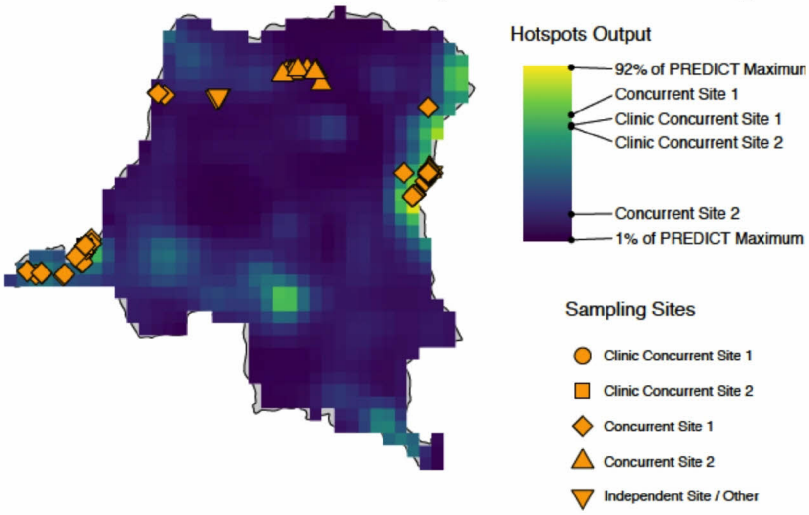
Emerging Threats Program 2 (EPT-2)

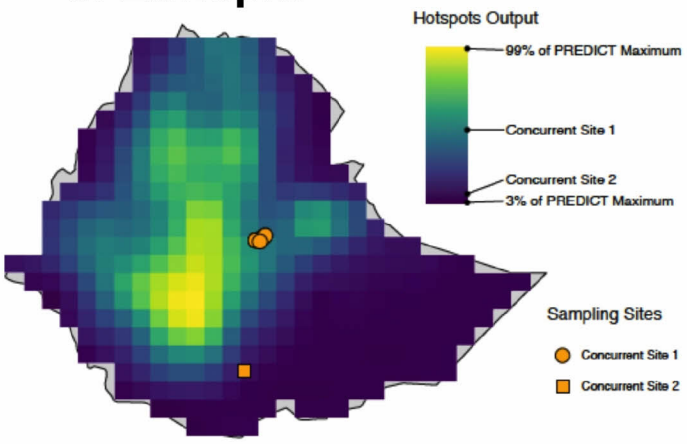
UCDUSR0012795

8-11 East & Central Africa Country-Level EID Risk Maps

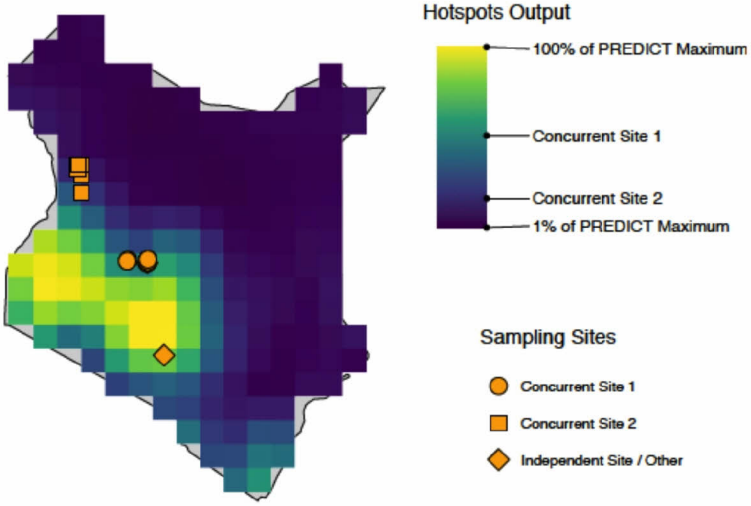
8. Democratic Republic of Congo



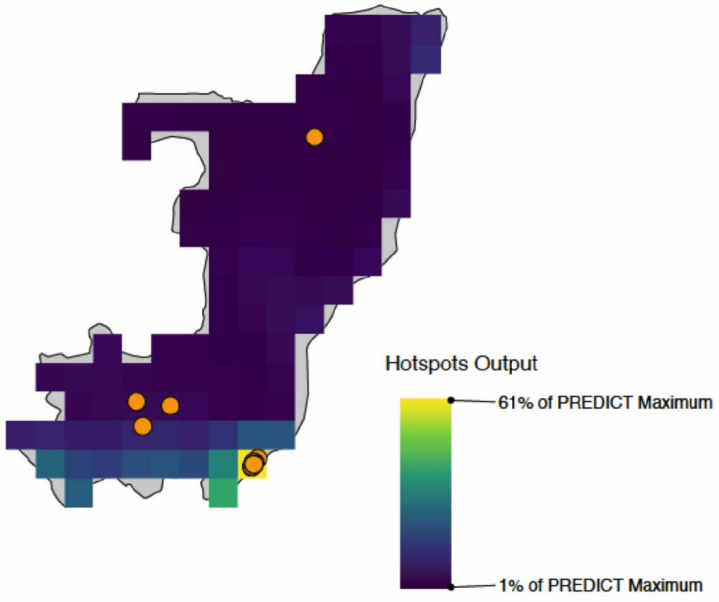
9. Ethiopia



10. Kenya



11. Republic of Congo



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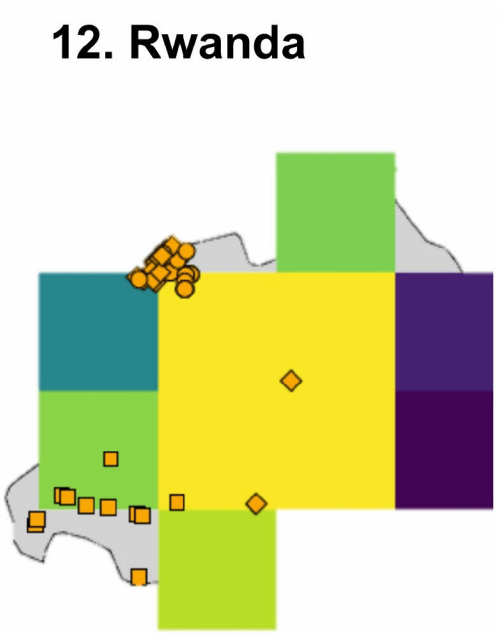
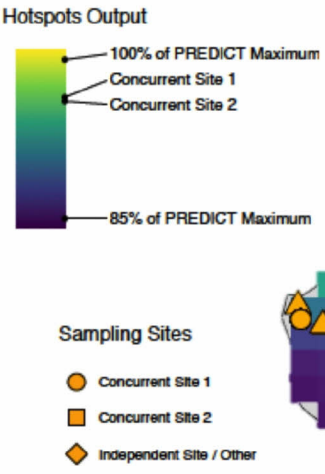
Emerging Threats Program 2 (EPT-2)

UCDUSR0012796

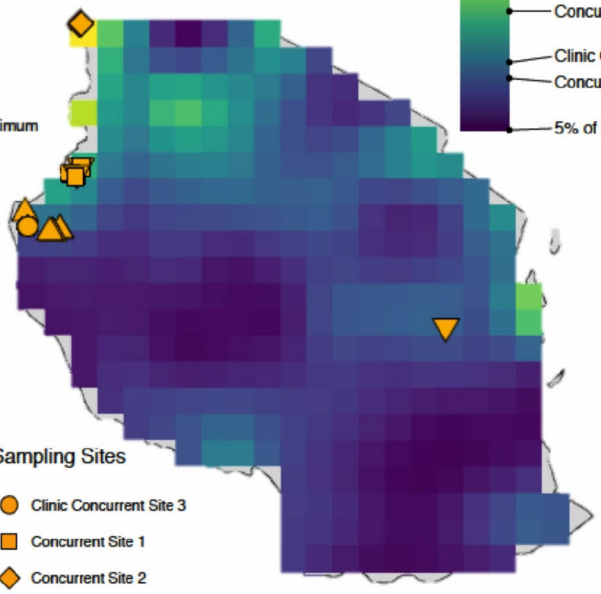
12-14 East & Central Africa Country-Level EID Risk Maps

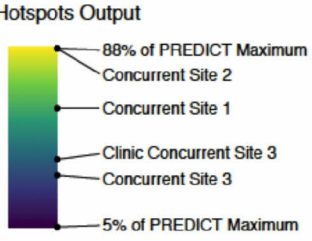
12. Rwanda

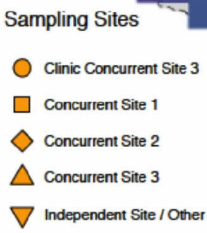




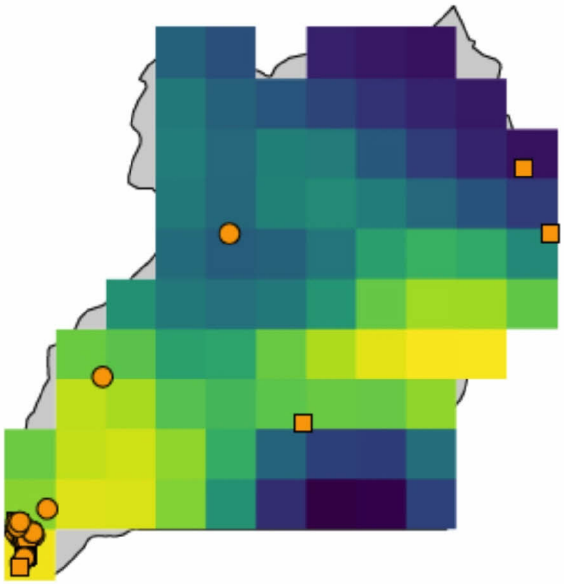
13. Tanzania

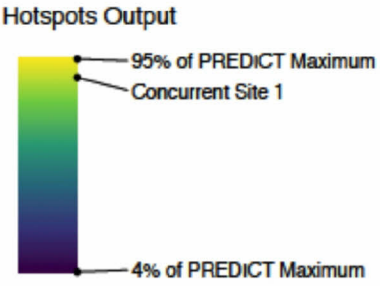


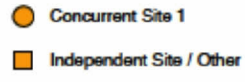




14. Uganda







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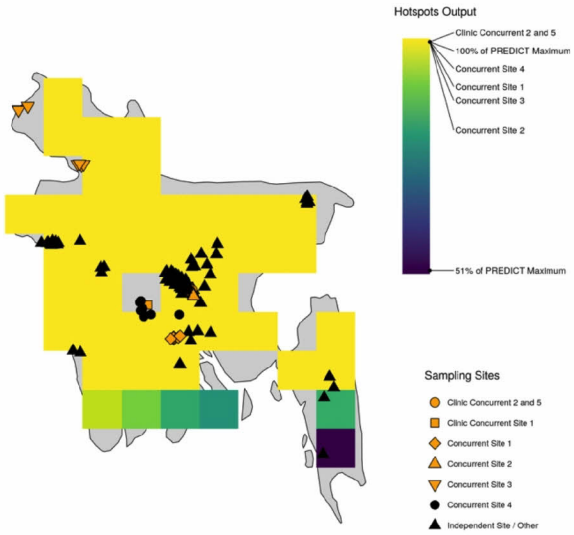
Emerging Threats Program 2 (EPT-2)

UCDUSR0012797

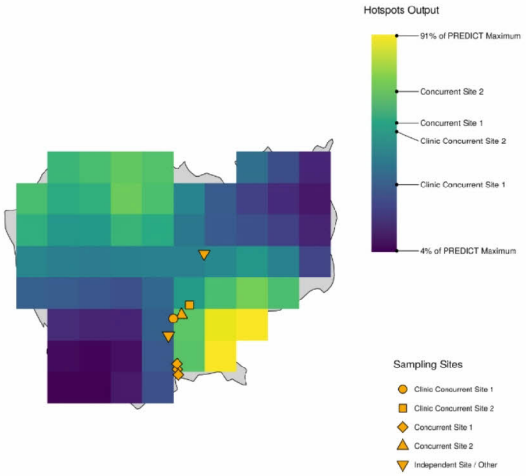
15-18 Asia

Country-Level EID Risk Maps

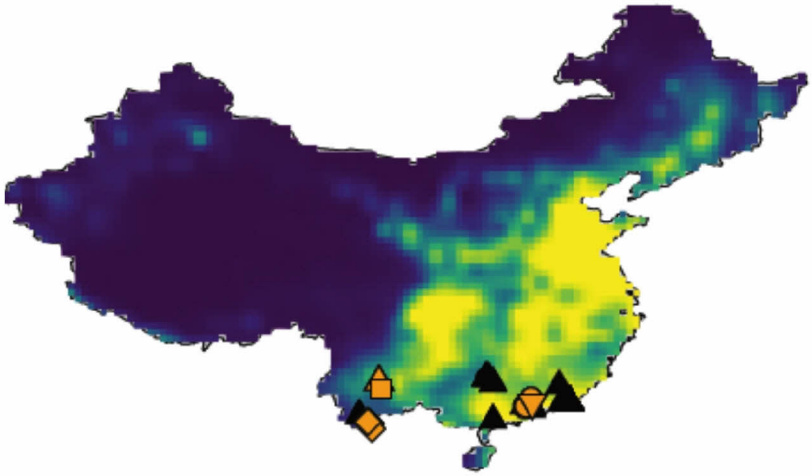
15. Bangladesh



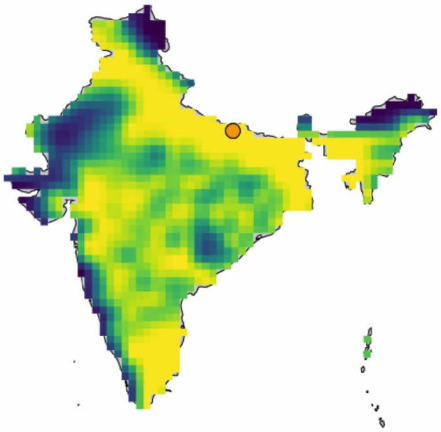
16. Cambodia

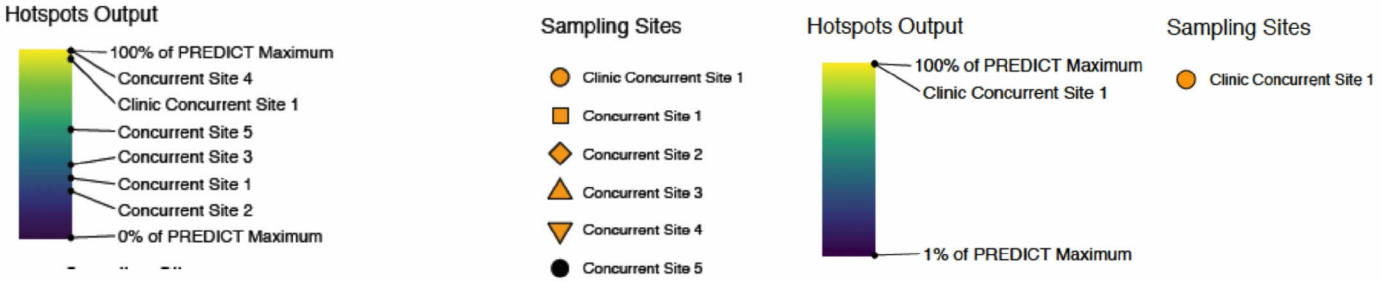


17. China



18. India





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Emerging Threats Program 2 (EPT-2)

UCDUSR0012798

19-22 Asia

Country-Level EID Risk Maps

19. Indonesia

Hotspots Output

100% of PREDICT Maximum

Concurrent Site 2

Clinic Concurrent Site 1

Concurrent Site 3

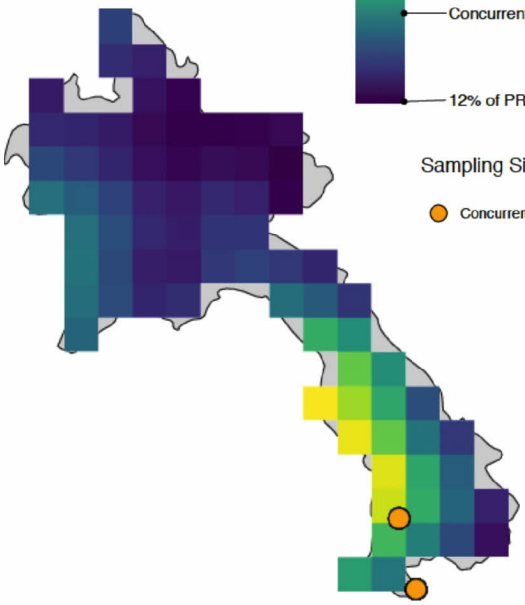
Concurrent Site 4

0% of PREDICT Maximum

Sampling Sites

- Clinic Concurrent Site 1
- Concurrent Site 1
- Concurrent Site 2
- Concurrent Site 3
- Concurrent Site 4
- Concurrent Site 5
- Independent Site / Other

20. Lao PDR



Hotspots Output

85% of PREDICT Maximum

Concurrent Site 1

12% of PREDICT Maximum

Sampling Sites

- Concurrent Site 1

21. Malaysia

Hotspots Output

81% of PREDICT Maximum

Concurrent Site 1

Concurrent Site 2

Concurrent Site 3

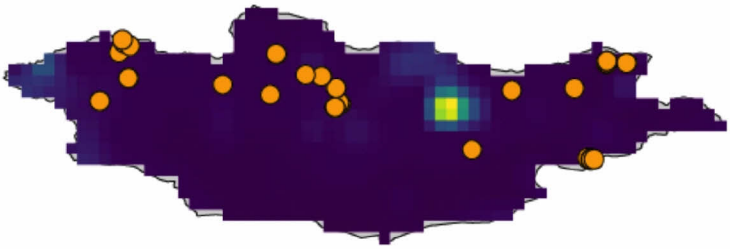
Clinic Concurrent Site 4

2% of PREDICT Maximum

Sampling Sites

- Clinic Concurrent Site 4
- Concurrent Site 1
- Concurrent Site 2
- Concurrent Site 3
- Independent Site / Other

22. Mongolia



Hotspots Output

16% of PREDICT Maximum

0% of PREDICT Maximum

Sampling Sites

- Independent Site / Other

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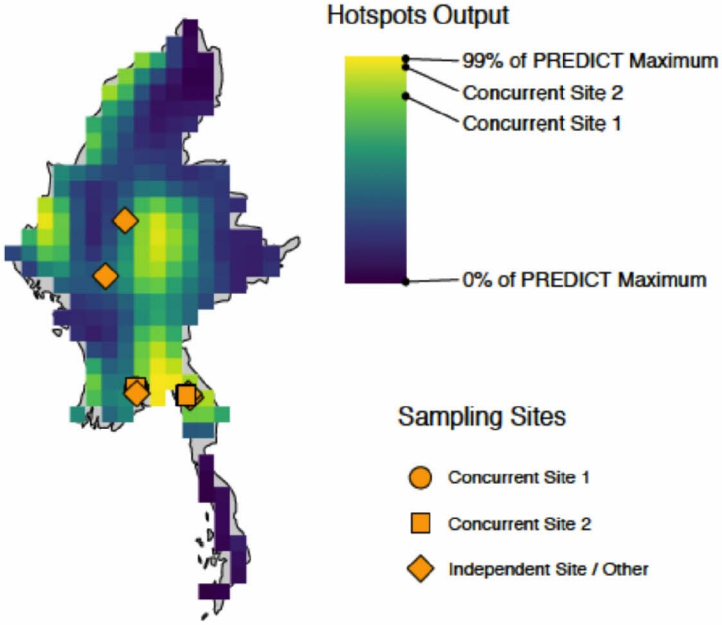
Emerging Threats Program 2 (EPT-2)

UCDUSR0012799

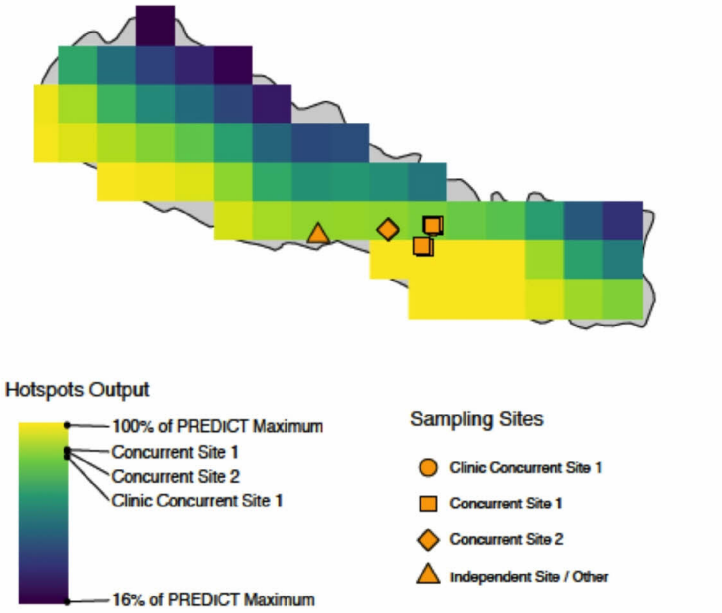
23-26 Asia

Country-Level EID Risk Maps

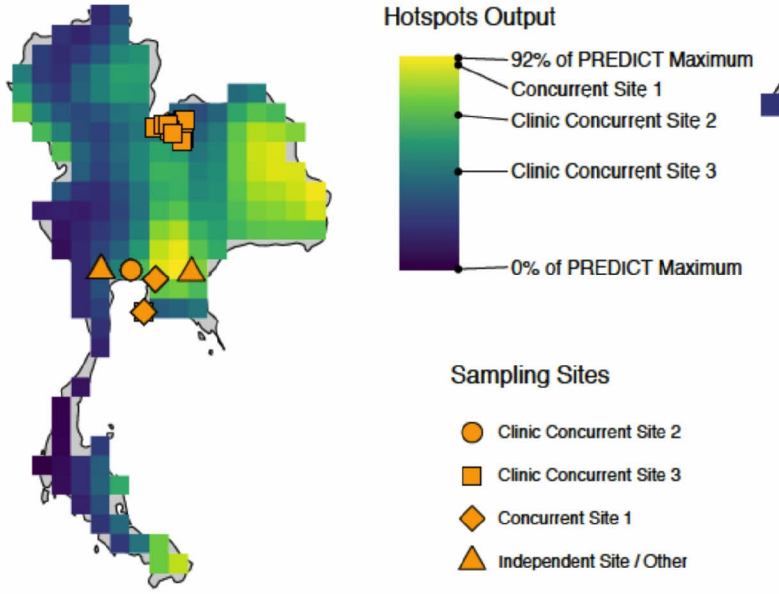
23. Myanmar



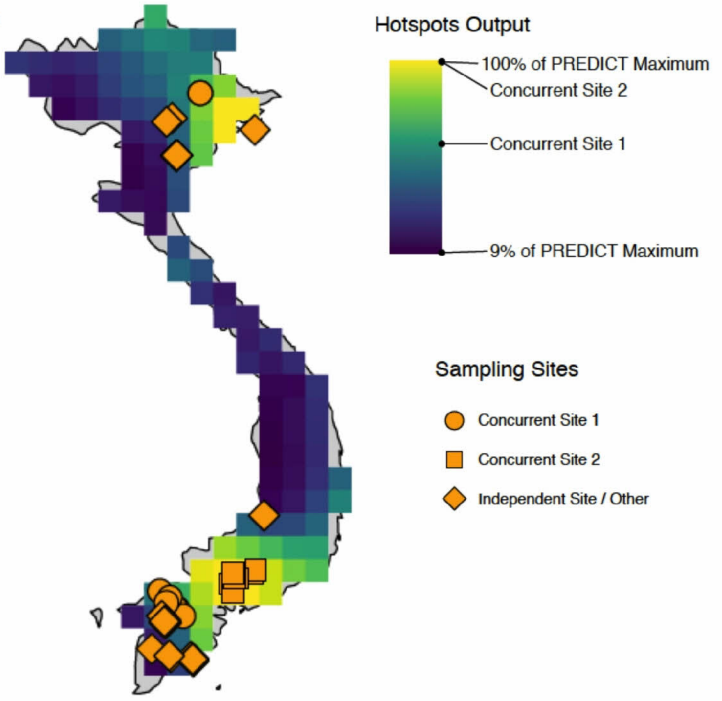
24. Nepal



25. Thailand



26. Vietnam



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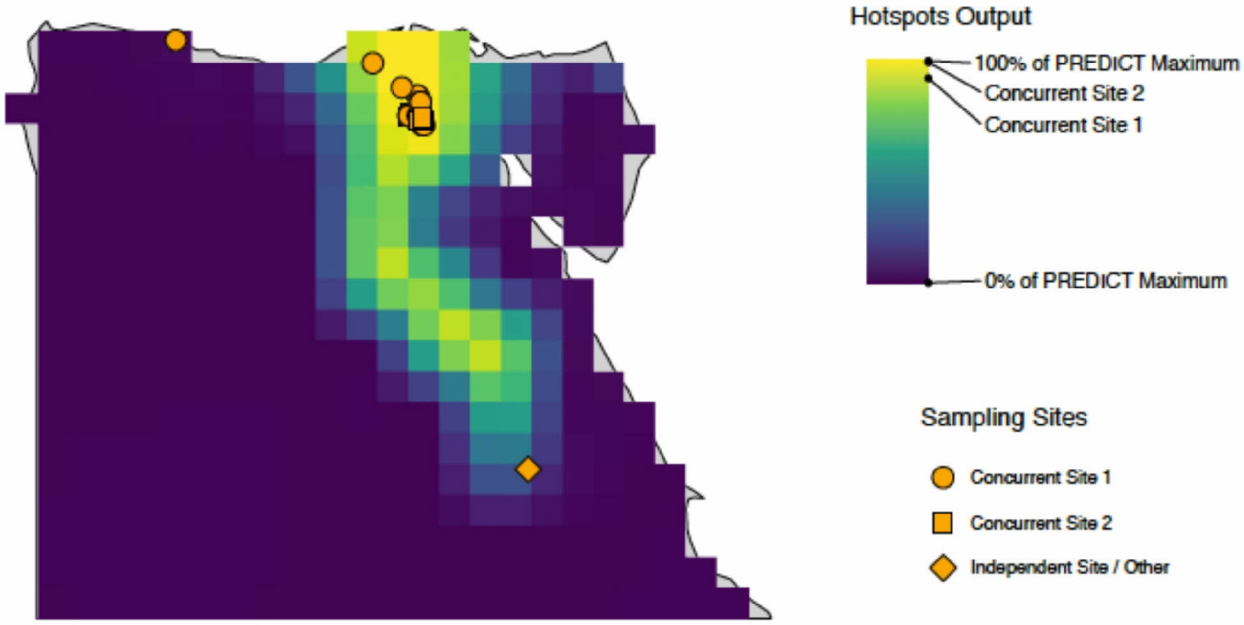
UCDUSR0012800

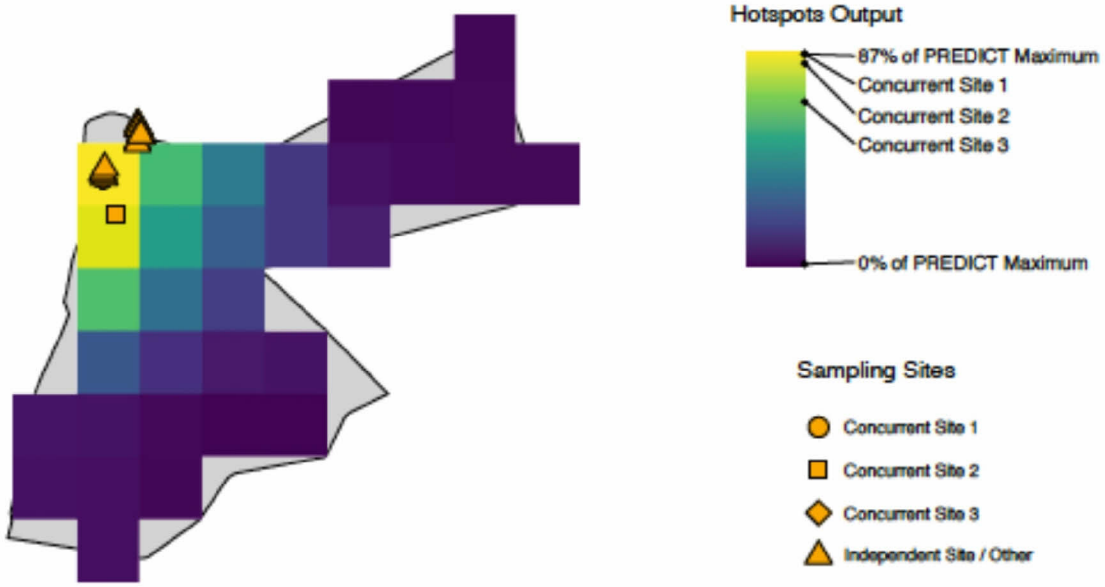
27-28 Middle East

Country-Level EID Risk Maps

27. Egypt



28. Jordan



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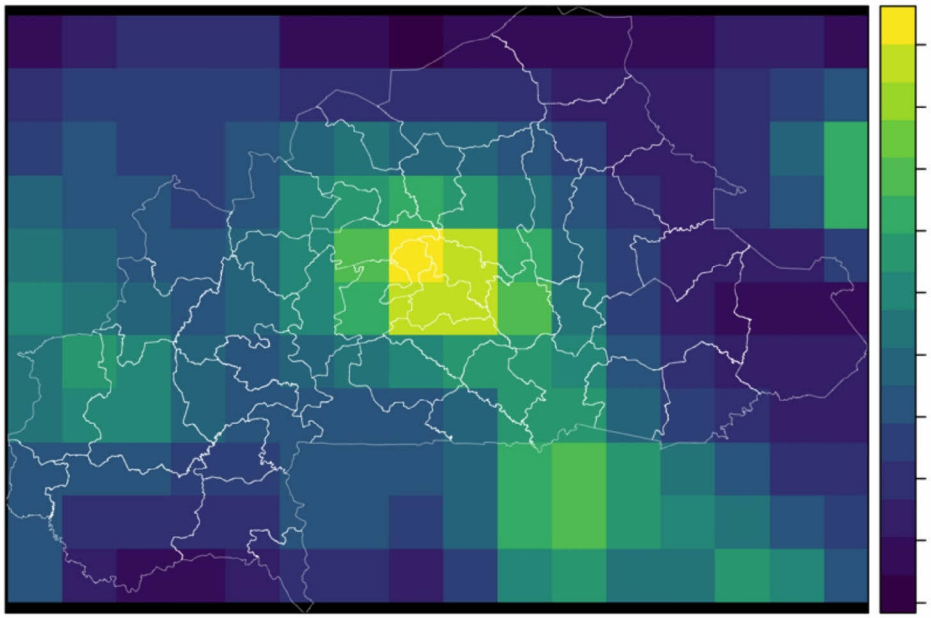
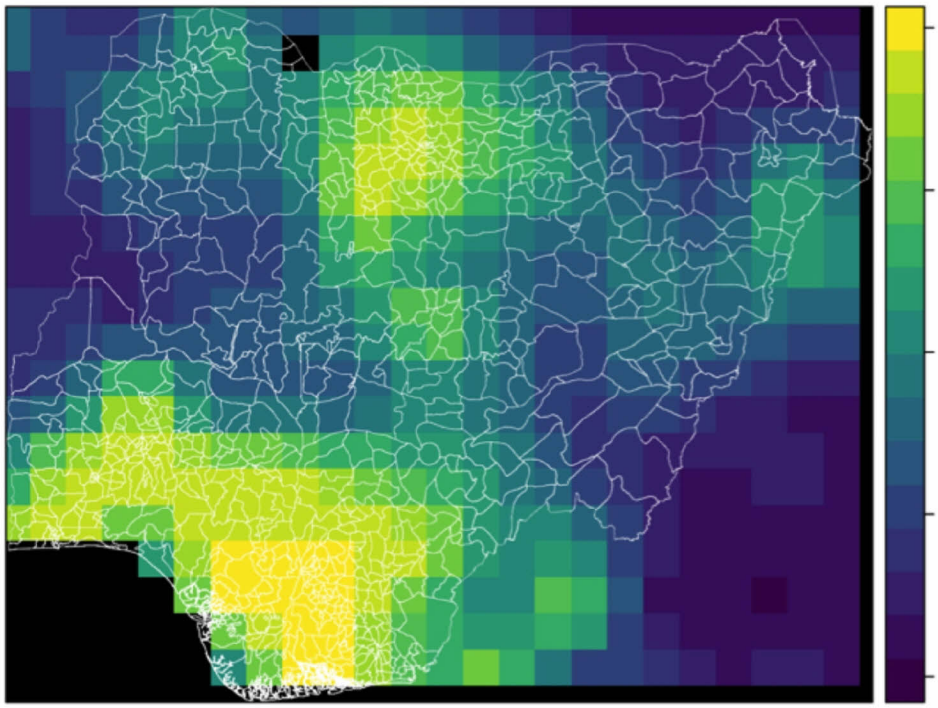
Emerging Threats Program 2 (EPT-2)

29-30 ASL2050 Countries Country-Level EID Risk Maps

29. Burkina Faso



30. Nigeria



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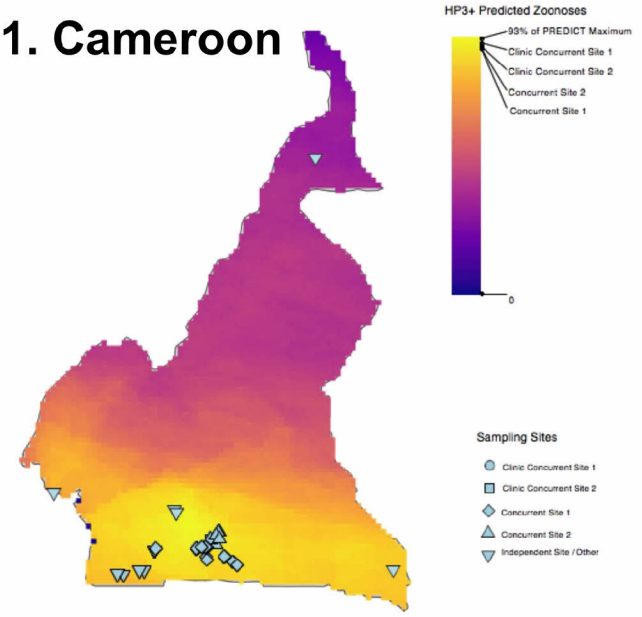
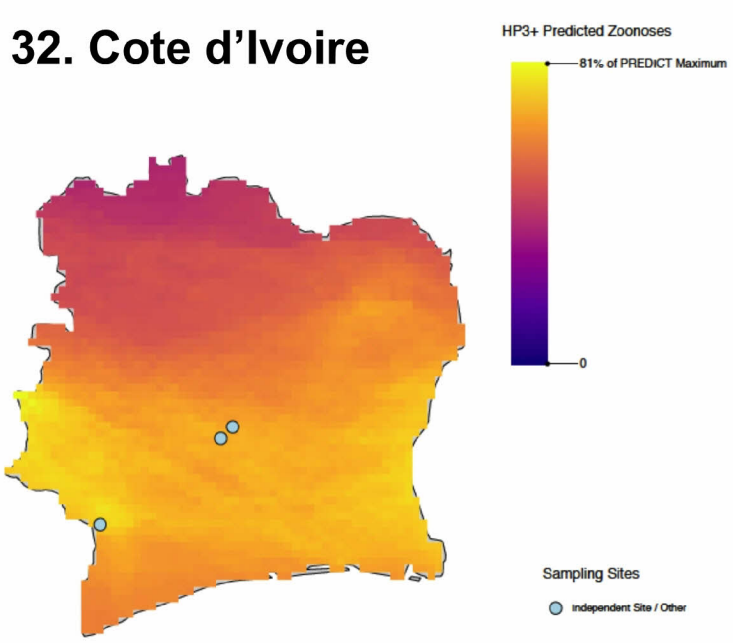
Emerging Threats Program 2 (EPT-2)

31-34 West Africa Country-Level Predicted Zoonoses Maps

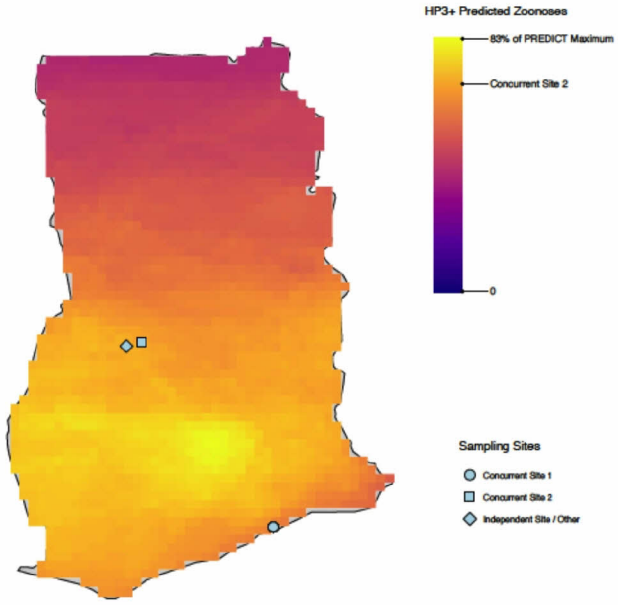
31. Cameroon



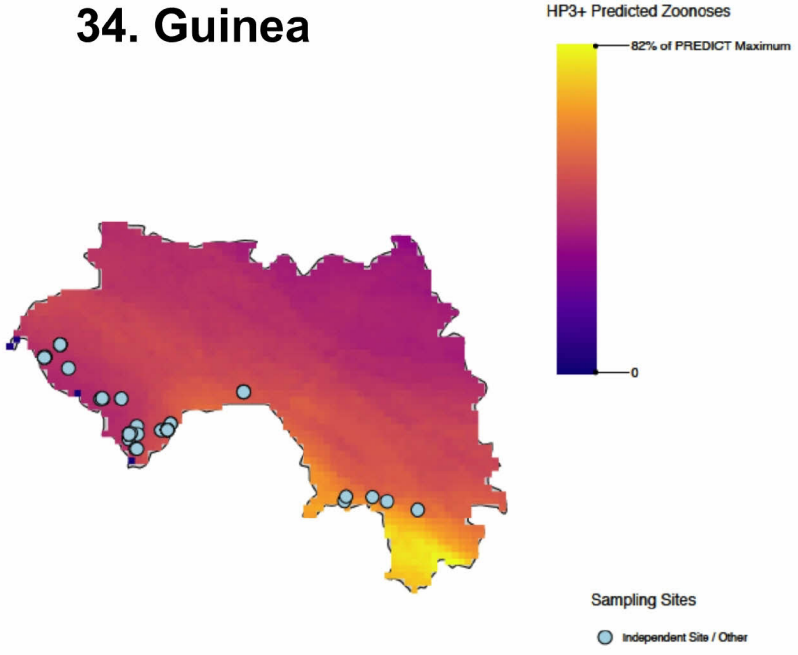
32. Cote d'Ivoire



33. Ghana



34. Guinea



31-58. Country-level predicted zoonoses maps. As part of the country reports at the Brussels PREDICT meeting, we created per-country distribution maps of predicted total diversity potential zoonotic viruses within mammals, based on Olival et al. 2017.

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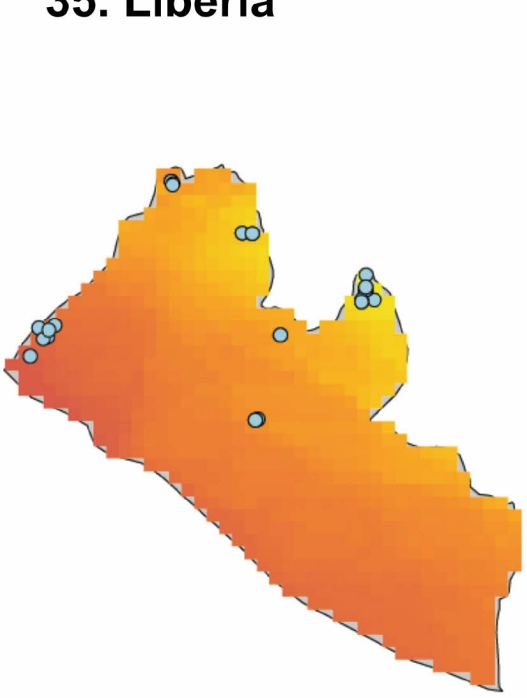
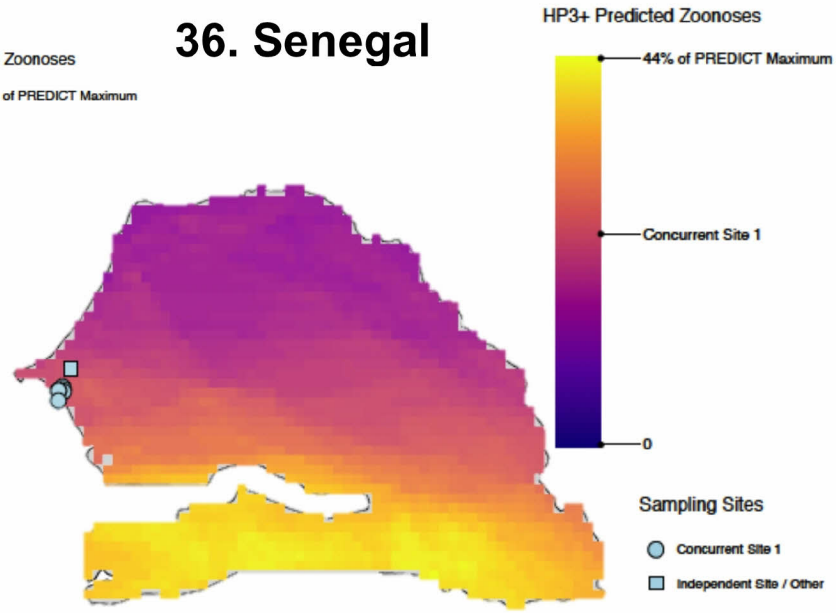
UCDUSR0012803

35-37 West Africa Country-Level Predicted Zoonoses Maps

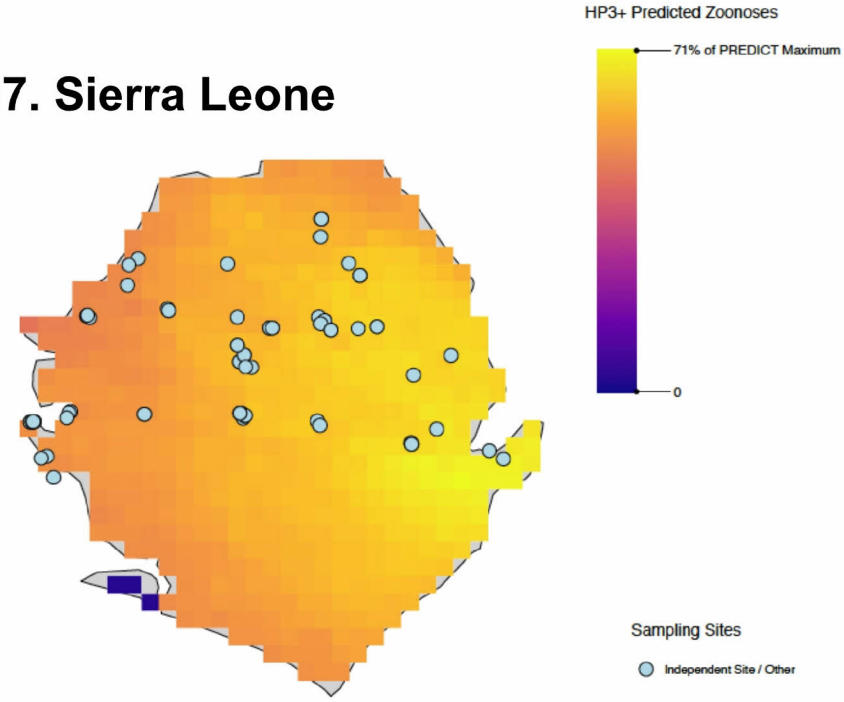
35. Liberia



36. Senegal



37. Sierra Leone



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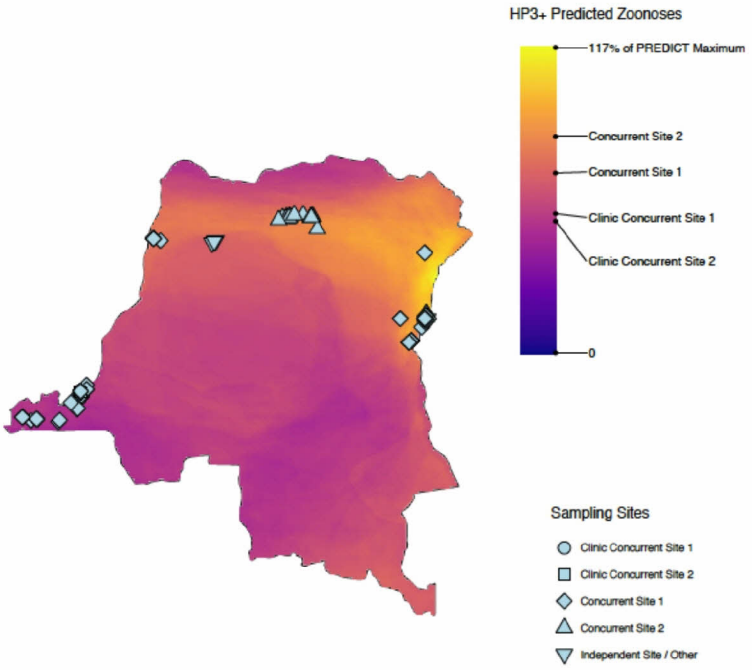
Emerging Threats Program 2 (EPT-2)

UCDUSR0012804

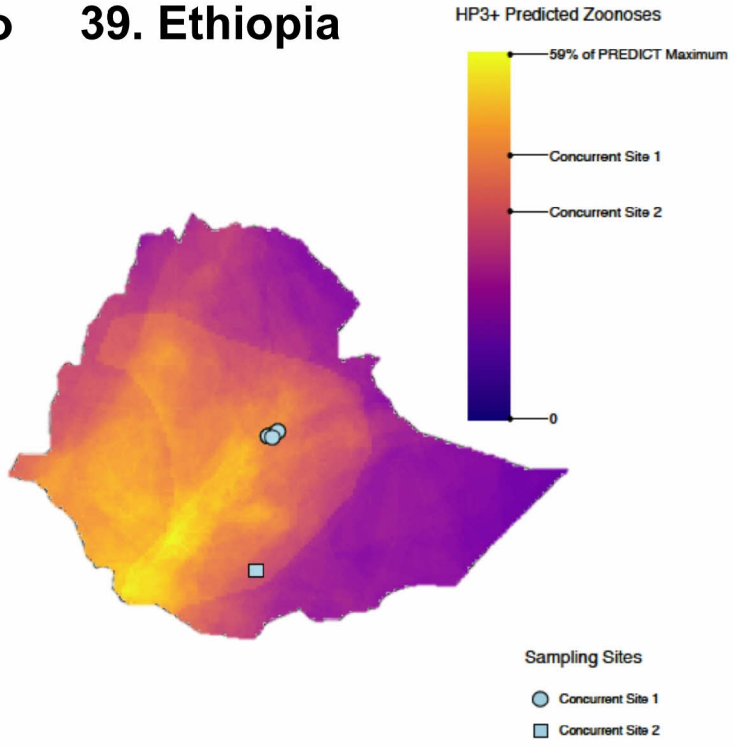
38-41 East & Central Africa

Country-Level Predicted Zoonoses Maps

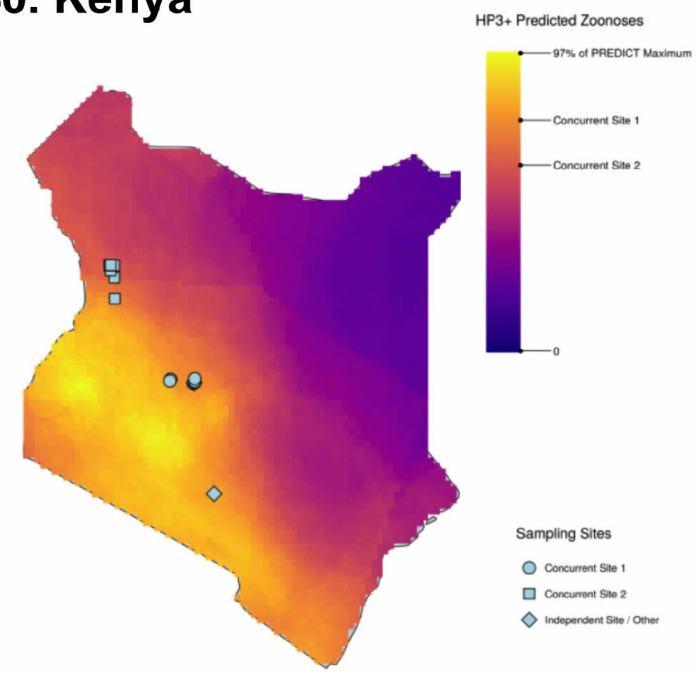
38. Democratic Republic of Congo



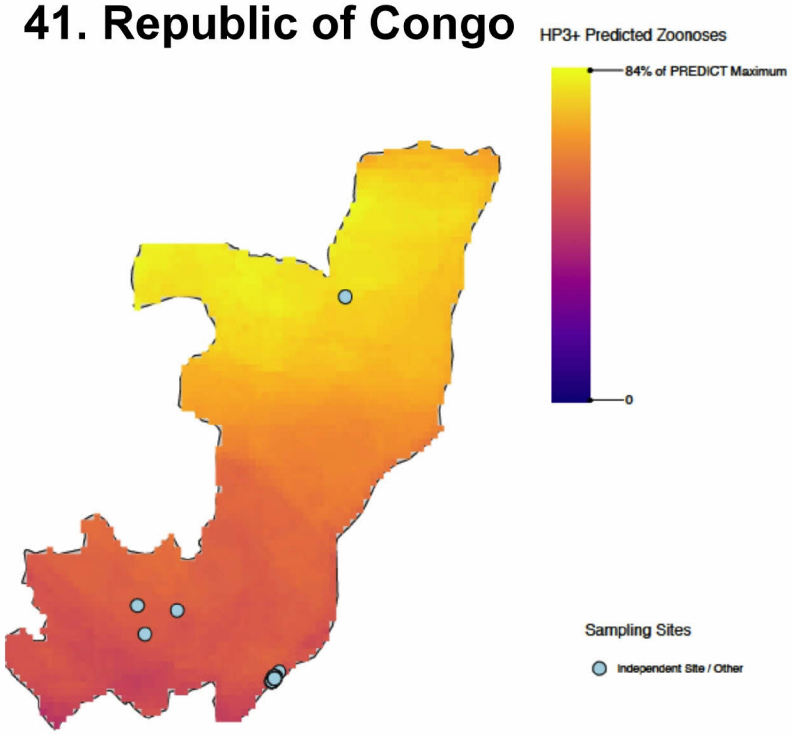
39. Ethiopia



40. Kenya



41. Republic of Congo



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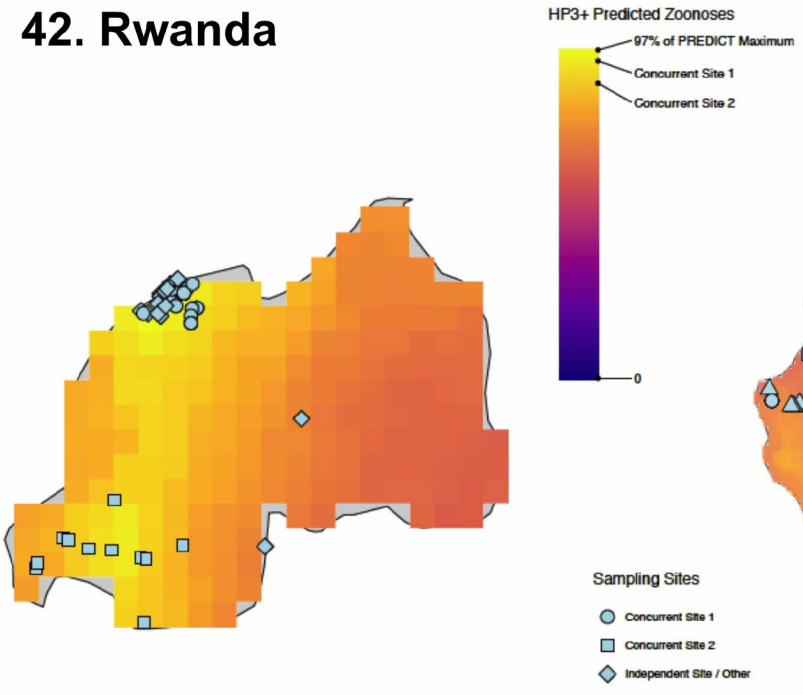
Emerging Threats Program 2 (EPT-2)

UCDUSR0012805

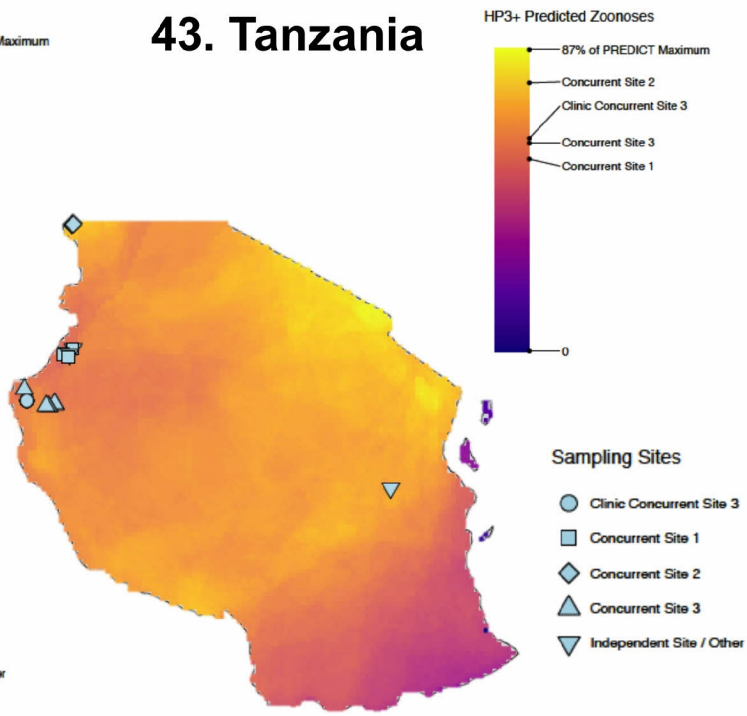
42-44 East & Central Africa

Country-Level Predicted Zoonoses Maps

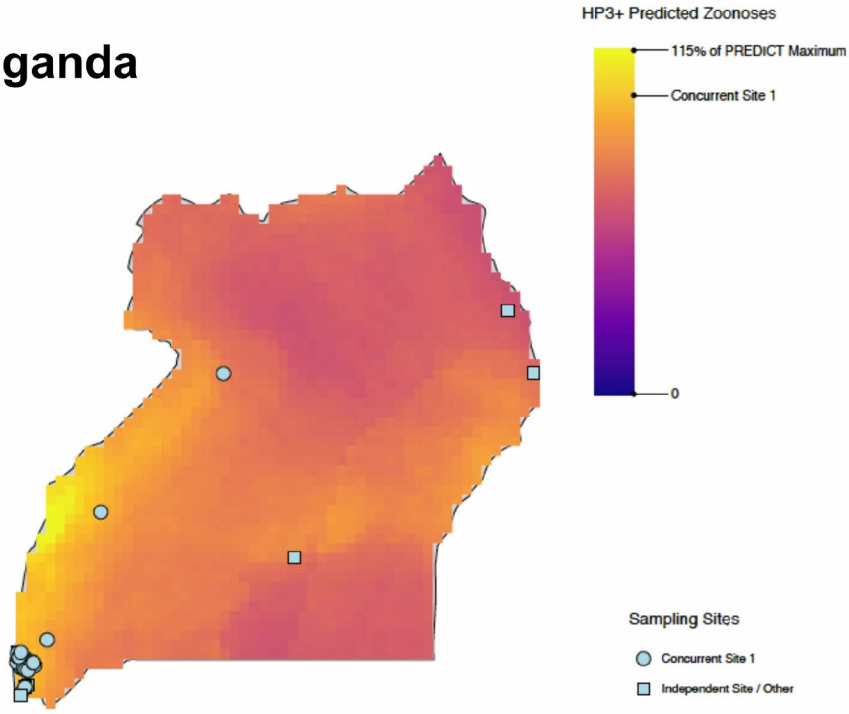
42. Rwanda



43. Tanzania



44. Uganda



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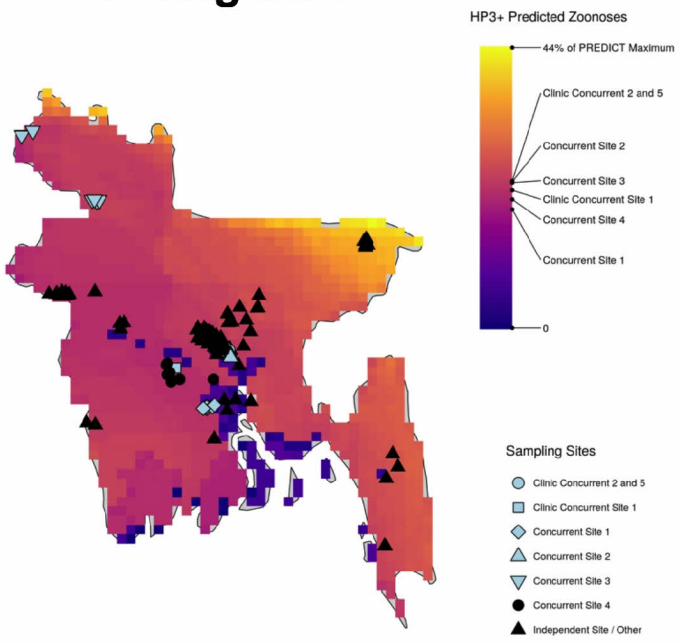
Emerging Threats Program 2 (EPT-2)

UCDUSR0012806

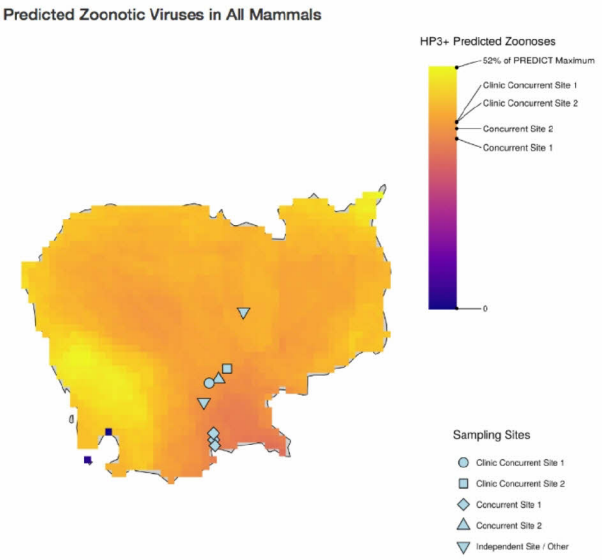
45-48 Asia

Country-Level Predicted Zoonoses Maps

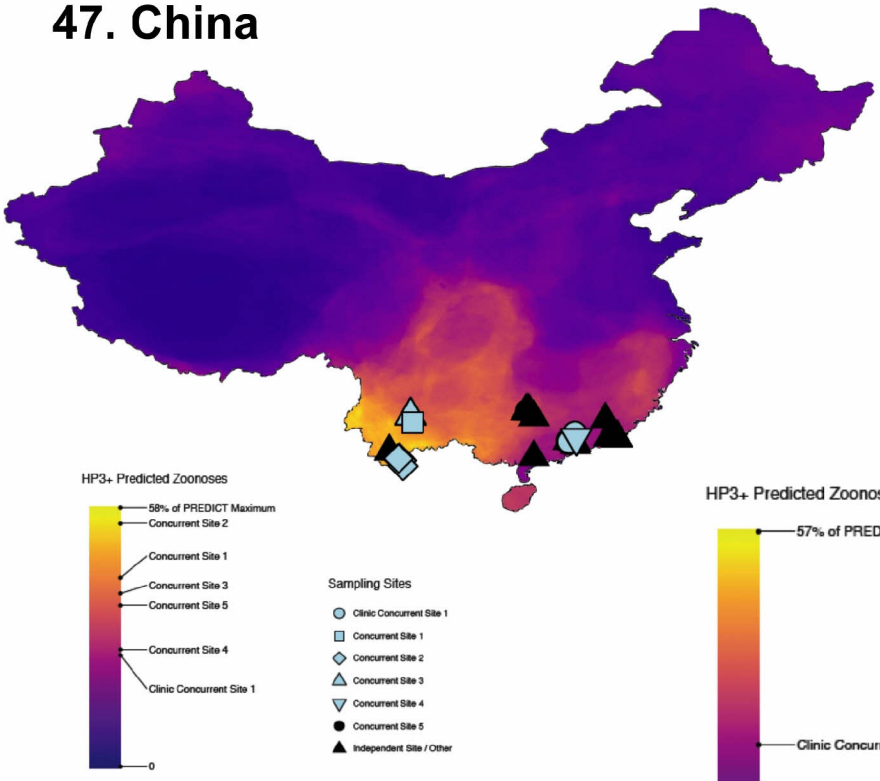
45. Bangladesh



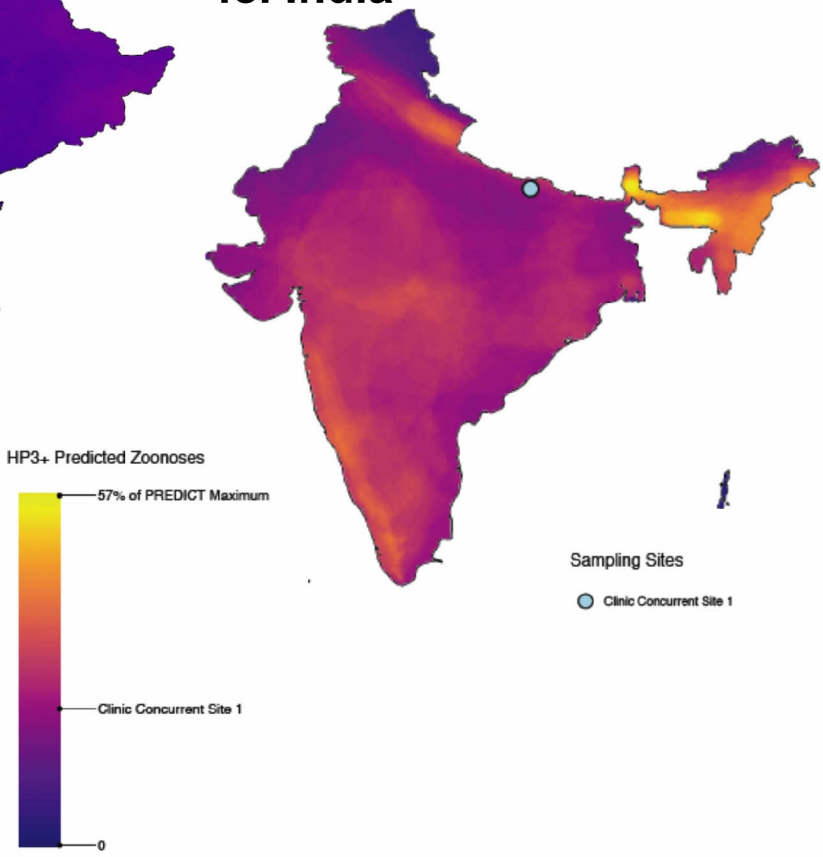
46. Cambodia



47. China



48. India



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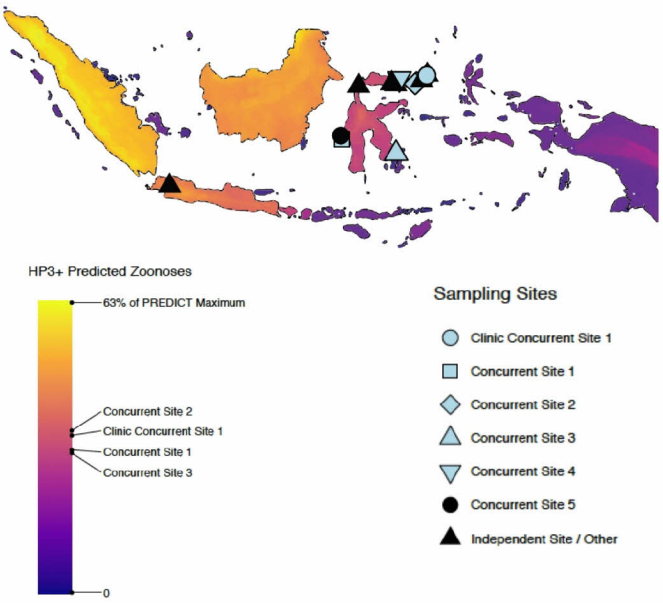
Emerging Threats Program 2 (EPT-2)

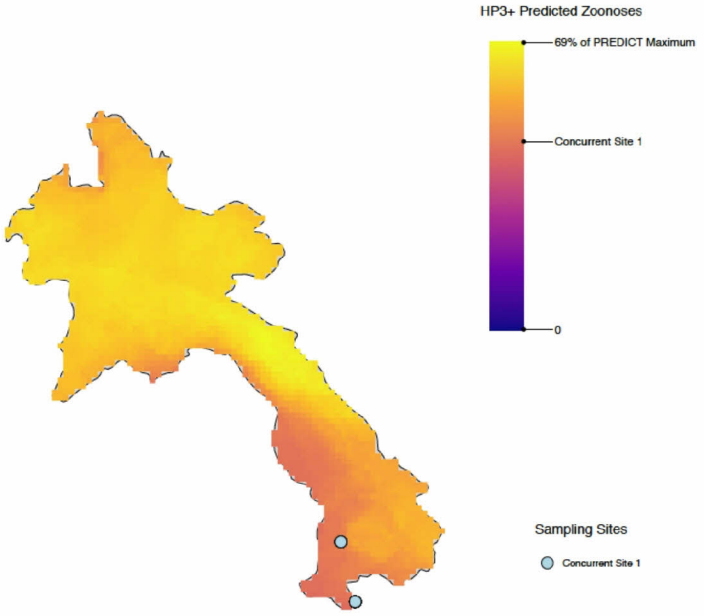
49-52 Asia

Country-Level Predicted Zoonoses Maps

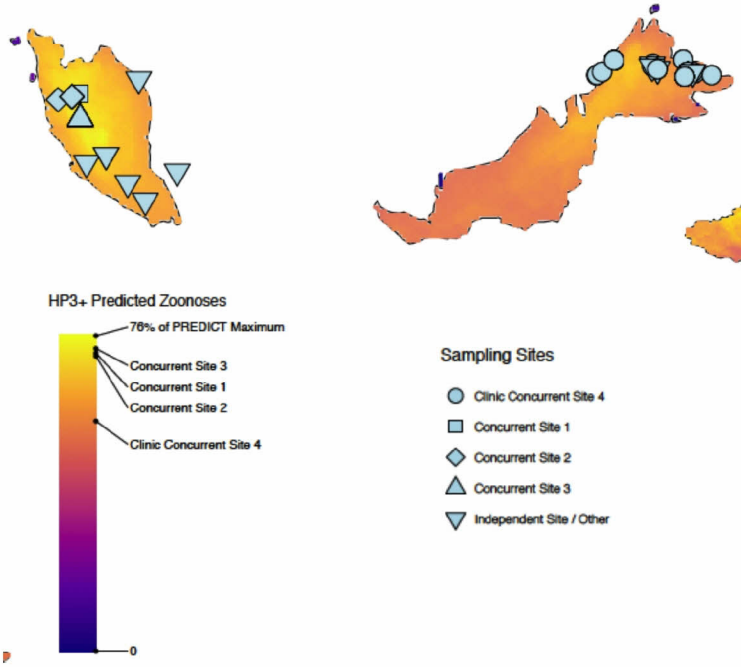
49. Indonesia



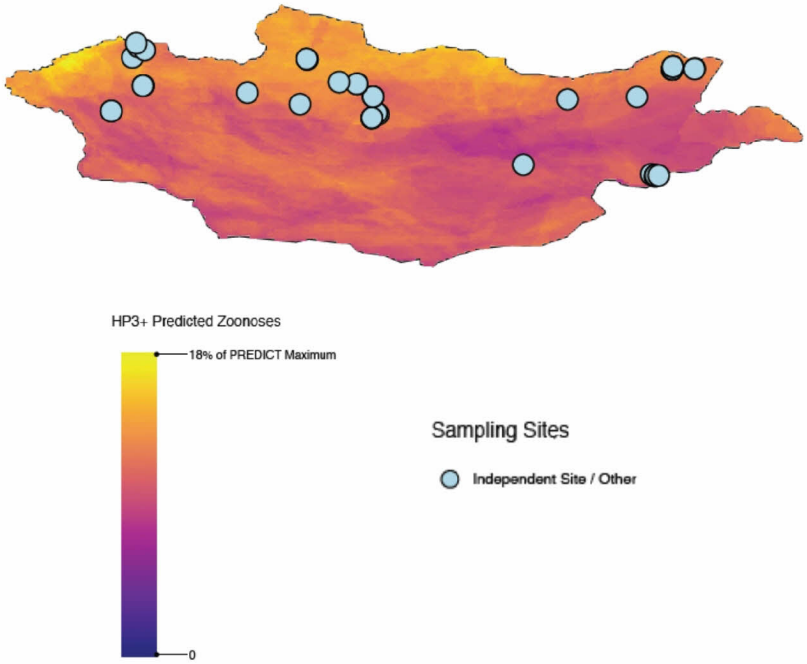
50. Lao PDR



51. Malaysia



52. Mongolia



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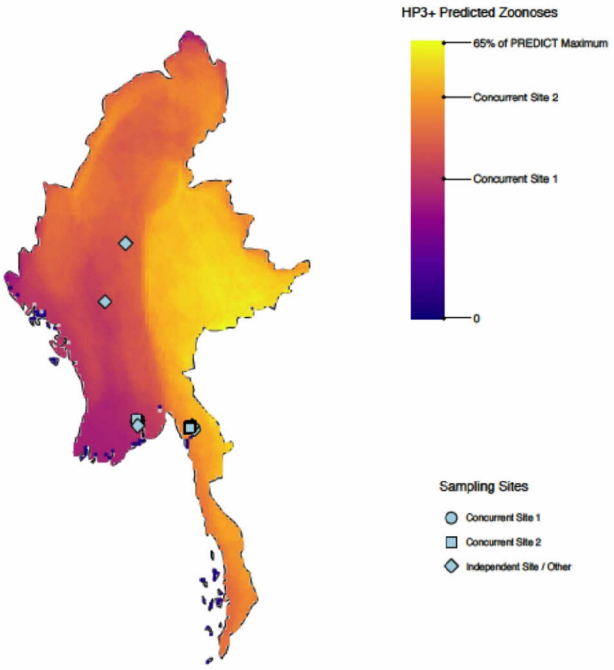
Emerging Threats Program 2 (EPT-2)

UCDUSR0012808

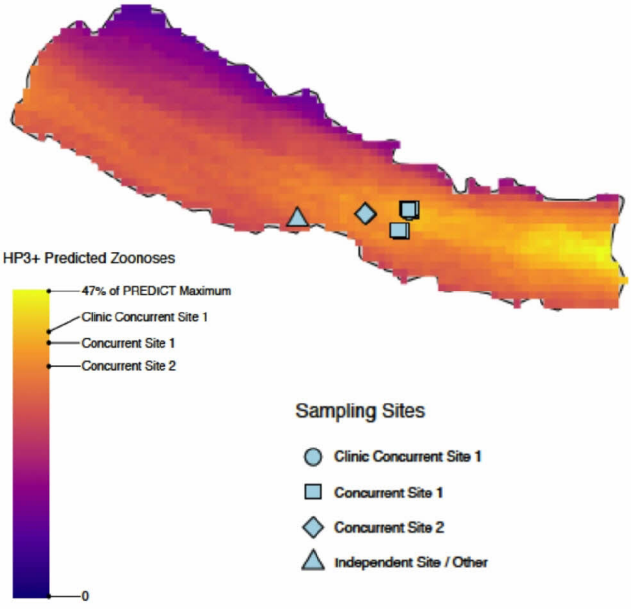
53-56 Asia

Country-Level Predicted Zoonoses Maps

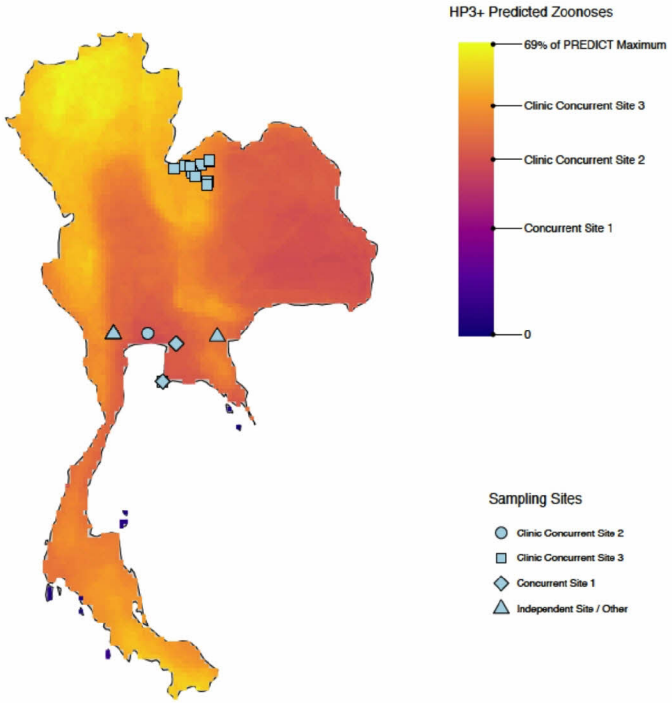
53. Myanmar



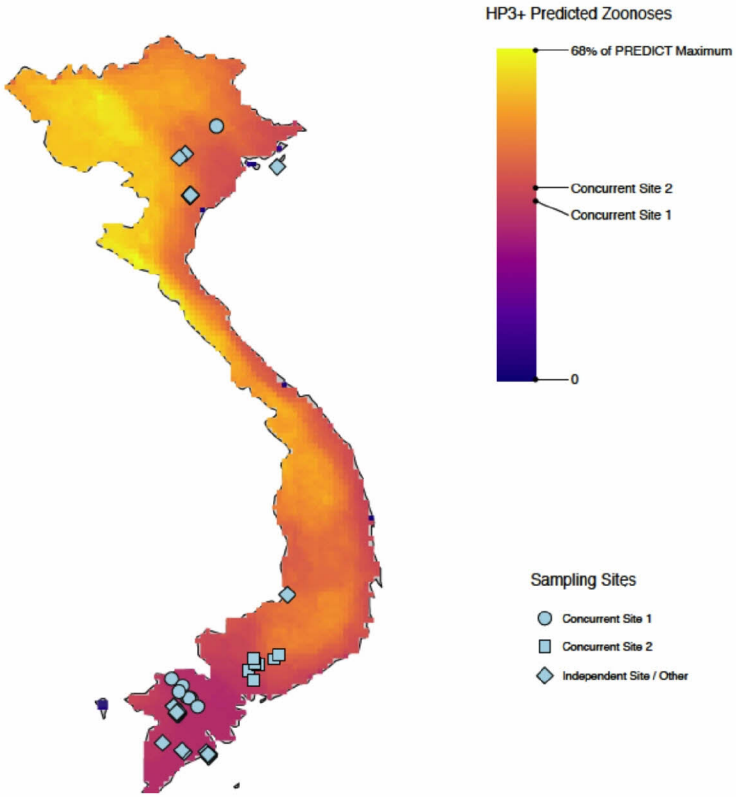
54. Nepal



55. Thailand



56. Vietnam



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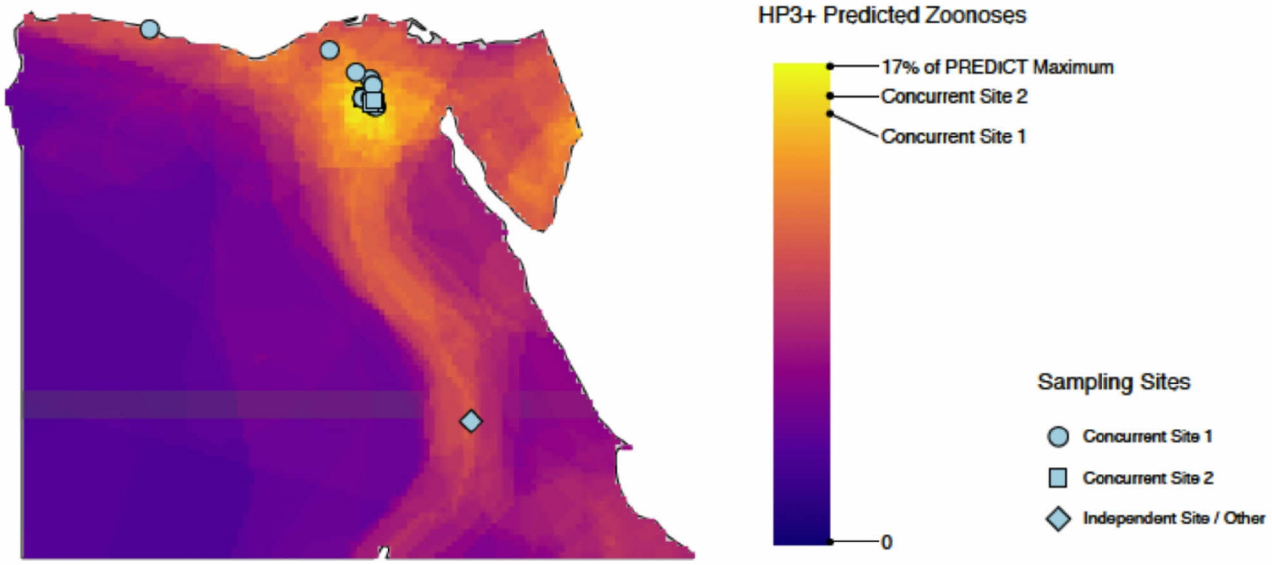
Emerging Threats Program 2 (EPT-2)

UCDUSR0012809

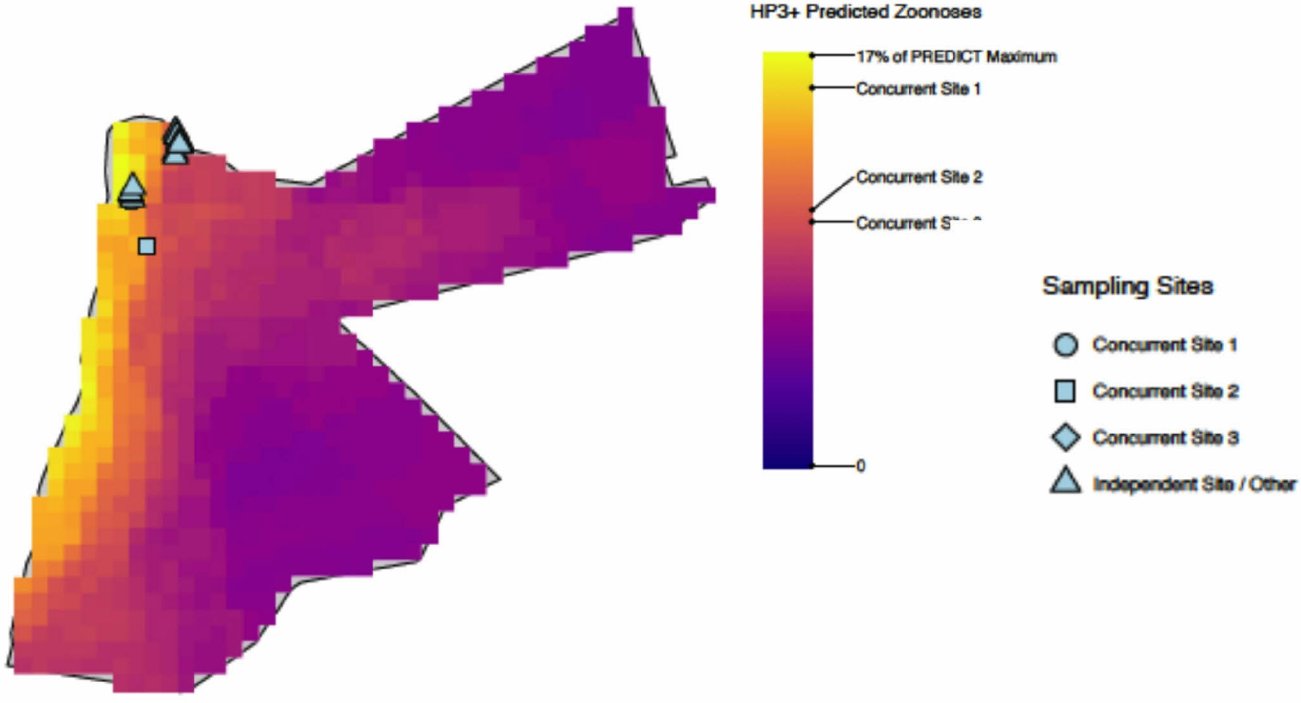
57-58 Middle East

Country-Level Predicted Zoonoses Maps

57. Egypt



58. Jordan



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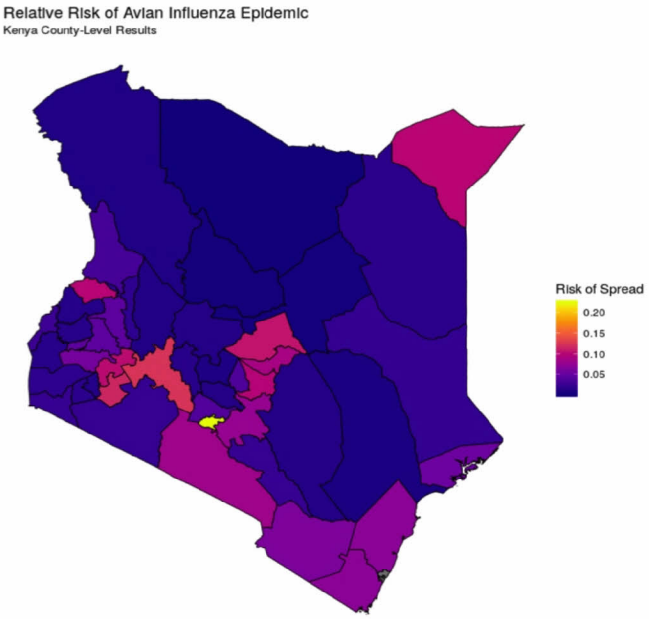
Emerging Threats Program 2 (EPT-2)

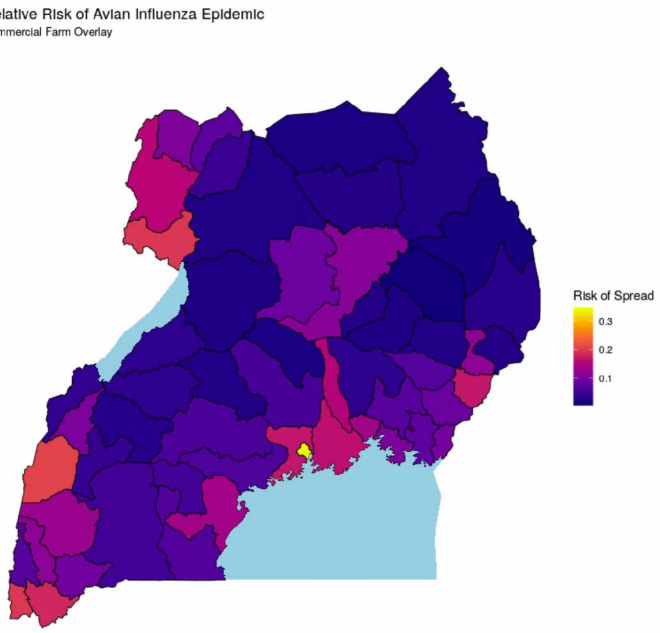
59-60 ASL2050 Countries

Avian Influenza Spread Risk Maps

59. Kenya



60. Uganda



59-60. Province-level avian influenza epidemic risk map. We continued to develop our metapopulation model to assess potential spread of avian influenza based on large-scale networks of interconnected household, market, and commercial farm poultry flocks for ASL2050 countries.

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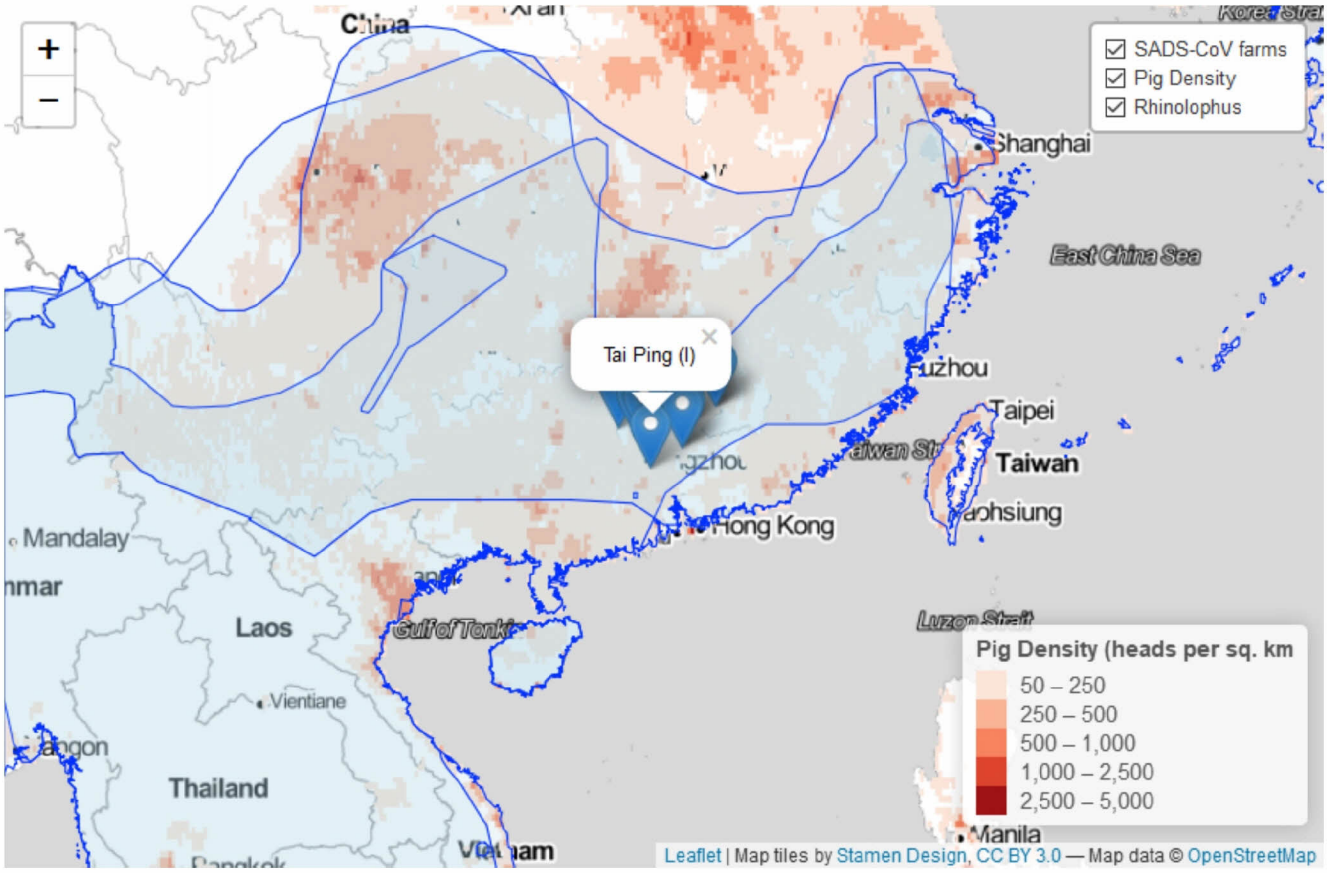
Emerging Threats Program 2 (EPT-2)

61. Asia

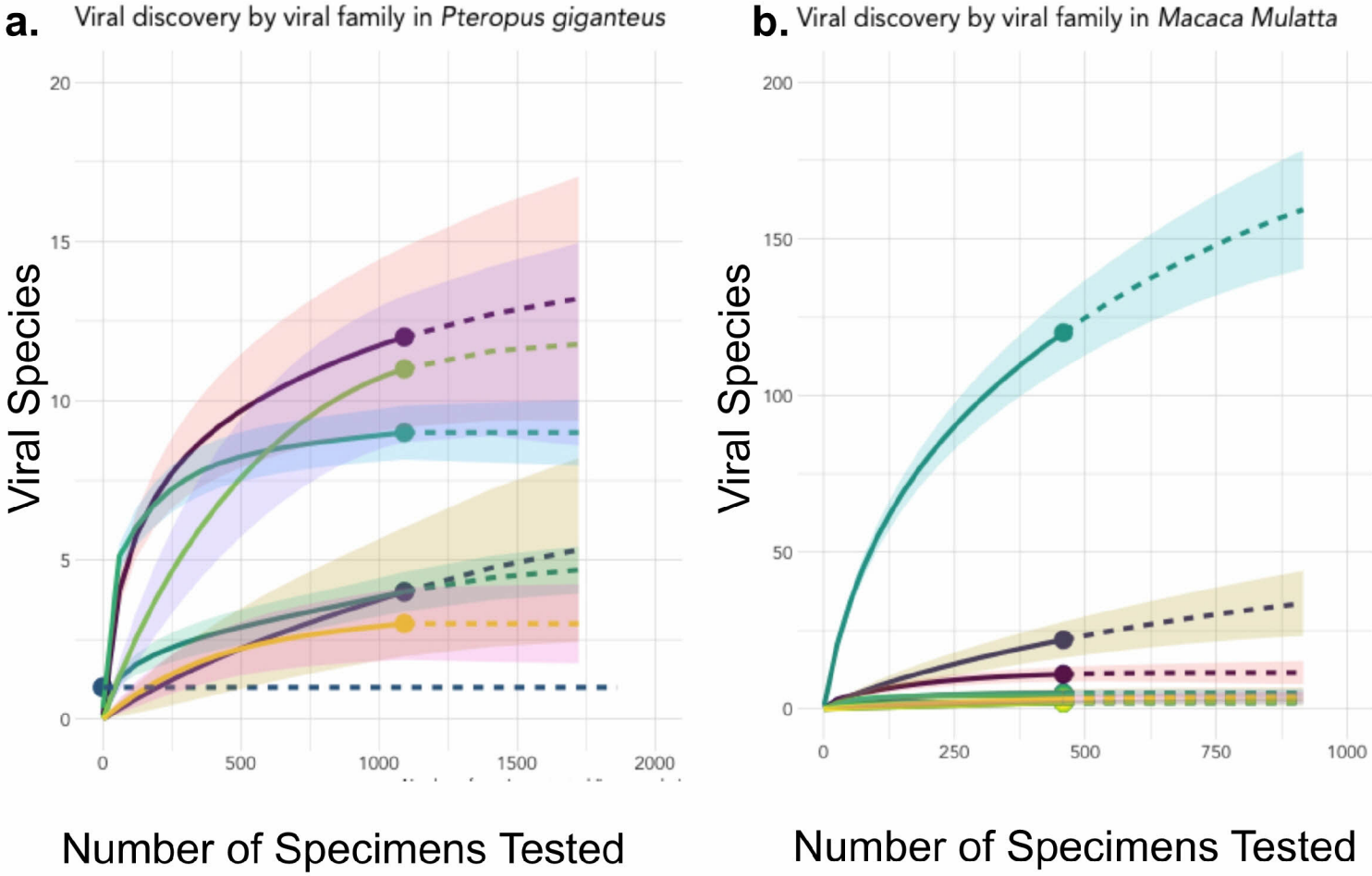
Regional Bat-Pig Overlap Maps



61. Regional overlap of *Rhinopholus* spp. bats and pigs, SE Asia. To inform areas at risk for future cross-species transmission events for SADS-CoV, we mapped the overlap of pig density and *Rhinolophus* spp. bat distributions. The red layer shows pig density along with the ranges of *Rhinolophus* species in which SADS-CoV has been detected (shaded blue). We also show the location of the farms that experienced the SADS-CoV epidemic, as published in *Nature* – April 2018. The map is interactive to allow viewing of separate layers.

62. Global

Viral Accumulation Curves by Viral Family



62. Viral species accumulation per viral family. To estimate the number of potentially zoonotic unknown viruses for the Global Virome Project (per Carroll *et al*. 2018, *Science*), we constructed viral accumulation curves calculated using underlying data from **a)** Anthony *et al*. 2013 and **b)** Anthony *et al*. 2015 to determine potential viral diversity independently for viral families. We found a per-viral family mean of 11.58 unknown species per family, and extrapolated this to 25 viral families that contain viruses known to infect people, to estimate 1.67 million unknown viruses in mammals and birds.

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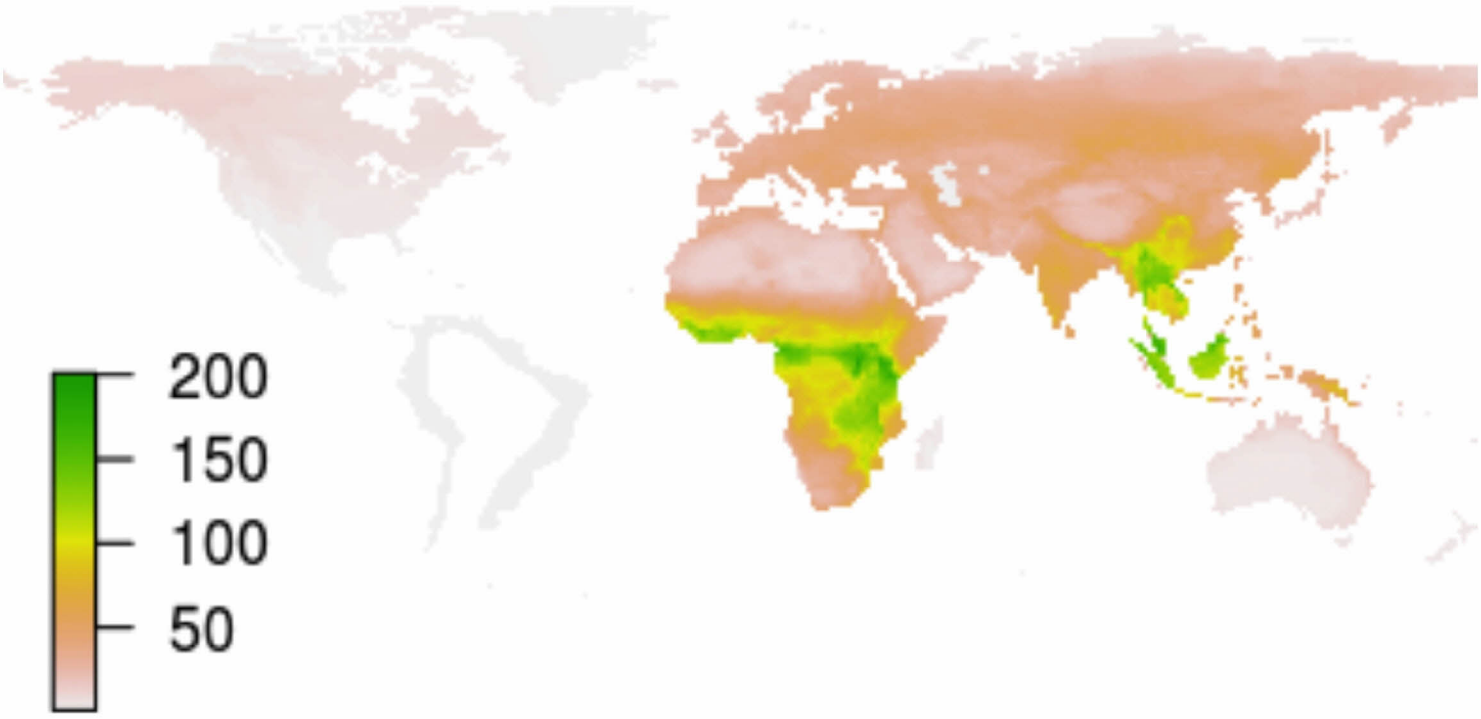
63. Global

PREDICT Wild Mammal Species Richness Map



63. Global distribution of wild mammals in PREDICT countries. As part of the country reports presented at the Brussels PREDICT meeting in January, we created an updated map of wild mammal diversity, one of the most important predictors of zoonotic disease risk and of the number of zoonotic viruses likely to be found in a location. Using this global map based on IUCN data, we produced maps for 28 PREDICT countries, additionally calculating per-country species richness for bats, rats, and primates.

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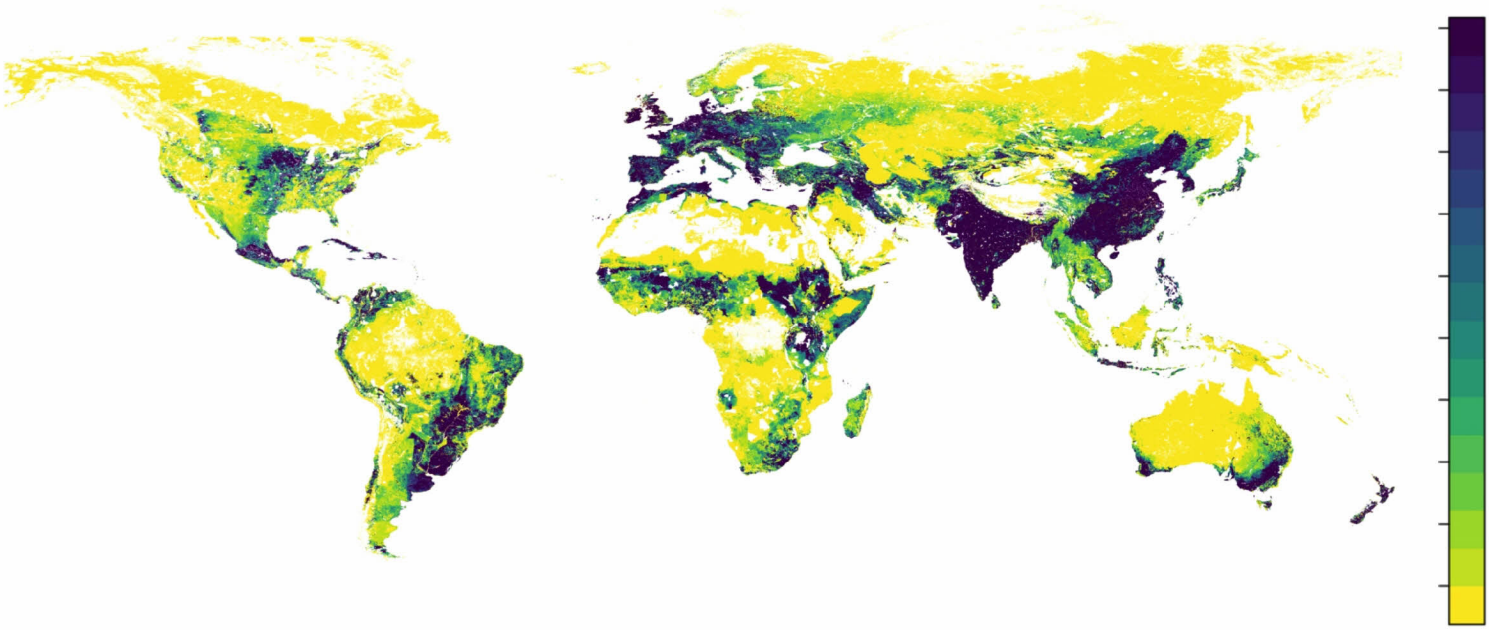
UCDUSR0012814

64. Global

Domestic Animal Density Map



64. Aggregated global mammalian livestock density. As part of the country reports presented at the Brussels PREDICT meeting in January, we created an updated aggregated map of mammalian livestock density, an important predictor of zoonotic disease risk. Livestock often act as "bridge hosts" allowing spillover of pathogens from wildlife to people, and here we show the total combined livestock population density of buffaloes, cattle, goats, pigs, and sheep. These densities are calculated from an FAO model that combines animal census data with predictors including several vegetation, climate, topography, and demography variables. We present mammalian livestock density on a log-scale for easier visualization and clipped this map for each of the 28 PREDICT countries.

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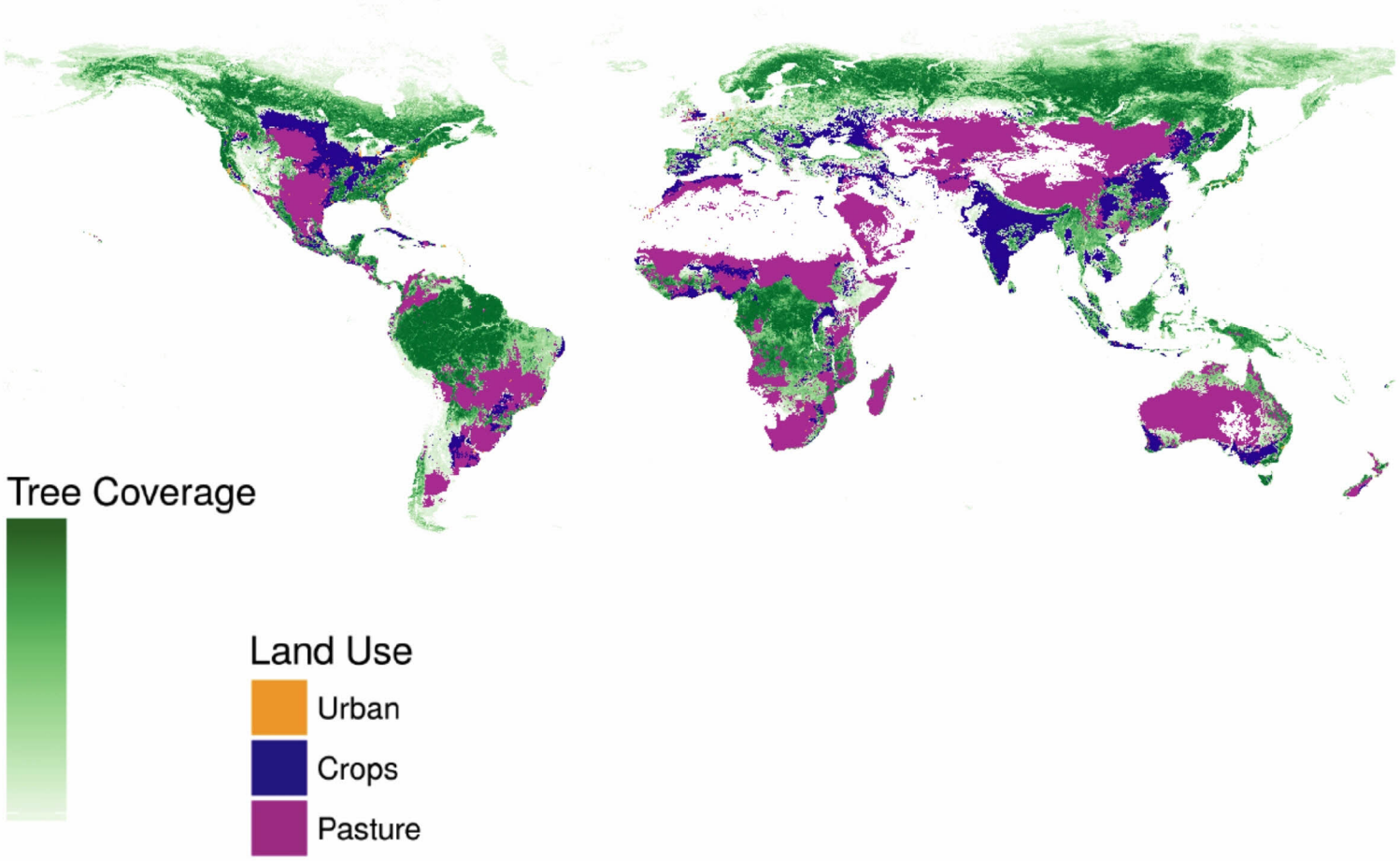
65. Global

Urban, Pasture, Crop, Land-Use with Tree Cover



65. Global map of land-use. As part of the country reports presented at the Brussels PREDICT meeting in January, we mapped global changes in land-use and urban area –important factors in predicting zoonotic spillover risk. We assigned human land-use categories as above for both 1970 and 2005 to show areas with the greatest change in urban, pasture, and cropland areas during that period.

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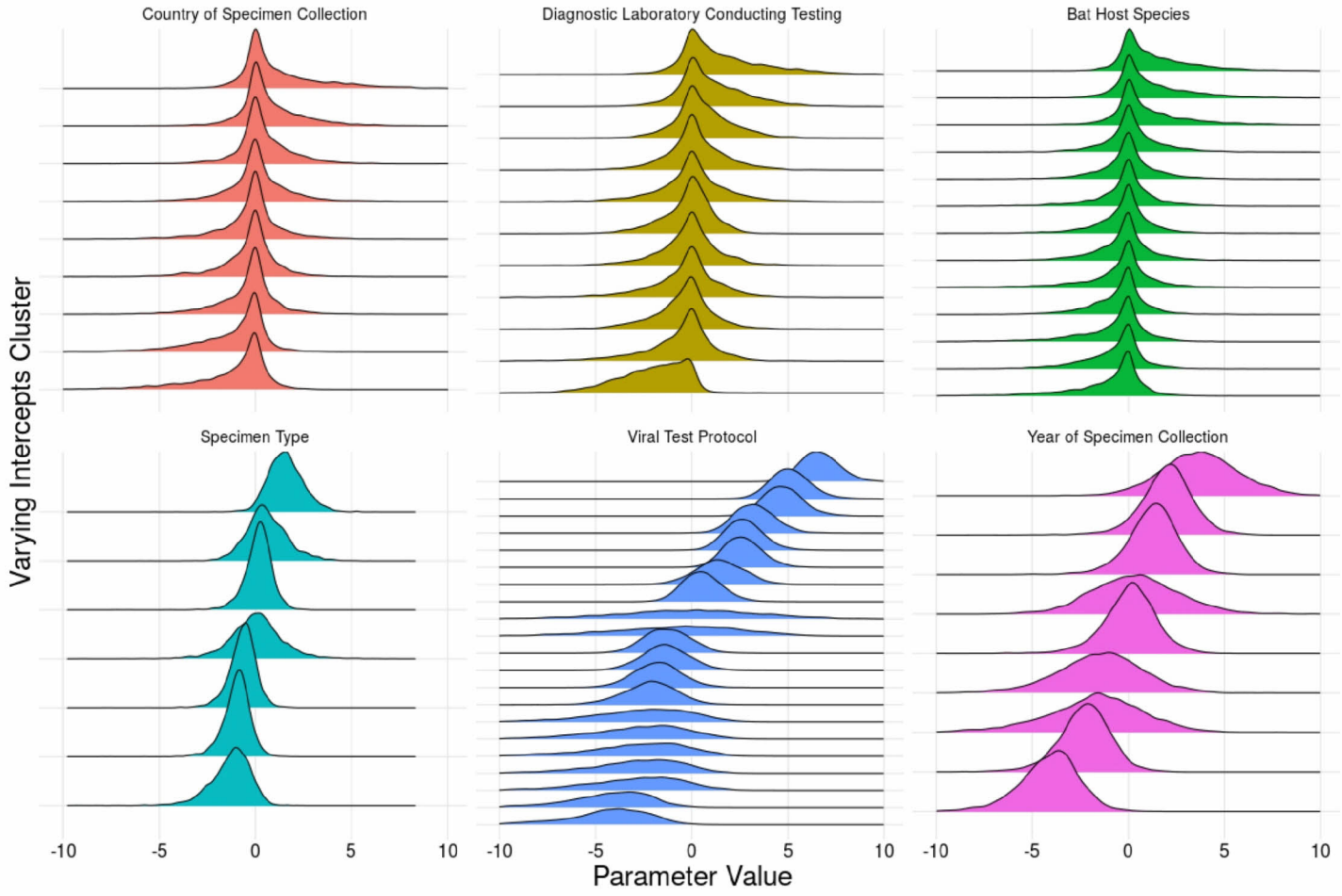
Emerging Threats Program 2 (EPT-2)

66. Global

Seasonality of Viral Shedding in Bats



66. Refined seasonal model of viral shedding in bats. We refined a new model to test for seasonal patterns in wildlife viral shedding (here shown for PREDICT bat data) while accounting for abiotic and biotic factors (e.g. age, gender, reproductive status) and controlling for methodological and technical variation within the data. These models will help us better understand viral dynamics in bats, which are particularly important for zoonotic disease transmission. They also demonstrate that large datasets such as PREDICT's are invaluable for scientific research.

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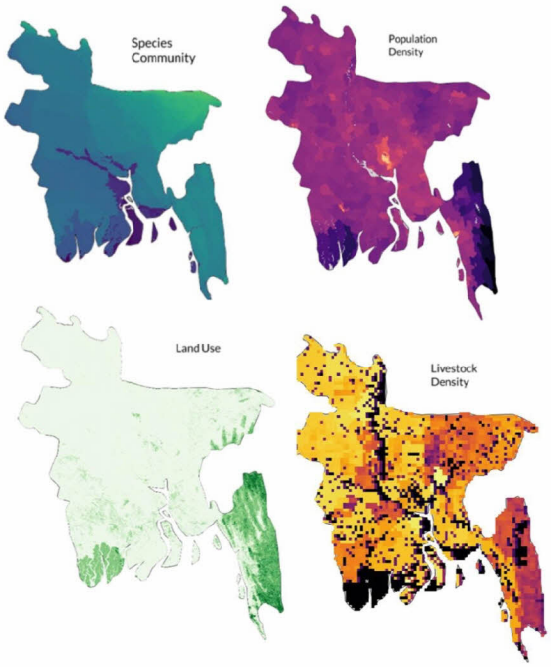
Produced in Native Format

Modeling and Analytics

Major highlights and successes

At the PREDICT All-Country Meeting in Brussels, *country-specific spatial zoonotic risk reports* were presented to each of the 28 PREDICT country teams. Each report utilizes data from two recent PREDICT projects, Hotspots 2.0 (assessing zoonotic spillover risk) and the Host Pathogen Phylogeny Project (predicting the number of 'missing' or unsampled zoonoses in wild mammals). They also map out how key drivers vary across countries (e.g. land use, population density). These major updates to previous maps include down-scaling of the Hotspots 2.0 model to give higher resolution maps for in-country use and extrapolation of the predicted zoonotic viruses model to include all mammals, even those with no recorded viral detection in the literature. Feedback from country teams was collected and will be integrated into an updated release.



Example of country-level maps of key contributing factors to zoonotic risk presented at the PREDICT All-Country Meeting. Bangladesh shown here.

The M&A team contributed to the analysis of the Global Virome Project's (GVP) predicted viral diversity and costs of viral discovery recently published in *Science*. Utilizing PREDICT findings, the team estimates that there are 631,000-827,000 undiscovered viruses capable of infecting humans.

At an Africa Sustainable Livestock 2050 (ASL2050) workshop in Kenya, March 26-30, PREDICT's M&A representative met with FAO and other partners to present new avian influenza epidemic spread models using within-household and commercial poultry density data for several African countries.

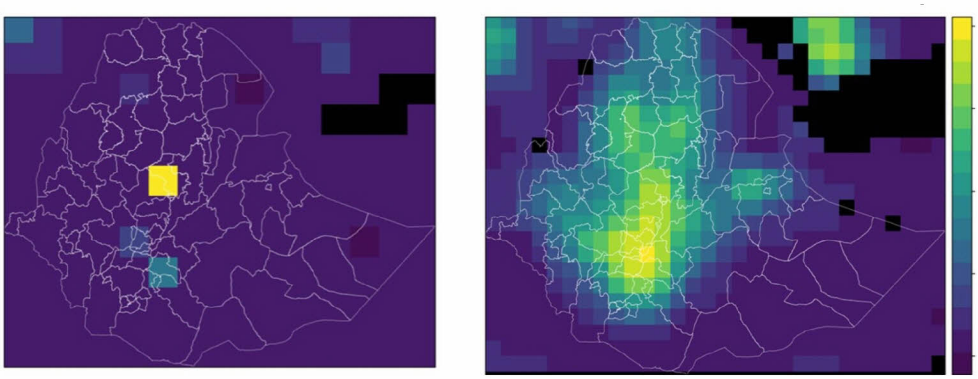
PREDICT M&A's representative leads a livestock epidemic risk mapping workshop with FAO and other ASL2050 partners in Nairobi, Kenya.

A representative from PREDICT's M&A team visited the Indonesia One Health Network (INDOHUN) offices for three weeks in March 2018. In collaboration with INDOHUN and the University of Minnesota, they helped design an economic model of land conversion for the Riau province.

Progress and new model development

PREDICT M&A has completed three rounds of scientific abstract screening to refine underlying data for a spatial 'hotspots' model of antimicrobial resistance emergence in humans, which will be the first of its kind. A todal of >49,000 articles have been screened to date. The project now moves on to full-text review of the selected articles. Additionally, we have harnessed the data generated during this time-and labor-intensive manual screening process to create a *machine learning model* that can pre-screen abstracts, and performs with >90% accuracy.

PREDICT has extended our metapopulation avian influenza model to country-specific poultry networks of Burkina Faso, Uganda, and Kenya to create maps of regional relative risk of avian influenza outbreaks. We have also downscaled the Hotspots 2.0 model for each ASL2050 country to give higher resolution maps for in-country interpretations (below).



The original Hotspots 2.0 EID risk maps for Ethiopia (left) with the updated country-level map at higher resolution (right).

The M&A team updated the EIDITH R package in collaboration with the Information Management team to allow individuals with EIDITH access to download their country-level PREDICT-2 data as per their permissions into the statistical analysis program, R. Site characteristics, behavioral risk, animal, or testing data can then be manipulated in R to explore and visualize data from the project in near real-time as it's entered into the database. Tutorials and examples showing how to navigate the PREDICT-2 data are also in development.

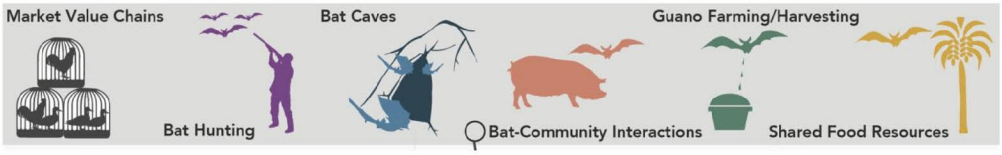
Analyzing PREDICT-1 data to support surveillance

The M&A team has refined a model to test for seasonal patterns in bat viral shedding while accounting for other potentially important factors (e.g. age, gender, reproductive status) and controlling for methodological and technical variation within the data. This analysis uses hierarchical Bayesian and will be reviewed and refined by our PREDICT partners then published in a peer-reviewed journal to demonstrate the value of large datasets such as PREDICT's to the global science community.

The team has refined estimates of viral richness using viral accumulation curves and data from PREDICT (described in a new *Emerging Disease Insight* document to be posted online in the next month). Our next step is to refine this approach using PREDICT data to groundtruth the estimates of viral diversity that have been used by the GVP, for example.

PREDICT M&A's representative collaborates with INDOHUN and University of Minnesota on the economics of land conversition in Indonesia.

Collaborations across teams to inform interventions



The six deep dive areas of the IMPACT projects.

The M&A team is supporting PREDICT's six "deep dive" areas to assess potential interventions (above). The M&A team is working on analyses of available data to provide information on the boundaries under which interventions might prove successful. In addition, the M&A team is working with PREDICT teams and country staff to conduct analyses of literature, data from PREDICT, and new data being collected in Yr 4 on 16 **IMPACT** projects (**I**ntervention **M**odeling **P**rojects **AC**ross **T**eams). These are intended to provide rapid answers to questions about the validity of proposed intervention strategies and have 3-, 6-, and 12-month timelines. As part of the one IMPACT project, a regional map of *Rhinopholus* bat and pig overlap has been produced to help target surveillance for mitigating future spillover events of the new Severe Acute Diarrheal Syndrome Coronavirus (SADS-CoV) recently discovered emerging from bats to swine.

For more information

A full list of PREDICT Modeling and Analytics team products and output is included in the *Monitoring and Evaluation Appendix 1*.

From: "Andrew Clements" <aclements@usaid.gov>
Sent: 02/02/2017 9:43:57 PM (-08:00)
To: "Alisa Pereira" <apereira@usaid.gov>
Cc: "Elizabeth Leasure" <ealeasure@ucdavis.edu>; "David John Wolking" <djwolking@ucdavis.edu>; "Cassandra Louis Duthil" <clouisduthil@usaid.gov>; "Christine Kreuder Johnson" <ckjohnson@ucdavis.edu>; "Eddy Rubin" <erubin@metabiota.com>; "Lindsay Parish" <lparish@usaid.gov>; "Peter Daszak" <daszak@ecohealthalliance.org>; "Jonna Mazet" <jkmazet@ucdavis.edu>; "Shana Gillette" <sgillette@usaid.gov>; "William Karesh" <karesh@ecohealthalliance.org>; "PREDICTMGT" <predictmgt@usaid.gov>; "Cara J. Chrisman" <cchrisman@usaid.gov>; "Ava Sullivan" <sullivan@ecohealthalliance.org>; "Alison Andre" <andre@ecohealthalliance.org>; "Amanda Fuchs" <fuchs@ecohealthalliance.org>; "Catherine Machalaba" <Machalaba@ecohealthalliance.org>; "Evelyn Luciano" <luciano@ecohealthalliance.org>; "Molly Turner" <turner@ecohealthalliance.org>; "Taylor Elnicki" <telnicki@metabiota.com>
Subject: Re: Need to reschedule PREDICT Management Team calls on 2/6 and 2/20

Works for me

Andrew P. Clements, Ph.D.
Senior Scientific Adviser
Emerging Threats Division/Office of Infectious Diseases/Bureau for Global Health
U.S. Agency for International Development
Mobile phone: 1-571-345-4253
Email: aclements@usaid.gov

On Feb 2, 2017, at 9:49 PM, Alisa Pereira <apereira@usaid.gov> wrote:

> Sounds good
>
> Sent from my iPhone
>
> On Feb 2, 2017, at 3:25 PM, Elizabeth Leasure <ealeasure@ucdavis.edu> wrote:
>
> > Hi everyone. Since most of you will be in Beijing for the GVP meeting next Monday (2/6) and 2/20 is a holiday (President's Day), can we combine the two calls into one and schedule it for **February 13th at the regular time (10 am PST/1 pm EST)**?
> >
> > Thanks,
> > Liz
> >
> > Elizabeth Leasure
> > One Health Institute
> > University of California, Davis
> > 530-754-9034 (office)
> > REDACTED (cell)

From: "William B. Karesh" <karesh@ecohealthalliance.org>
Sent: 02/24/2017 8:27:40 AM (-08:00)
To: "Juan Lubroth" <[REDACTED]>
Cc: "Andrew Clements" <aclements@usaid.gov>; "ghsdunitmaillistusaid@usaid.gov" <ghsdunitmaillistusaid@usaid.gov>; "Morzaria, Subhash (TCE)" [REDACTED]; "Sophie Von dobschuetz" <[REDACTED]>; "Gwenaelle Dauphin" <[REDACTED]>; "Jonna Mazet" <jkmazet@ucdavis.edu>; "Chris Johnson" <ckjohnson@ucdavis.edu>; "Peter Daszak" <daszak@ecohealthalliance.org>; "Wenqing ZHANG" <[REDACTED]>; "A. Danielle (CDC/OID/NCIRD) Iuliano" <aoi0@cdc.gov>; "Dan Schar" <dSchar@usaid.gov>; "Sudarat Damrongwatanapokin (RDMA/OPH)" <sDamrongwatanapokin@usaid.gov>; "Lisa Kramer" <lkramer@usaid.gov>; "Marini, Corina (AGAH)" <[REDACTED]>; "Gounalan Pavade" <[REDACTED]>; "Tianna Brand" <[REDACTED]>; "David Swayne" <David.Swayne@ars.usda.gov>
Subject: Re: France is Killing All of Its Ducks. Here's Why | UN Dispatch

The UN dispatch is about domestic ducks correct? Not culling wild ducks.

BK

On Feb 24, 2017, at 9:33 AM, Lubroth, Juan (AGAH) <[REDACTED]> wrote:

Too bad …. I could have said something here. The FAO position is due out shortly in French.

> *FAO recognises the scientific evidence that wild birds, especially waterfowl, are natural reservoirs for influenza A viruses. In the efforts to better control the disease however, FAO does not recommend action against wild birds, but limit their potential contact with the poultry production sector – large and small. Activities based on hunting, poisoning of populations or habitat destruction in order to remove the threat wild birds are likely accelerate their dispersal and potentially further spreading the infection to other parts of the country or neighbouring countries, kill other species, contaminate or destroy environment or ecosystem balances.*
>
> *FAO supports the investment in strengthening good hygiene practices and biosecurity interventions on poultry farms, during transport or marketing of poultry and safeguarding their products. These efforts would be paramount for risk management and threat reduction, as opposed to indiscriminate hunting or habitat destruction. FAO would also urge that there is no justification for pre-emptive culling of endangered species in zoological collections. Control measures for captive wild birds in places where virus is detected should be based on strict movement control, isolation and only when necessary limited culling of affected birds.*
>
> *The use of disinfectants in the environment where sick or dead birds are found is likely ineffective because of the high organic content and could be environmentally damaging long-term.*

From: Andrew Clements [mailto:aclements@usaid.gov]
Sent: 24 February 2017 15:14

To: ghsdunitmaillistusaid@usaid.gov; Morzaria, Subhash (TCE) <REDACTED>; VonDobschuetz, Sophie (AGAH) <REDACTED>; Dauphin, Gwenaelle (AGAH) <REDACTED>; Lubroth, Juan (AGAH) <REDACTED>; William Karesh <Karesh@ecohealthalliance.org>; Jonna Mazet <jkmazet@ucdavis.edu>; Christine Kreuder Johnson <ckjohnson@ucdavis.edu>; daszak@ecohealthalliance.org; REDACTED A. Danielle (CDC/OID/NCIRD) Iuliano <aoi0@cdc.gov>; Daniel Schar (RDMA/OPH) <dSchar@usaid.gov>; Sudarat Damrongwatanapokin (RDMA/OPH) <sDamrongwatanapokin@usaid.gov>; Lisa Kramer (Nairobi/EA/RHH) <lkramer@usaid.gov>
Subject: France is Killing All of Its Ducks. Here's Why | UN Dispatch

FYI

http://www.undispatch.com/france-just-killed-ducks-heres/

Andrew P. Clements, Ph.D.
Senior Scientific Adviser
Emerging Threats Division/Office of Infectious Diseases/Bureau for Global Health
U.S. Agency for International Development
Mobile phone: 1-571-345-4253
Email: aclements@usaid.gov

From: "Melinda Rostal" <rostal@ecohealthalliance.org>
Sent: 03/03/2017 9:07:57 PM (-08:00)
To: "Peter Daszak" <daszak@ecohealthalliance.org>
Cc: "Jonna Mazet" <jkmazet@ucdavis.edu>; "William B. Karesh" <karesh@ecohealthalliance.org>; "Jon Epstein" <epstein@ecohealthalliance.org>; "Ariful Islam" <arif@ecohealthalliance.org>; "Emily Hagan" <hagan@ecohealthalliance.org>; "predict-outbreak@ucdavis.edu" <predict-outbreak@ucdavis.edu>
Subject: Re: URGENT - Notice of Nipah virus cases in Bangladesh

Dear all,
I have been in touch with Arif. He needs to confirm a few details of the report with Dr Flora at IEDCR. Since the weekend is on Friday and Saturday in Bangladesh, the government offices are closed and he won't be able to speak to her until Sunday. We will send the first outbreak report on Sunday.

Thanks,
Mindy

Sent from my iPhone

On Mar 3, 2017, at 12:07 PM, Peter Daszak <daszak@ecohealthalliance.org> wrote:

> Hi Jonna – glad we've got the go-ahead for this. Jon's [REDACTED] but Mindy will get in touch with Arif and get things moving in Bangladesh.
>
> Re. contacting Stuart – I think that's a great idea – please go ahead and cc me, Billy, Jon and Mindy so we can follow-up where necessary and keep in touch with their plans.
>
> Cheers,
>
> Peter
>
> **Peter Daszak**
> *President*
>
> EcoHealth Alliance
> 460 West 34th Street – 17th Floor
> New York, NY 10001
>
> +1.212.380.4473 (direct)
> +1.212.380.4465 (fax)
> www.ecohealthalliance.org
>
> *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.*
>
> **From:** [REDACTED] **On Behalf Of** Jonna Mazet
> **Sent:** Friday, March 3, 2017 9:17 AM

To: Peter Daszak; William B. Karesh; Dr. Melinda Rostal; Jon Epstein; Ariful Islam; Emily Hagan
Cc: predict-outbreak@ucdavis.edu
Subject: Fwd: URGENT - Notice of Nipah virus cases in Bangladesh

Please proceed as requested and appropriate with government/Mission communications. See Andrew and my chain below on initial activities being approved but forward actions being subject to budget considerations, so please start the outbreak form and come back with a budget estimate if the field situation warrants ongoing activities.

Peter, I'd like to reach out to Stuart Nichol if that is all right with you. He specifically mentioned coordinating on Bangladesh outbreaks in the future, asking if we would be interested in bat sampling when their teams are involved in human clinical response. So I think it prudent and collegial to let him know about this one, in case he doesn't already, and that we are responding. Sound okay if I send him a quiet FYI email?

Nice job on the communications on this one,
Jonna

---------- Forwarded message ----------
From: **Jonna Mazet** <jkmazet@ucdavis.edu>
Date: Fri, Mar 3, 2017 at 6:10 AM
Subject: Re: URGENT - Notice of Nipah virus cases in Bangladesh
To: Andrew Clements <aclements@usaid.gov>
Cc: PREDICTMGT <predictmgt@usaid.gov>, "predict-outbreak@ucdavis.edu" <predict-outbreak@ucdavis.edu>

Thanks,
We'll evaluate the situation while taking some samples with minimal associated costs initially and come back with an assessment of the situation and likely budget implications before expending too much funds.
Thank you,
Jonna

On Thu, Mar 2, 2017 at 11:16 PM, Andrew Clements <aclements@usaid.gov> wrote:
Thanks, Jonna.

If you think it will provide useful information then please go ahead. My only concern is how much would it decrease the outbreak reserve funding. If only a little, then no problem. If it leaves very little funding in the reserve then we should discuss further.

Andrew

Andrew P. Clements, Ph.D.
Senior Scientific Adviser
Emerging Threats Division/Office of Infectious Diseases/Bureau for Global Health
U.S. Agency for International Development
Mobile phone: 1-571-345-4253
Email: aclements@usaid.gov

On Mar 3, 2017, at 12:56 AM, Jonna Mazet <jkmazet@ucdavis.edu> wrote:

Dear Andrew, Alisa, and Shana,
Please see the message below regarding the opportunity to evaluate transmission dynamics for Nipah in Bangladesh. This type of opportunistic sampling has also been suggested as a target for collaboration between Predict and the CDC Special Pathogens Branch in the past (not yet discussed for this outbreak).
Please advise on you thoughts, concerns, and/or encouragements regarding moving forward. The proposed activities would fit within the general scope of Predict activities but would likely represent an expansion of sites and possibly dip into our outbreak funding reserve.
Thanks in advance for your advice,
Jonna

From: Dr. Melinda Rostal [mailto:rostal@ecohealthalliance.org]
Sent: Thursday, March 2, 2017 2:02 PM
To: Peter Daszak
Cc: Jon Epstein; William B. Karesh; Ariful Islam; Emily Hagan
Subject: Notice of Nipah virus cases in Bangladesh

Dear Peter,
I wanted to let you know that Arif has been informed that there are cases of Nipah virus in people in Bangladesh right now (it is Nipah season). The director of IEDCR (Institute of Epidemiology, Disease Control and Research) unofficially offered to let PREDICT sample bats in coordination with the human investigation. This is not a formal request at this time. Right now there are no plans for any institution there to sample the bats during the investigation.

While the government has not announced outbreak to the media yet, we thought you should be informed at this time because the CDC and, perhaps more importantly, the USAID Mission are already aware of the cases. The Mission did ask Arif whether PREDICT would be responding to the outbreak. At this time we are not planning any field activities in response to the outbreak as we have not been officially requested to help nor do we have USAID DC approval.

Please let us know if you have any questions regarding this notice.

Best,
Mindy

Melinda Rostal DVM, MPH
Senior Research Scientist
PREDICT 2 Surveillance Coordinator for EcoHealth Alliance
Rift Valley Fever Virus Project Manager
EcoHealth Alliance
460 West 34th Street – 17th floor
New York, NY 10001

1.212.380.4489 (direct)
1.212.380.4465 (fax)
www.ecohealthalliance.org

Visit our blog: www.ecohealthalliance.org/blog

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.

From: [redacted] on behalf of "Jonna Mazet" <jkmazet@ucdavis.edu>
Sent: 03/26/2017 6:06:15 PM (-07:00)
To: "Eddy Rubin" <erubin@metabiota.com>
Subject: Re: Dividing up the CUGH presentation

Will do,
J

On Sun, Mar 26, 2017 at 3:56 PM, Eddy Rubin <erubin@metabiota.com> wrote:

> Hi Jonna
>
> Opps sorry, didn't mean to exclude anyone. I just thought that we were doing it, as Dennis suggested, how we did it at the Pasteur. There we broke it into 3 components with the 4th being the moderator slot. If we want to divide it into 4 segments I can imagine breaking the last section into 2: A) introducing GVP at a high level talking about what big data gives us, parallels to the human genome program and B) describing a.) what exactly we are proposing in its different forms b.) where we are at c.) where we need to go… Just one way to break things up but in this format I could do A. (I also do not feel compelled to present at the session but could be there for the discussion and to answer questions.)
>
> Sorry to miss this week's GVP call. Since you're the real link to CUGH it might be good if you decide how to break things up and let me know how I can contribute.
>
> Eddy

From: Jonna Mazet [redacted] on behalf of Jonna Mazet <jkmazet@ucdavis.edu>
Date: Saturday, March 25, 2017 at 6:21 PM
To: Eddy Rubin <erubin@metabiota.com>
Cc: Dennis Carroll <dcarroll@usaid.gov>, Peter Daszak <daszak@ecohealthalliance.org>
Subject: Re: Dividing up the CUGH presentation

Please see my other email -- there are 4 of us. I am the moderator and have organized it for four fifteen minute sections then discussion and Q&A.

Jonna

On Sat, Mar 25, 2017 at 4:08 PM, Eddy Rubin <erubin@metabiota.com> wrote:

> Dennis and Peter
>
> I think that this version that Dennis used for his presentation at UCSF, seems at the correct level and could be split up into 3 sections. One way to rearrange and divide it up for 3x 15 minute would be to first move the section about PREDICT and resulting insights to before the ending discussion about the GVP(I have done this is the GVP rearranged attached document). Possible way to divide the material so that each of the presentations covered

defined units would be (GVP rearranged ppt) Dennis 1-16, Peter 17-28 and me 29-39. I have no strong affinity for any of the sections, other the discussion of the human genome project stuff. This is just a first crack so please move ppts and topics as you think best. I am in Singapore next Monday till Saturday AM. Please let me know how you think is best do this and let me know which ppts I should present.

Cheer

Eddy

From: Dennis Carroll <dcarroll@usaid.gov>
Date: Sunday, March 19, 2017 at 8:41 PM
To: Eddy Rubin <erubin@metabiota.com>, Jonna Mazet <jkmazet@ucdavis.edu>, Peter Daszak <daszak@ecohealthalliance.org>
Subject: CUGH presentation

Eddy, we can divide the presentation up like we did at Pasteur. Attached is the version I gave at UCSF - why don't you all edit to carve out your space per Pasteur.

d

Dr Dennis Carroll

Director, Emerging Threats Program

U.S. Agency for International Development

Office: (202) 712-5009

Mobile: REDACTED

Begin forwarded message:

> **From:** Dennis Carroll <dcarroll@usaid.gov>
> **To:** DCarroll <dcarroll@usaid.gov>, Dowen Carroll REDACTED
> **Subject: GVP.UCSF**
>
> --
>
> Dr. Dennis Carroll
>
> Director, Emerging Threats Program

Bureau for Global Health

U.S. Agency for International Development

Office: 202-712-5009

Mobile: REDACTED

From: Elizabeth S Chase <eschase@ucdavis.edu>
To: " (dcarroll@usaid.gov)" <dcarroll@usaid.gov>, " (erubin@metabiota.com)" <erubin@metabiota.com>, "daszak (daszak@ecohealthalliance.org)" <daszak@ecohealthalliance.org>, " (nwolfe@metabiota.com)" <nwolfe@metabiota.com>, Jonna Mazet <jkmazet@ucdavis.edu>, Cara Chrisman <cchrisman@usaid.gov>
Subject: Media List of PREDICT/GVP
Sent: Fri, 31 Mar 2017 00:13:56 +0000
PREDICT Coverage2.0.docx

Greetings all,
As discussed on the GVP call today, please find attached, a master list of list recent and upcoming PREDICT press. This would include TV, radio and print.
Best, Liz

Liz Chase
Executive Assistant to Dr. Jonna Mazet
One Health Institute, University of California, Davis
530-752-3630

PREDICT Coverage

In progress

Virus (Upcoming Discovery Channel project)

Brian Walsh story on PREDICT and Global Virome Project (Time Magazine)

MERS-like Coronavirus identified in Ugandan bat (Upcoming publication)
April 4, 2017

Recent coverage

Finding the next patient zero: The Global Virome Project (World Affairs Council)
https://www.youtube.com/watch?v=pQZgFxXgbsw

PREDICT partner lab in Nepal implements safety policies to protect citizens (Kathmandu Post)
http://kathmandupost.ekantipur.com/news/2017-03-25/implement-safety-policies-to-protect-citizens-advise-experts.html

Key PREDICT partner becomes anti-poaching champion in Asia (USAID)
https://www.usaid.gov/asia-regional/press-releases/mar-15-2017-celebrity-vet-promotes-usaid-counter-wildlife

How Zika response is going beyond reactive approaches (Devex)
https://www.devex.com/news/how-the-zika-response-is-going-beyond-reactive-approaches-88448

Center for Molecular Dynamics Nepal staff visit One Health Institute for training (KDRT)
https://soundcloud.com/one-health-institute/a-talk-withajay-narayan-sharma-and-tarka-raj-bhatta

Why killer viruses are on the rise (NPR)
http://www.npr.org/sections/goatsandsoda/2017/02/14/511227050/why-killer-viruses-are-on-the-rise

Talking emerging pathogen surveillance with Dr. Jonna Mazet (American Society for Microbiology)
https://www.asm.org/index.php/asm-video-on-demand/documentaries-interviews-podcasts-and-more-videos/interviews-videos/item/5458-emerging-pathogen-surveillance-with-jonna-mazet-phd

Finding the world's unknown viruses before they find us (STAT)

https://www.statnews.com/2016/12/13/world-viruses-global-virome-project/

A proactive approach to zoonotic diseases (Microbe Talk Podcast)
https://microbepost.org/2016/11/30/microbe-talk-november-2016/

PREDICT lead Dr. Jonna Mazet receives Zoetis Award for Research (UC Davis)
http://www.vetmed.ucdavis.edu/whatsnew/article.cfm?id=3662

Gorilla Doctors featured on 60 Minutes (CBS/60 Minutes)
http://www.cbsnews.com/news/60-minutes-gorilla-doctors-lara-logan/
and
http://www.gorilladoctors.org/gorilla-doctors-in-360-degree-video/
(Note: Full doc can't be streamed at the moment. 360 video can be)

Spillover: Zika, Ebola and Beyond (PBS)
http://www.pbs.org/video/2365815991/

Danger at wildlife markets of Lao PDR (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

An ounce of prevention: crises of infectious disease (The Economist)
http://www.economist.com/news/leaders/21695036-crises-infectious-diseases-are-becoming-more-common-world-should-be-better-prepared

Tropical diseases, global crises (NPR / KCRW)
http://www.kcrw.com/news-culture/shows/to-the-point/tropical-diseases-global-crisis

Mosquito borne diseases and Zika preparedness (Hawaii Public Radio)
http://hpr2.org/post/conversation-thursday-february-25th-2016

UC Davis researcher heads global effort to avert the next Ebola or Zika outbreak (Sacramento Bee)
http://www.sacbee.com/news/local/health-and-medicine/article92997847.html

From: predict-request@ucdavis.edu on behalf of "Elizabeth Leasure" <ealeasure@ucdavis.edu>
Sent: 05/05/2017 9:23:51 AM (-07:00)
To: "Andrew Clements" <aclements@usaid.gov>; "predict@ucdavis.edu" <predict@ucdavis.edu>; "Christine Kreuder Johnson" <ckjohnson@ucdavis.edu>
Cc: "Alisa Pereira" <apereira@usaid.gov>; "Shana Gillette" <sgillette@usaid.gov>; "Amalhin Shek" <ashek@usaid.gov>; "Lindsay Parish" <lparish@usaid.gov>; "Katherine Leasure" <kaleasure@ucdavis.edu>
Subject: RE: [predict] Request for more information on Predict AMR activity in Nepal
Attachments: Pages from PREDICT 2016-2017 Workplan (Final)_Nepal brief.pdf

Hi Andrew. The AMR work was included in the approved Year 3 work plan. I've attached the Nepal country brief from the work plan for your reference and to share with Dan.

Thanks,
Liz

Elizabeth Leasure
One Health Institute
University of California, Davis
530-754-9034 (office)
REDACTED (cell)

From: predict-request@ucdavis.edu [mailto:predict-request@ucdavis.edu] **On Behalf Of** Andrew Clements
Sent: Friday, May 05, 2017 4:03 AM
To: predict@ucdavis.edu; Christine Kreuder Johnson
Cc: Alisa Pereira; Shana Gillette; Amalhin Shek; Lindsay Parish
Subject: [predict] Request for more information on Predict AMR activity in Nepal

See below for a request from the RDMA mission. Thanks!

Andrew P. Clements, Ph.D.
Senior Scientific Adviser
Emerging Threats Division/Office of Infectious Diseases/Bureau for Global Health
U.S. Agency for International Development
Mobile phone: 1-571-345-4253
Email: aclements@usaid.gov

Begin forwarded message:

> **From:** Daniel Schar <dschar@usaid.gov>
> **Date:** May 5, 2017 at 2:55:39 AM GMT+2
> **To:** aclements@usaid.gov
> **Cc:** sdamrongwatanapokin@usaid.gov
> **Subject: Fwd: [predict] Re: PREDICT International Travel Requests**
>
> Hi andrew, Could we have more information re the AMR work mentioned below please? We haven't been made aware of this effort under P2 previously. Thanks! Dan
>
> Begin forwarded message:
>
> > **From:** Cassandra Louis Duthil <clouisduthil@usaid.gov>
> > **Date:** May 5, 2017 at 3:41:30 AM GMT+7

To: Linda Kentro <lkentro@usaid.gov>, Navin Hada <nhada@usaid.gov>, Daniel Schar <dschar@usaid.gov>, "Damrongwatanapokin, Sudarat (RDMA/OPH)" <sdamrongwatanapokin@usaid.gov>
Cc: Alisa Pereira <apereira@usaid.gov>, Andrew Clements <aclements@usaid.gov>, Katie Leasure <kaleasure@ucdavis.edu>, Elizabeth Leasure <ealeasure@ucdavis.edu>, David John Wolking <djwolking@ucdavis.edu>
Subject: Fwd: [predict] Re: PREDICT International Travel Requests

H

ello team Nepal,

the following travel approval requests have

come in from PREDICT. We appreciate your concurrence and welcome any questions you may have. *Please note: All travelers should be prepared to provide an in/out brief*

during the duration of their travel.

6. UC Davis would like to request travel approval for Dr. Christine Kreuder Johnson to travel to from Miami, Florida, USA to Kathmandu, Nepal from July 11-18, 2017 for PREDICT fieldwork and government and stakeholder meetings.

Trip purpose: Dr. Johnson, the senior biological and ecological surveillance coordinator, will be traveling to Nepal to oversee PREDICT field sampling efforts, share test results and project findings to date with government partners, and further collaboration on PREDICT activities with government and stakeholder partnerships.

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AMR module of the PREDICT human questionnaire. Additionally, Ms. Young will be working with the PREDICT Nepal lab team on storage, processing, and extraction of the AMR samples. She will attend government and stakeholder meetings with Dr. Johnson as appropriate.

Cassandra Louis Duthil
Program Assistant
Emerging Threats Division
U.S. Agency for International Development (USAID)
Telephone: 202-712-5583 Cell: REDACTED | **clouisduthil@usaid.gov**

*NEPAL
October 2016-September 2017

Implementing Partners: UC Davis, Center for Molecular Dynamics Nepal (CMDN)
Country Coordinator: Dibesh Karmacharya, CMDN
Global Point of Contact: Christine Johnson, UC Davis

Existing and Prospective Partners

- Ministry of Health and Population (MoHP), Kathmandu, Nepal
- Epidemiology and Disease Control Division (EDCD) within MoHP, Kathmandu, Nepal
- Department of National Parks and Wildlife Conservation (DNPWC), Kathmandu, Nepal
- Ministry of Science, Technology, and Environment, Kathmandu, Nepal
- Department of Agriculture (DoA), Kathmandu, Nepal
- Department of Livestock Services (DLS), Kathmandu, Nepal
- *DLS Central Veterinary Laboratory (CVL), Kathmandu, Nepal
- FAO Nepal, Lalitpur, Nepal
- WHO Nepal, Surveillance Medical Office, Kathmandu Nepal
- *Patan Academy of Health Sciences (PAHS), Patan Teaching Hospital, Nepal
- *Chitwan Medical College, Chitwan, Nepal
- *Kantipur Hospital, Jadibuti, Kathmandu, Nepal
- *Center for Disease Control and Prevention (CDC), Kathmandu, Nepal
- *National Public Health Laboratory (NPHL), Kathmandu, Nepal
- Walter Reed/ AFRIMS Research Unit-Nepal (WARUN), Kathmandu, Nepal
- One Health Alliance of Nepal (OHAN), Kathmandu, Nepal
- World Health Organization (WHO), Nepal
- USAID Nepal and Regional South Asia
- US State Department, Regional South Asia
  *Partnership in development

Geographic Areas and Sampling Plans

PREDICT/Nepal's animal surveillance activities (Silinge, Makwanpur, Madi, Meghauli, Chitwan and Kathmandu) will be focused on targeted sampling of wildlife (non-human primates-macaques, bats, and rodents), and coordination with FAO Nepal on livestock sampling (mallards, chicken, swine, and cattle) as appropriate.

Human surveillance activities will include community-based surveillance (Silinge, Makwanpur, Madi, Meghauli, Chitwan, and Kathmandu) and syndromic surveillance at hospitals/clinics including Patan Academy of Health Sciences Hospital, Chitwan Medical College and Kantipur Hospital as resources allow.

PREDICT also plans to implement novel AMR testing strategies targeting antimicrobial resistance genes circulating in humans, animals, and the environment to pinpoint specific resistance patterns for future surveillance and to assist in the prioritization of prevention policies.

- **Chepang Village, Silinge, Makwanpur District located centrally in the Terai region:** Land Conversion and Animal Value Chain pathways
  - Sampling targets at location
    - Wildlife: bats, non-human primates, and rodents in and around the indigenous Chepang community and bats being consumed by local Chepang community
    - Community surveillance (biological sampling and behavioral risk investigations) of people from the Chepang community living in highly biodiverse area and dependent on subsistence hunting of local bat population
    - Syndromic surveillance of patients at the Chitwan Medical College who present with symptoms with febrile illness
    - Risk-based occupational surveillance (including potential for biological sampling) of Chepang community members will be assessed

- **Kathmandu, Jadibuti temporary settlements:** Intensification of Animal Production Systems and Animal Value Chain pathway
  - Sampling targets at location
    - Wildlife: rodents/shrews and mallards within urban temporary settlements and areas with animal production and animal value chain (slaughterhouses and local restaurants)
    - Collaborative livestock sampling of swine, poultry, and domestic ducks with FAO
    - AMR sampling of people, livestock, wildlife and environment
    - Community surveillance (biological sampling and behavioral risk investigations) of vulnerable communities living in temporary settlements with intensifying animal production within Jadibuti
    - Syndromic surveillance of patients with severe acute respiratory and acute encephalitis at Patan Academy of Health Sciences

- **Chitwan National Park and outskirts, Chitwan District located in South-Central Terai region:** Land Conversion and Animal Value Chain pathways
  - Sampling targets and specific locations to be planned collaboratively with FAO and our EPT and in-country partners, if budget allows, and will focus on buffer zones areas and locations with human-wildlife conflict

Laboratory Systems Plans

PREDICT's collaborating lab partner, the Center for Molecular Dynamics Nepal (CMDN), is conducting viral family-testing using PREDICT protocols and plans to expand the list of assays to include additional high priority families. This lab will continue to be the primary location of PREDICT engagement. CMDN will continue to engage and provide technical support to government veterinary and public health laboratories to train staff on sample testing using PREDICT-2 protocols to strengthen capacity to conduct novel and known potentially zoonotic pathogen detection and characterization at these labs.

Collaborating labs (animal and human samples): Center for Molecular Dynamics, Nepal (CMDN), with training and transfer of protocols to the Nepal Department of Livestock Services (DLS) Central Veterinary Laboratory for capacity strengthening

From: predict-request@ucdavis.edu on behalf of "Andrew Clements" <aclements@usaid.gov>
Sent: 05/05/2017 12:01:32 PM (-07:00)
To: "Elizabeth Leasure" <ealeasure@ucdavis.edu>
Cc: "predict@ucdavis.edu" <predict@ucdavis.edu>; "Christine Kreuder Johnson" <ckjohnson@ucdavis.edu>; "Alisa Pereira" <apereira@usaid.gov>; "Shana Gillette" <sgillette@usaid.gov>; "Amalhin Shek" <ashek@usaid.gov>; "Lindsay Parish" <lparish@usaid.gov>; "Katherine Leasure" <kaleasure@ucdavis.edu>
Subject: Re: [predict] Request for more information on Predict AMR activity in Nepal

Ok. Thanks!

Andrew P. Clements, Ph.D.
Senior Scientific Adviser
Emerging Threats Division/Office of Infectious Diseases/Bureau for Global Health
U.S. Agency for International Development
Mobile phone: 1-571-345-4253
Email: aclements@usaid.gov

On May 5, 2017, at 8:49 PM, Elizabeth Leasure <ealeasure@ucdavis.edu> wrote:

> Chris confirmed that she and Cristin can do a call with Dan, if requested.
>
> Elizabeth Leasure
> One Health Institute
> University of California, Davis
> 530-754-9034 (office)
> REDACTED (cell)
>
> ---
>
> **From:** predict-request@ucdavis.edu [mailto:predict-request@ucdavis.edu] **On Behalf Of** Andrew Clements
> **Sent:** Friday, May 05, 2017 11:40 AM
> **To:** Elizabeth Leasure
> **Cc:** predict@ucdavis.edu; Christine Kreuder Johnson; Alisa Pereira; Shana Gillette; Amalhin Shek; Lindsay Parish; Katherine Leasure
> **Subject:** Re: [predict] Request for more information on Predict AMR activity in Nepal
>
> Thanks, Liz. I've passed it along to Dan.
>
> If he wants more information, can we set up a call between him and Cristin?
>
> *Andrew P. Clements, Ph.D.*
> *Senior Scientific Adviser*
> *Emerging Threats Division/Office of Infectious Diseases/Bureau for Global Health*
> *U.S. Agency for International Development*
> *Mobile phone: 1-571-345-4253*
> *Email: aclements@usaid.gov*
>
> On May 5, 2017, at 6:26 PM, Elizabeth Leasure <ealeasure@ucdavis.edu> wrote:
>
> > Hi Andrew. The AMR work was included in the approved Year 3 work plan. I've attached the Nepal country brief from the work plan for your reference and to share with Dan.
> >
> > Thanks,

Liz

Elizabeth Leasure
One Health Institute
University of California, Davis
530-754-9034 (office)
REDACTED (cell)

From: predict-request@ucdavis.edu [mailto:predict-request@ucdavis.edu] **On Behalf Of** Andrew Clements
Sent: Friday, May 05, 2017 4:03 AM
To: predict@ucdavis.edu; Christine Kreuder Johnson
Cc: Alisa Pereira; Shana Gillette; Amalhin Shek; Lindsay Parish
Subject: [predict] Request for more information on Predict AMR activity in Nepal

See below for a request from the RDMA mission. Thanks!

Andrew P. Clements, Ph.D.
Senior Scientific Adviser
Emerging Threats Division/Office of Infectious Diseases/Bureau for Global Health
U.S. Agency for International Development
Mobile phone: 1-571-345-4253
Email: aclements@usaid.gov

Begin forwarded message:

> **From:** Daniel Schar <dschar@usaid.gov>
> **Date:** May 5, 2017 at 2:55:39 AM GMT+2
> **To:** aclements@usaid.gov
> **Cc:** sdamrongwatanapokin@usaid.gov
> **Subject: Fwd: [predict] Re: PREDICT International Travel Requests**
>
> Hi andrew, Could we have more information re the AMR work mentioned below please? We haven't been made aware of this effort under P2 previously. Thanks! Dan
>
> Begin forwarded message:
>
> > **From:** Cassandra Louis Duthil <clouisduthil@usaid.gov>
> > **Date:** May 5, 2017 at 3:41:30 AM GMT+7
> > **To:** Linda Kentro <lkentro@usaid.gov>, Navin Hada <nhada@usaid.gov>, Daniel Schar <dschar@usaid.gov>, "Damrongwatanapokin, Sudarat (RDMA/OPH)" <sdamrongwatanapokin@usaid.gov>
> > **Cc:** Alisa Pereira <apereira@usaid.gov>, Andrew Clements <aclements@usaid.gov>, Katie Leasure <kaleasure@ucdavis.edu>, Elizabeth Leasure <ealeasure@ucdavis.edu>, David John Wolking <djwolking@ucdavis.edu>
> > **Subject: Fwd: [predict] Re: PREDICT International Travel Requests**

H

ello team Nepal,

the following travel approval requests have

come in from PREDICT. We appreciate your concurrence and welcome any questions you may have. *Please note: All travelers should be prepared to provide an in/out brief*

during the duration of their travel.

6. UC Davis would like to request travel approval for Dr. Christine Kreuder Johnson to travel to from Miami, Florida, USA to Kathmandu, Nepal from July 11-18, 2017 for PREDICT fieldwork and government and stakeholder meetings.

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questionnaire. Additionally, Ms. Young will be working with the PREDICT Nepal lab team on storage, processing, and extraction of the AMR samples. She will attend government and stakeholder meetings with Dr. Johnson as appropriate.

Cassandra Louis Duthil
Program Assistant
Emerging Threats Division
U.S. Agency for International Development (USAID)
Telephone: 202-712-5583 Cell: REDACTED
REDACTED **clouisduthil@usaid.gov**

<Pages from PREDICT 2016-2017 Workplan (Final)_Nepal brief.pdf>

From: "David J Wolking" <djwolking@ucdavis.edu>
Sent: 07/06/2017 3:05:44 PM (-07:00)
To: "Ricardo Echalar" <rechalar@usaid.gov>
Cc: "David J Wolking" <djwolking@ucdavis.edu>; "Jonna Mazet" <jkmazet@ucdavis.edu>; "PREDICTMGT" <predictmgt@usaid.gov>; "Sarah Paige" <spaige@usaid.gov>; "Richard Greene" <rgreene@usaid.gov>; "Dennis Carroll" <dcarroll@usaid.gov>
Subject: Re: AORs/TAs ACTION REQUIRED Fwd: REQUEST FOR MATERIALS: GHSA Toolkit
Attachments: Emerging Disease Insights.zip, Modeling and analysis.zip, One Health tools.zip, Behavioral risk investigations.zip, Biosafety and lab.zip, Safe sample transport and shipping.zip

Ricardo,

It is our pleasure. We hope these are useful for the repository and please let us know if you or Casey and the CDC team have any questions or need clarification.

I'm attaching part 1 of 2 here, these are all zipped files by topic, included here are PREDICT tools or guides/protocols on:

- Disease modeling and analytics
- One Health case studies and lessons learned
- Guides for behavioral risk investigations
- Biosafety and lab safety protocols
- Safe sample transport and shipping
- A few of our Emerging Disease Insights (designed to inform policy and zoonotic disease surveillance)

Part 2 coming next will be our field sampling guides and protocols.

David

On Thu, Jul 6, 2017 at 2:45 PM, Ricardo Echalar <rechalar@usaid.gov> wrote:

> Eek. I think breaking it up in pieces. Thanks for your help!
>
> Ricardo
>
> – –
>
> Ricardo Echalar, MPH
> Senior Public Health Advisor
> Office of Infectious Diseases, Emerging Threats Division
> Bureau for Global Health
> U.S. Agency for International Development (USAID)
> 1300 Pennsylvania Ave, NW, 3.6-53, 3rd Floor, RRB
> Washington, DC 20523
> (M) REDACTED | (W) +1.202.712.4003 | E-mail: rechalar@usaid.gov

On Thu, Jul 6, 2017 at 5:43 PM, David J Wolking <djwolking@ucdavis.edu> wrote:

> Hi Ricardo,
>
> I've been working on this today with our operations team leads and have a rather large file (>35MB) prepared. What's the best way to get it to you? Break it up into pieces or share to a Drive link?

Thanks!

David

On Thu, Jul 6, 2017 at 2:29 PM, Ricardo Echalar <rechalar@usaid.gov> wrote:

Hi, David,

I got an out of office response from Jonna. Could you or someone else from the PREDICT team help with this request? Thanks,

Ricardo

– –

Ricardo Echalar, MPH
Senior Public Health Advisor
Office of Infectious Diseases, Emerging Threats Division
Bureau for Global Health
U.S. Agency for International Development (USAID)
1300 Pennsylvania Ave, NW, 3.6-53, 3rd Floor, RRB
Washington, DC 20523
(M) REDACTED | (W) +1.202.712.4003 | E-mail: rechalar@usaid.gov

---------- Forwarded message ----------
From: **Ricardo Echalar** <rechalar@usaid.gov>
Date: Thu, Jul 6, 2017 at 5:26 PM
Subject: Fwd: AORs/TAs ACTION REQUIRED Fwd: REQUEST FOR MATERIALS: GHSA Toolkit
To: Jonna Mazet <jkmazet@ucdavis.edu>
Cc: PREDICTMGT <predictmgt@usaid.gov>, Sarah Paige <spaige@usaid.gov>, Richard Greene <rgreene@usaid.gov>, Dennis Carroll <dcarroll@usaid.gov>

Hi, Jonna,

Can you and the PREDICT team help with this request from CDC? If you have tools/resources that you think would be appropriate to share, could you send them to me? I'd like to compile everything from the EPT-2 partners and send it as one e-mail.

Thanks,

Ricardo

– –

Ricardo Echalar, MPH
Senior Public Health Advisor
Office of Infectious Diseases, Emerging Threats Division
Bureau for Global Health
U.S. Agency for International Development (USAID)
1300 Pennsylvania Ave, NW, 3.6-53, 3rd Floor, RRB
Washington, DC 20523
(M) REDACTED | (W) +1.202.712.4003 | E-mail: rechalar@usaid.gov

---------- Forwarded message ----------
From: **Barton Behravesh, Casey (CDC/OID/NCEZID)** <dlx9@cdc.gov>
Date: Wed, Jun 21, 2017 at 2:38 PM
Subject: REQUEST FOR MATERIALS: GHSA Toolkit
To: "Ricardo Echalar (rechalar@usaid.gov)" <rechalar@usaid.gov>
Cc: "Goryoka, Grace (CDC/OID/NCEZID)" <lie0@cdc.gov>, "One Health (CDC)" <onehealth@cdc.gov>, Sarah Paige <spaige@usaid.gov>

Dear Ricardo,

CDC is creating a repository of tools and resources across GHSA countries and Action Packages. This repository will be accessible to CDC field missions, CDC headquarters, and in-country partners to support program design, work plan development, monitoring and evaluation, and technical assistance. Please find the one-pager attached for more information.

Support for this repository has broadened following the call for tools and resources at the *Multicountry/Multisector Partner* plenary session at a recent CDC global health meeting (the DGHP Annual Meeting). We are reaching out to partners and countries for the tools and resources they use to implement GHSA activities. I wanted to specifically reach out to our One Health partners for information.

Understanding the importance of your subject matter expertise, we want to ensure we include tools and resources that CDC perceives as critical to GHSA. We invite you to share policies, standard operating procedures, M&E frameworks, and other tools and resources that you perceive as good examples for countries and partners to reference.

If there are materials you would like us to share with this repository (i.e. overview of the NOHPs), please send it to onehealth@cdc.gov no later than June 28th. We will turn in all materials we received to the repository. Also, as future materials become available, we can add to the repository to share One Health information widely. I thought it would be useful to share the NOHP summary overview as a resource in this tool kit as a way to provide CDC country staff with key information on the NOHPs. You are welcome to share additional materials that you think would be useful. Eventually, we can add the One Health interagency talking points.

Many thanks,

Casey
Casey Barton Behravesh MS, DVM, DrPH, DACVPM

Captain, U.S. Public Health Service

Director, One Health Office

National Center for Emerging and Zoonotic Infectious Diseases

Centers for Disease Control and Prevention

e-mail: CBartonBehravesh@cdc.gov

www.cdc.gov/onehealth

Click on the icon to subscribe to One Health updates from CDC.

Section 5.6. Qualitative Research Introduction and Observational Research Guide

Prepared by
Maureen Miller, EcoHealth Alliance
Karen Saylors, Metabiota
Emily Hagan, EcoHealth Alliance
Jason Euren, Metabiota
Aleksei Chmura, EcoHealth Alliance
Taylor Gabourie, University of California, Davis
Toph Allen, EcoHealth Alliance
Elizabeth Loh, EcoHealth Alliance
Sarah Olson, Wildlife Conservation Society
Robyn Schreiber, EcoHealth Alliance
Karissa Whiting, EcoHealth Alliance
David Wolking, University of California, Davis
and the PREDICT One Health Consortium

Objectives: 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.

This document was made possible by the generous support of the American people through the United States Agency for International Development (USAID) Emerging Pandemic Threats PREDICT program. It was drafted to support activities conducted under PREDICT and is intended for an audience of qualified professionals trained in standard, associated best practices. This guide is not intended for use by untrained individuals.

The contents of this document are the responsibility of the authors and do not necessarily reflect the views of USAID or the United States Government. USAID, PREDICT, and the authors of this guide bear no responsibility for the actions of non-PREDICT-affiliated individuals implementing the material herein.

The authors assert that human surveillance activities should always occur in compliance with all applicable laws and regulations and should only be undertaken after securing all necessary permits and approvals, including ethical approvals.

For more information about the contents of this guide, please contact predict@ucdavis.edu.

Suggested Citation Form: PREDICT One Health Consortium 2016. PREDICT Operating Procedures: Qualitative Research Introduction and Observational Research Guide.

Table of Contents: Qualitative Research Introduction and Observational Research Guide

Section 5.6.1. Qualitative Research: An Introduction

Qualitative Research is an exploratory type of research that is used to gain insight into people's lives. Qualitative data can be collected at multiple levels within the community using different and complementary methods. Figure 1 shows three different levels: human environment, community life, and individuals and households. These three levels are linked to three different qualitative methods of data collection: observational research, focus groups and ethnographic interviews.

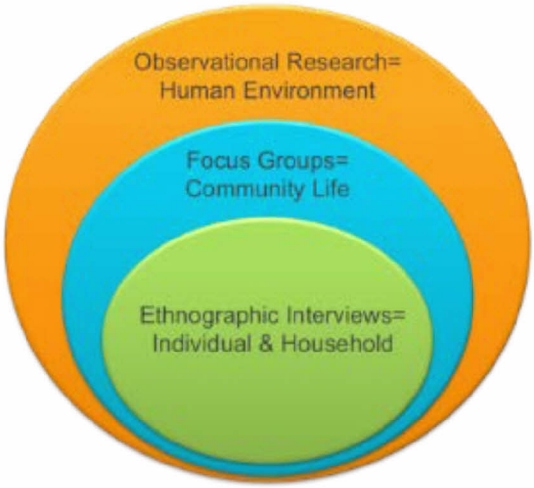

Figure 1: Levels of Qualitative Data

Qualitative research is the best method for understanding the individual motivations that influence behaviors, particularly private, unpopular or taboo behaviors. People are more likely to provide information on such behaviors if they are able to provide the context or a justification. For example, a person who would not admit to hunting in a protected area if asked in a survey may disclose hunting activities in a one-on-one ethnographic interview, offering the justification that hunting was necessary to feed the family.

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.

The limitation of qualitative research is that findings may only apply to small groups of people who are similar to those participating in the research. While there is great depth and detail to the data collected using these methods, and much important information is learned, it cannot be said with certainty that the behaviors and practices identified in small group settings are the same as those in the larger community. That is why a qualitative approach is often combined with other types of data collection (e.g., large surveys) to address complex issues that require timely intervention.

The PREDICT project strategy is to use the data collected through the qualitative research step of the process to improve on behavioral risk questionnaires that have been conducted with large populations. The qualitative data will be analyzed based on the experiences of people who are at increased risk of zoonotic disease transmission. In addition, after the behavioral survey has been completed with a larger population, the findings from the qualitative analysis can be used to help interpret survey findings, as well as to inform risk mitigation strategies.

Figure 2: PREDICT project strategy

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. Focus groups and ethnographic interviews require institutional review board (IRB) or other in-country ethical committee approvals before they may be conducted. All staff conducting ethnographic interviews or focus groups or participating in data analysis must complete human research ethics training (e.g., Collaborative Institutional Training Initiative [CITI] training; National Institutes of Health Protecting Human Research Participants training) before working with research subjects or their identifying information.

Section 5.6.2. Targeted Approach

The qualitative methods outlined in this protocol use a targeted qualitative approach. This approach involves assessing current knowledge and perspectives of specific populations, in order to gain insight into a set of core themes.

Section 5.6.2a. Core Themes

The **core themes** are the topics that guide the research in this protocol. These are topics about which incomplete or no information is known, particularly in regard to their relationship with zoonotic disease transmission. There are five core themes that interviewers will focus on when guiding the conversation. The five core themes and the research goals for each theme are listed below. Examples of types of questions that can be asked for some of the core theme are included in the ***Ethnographic Interview Guide (Appendix 5.6.5c.)*** at the end of the protocol.

1. **Human Movement:** To understand how far people travel and why
2. **Socioeconomics and Daily Living:** To understand a typical day and how socioeconomic factors impact animal contact risk
3. **Biosecurity in Human Environments:** To understand how sanitation or hygiene factors could play a role in disease transmission
4. **Illness, Medical Care/Treatment and Death of Humans:** To identify any unusual disease experiences—signs, symptoms and sources—as well as how people respond to illness
5. **Human-Animal Contact:** To understand 1) physical interactions and exposure to animals, 2) the use of animals and animal byproducts, and 3) knowledge and beliefs about animals

Section 5.6.2b. Timeline

Table 1: Timeline for Behavioral Research Activities

Method	Timeline
Observational Research	Can occur as soon as PREDICT staff are at a site at any time/place.
Focus Groups	4-8 weeks total (can occur concurrently with Observational Research and Ethnographic Interviews)
Ethnographic Research	4-8 weeks total (can occur concurrently with Observational Research and Ethnographic Interviews)

Section 5.6.2c. Target Population

The **target population** is the group of people who are actively exposed to animals along one of the PREDICT project pathways: 1) land use conversion, 2) animal production intensification, or 3) animal value chain.

Different kinds of people will be found in the three PREDICT project pathways. For example, the kinds of people that may be found on the land use change pathway could include extractive industry workers (e.g., the people who cut down and carry logs out of the forest), the foreman at a mine, engineers working at a new port or roadway being built, or the people who sell animals or other food to the workers. Below is a list of some of the kinds of people that may be found on the project pathways. There are others not included on this list.

Table 2: Examples of Members of Targeted Populations for each of the three Pathways

Land Use Conversion	Animal Production Intensification	Animal Value Chain
• Laborers • Foremen/headman on site • Family members of laborers • Local food suppliers (e.g. local or informal restaurants for workers) • Transporters • Residents near changing land • Fuel/wood harvesters • Farmers • Pastoralists • Miners/loggers	• Farm or ranch owner • Farm or ranch worker • Backyard animal raiser • Distributors • Transporters • District vets • Feed/supplement sales people • Abattoir workers • Butchers • Traders • Herders	• Wildlife farmers • Market vendors • Wildlife restaurant owners/worker • Transporters • Users of animal based medicine • Healers/traditional medicine • Hunters • Consumers • Marketplace owners/managers

It is important to interview a diverse group of people from the target population; therefore, approximately 35-40% of participants should be women. Efforts should 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). All of these different groups of people are likely to have different risk behaviors, practices and experiences. An important goal is to be able to understand and report on as wide a range of experiences as possible.

There are no strict rules concerning sample size or how many people need to be interviewed in targeted qualitative research. The most important factor is diversity of the people interviewed. The goal of this type of research is to get many different perspectives on a limited set of core themes. The lists above have approximately 10 different kinds of people that can be found on the project pathways. Each individual type of person may differ by age, gender, ethnicity, social status, or place of birth. These types of differences should be represented in the final sample. Researchers who have considered sample size issues suggest a range of 20-30 participants per site.

Section 5.6.3. Observational Research

Purpose: Observational Research is intended to be the first step in the research process and is carried out in order to observe the setting and the people who may meet the targeted population criteria at the sites that are being considered for surveillance and sampling.

Section 5.6.3a. Observational Research Overview

Table 1: Observational research key points

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	• 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

Section 5.6.3b. 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: The 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.

Section 5.6.3c. 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. Informal conversations must be limited to casual or introductory conversations about what PREDICT is doing in the community and cannot involve direct questions about the Informant or community member's work or personal life, as in-depth discussions that reveal dynamics that we are trying to understand about zoonotic disease transmission would be considered 'Human Subjects research' and would require the completion of a Participant Consent form according to PREDICT's human research ethics review board approvals.

Informal conversations often provide a good opportunity to inquire about other key informants: for example, "Is there a market manager whom I might talk to and can you direct me to her?" or "Is there a site foreman and where is his office?" All observation and informal conversations must be documented as Field Notes.

Field Notes (i.e. 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 ***Section 5.6.4. Appendix I. Observational Field Notes Excerpts***.

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. Observation is an active activity, requiring focused attention to one's surroundings and involving all five of the human senses, including visual, auditory or olfactory information.

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 ***Section 5.6.5. Appendix II. Observational Map Examples***.

Observational research should continue through the life of the project. Observational research does not require IRB approval.

Section 5.6.4. Appendix 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.

Section 5.6.5. Appendix 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).

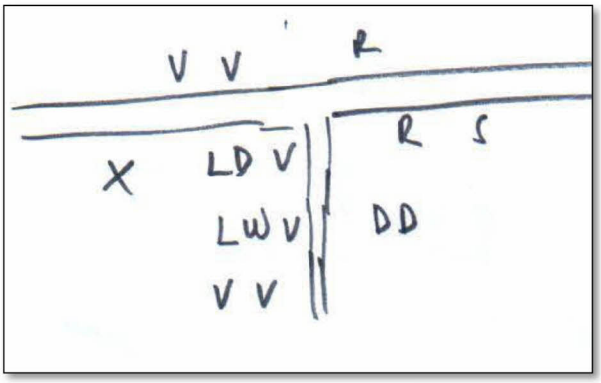

Figure 1: Market without zoning

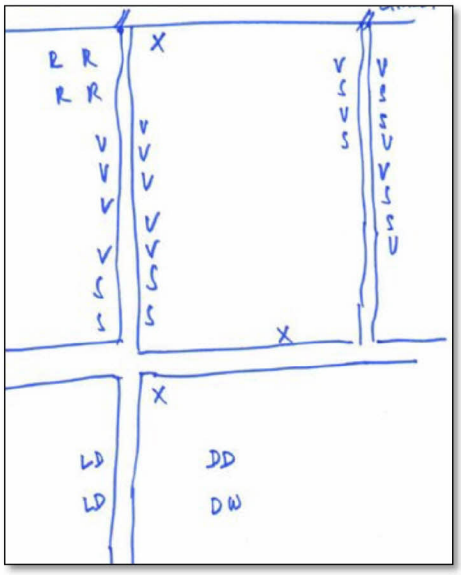

Figure 1: Market with zoning

Section 5.7 Qualitative Research: Focus Groups, Ethnographic Interviews, and Data Analysis Guide

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Objectives: 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.

This document was made possible by the generous support of the American people through the United States Agency for International Development (USAID) Emerging Pandemic Threats PREDICT program. It was drafted to support activities conducted under PREDICT and is intended for an audience of qualified professionals trained in standard, associated best practices. This guide is not intended for use by untrained individuals.

The contents of this document are the responsibility of the authors and do not necessarily reflect the views of USAID or the United States Government. USAID, PREDICT, and the authors of this guide bear no responsibility for the actions of non-PREDICT-affiliated individuals implementing the material herein.

The authors assert that human surveillance activities should always occur in compliance with all applicable laws and regulations and should only be undertaken after securing all necessary permits and approvals, including ethical approvals.

For more information about the contents of this guide, please contact predict@ucdavis.edu.

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Table of Contents: Qualitative Research: Focus Groups, Ethnographic Interviews, and Data Analysis Guide

Note: Focus groups and ethnographic interviews require institutional review board (IRB) or other in-country ethical committee approvals before they may be conducted. In addition, all staff conducting ethnographic interviews or focus groups or participating in data analysis must complete human research ethics training (e.g., Collaborative Institutional Training Initiative [CITI] training; National Institutes of Health Protecting Human Research Participants training) before working with research subjects or their identifying information.

Section 5.7.1. Focus Groups

Purpose: To assess the distribution and overlap of animals in the community setting; and to discuss 1) animal contact and context, 2) illness in animals and humans, and 3) rules and restrictions surrounding both wildlife and livestock.

Section 5.7.1a. Targeted Focus Group Overview

Table 1: Focus group key points

What Is It?	Research Goals
• Guided group discussion focused on limited topics • A group of 6-10 people not from the same household/family • Group members share relevant characteristics • Conducted over a short time period (all within 4-8 weeks)	• Identify **how groups of people think or feel** about behaviors and practices that may be linked to disease transmission • Explore reasons **why certain opinions are held** • Examine social, cultural and economic factors

Section 5.7.1b. Who is Involved in Focus Group Research

The people who conduct a focus group are the **Moderator** and the **Recorder/Observer**.

Moderator: the person who leads the focus group discussion. A moderator should have a charismatic, friendly personality and should not be timid, authoritarian, or judgmental. The moderator introduces each question or activity and encourages all focus group participants to contribute to the discussion. The moderator asks follow up questions, a process also called probing, until a topic is exhausted or no new information is being learned. It is the responsibility of the moderator to make sure that all voices are heard, and that the participants share and discuss a full range of information.

Recorder/Observer: the person who supports the moderator and records the focus group. The support is provided by observing the behaviors and responses of the focus group participants, as

well as documenting highlights of the topics discussed, particularly for any new or unique information. In addition, the recorder/observer may become aware of additional follow up questions that the moderator may wish to probe. It is the responsibility of the recorder/observer to discretely share this information with the moderator and suggest probing questions. The highlight notes that the recorder/observer writes are part of the data that will be analyzed.

Section 5.7.1c. Focus Group Methods

A **targeted focus group** is conducted by two people, one who leads the discussion (the **moderator**) and the **recorder/observer** who supports the moderator. Focus groups are generally conducted with a group of 6 to 10 people from the target population who share a relevant characteristic (e.g., wildlife farmers or workers). A focus group generally lasts between 60 and 90 minutes. The setting where the focus groups take place should be selected and prepared ahead of time. It should be a private area where the group will be undisturbed for the length of the Focus Group. Focus groups will be tape recorded, so that they may be transcribed, coded and analyzed.

The discussion is semi-structured and guided. That means that the topics of discussion for the group are well defined before the focus group begins. The questions that are used to guide the discussion are called the **Focus Group Guide**. The questions and activities included in the Focus Group Guide are meant to engage all members of the focus group and to stimulate the discussion.

The Focus Group Guide for this project includes a 'community mapping' component. Community mapping is an activity that immediately engages all group members as they provide information about the location of various animals in the community. Examples of animal maps are included in Section 5.7.4. Appendix I. Focus Group Animal Mapping Exercise Examples. 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. It is important for the moderator to make sure that everyone has a turn to speak. After the community mapping activity, the group focuses on animal contact and context, illness in animals and humans, and rules and restrictions surrounding both wildlife and livestock. The map may be used for reference during the discussion.

Section 5.7.2. Ethnographic Interviews

Purpose: To understand the personal context and potential risk practices and behaviors of individuals at high risk of zoonotic disease spillover.

Section 5.7.2a. Targeted Ethnographic Interview Overview

Table 1: Targeted ethnographic interview key points.

What Is It?	Research Goals
• One-on-one semi-structured interviews • Focused on limited topics (core themes) • Conducted over a short time period (all within a total of 4-8 weeks)	• Identify behaviors and practices that may be linked to zoonotic spillover • Explore reasons underlying behaviors/practices • Examine social, cultural and economic factors

Section 5.7.2b. Ethnographic Interview Methods

A **targeted ethnographic interview** consists of the **Interviewer**, the person who conducts the interview, and a **Respondent**, an individual from the target population. Targeted ethnographic interviews are semi-structured and guided discussions. The topics of discussion are well defined before the interview begins and are based on the **core themes** of interest, described in detail on below.

The **core themes** guide the ethnographic interview discussion. The themes are topics for which limited information is known, but which are strongly suspected to play a role in the transmission of diseases from animals to humans. The **Interview Guide** is a list of core themes that also includes subthemes and suggested questions that may be asked during an ethnographic interview. Not all questions listed will be asked in any one interview. In fact, if the respondent is providing detailed information that is unique (e.g., the person is describing burial methods in a culture where no one is comfortable talking about death), the interviewer should spend time asking additional questions in order to get more detailed information.

One of the biggest challenges to using the Interview Guide is figuring out which of the many questions should be asked during one interview. One way to address this challenge is to imagine different kinds of respondents and think about the kind of information those people could provide. For example, a 13-year-old girl who lives next to a forest with bats may not know the family income, but she could provide insight as to where the bats live during the day, the kinds of bats she sees, how frequently and where she bathes, whether her parents travel for work and how far, what she learns about animals at school, her responsibilities with the family chickens, how they differ from her brother's responsibilities and from what hers will be when she gets

older. Thinking through the kinds of information that a particular respondent could provide helps in selecting appropriate questions from the Interview Guide. The key to a successful ethnographic interview is being as prepared as possible ***before*** the interview begins, and being flexible during the interview.

Interviews generally last between 60 and 90 minutes, and should not last longer than 120 minutes. The setting where the interviews take place should be selected and prepared ahead of time. Individual interviews are conducted in private, ensuring that others cannot hear the interviews. A barrier should be created so that no other individuals can view the respondents while they are being interviewed. 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. Interviews will be audio recorded with permission, so that they may be transcribed, coded and analyzed.

The **Interview Checklist** is a document that lists the core themes and subthemes that are included in the interview guide (see Section 5.7.6. Appendix III. PREDICT Sample Interview Checklist). Because it is not expected that all core themes and subthemes will be discussed in every interview, the Interview Checklist allows the interviewer to check off only the themes that were discussed during the interview. This document is important for the coding and analysis of ethnographic interview data. Qualitative data coding and analysis can be time consuming. A completed Interview Checklist ensures that time is not wasted looking for data on a theme that was not discussed in the ethnographic interview. The Interview Checklist should be filled out immediately following the completion of the interview.

Section 5.7.3. Analysis

Purpose: The primary goals of the qualitative data analysis are to 1) systematically review and prepare the data for analysis, 2) uncover new information that was shared by individuals during the interviews and focus groups, 3) review information from the observational research that may help contextualize research findings.

Section 5.7.3a. Data Analysis Process

There are two steps involved in the analysis of qualitative data: 1) coding and 2) preliminary data analysis in the form of summary notes.

Section 5.7.3b. Coding

Data coding is the way that data are defined in qualitative research. Codes can be thought of as "tags" that are applied to discrete sections of narrative text. Codes allow researchers to assemble information into meaningful analytic groupings. Each coded piece of information represents a data point that can then be analyzed or considered in relation to other data points.

Data coding for preliminary data analysis will be focused exclusively on the five core themes and subthemes that guide the PREDICT qualitative research. Coding data requires a close reading of the transcribed document. Reading the document closely for the first time provides an opportunity for the researcher to objectively review the range and type of information that was collected during the interview, as well as to take good notes on the major themes discussed preparatory to coding.

The coding process uses a suggested coding keywords document (see Section 5.7.8. Appendix V. PREDICT Sample Suggested Coding Key Words) to code the transcribed focus group and ethnographic interview documents. **Coding keywords** are words that are associated with the core themes and subthemes. Coding keywords help the coder search through a document to identify the information to be coded. The list of keywords is meant to be an aide in the coding process. The list of **coding keywords** will be provided to all research staff who will code the data.

In countries where internet is stable and the resources are available, it is ideal to use qualitative software package for data analysis (Dedoose, NVivo, Atlas.ti, etc.), as any of these platforms allow for the data analyst to query data to look for patterns across interviews. In countries without stable internet, data can be coded using the COMMENT function. Examples of coded transcripts are found in Section 5.7.9. Appendix VI. Examples of Coded Text.

Section 5.7.3c. Quote Selection (for Ethnographic Interviews and Focus Groups)

From the transcript of each interview and focus group, the researcher will select a few quotes that are good examples of specific core themes. The close reading that the researcher does in preparation for coding also provides a good opportunity to identify quotes that 'stand out' because they clearly express one of the core themes in an interesting way or they provide new information. These 'stand out' quotes should be highlighted in the transcribed document and copied to the final summary document, with the transcript page number noted. In addition to selecting the quotes, each researcher will identify which core themes or subthemes the quotes represent, as well as provide an opinion as to why these quotes were selected as good examples.

Section 5.7.3d. Brief Summary Notes (for Ethnographic Interviews and Focus Groups)

The researcher codes the document by each core theme, one at a time. For example, for the core theme of **socioeconomics**, throughout the interview a market cleaner may talk about the unpredictability of the schedule, the certainty of blame when inspectors come, unreliability of payment for services and sometimes stealing food from the butcher table when the butcher is not looking. When this same interview is coded for **human movement**, the market cleaner may reveal not having a home and sleeping with animals in the market to stay warm at night, having moved to the area from the countryside for work and finding limited options, and of wanting to return home but the situation is worse there.

The analytic object is to briefly summarize the situations and experiences of the individual as they relate to the core themes. For each of the five core themes, there will be summary notes describing the major ideas or issues discussed by the individual. New information should be emphasized and transcript page numbers for new information should be included in the summary notes. If a core theme was not discussed in the interview, please note that fact in the summary document.

Section 5.7.3e. Summary Documents

A summary document will be required for each ethnographic interview and focus group. The summary document will consist of quotes that are good examples of specific core themes, as well as the explanation and transcript page numbers for quote selections. The summary document will also contain brief summary notes by each of the five core themes.

Section 5.7.3f. Training

Preliminary data coding and analysis may be conducted by local research staff; however, preliminary analysis of qualitative data is not mandatory. For countries interested in conducting preliminary analyses for the PREDICT project, training will be provided on request.

Section 5.7.4. Appendix I. Focus Group Animal Mapping Exercise Examples

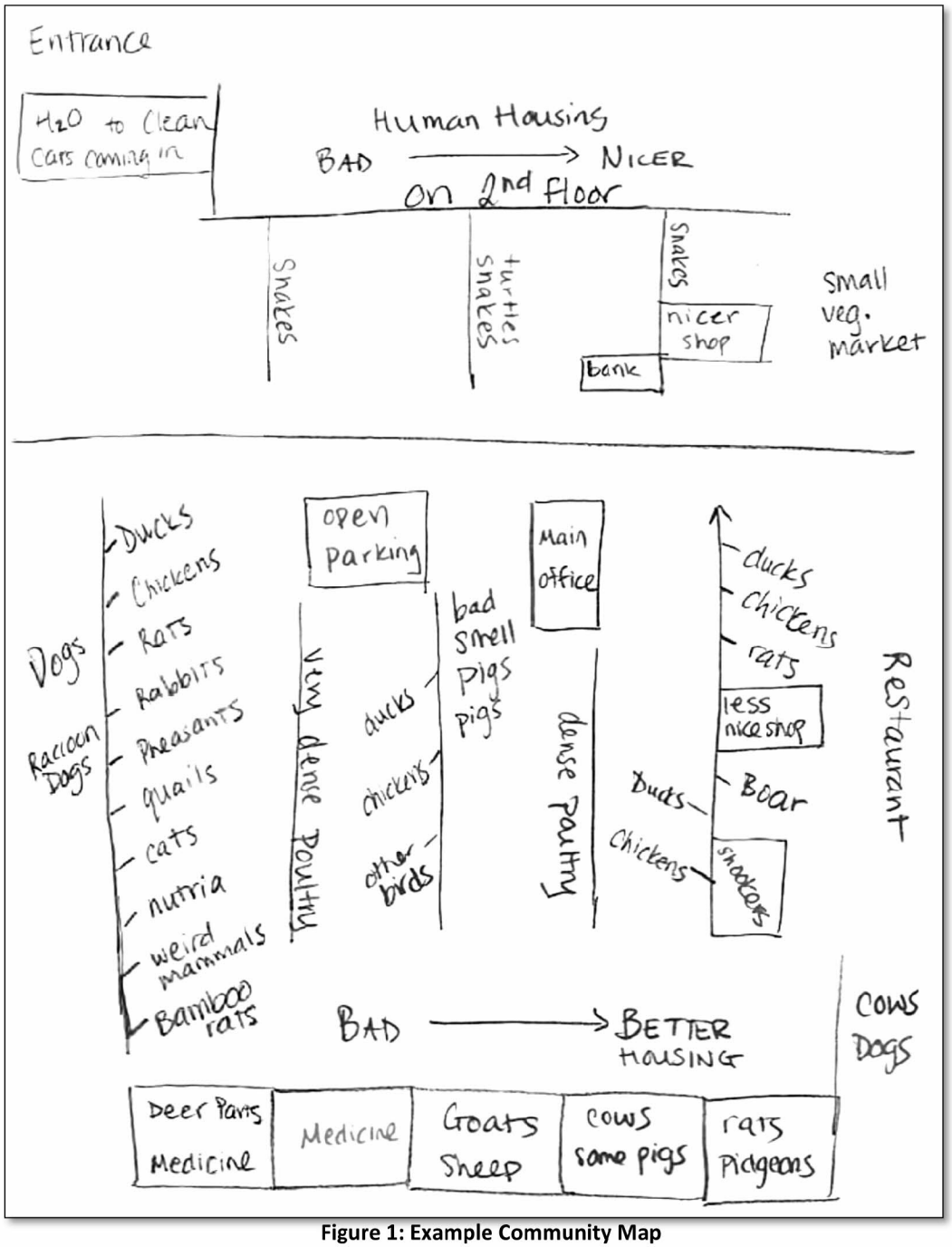


Figure 1: Example Community Map

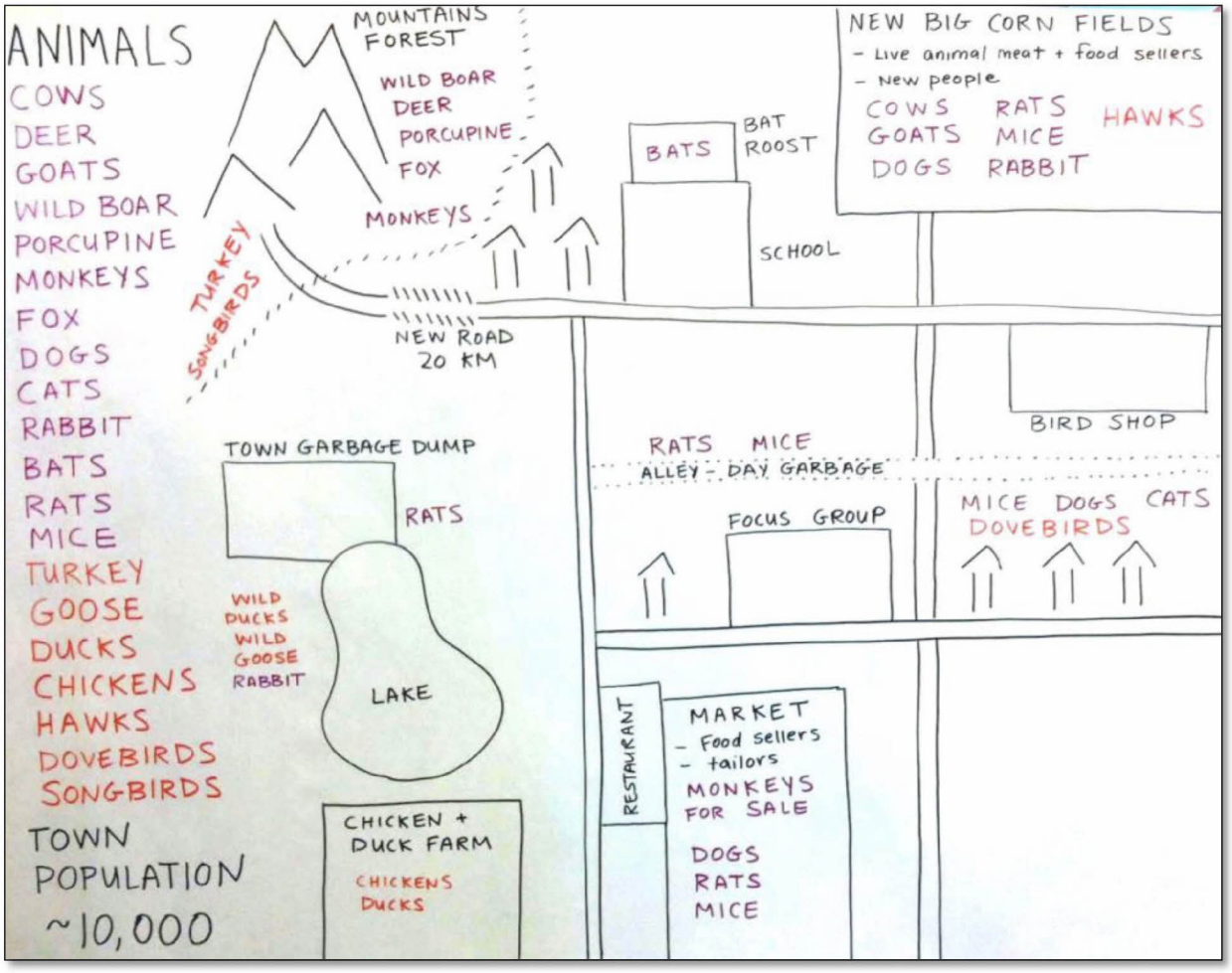


Figure 2: Example Community Map

Section 5.7.5. Appendix II. Example Focus Group Excerpt

Q: and what do you do? When you see that dead animal?
A5: when we see an animal in that state, if the animal is already decomposed, we cannot
A1, A4, A7: yes… it is spoiled…
A7: if it's still in the good state, if it's still in the good state we can consume the animal.
A6: good meat.
A7: and there are times you can go to the bush, somebody sets a trap
A6: yeah.
A7: you meet an animal there. That is maybe already dead. If you…From judging you can discover that the animal… maybe it is still…
A4: fresh
A7: fresh….
A5: yes
A7: not in the decomposed state. You can eat that
A5: why won't you eat?
A7: but when you look around and flies are already visiting. Heuh…you have maggots around
A5: yes
A7: you cannot eat
All: (laughing and noise)
A9: somebody like me I will
A7: when it is expose
A6: when we meet…(laughing) or that the animals feld into you must ask yourself questions before euh… thinking of eating such an animal.
Q: tell me, when you see a dead animal. How can you know that the animal is already… that you can cook it or you cannot cook it?
All: it is… (noise)
A6: they gave you the reason
Q: you can know that the animal is…..
A3: from the smell
A5: the smell
Q: the smell?
A8: yes the scent.
A5: they talk of the smell, the scent, flies,
A7: flies appears
A5: flies on the decomposing euh… euh… euh….
A3: situation
A5: situation. You can easily detect whether you can eat or not. We need the fowl that is already… smelling
Q: yes.
A5: and flies are already all over the whole place.
Q: hum euh.
A5: I am not sure a normal human being will eventually eat such an animal

Section 5.7.6. Appendix III. PREDICT Sample Interview Checklist

Participant ID: _____
Interviewer: _____

INTERVIEW CHECKLIST

PREDICT-2 Spillover Pathways

- ☐ Land conversion for commercialization
- ☐ Intensification of animal production systems
- ☐ Animal value chains

CORE THEMES

☐ **Human movement**

- ☐ Home
- ☐ Work
- ☐ Travel
- ☐ Observed environment

☐ **Socioeconomics**

- ☐ Daily routine
- ☐ Animal responsibilities
- ☐ Education
- ☐ Economics

☐ **Biosecurity in human environments**

- ☐ Water and food
- ☐ Sanitation
- ☐ Hygiene

☐ **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

Section 5.7.7. Appendix IV. Ethnographic Interview Excerpts

Two Examples of Good Ethnographic Interviews

1) WOMAN AGED 52

INT: What are the kinds of jobs that children have with animals. You were just talking about your first cow.

NYCQ01: I loved the cow. I told my mom I want this cow for myself and she said ok she was going to sell it and I said no. I said I want the cow. She gave it to me. She says your responsibility. When the cow first dropped, she gave me the little calf. I started…I didn't know how to milk and I started to shoot the milk into my mouth. It was funny but I enjoy it. I continue selling milk take the money put it away then I bought the other cow. Same thing I do and I started multiplying cows. Then my mom she decided to give me some money. If you want another cow you could buy. It was so cheap. Then I bought it. When I bought he cow I enjoyed doing the things I do. I had one little sheep that my uncle gived to me. I raised the sheep and sheep is not getting big and I started to plead with the sheep "get big." I got another sheep and I took the money from the milk and bought another one and started to raise them. So after I started to do that I ended up with about 15 cows and about 12 sheep no goat sheep. I started to selling because I am selling tomatoes, spinach, mangoes. I am selling all kinds of things and making the money. So I finally don't want to go back to school.

2) MAN AGED???

INT: Do you know who got an infectious disease from an animal?

CHY26: I don't know, I also have no education, I haven't heard of that kind of things.

INT: Do you know animals can spread diseases?

CHY26: No, I used to hear from veterinarian, but I don't know

Later in the interview…

INT: How do you kill cows, introduce the entire process to me.

CHY26: Tie the rope and with one stroke of the hammer the cow will fall down. Then take out the blood, and then from the chest kill like a pig kill. It will be similar to killing a pig.

INT: What do you do once the cow is dead?

CHY26: Some people want to take skin, use hot boiling water directly. Some don't, then put the skins, put out in the garbage. In addition there is ox hair, cow excrement, other things that can be used. Nothing will be wasted.

INT: How do you treat the skin of the cows?

CHY26: They buy them to make leather. Cowhide can sell for three to four hundred yuan.

INT: How long does it take to kill a cow?

CHY26: Depends on the size of the cow, if you need to peel the skin off. Small one maybe two hours, if bigger, it will take more than three hours.

INT: How many people do you need to kill a cow?

CHY26: At least three people, one person is not enough. We have to pay attention to health, keep the meat clean.

Example of Bad Ethnographic Interview

INT: How often do you kill a cattle?

CHY24: About ten days, thirty-one a year.

INT: Do you usually buy it in local market?

CHY24: We prefer to buy cattle in local farm, because they are large-scale farms, Well, we trust it. In contrast, the beef in the market may have problems.

Interviewer should have asked: WHAT KIND OF PROBLEMS? WHY ARE LARGE SCALE FARMS BETTER/ ARE THERE TIMES WHEN LARGE SCALE FARMS COULD BE BAD?

INT: How do you treat the polluted water after slaughter?

CHY24: There are some special place to treat them.

Interviewer should have asked: WHAT SPECIAL PLACES? WHAT EXACTLY IS DONE?

INT: Burn it?

Interviewer should recognize: STILL NOT ANSWERED. THE INTERVIEWER SHOULD CONTINUE ASKING ANYTHING ELSE?

CHY24: Ah, offal could be the beast manure.

Interviewer should have asked: IS IT USED WITH ANY SPECIAL CROP? WHAT OTHER THINGS ARE USED AS MANURE?

INT: You have opened restaurant for so many years, have you contacted with any other animals?
CHY24: Well we are Muslims, so cattle, sheep, chickens, fish, geese and ducks are rare for us.

Interviewer should have asked: WHY ARE THESE FOODS RARE?

INT: Sheep?
CHY24: We don't buy it.

Interviewer should have asked: WHAT ANIMALS DO YOU HAVE AT THE RESTAURANT? ARE THEY LIVE ANIMALS? DO YOU KILL THEM AT THE RESTAURANT? WHERE? KILLED IN SPECIAL WAY BECAUSE YOU ARE MUSLIM? THERE ARE TONS OF QUESTIONS TO BE ASKED. INSTEAD, THE INTERVIEWER ASKS ABOUT TRAVEL...

INT: Do you travel every year?

CHY24: Child is too young, only three or four, he-he, so we did not go out anymore, only the local neighborhood around it, there is no time.

INT: Do you have holiday?

CHY24: Annual Eid Well, just the same as your Spring Festival.

INT: Any rituals?

CHY24: If I told you, you will also not understand it.

EVERY TIME SOMEONE SAYS 'YOU WILL NOT UNDERSTAND' IT IS THE INTERVIEWER'S RESPONSIBILITY TO ASK MORE QUESTIONS. FOR EXAMPLE ANY OF THESE SENTENCES COULD WORK: I AM VERY CURIOUS, I WOULD LIKE TO LEARN MORE ABOUT THIS. I WOULD LIKE TO UNDERSTAND.

Section 5.7.8. Appendix V. PREDICT Sample Suggested Coding Key Words

Human Movement

Home
Dwelling, living quarters, sleeping quarters
Children, family
Daily movement/travel
Flood
Drought
Conflict
Protection from predators/ animals
Safety
Religion

Work
Work activities
Agriculture areas
Grazing areas
Hunting territories
Boundaries
Livestock areas
Markets
Crops
Business

Travel
Traveling to Shop/buy/sell/trade
Hunting trips
Transporting animals
Transportation: Walking, biking, cart, truck, plane, boat, trains
Overnight trips
Reasons for travel
Travel destinations
Border crossings
Travel obstacles/issues
Transportation of resources/moving

Observed Environment
Town roads/ports/ trains
New buildings/roads/construction
Route changes
Abandoned land

Socioeconomics

Daily routine
Meal preparation
Shopping
Childcare
Market trips
Groceries
Purchases
Errands

Animal responsibilities
Animal duties/responsibilities
Feeding/grazing
Tasks/roles by age or gender
Sick animals
Slaughtering/Butchering

Education
School/education/graduation
Reading/understanding numbers
Dropping out

Economics
Livelihood
Earning/earning changes throughout year
Large purchases
Income
Purchases for event/holiday
Social standing (compared to Neighbors/others)
Expenses
Number of jobs/activities

Biosecurity in Human Environments

Water and food
Water source (where does it come from?)
Water taste/quality/purification
Rain/rainwater/water taps/well
Storing food/storing water
Pests/rats/pesticides/cockroaches/insects
Kitchen
Cleaning
Water usage

Sanitation
Waste management/garbage
Toilets/latrines/bathroom
Cleaning bathroom/kitchen
Feces
Urine
Pesticides

Hygiene
Washing hands
Showering/bathing
Soap
Leave shoes/footwear outside

Illness, Medical Care/ Treatment and Death

Household illness/Wellness
Sick relatives
Caretaking of sick
Types of sickness
Unusual illness
Symptoms of illness (fever, bleeding, difficulty breathing, etc....)
Ebola
SARS
MERS
(Other endemic zoonotic diseases)
Dispensaries/medication
Births

Illness from animals
Illness from animals

Medical Care and Treatment
Doctor/clinic visit
Medicine/Treatment
Cost of medicine/doctor/treatment
Professionals (doctor, nurse, religious leader, healthcare worker etc...)
Traditional medicine
Ethno botany
Healthcare protocols

Death
Reporting death
Burial/ burial rites
Funeral tradition/rites
Dead body/corpse
Body preparation

Human Animal Contact

Indirect Contact/Food:
Meat/animal consumption
Acquisition of meat
Preparing meat
Meat/animal storage
Butchering
Animal taboos
Infected animals
Wildlife consumption
Purchasing meat or wildlife
Cleaning up after animals
Meat/dead animal markets
Animals around dwelling/pests
Signs of animals (hear, smell)
Feces
Animal tracks
Garbage disturbance
Observed animals
Hunting

Direct Contact
Ownership of animals
Live animals
Pets
Playing with animals (wild or domestic, alive or dead)
Animal caretaking
Feeding animals
Grazing animals
Working with animals
Live animal markets/wet markets
Ranching
Animal husbandry
Buying/selling/trading live animals
Bite
Scratch
Animal handling
Killing live animals/slaughtering
Handling of wildlife

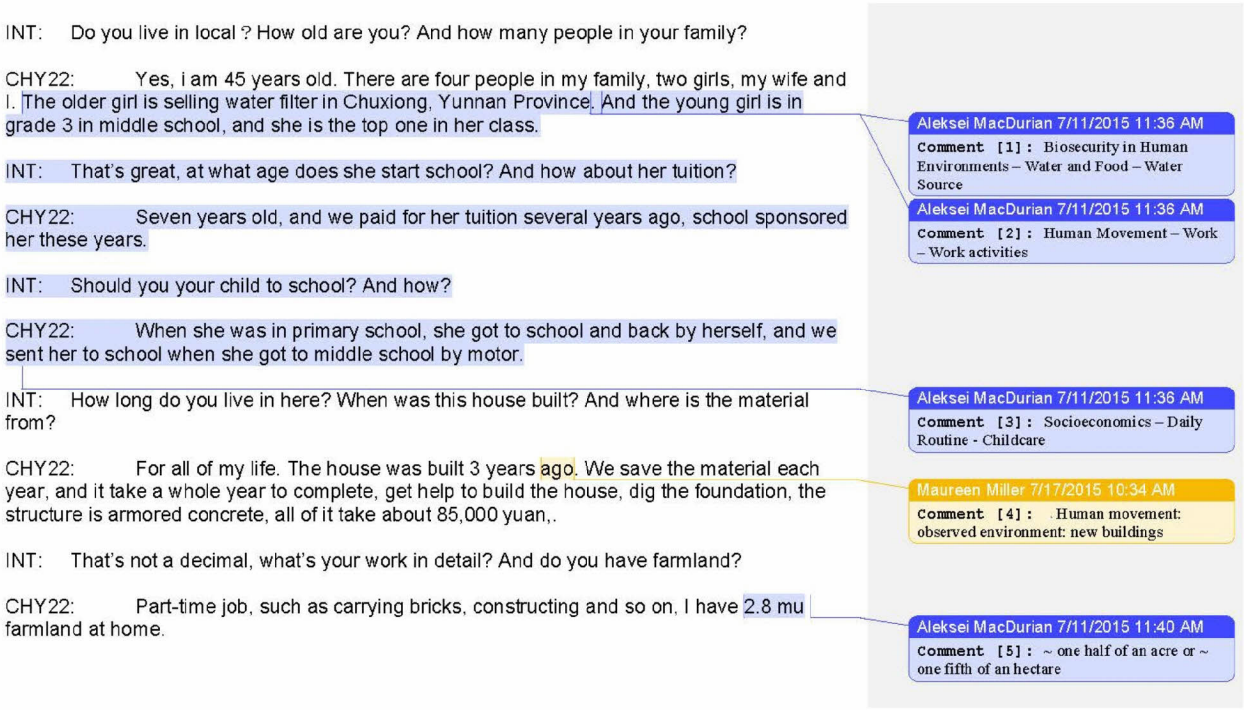
Animal products/rites
Animal byproducts (milk, leather, magic, medical)
Magic involving animals
Fertilizer

Animal health
Animals eating/sleeping/grazing
Sick animals
Animal caretaking activities/roles
Animal waste
Cleaning animal areas
Veterinary care
Vaccinations
Outbreak
Die off

Perceptions and knowledge
Exotic or expensive animals
Wildlife consumption
Regulations/laws regarding animals (e.g., Hunting, eating, poaching regulations)
Danger from animals
Conservation
Taboos
Special occasions/holidays
feasts/ holy days

Section 5.7.9. Appendix VI. Examples of Coded Text

Example 1:



Example 2:

Example 3:

Section 5.7.10. Appendix VII. Ethnographic Interview Summary Document Examples

INTERVIEW ID: CHY26
MAN AGED ??

Summary

Human Movement p 2
The interviewee takes the cattle to town in a lorry for slaughter. He usually takes about 5-6 large ones and 8-10 smaller ones. The cattle market is about 1 kilometer away.

Socioeconomics pp 1-2
He finished one grade, while his wife graduated from primary school. He considers himself to be of a middle economic level as compared to others in his village. His income varies throughout the year with the rise and fall in prices of meat. He considers wild animals to be too expensive to eat.

Biosecurity in Human Environments pp1-2
They drink from a local spring and use the tap water to cook. Depending on the amount of people in the house, they will collect garbage anywhere from 1-3x a week.
He carries a water tank with him in order to wash his hands.
Very hot water is used during the slaughtering of animals.

Illness, medical care/treatment and death p 7
His hand was seriously injured. He sawed off 4 fingers. He was treated at the best orthopedic hospital in the province.
He has heard of animal infectious diseases from his veterinarian, but does not really know what they are.
He will go to the hospital and take medication if necessary.
He briefly explains the burial practices surrounding his father's death. His body remained in the house for 5 days.

Human Animal Contact pp 2, 8, 10-11
He raises about 20-30 cattle and chickens. They will kill cows for special occasions (e.g. weddings).
They only consume "regular" animals (especially pork), not wildlife. He feels wildlife is too expensive.
They slaughter their own chickens and cattle. It usually takes 3 people to slaughter a cow because of the necessary health precautions that need to be taken. He has previously been hurt during the slaughter process.
He has also been bitten by a dog on the leg a long time ago.
He will not purchase cattle that have not been vaccinated. He refers to the governmental regulations that exist on vaccinating animals.

SPECIFIC QUOTES

Page 2: **Human animal contact**: *Indirect contact/food:* acquisition of meat, purchasing meat or wildlife; **Socioeconomics**: *daily routine*: purchases; **Human animal contact**: *direct contact:* buying/selling/trading live animals; **Socioeconomics:** *daily routine*: purchases

CHY26: Both, mostly I buy the killed ones. Some are not suited to eat, for example-calf, then I would make a change-buying some sheep. If the big cattle are not fat, we would buy them back to raise for some days.

Page 7: **Illness, Medical Care**, **Treatment and Death**: *Illness from animals*: Illness from animals

INT: Do you know someone got animal infectious disease?
CHY26: I don't know, I also have no culture, I haven't heard of that kind of things.
INT: Do you know animals can spread diseases?
CHY26: No, I used to hear from veterinarian, but I don't know

Page 10: **Human animal contact**: *direct contact*: killing live animals/slaughtering; **Biosecurity in human environments**: *water and food*: cleaning

INT: How many people do you need to kill a cow?
CHY26: At least three people, one person is not enough, we have to pay attention to health, keep the meat clean.

Page 8: **Human animal contact**: *indirect contact*: meat/animal consumption, wildlife consumption; **Human animal contact**: *perceptions and knowledge*: exotic or expensive animals; **Socioeconomics**: *economics*

INT: Eat wild animals' meat?
CHY26: Do not eat, expensive!
Page 12: **Human animal contact**: *indirect contact/food*: meat/animal consumption
INT: What meat your family don't eat?
No, eat any kind of meat!

Page 10: **Human animal contact***: direct contact*: animal handling, killing live animals/slaughtering **Human animal contact**: *direct contact*: bite

INT: Have you been hurt in the process of killing cattle?
CHY26: Yes, we do cattle business, some cattle temperament is bad
INT: Have you been hurt by other animals?
CHY26: Bitten by a dog
Page 11: **Human animal contact**: *animal health*: vaccinations; **Human animal contact**: *perceptions and knowledge:* regulations/laws regarding animals
INT: Usually play the vaccine?
CHY26: Yes, when we go to the farmers to buy we will ask whether the cattle ever been play with a vaccine, if the cattle haven't been treat with any vaccine, we don't buy, afraid of an accident, if the government pursue, we will be in big trouble

Section 4. Biosafety and Personal Protective Equipment (PPE) Use

Prepared by
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and the PREDICT One Health Consortium.

Objective: To provide principles and general guidelines for the use of Personal Protective Equipment (PPE) to prevent exposure to and transmission of infectious pathogens during PREDICT activities.

This document was made possible by the generous support of the American people through the United States Agency for International Development (USAID) Emerging Pandemic Threats PREDICT program. It was drafted to support activities conducted under PREDICT and is intended for an audience of qualified professionals trained in standard, associated best practices. This guide is not intended for use by untrained individuals.

For more information about the contents of this guide, please contact predict@ucdavis.edu.

Suggested Citation Form: PREDICT One Health Consortium 2016. PREDICT Operating Procedures: Biosafety and Personal Protective Equipment (PPE) Use.

Table of Contents: Biosafety and Personal Protective Equipment (PPE) Use

*Adapted from the *USAID STOP-AI Training Module: Introduction to PPE*

Section 4.1. Learning Objectives and Confirmation

After studying this guide, you will be able to:

- Implement basic biosafety precautions.
- Describe the factors to consider when assessing the biological risk of handling animals and collecting human and animal samples, and other field and laboratory activities that may have potential risk for zoonotic disease exposure.
- Understand factors to consider when choosing appropriate PPE based on identified risks.
- Identify and describe the functions of each component of PPE.
- Correctly put on and take off appropriate PPE for PREDICT sample collection and handling activities in a non-outbreak setting. For collecting samples from hospital and clinic patients and during disease outbreaks, specific PPE components and procedures to put on and take off PPE should be adapted based on the determined risk level.
- Describe the importance of respirator fit and fit testing.

Confirm you understand the material of this guide:

When you are familiar with the information in this guide, take the PREDICT quiz in ***Section 8.4.3. Biosafety and PPE Use***.

Section 4.2. Biosafety Overview

Personal Safety Responsibilities

- Individuals have the primary responsibility for their own health and safety. Nothing substitutes for good training and vigilance.
- Follow safety procedures outlined in PREDICT protocols regarding each activity that involves potential exposure to infectious pathogens.
- Use appropriate safety equipment.
- Report unsafe or hazardous situations, injuries, and accidents immediately to your supervisor or instructor.
- Report any illness to your PREDICT supervisor.
- Participate in required safety training.

Follow PREDICT waste disposal procedures (see ***Basic Laboratory Safety (Section 6.3.)*** *and* ***Safe Disposal of Carcasses and Infectious Waste Guide (Section 2.5.)***) consistent with the ***PREDICT Environmental Mitigation and Monitoring Plan (Section 2.4.)***.

Responsibilities of the Country Coordinator and Field Supervisors

- Provide and document training for all personnel who will participate in PREDICT project activities.
- Ensure compliance with relevant PREDICT or organizational task protocols.
- Ensure compliance with the PREDICT Environmental Mitigation and Monitoring Plan.
- Ensure compliance with local permit requirements and regulations.
- Report injuries/accidents and ensure compliance with associated mitigation.
- Ensure that all field personnel are trained on the safe use of field equipment.

General Zoonoses Biosafety Precautions

There is a risk of exposure to pathogens, including zoonotic pathogens, when handling animals, and human and animal samples in the field. Therefore, it is important to implement measures to minimize the risk of pathogen transmission.

The following list of general precautions applies to most situations:

- Inform all who enter potential zoonotic pathogen risk areas of their potential for exposure and the associated risks.
- Review information regarding the zoonotic agents likely to be found in the samples or animals to which you or others may be exposed.
- Wear the appropriate PPE based on protocols for the activity and species and as directed by the Country Coordinator or Field Supervisor.
- Use disposable supplies whenever possible.
- Wash hands and wrists after removing your gloves.
- Don't wear field or lab clothing or shoes outside of work areas where there may be zoonotic pathogen exposure. Change clothing and shoes before getting into your vehicle.
- Launder contaminated protective clothing at work. Don't take your protective clothing home with you.
- Never eat or drink in areas where human sampling, animals, their wastes, or their products (e.g., blood) are present.
- Wash your hands frequently and practice good hygiene. Avoid touching your face while working with animals, human and animal samples, or other sources of pathogens. Although a normal, healthy adult person may have only mild symptoms of a zoonotic disease, that person may unknowingly spread the disease to others. Unfortunately, animal handlers have "carried home" zoonotic pathogens to their infants with fatal consequences. Therefore, good hygiene is not only to protect the person working directly with human and animal samples; but it is also for all persons and animals with whom they have contact.
- When seeking medical advice for any illness, inform your physician of your work with humans and animals.
- Make sure a first aid kit is immediately available during all field and laboratory activities.
- Refer to established procedures for how to respond to a bite, cut, scratch, puncture or other injury that results in possible zoonosis exposure.

- Refer to established procedures for disinfecting all equipment, samples, cages, and traps according to guidance provided below.

Hand Washing - Teach and Practice Good Hand Washing Technique

The importance of hand washing in preventing infection and the spread of infectious pathogens cannot be over emphasized.

Always wash your hands before:

- Putting on PPE for handling animals or collecting or handling human and animal samples
- Contact with a sick or injured person or animal
- Treating wounds or administering medications
- Preparing food
- Eating
- Inserting or removing contact lenses

Always wash your hands after:

- Taking off PPE
- Touching an animal, human and animal samples, waste, products or animal equipment
- Collecting and handling diagnostic samples
- Visiting field sampling sites or clinics/hospitals
- Preparing foods, especially raw meat or poultry
- Using a toilet
- Changing a diaper
- Blowing your nose, coughing or sneezing into your hands
- Treating wounds
- Touching a sick or injured person
- Touching garbage or other potentially contaminated materials
- Finishing work in the laboratory

Plan for hand washing:

- Plan for hand washing in the field by identifying any locations with running water near the site and bringing supplies (i.e., water, soap, bucket, paper towels, hand sanitizing gels and germicidal wipes that contain at least 60% alcohol)
- Plan when you will need to wash to ensure supplies are ready and available

See the WHO guidelines below for proper hand washing technique. If soap and water are not available, use an alcohol-based hand sanitizing gel that contains at least 60% alcohol. These products significantly reduce the number of microbes on the skin and are fast acting. However, they are not effective if hands are visibly dirty. Organic matter and natural oils on hands create a barrier that blocks the effectiveness of the sanitizer. See http://www.cdc.gov/handwashing/show-me-the-science-hand-sanitizer.html for more information.

How to Handwash?

WASH HANDS WHEN VISIBLY SOILED! OTHERWISE, USE HANDRUB

Duration of the entire procedure: 40-60 seconds

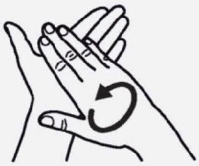
0

Wet hands with water;

1

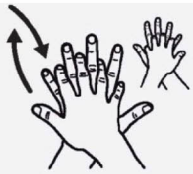
Apply enough soap to cover all hand surfaces;

2



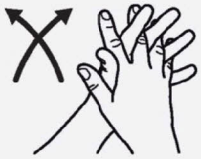
Rub hands palm to palm;

3



Right palm over left dorsum with interlaced fingers and vice versa;

4

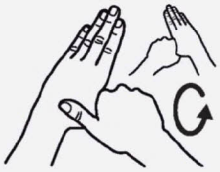


Palm to palm with fingers interlaced;

5

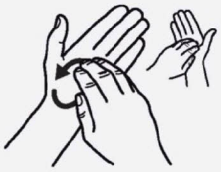
Backs of fingers to opposing palms with fingers interlocked;

6



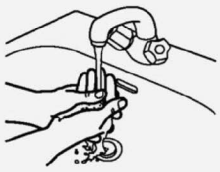
Rotational rubbing of left thumb clasped in right palm and vice versa;

7



Rotational rubbing, backwards and forwards with clasped fingers of right hand in left palm and vice versa;

8

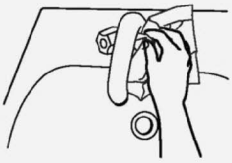


Rinse hands with water;

9

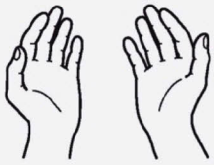
Dry hands thoroughly with a single use towel;

10



Use towel to turn off faucet;

11



Your hands are now safe.

World Health Organization | Patient Safety — A World Alliance for Safer Health Care | SAVE LIVES Clean Your Hands

WHO acknowledges the Hôpitaux Universitaires de Genève (HUG), in particular the members of the Infection Control Programme, for their active participation in developing this material.

May 2009

Disinfection of Surfaces and Materials

Dirt and organic matter can protect microbes from decontaminants (antiseptics, chemical germicides and disinfectants). Therefore, precleaning contaminated surfaces as well as reusable supplies, equipment and PPE is important to achieve proper disinfection. Precleaning should be carried out cautiously to avoid exposure to pathogens.

Contact times for disinfectants are specific to the type of solution and the manufacturer. Therefore, it is important to follow the manufacturers' specifications. Further, solutions used for precleaning and disinfection should be the same or chemically compatible.

There are several types of disinfectants on the market and formulations should be selected for specific needs. High temperatures can degrade chemical disinfectants, so shelf-life may be decreased in areas with high ambient temperatures.

Chlorine bleach or Virkon disinfectant solution are commonly used as general-purpose disinfectants. See the WHO Laboratory Biosafety Manual (http://www.who.int/csr/resources/publications/biosafety/en/Biosafety7.pdf) for frequently used classes of disinfectants, with general information on their applications and safety profiles, as well as recommended dilutions for chlorine-releasing compounds, such as chlorine bleach.

Section 4.3. Assessing Biosafety Risk of Zoonotic Pathogens and Selecting PPE

Key to the practice of biosafety is assessing the risk of infection associated with a specific procedure under specific environmental conditions. There are many considerations in the assessment of risk and it is the job of the supervisor to weigh these considerations to determine the appropriate measures to protect humans and animals from infection.

Factors to Consider when Assessing Biological Risk of Procedures to Determine Necessary PPE

1. Species to be handled and sampled.
2. Pathogens likely to be present in these species/samples.
3. Pathogenicity of these pathogens (see WHO classification of infective microorganisms by risk group below).
4. Potential exposure opportunities and routes of infection for the pathogens given the planned activity.
5. Potential result of exposure to the pathogens.
6. Estimated infectious dose and stability of the pathogens in the environment.
7. Information available in the literature, including animal studies and clinical reports that would help inform on risk.
8. Measures to reduce the risk of exposure, such as sanitary measures (e.g., food and water hygiene) and control of animal reservoirs or arthropod vectors, the movement of people or animals, and the importation of infected animals or animal products.
9. Local availability of effective prophylaxis and treatment. Prophylaxis may include vaccination or antisera. Treatment options may include passive immunization and post-

exposure vaccination, antibiotics, and chemotherapeutic agents, taking into consideration the possibility of the emergence of resistant strains.

Based on the risk assessment considering the factors listed above, the following should be determined by the PREDICT activity supervisor (often Country Coordinators):

1. Hazards and risk of exposure.
2. Appropriate PPE required to implement the activity safely and to prevent transmission of infectious pathogens. (Components of PPE to consider are discussed later in this document).
3. Special procedures, such as disinfection procedures between handling individual animals and people or between site visits, that may be required to reduce risk of transmission and provide adequate protection for humans and animals.
4. Vaccinations or prophylaxis required for PREDICT personnel before the activity.

World Health Organization (WHO) Classification of Infective Microorganisms by Risk Group (2004)

WHO provides the guidelines below for classifying biological risk categories, based on pathogenicity of the organism and modes of transmission and host range of the organism. These primary factors are affected by existing levels of immunity, density and movement of host population (human or animal), presence of appropriate vectors and environmental conditions, and availability of effective preventive measures and treatment. Countries usually adopt a similar set of risk categories. The WHO risk group classification was developed for laboratory work. See **http://www.absa.org/riskgroups/** for more information and a link to the Risk Group Database where information on risk can be obtained for specific microbes and/or microbe families.

The WHO risk categories are:

WHO Risk Group 1 (no or low individual and community risk) -- A microorganism that is unlikely to cause human disease or animal disease.

WHO Risk Group 2 (moderate individual risk, low community risk) -- A pathogen that can cause human or animal disease but is unlikely to be a serious hazard to laboratory workers, the community, livestock or the environment. Laboratory exposures may cause serious infection, but effective treatment and preventative measures are available and the risk of spread of infection is limited.

WHO Risk Group 3 (high individual risk, low community risk) -- A pathogen that usually causes serious human or animal disease but does not ordinarily spread from one infected individual to another. Effective treatment and preventive measures are available.

WHO Risk Group 4 (high individual and community risk) -- A pathogen that usually causes serious human or animal disease and that can be readily transmitted from one individual to another, directly or indirectly. Effective treatment and preventive measures are not usually available.

Appropriate PPE for PREDICT Activities

While PREDICT field staff will be working in very different environments with varying levels of biological risk, there are some tasks for which **minimum PPE requirements** have been established and detailed in Table 1.

Table 1. Minimum PPE to wear for some PREDICT Tasks:

Taxa/Task	Respirator (N95 or respirator with comparable filtering rating	Goggles, Face shield or protective glasses	Gloves*	PPE Coveralls or Dedicated Clothing with washable shoes
Handling human and animal specimens	Yes	Yes	Yes	Yes (either PPE or coveralls or dedicated clothing)
Handling primates (live or carcass)	Yes	Yes	Yes	Yes (either PPE or coveralls or dedicated clothing)
Handling rodents or bats (live or carcass)	Yes	Yes	Yes	Yes (either PPE or coveralls or dedicated clothing)
Sampling in bat caves	Yes	Yes	Yes	PPE coveralls
Sampling or necropsy of sick/dead animals	Yes	Yes	Yes	Yes (either PPE or coveralls or dedicated clothing) with apron
Sampling bushmeat	Yes	Yes	Yes	Yes (either PPE coveralls or dedicated clothing) with apron
Handling poultry or waterfowl	Yes	Yes	Yes	Yes (either PPE or coveralls or dedicated clothing)
Handling livestock	Depends**	Depends**	Yes	Yes (either PPE or coveralls or dedicated clothing)
Sampling apparently healthy humans	Depends***	Depends***	Yes	Depends***
Collection of animal feces or urine from the environment	Depends****	Depends****	Yes	Depends****
Sampling an animal once it has been anesthetized	Recommended if in close contact with the animal during sampling activity	Recommended for those in close contact with the animal during sampling activity	Yes	Yes (either PPE or coveralls or dedicated clothing)

Table Definitions

* When handling live animals that pose a bite or scratch risk, it is recommended that leather gloves be worn above nitrile gloves for added protection. Nitrile gloves are more puncture resistant than latex and may reduce the risk of exposure from a bite or scratch. In many cases chemical restraint (anesthesia) is recommended to prevent injury to either the handler or the animal during sample collection.

** It is recommended to use a respirator, full protective clothing and eye protection when in contact with livestock suspected of harboring a biohazardous agent and pregnant livestock or livestock recently giving birth, and upon entering and/or working in abattoir settings or other settings where livestock are being slaughtered and/or butchered.

*** For routine sample collection from apparently healthy people, gloves are recommended. For collecting samples from hospital and clinic patients and during outbreaks, PPE should be adapted based on the determined risk level.

**** In some cases, such as during the collection of urine underneath a colony of fruit bats roosting in trees where there is a high risk of aerosolizing of excreta and microbial agents, then it is recommended to use a respirator (N95 respirator is recommended as the minimum level of protection), full protective clothing and eye protection.

Higher Risk Taxa

Below is a summary of special biosafety considerations for some of the key groups of species (bats, rodents, and non-human primates) to be handled as part of PREDICT activities.

Rodents, bats, non-human primates and other wild species may harbor pathogens that are transmittable to, and highly pathogenic in, humans. When handling these rodents, bats or non-human primates, careful consideration needs to be given to conscientious use of PPE, good personal hygiene (i.e., hand washing), safety training, and application of good animal handling and sampling techniques to minimize exposure to infection or injury.

In the event of an injury while handling animals that pose risk of zoonotic pathogen exposure, appropriate first aid must be applied. The risk of infection can be significantly reduced with immediate and thorough scrubbing of the wound with soap or antiseptic.

Vaccination to prevent rabies infection: Personnel who are handling animals that are known reservoirs for rabies (i.e., bats and dogs) should be immunized against rabies virus according to World Health Organization and CDC recommendations.

Investigators should familiarize themselves with known biohazards specific to species under study and with the procedures for the isolation and control of zoonotic pathogens.

Specific considerations with regard to working with rodents, bats and non-human primates are discussed below:

Rodents

Wild rodents have the potential to carry a variety of zoonotic bacteria and viruses that can be passed on to those handling them. Because of the serious consequences of becoming infected, personnel must always follow good personal hygiene and animal handling procedures and use the provided PPE to protect against exposure.

Special Precautions:

- Wear the minimum PPE for handling rodents including an N95 mask, eye-protection, gloves and coveralls, or clean dedicated clothing.
- Personnel who are handling animals should be immunized against rabies virus according to the World Health Organization and CDC recommendations.

Bats

Exposure to wild bat roosts (in caves or trees), handling of bats in the field or handling bat excreta (urine or feces) presents a potential for exposure to zoonotic pathogens. Rabies, Nipah virus, Ebola virus, and the fungal disease histoplasmosis are examples of zoonotic pathogens carried by some bat species. Bat bites, scratches and wound and mucous membrane exposure to bat saliva are the ways in which rabies can be transmitted. Spores of histoplasmosis can be present in soil and debris enriched with bird and bat droppings. When this dry soil is disturbed, spores can become airborne and cause infection by inhalation.

Special Precautions:

- When working around bats in enclosed spaces, such as in a cave, wear at a minimum an N95 respirator, goggles, gloves and Tyvek coveralls (or dedicated long-sleeved clothing).
- Personnel who are handling animals such as bats should be immunized against rabies virus and be aware of appropriate post exposure prophylaxis in the case of bites according to World Health Organization and CDC recommendations.

Non-Human Primates

Non-human primates may be infected with a number of potentially serious zoonoses. For example, all macaque monkeys and their fluids should be considered to be infected with **Herpes Simian B virus**. Marmosets, although they do not carry the herpes B virus, can carry other disease agents that affect humans such as lymphocytic choriomeningitis virus and *Trypanosoma cruzii,* the cause of Chagas' disease. It is critical that work with non-human primates be done while wearing the appropriate personal protective equipment and with the well-established safe protocols and procedures.

Special Precautions:

- Personnel must follow strict hygiene procedures. Frequent and thorough hand washing, although too often overlooked by the staff, is critical to physically remove bacterial contamination and prevent ingestion exposure.
- PREDICT personnel must wear the minimum PPE for handling non-human primates including an N95 mask, eye-protection, gloves and coveralls or clean dedicated clothing.

Section 4.4. Use and Disposal of PPE

Considerations When Using PPE

Personnel wearing PPE may experience heat stress and general discomfort in hot or humid environments. It is important to remain hydrated by drinking adequate water before and after wearing PPE. Length of time wearing full PPE should be limited, based on environmental conditions, to avoid the risk of heat exhaustion or heat stroke. Personnel should inform their supervisor(s) if they experience severe discomfort during animal capture or sampling activities, so that they may take a break.

When workers are heat-stressed, uncomfortable, or unable to see out of their fogged goggles, they are more likely to remove their goggles or mask in risky environments, exposing themselves to potential pathogens.

Most PPE items to be worn during PREDICT activities are disposable and designed to be used only once, and should be properly disposed of as medical waste after each use. Plastic goggles and rubber boots may be re-used, but must be disinfected between each use.

Designate a clean area for putting on PPE. It should ideally be a clean area away from any potentially contaminated animal equipment, such as cages, crates, or farm tools. All personnel should use this area to put on their PPE. Also, designate a decontamination and PPE removal site.

Always wear the respirator properly when you are working. Ensure that there is a tight seal formed around the mask and never hang it around your neck.

When wearing coveralls, ensure there is no exposed skin between your sleeves and gloves. If any piece of PPE is torn, it should be changed at the PPE decontamination site as soon as possible following the steps outlined in the section on how to take off PPE.

It is beneficial to have a colleague confirm that PPE is properly worn. Working in teams when putting on and removing PPE can help avoid mistakes and react immediately if accidents occur.

Planning and Preparations for PPE Use

1. Prior to going to the field, the level of risk for the field tasks and the appropriate PPE needed to safely perform the field tasks should be determined.
2. PPE kits should be assembled for each person who will be involved in the field tasks. Multiple kits per person may be required, based on the number of animals to be handled, the number of breaks that personnel may take, and to account for potential tears in gloves and coveralls, etc.
3. Prior to going to the field, PPE supplies should be organized. Along with required sets of PPE, supplies should include disinfectants, alcohol-based hand sanitizing gel and germicidal wipes, large color coded bags for infectious waste disposal according to national codification, and collection bags for equipment (such as plastic goggles, face shields and rubber boots) that will be disinfected for re-use.
4. Bottled water should be available for consumption before and after use of PPE. PPE can be very hot, and personnel are more likely to suffer heat stress if they do not consume adequate amounts of water.
5. Bring additional tape and extra collection and disposal bags. Tape can be used to secure shoe covers and protective clothing and seal bags.
6. Plan for disposing of PPE:
   a. An area for removing PPE should be identified. This area should be away from the contaminated area and away from animals. All personnel should use this area to remove their PPE.
   b. Remove all of your PPE carefully, following the recommended steps for PPE removal (below) and discard them (or put reusable items in bags for disinfection) before taking a break. Put on a new set after the break.
   c. Immediately after removing PPE, place it directly into the color coded infectious waste bag (or marked biohazard waste bag).
   d. Color coded infectious waste bags should be sealed and properly disposed. Follow the instructions of the local officials or person supervising the work on where to dispose infectious waste bags when they are full.
   e. Disposal methods (such as burning or burial) may differ by situation or location. Local officials and/or those supervising the work will likely decide on how best to dispose of used PPE and other disposable items that are potentially contaminated. For guidelines, see PREDICT Safety Guide: Laboratory Operations, Environmental Guidelines for Small-Scale Activities in Africa (EGSSAA) Ch. 8: Healthcare Waste: Generation, Handling, Treatment and Disposal (http://www.encapafrica.org/egssaa/medwaste.pdf); and WHO Safe Management of Wastes from Health-Care Activities (http://www.who.int/water_sanitation_health/medicalwaste/wastemanag/en/).

Components of PPE Kits

1. Coveralls, dedicated clothing and shoes, and aprons – for high-risk tasks, full coverage may be warranted. In that case, Tyvek or Tychem coveralls, shoe covers or boots, and an apron may be used. For lower-risk tasks, just an apron and/or dedicated clothing and shoes may be appropriate. An apron should be a disposable type that is properly disposed of together with

gloves and masks after each use. Dedicated clothing (e.g., cotton coveralls) at the work site should be removed and laundered after each use.

Regarding the use of Tyvek or Tychem coveralls:

- Wear these coveralls to protect your skin and/or clothing against contamination when in contact with human samples, animal droppings, dust, animal urine or droppings, or animal fluids such as blood, saliva, and mucous.
- The synthetic material Tyvek is water resistant and Tychem is water proof, so even if the coveralls get dirty or wet, they will offer protection. Tychem offers more protection from liquids and should be considered in situations with high risk of exposure to blood-borne pathogens (e.g., hemorrhagic disease, EVD outbreak investigations).
- You can wear your dedicated shoes and clothing under the coveralls.

2. Shoe Covers or Washable Rubber Boots

- Because pathogens in human and animal samples including feces, secretions, or blood can easily contaminate your footwear, it is important to have disposable shoe covers or rubber boots that can be disinfected.
- The shoe covers provided in some PPE kits fit over your coverall feet, or over your shoes.
- Rubber boots may be worn with dedicated pants pulled over the top of them. If using PPE coveralls with rubber boots, purchase the coveralls without feet (or cut the feet off) and pull the pant legs of the coveralls over the top of the boots.
    - A footbath should be prepared with either chlorine bleach or Virkon disinfectant. This can be used to disinfect boots and other footwear upon leaving the field site. A boot brush should be available for scrubbing surfaces of footwear prior to using the footbath. It is critical to remove all organic material from footwear prior to disinfection to ensure effectiveness of disinfectants.

3. N95 Respirator

- N95 respirators (masks) protect you from inhaling droplet or aerosolized pathogens into your nose and lungs. Surgical masks are not respirators. They do not protect against aerosol and small droplets. They filter out large-size particles in the air and offer protection from large droplets and direct contact.
- There are several different models, styles, and sizes of N95 and comparable respirators that fit a variety of face shapes and sizes. Each person requiring a respirator for PREDICT activities should be individually fit tested to identify a respirator that appropriately and comfortably fits her or his face.
- Respirators with exhalation valves are generally more comfortable as the exhalation valve prevents resistance to exhalation when the filters load with dust.
- See ***Section 4.5*** on respirator use to learn more about respirators and fit testing.

4. Goggles and Face Shields

- Goggles protect your eyes from splashes and liquids.
- They are adjustable to ensure the best fit. Adjust the head strap before putting on all of the PPE. The goggles should fit snuggly over and around your eyes.
- Personal glasses are not a substitute for goggles or safety glasses; if you wear eyeglasses, the goggles or safety glasses should be placed over them.
- If ordering goggles, be sure to order fog-free goggles. If they are not fog-free, they are likely to fog up in a few minutes, rendering them useless. If all you have are non-fog-free (regular) goggles, you may rub a little soapy water on the inside of the lens prior to use to reduce fogging.
- Goggles (and rubber boots) are one of the few components that may be re-used if disinfected properly after each use.

5. Gloves

- Nitrile gloves are best for use for infectious agent exposure protection. **Gloves are a component of minimum PPE required for sample collection and handling tasks conducted under PREDICT.**
- Two pairs of nitrile gloves are recommended when using sharps.
- Heavy rubber gloves or leather gloves may be required when handling animals and can be worn over the nitrile gloves. PREDICT teams have good success with Hexarmor Hercules 400R6E gloves.

6. Disinfecting Wipes and Alcohol-based Hand Sanitizing Gel (at least 60% alcohol) -- for disinfecting gloves and hands.

- Disinfecting wipes that contain at least 60% alcohol should be used to clean your gloves and other PPE before removing them.
- Alcohol-based wipes or hand sanitizing gel can be used to clean areas of skin that may have been contaminated. It is critical to remove organic material before using sanitizers to ensure effectiveness of disinfectant.
- It is recommended that you ALWAYS disinfect and wash your hands after removing gloves, regardless of contamination.

7. Infectious Waste Bag—for the safe disposal of PPE and other medical waste.

- A color coded infectious waste bag (or otherwise labeled biohazard bag) should be available at the field site for containing and disposing of used PPE items.
- As soon as you remove a contaminated item, place it in the infectious waste bag.
- Do not over fill bags and ensure they can be closed and tied.
- Tie the bag at the top and spray the outside of the bag with disinfectant once it is closed and tied. Wet waste should be double-bagged to prevent leakage.
- Leave it at the designated collection site or place it in in a secure container for transport to a proper disposal site.
- Containers should be constructed to contain all contents and prevent leakage of fluids during handling, storage, and transport.
- It is strongly recommended that field teams do not burn or bury medical waste at the field site. Incomplete burning may leave infectious or dangerous materials, and animals or children may dig up buried waste. All bio-hazardous waste should be contained and returned to a medical center for autoclaving or incineration. **See *Section 2.5 Safe Disposal of Carcasses and Infectious Waste Guide* for information regarding guidelines for waste disposal.**

Procedure for Putting on PPE

All of the components of PPE discussed below are not necessary or appropriate for all PREDICT tasks. For instance, Tyvek or Tychem coveralls and aprons are not necessary for many PREDICT tasks. However, when investigating disease outbreaks or other potentially high-risk situations, the PPE and donning and doffing procedures may be substantially enhanced to reduce risk of exposure. See http://www.cdc.gov/vhf/ebola/hcp/ppe-training/index.html for CDC Guidelines for Personal Protective Equipment (PPE) Donning and Doffing Procedures during management of Ebola virus disease cases.

1. Wash your hands and/or disinfect them with alcohol-based hand sanitizing gel prior to putting on PPE.

2. Coveralls or dedicated clothing go on FIRST. Always start with the coveralls (which should be big and loose to fit over clothing and not restrict movement) or dedicated clothing. Be certain to zip up coveralls or button up clothing.

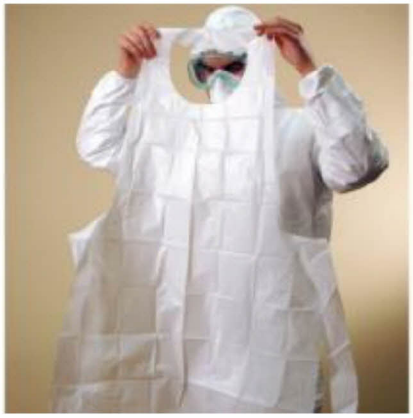
3. **Shoe covers or boots go on SECOND.** Shoe covers fit over the coverall feet. Pant legs of dedicated clothing and coveralls should fit over the boots.

4. **Respirator or surgical mask goes on THIRD.** Of the equipment to be worn around the head and face, the mask or respirator is always first on and last off. On a mask with a metal nose clip, be sure to form the clip around the nose for a nice fit. Any time you put on a respirator, perform a seal check by inhaling sharply. If there is air leakage around the edges of the mask, readjust to ensure a proper seal.

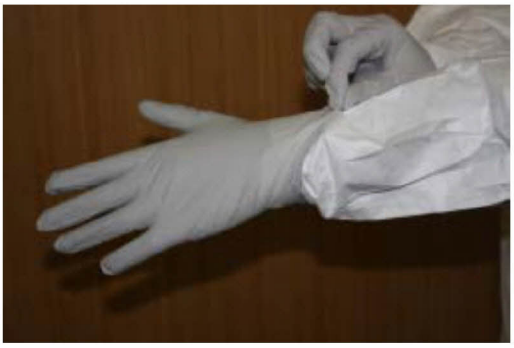
5. **Goggles go on after the respirator.** Goggles should fit snuggly over and around your eyes. Goggle straps should be adjusted to fit your head.

Once the respirator and goggles are in place, pull the hood on your coveralls over your head (or put on the separate head cover if the coveralls do not have a hood).

6. **Tie on the apron over the coveralls or your dedicated clothing.** Place the apron over your head and then tie it in the back.



7. **Put on two pairs of gloves.** The inner glove should go under the sleeve of the coverall to prevent exposed skin between the coverall and the glove. Coveralls with finger loops that secure the sleeve over the first pair of gloves are ideal to avoid exposure of the wrist area (or you can make a small cut in the coverall sleeve and introduce your thumb). Otherwise, tape the coverall sleeve to the inner glove. Put the second pair of gloves on over the first pair and extend the gloves over the coverall cuffs.



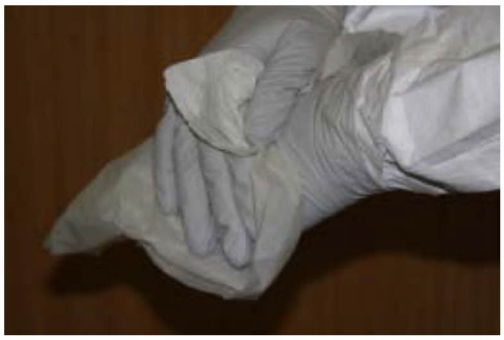
Procedure for Removing PPE

After completing your work, assume the exterior of the PPE is contaminated. The goal of correct removal of PPE is to minimize contact between your clothes and skin and the contaminated outer surfaces of the PPE.

1. **Wipe off any visible contamination of the PPE** using germicidal or alcohol-based wipes and dispose of the used wipe in the infectious waste bag.

2. **Remove and dispose of the apron** in the infectious waste bag.

3. **Wipe off outer gloves with a germicidal wipe and dispose of the used wipe** in the infectious waste bag.

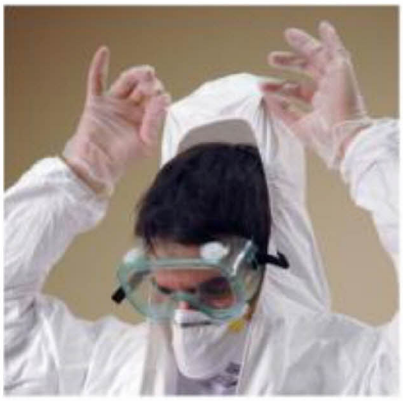


4. **Remove boots or remove shoe covers** by holding the top and rolling them off of your feet. Place the shoe covers in the infectious waste bag. Place the boots in the equipment collection bag for disinfection and re-use.

5. **Remove the outer gloves** and place them in the infectious waste bag. Using one gloved hand, grasp the outside of the opposite glove near the wrist. Pull and peel the glove inside-out and away from the hand. Hold the removed glove in the opposite gloved hand. Then, slide one or two fingers of the ungloved hand under the wrist of the remaining glove. Peel glove off from the inside, creating a bag for both gloves. Dispose of the gloves in the infectious waste bag.

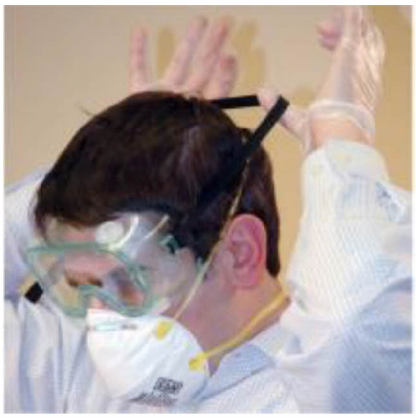
6. **Disinfect your inner gloves with alcohol-based hand sanitizing gel.**

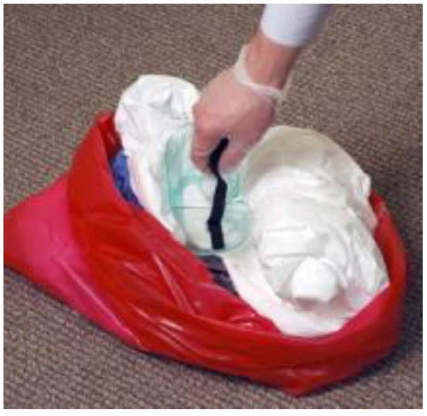
7. Unzip and roll down the coveralls until they are inside out and place them in the infectious waste bag.


8. Disinfect gloves with alcohol-based hand sanitizing gel.

9. Remove the goggles by the strap and place them in the infectious waste bag or equipment collection bag for disinfection and re-use if re-usable. Re-suable goggles can be disinfected using a chlorine bleach solution.

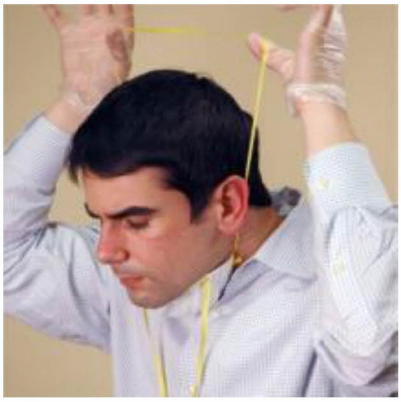




10. Disinfect gloves with alcohol-based hand sanitizing gel.

11. Close the biohazard bag by tying the corners of the top of the bag together.

12. Remove the respirator by grabbing the top and then the bottom elastic bands, and pulling the bands up over your head or by grabbing the nose and pulling forward and then off. Place the respirator **in a second clean red infectious waste bag**.



13. Disinfect gloves with alcohol-based hand sanitizing gel.

14. Remove the inside gloves using the procedures listed in #5 above and place them in the second infectious waste bag. Dispose of infectious waste bags according to guidelines in Section 4, #6 e above.

15. Disinfect your hands with alcohol-based hand sanitizing gel.

16. Wash your hands and wrists using soap and running water (from a tap or poured) following the guidelines presented in Section 2.

If PPE is compromised, falls off, rips or is removed while you are handling or are exposed to biological hazardous materials, stop your current activity, remove PPE in the designated area, and wash or disinfect the exposed skin/surfaces. In addition, immediately inform your supervisor to determine if prophylaxis is indicated.

Section 4.5. Respirator Use

- Using respirators alone will not fully protect you from acquiring an infection – the respirator must be used in combination with all of the other PPE components.
- Each person using respirators must be fit tested to identify a respirator that he or she can comfortably and securely wear. Fit testing is a process that takes approximately 15-20 minutes to complete and should be performed for each member of the field team before he or she uses any respirators in the field. Qualitative fit test kits are available for purchase through 3M. A video on fit testing is available online at https://www.youtube.com/watch?v=7IAsoU6h-8g. After passing a fit test with a respirator, you should always use the same make, model, style, and size of respirator that was found during the fit test process to create an effective seal around your face. If you have facial hair, it is unlikely that you can properly fit a disposable particulate respirator. Workers who cannot ensure a proper fit because of facial hair or other fit limitations should consider a loose-fitting (i.e., helmeted or hooded) powered air purifying respirator equipped with high-efficiency filters. More information on respirators and respiratory protection can be found at: https://www.osha.gov/SLTC/etools/respiratory/index.html.
- Do not use or provide others with respirators without instruction on the health risks associated with them. For example, workers with respiratory problems may not be able to wear these respirators. Anytime someone indicates they are having trouble breathing while wearing a respirator, they should go to the PPE removal site and remove their respirator.

- When disposable particulate respirators become wet from saliva, sweat, or respiratory secretions, they lose their protective properties and must be changed.
- If a respirator is splashed and becomes wet, it should be changed using gloves and the gloves disinfected or washed following hand washing procedures.
- Respirators should be discarded and replaced after 4-6 hours of use.
- Respirators should not be hung around your neck when working. Always wear them when working.

Section 4.6. References

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Section 6.3. Basic Laboratory Safety

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Objective: To provide a safe and healthy environment for staff, volunteers and all personnel involved in PREDICT activities. This Guide is to provide basic information to ensure a safe laboratory environment and to comply with environmental standards. The recommendations in this Guide are consistent with the requirements of the U.S. Occupational Safety and Health (OSHA) Act of 1970, Executive Order 12196.

This document was made possible by the generous support of the American people through the United States Agency for International Development (USAID) Emerging Pandemic Threats PREDICT program. It was drafted to support activities conducted under PREDICT and is intended for an audience of qualified professionals trained in standard, associated best practices. This guide is not intended for use by untrained individuals.

For more information about the contents of this guide, please contact predict@ucdavis.edu.

Suggested Citation Form: PREDICT One Health Consortium 2016. PREDICT Operating Procedures: Basic Laboratory Safety.

Table of Contents: Basic Laboratory Operations

Section 6.3.1. Learning Objectives

If you understand the material in this Guide, you should be able to:

- Work safely in a basic laboratory environment.
- Recognize laboratory hazards and take the appropriate measures to reduce those hazards.
- Obtain a Material Data Safety Sheet (MSDS) for a hazardous material and explain the kinds of information in an MSDS.
- Explain important precautions to avoid needlestick injuries.
- Explain how to avoid exposure to pathogens in the laboratory.
- Describe the safety measures for a BSL 2 laboratory.
- Explain why medical monitoring of laboratory personnel is important.
- Describe the proper disposal of sharps and medical waste.
- Describe safety procedures for handling chemicals in the laboratory.

Confirm you understand the material of this Guide:
When you are familiar with the information in this Guide, take the PREDICT quiz on ***Basic Laboratory Safety (Section 8.4.16.)***.

This training module is mandatory for all laboratory and field staff.
Once you have passed the quiz please supply proof of training and completion to your supervisor.

Section 6.3.2. Principles

Guiding principles for PREDICT laboratory operations:

1. Prevent loss of life, personal injury or illness, property loss or damage, or environmental harm.
2. Comply with the ***PREDICT Environmental Compliance Protocol*** and local and national safety and health requirements.
3. Comply with applicable local building safety codes.
4. Ensure all PREDICT personnel understand relevant safe and healthy work practices.
5. Identify and assess hazards in the laboratory environment.
6. Establish overall safety and health guidelines that ensure employee safety and health at all times during PREDICT activities.
7. Periodically review and evaluate PREDICT plans, facilities, equipment, and activities to ensure that safety and health objectives are achieved.

Section 6.3.3. General Guidance for Laboratory Safety

This Laboratory Safety Guide describes safe work practices, personal protective equipment, and other control measures necessary for the safe use of chemicals and other hazardous materials

and procedures in the basic laboratory environment. PREDICT personnel involved in laboratory activities must review and follow this Guide. Staff, interns, visiting scientists, and volunteers are to receive this Guide prior to conducting laboratory activities for the PREDICT Program. This Guide will be updated as needed to improve safety procedures.

Ensure Safe Working Conditions

- Inspect your personal protective equipment (PPE), such as goggles and gloves, to ensure that each component fits well and works properly. Examine your gloves for cracks. Nitrile and latex gloves are disposable and a new pair should be used for each task.
- If you are working with PPE kits, ensure that the kit is complete (a list with the contents of the PPE kit should be available).
- Dispose of broken glass and biohazard materials in designated sharps and hazardous waste containers in the laboratory.
- Help provide a safe work environment by keeping the workspace neat and uncluttered.
- Sinks and eye wash stations should be kept clear.
- Wash your hands and forearms after you have removed and disposed of your PPE.

Hazard Identification and Assessment

Personnel should be able to recognize the possible hazards and inherent risks associated with laboratory procedures and equipment.

Table 1: Hazards associated with laboratory procedures

Procedure	Possible hazards	Likelihood of illness or injury	Risk
Using autoclave or hotplate	High temperature	Moderate	Burns
Handling animal and human samples including body fluids, tissues, swabs	Infectious organisms	Low to moderate	Pathogen exposure zoonotic diseases
Reagent preparation	Acids or alkalines Solvents (alcohols, acetone)	Low Low	Burns Inhalation irritant
Disposal of needles and slides	Sharp objects Infectious organisms	Low to moderate	Needlesticks, cuts, zoonotic disease, pathogen exposure
Dry ice, liquid nitrogen or ultra-low freezers	Extreme cold (~-100F)	Low	Burns
Media preparation	Extreme heat	Low	Burns
Formaldehyde	Inhalation of vapors, ingestion of liquid or direct contact with the liquid or vapor (skin, eye contact)	Moderate	Cancer, skin, eye and respiratory tract irritation
TRIzol Reagent (or Tri reagent; phenol solution)	Toxic if inhaled, absorbed through skin or ingested; reacts with bleach	Moderate	Contact burns, systemic poisoning; creates toxic gas if mixed with bleach

Safe Laboratory and Operating Procedures

Personnel must understand and follow the safe operating procedures of laboratory equipment and PPE to minimize health and safety risks. **The use of the PPE for specific laboratory tasks, listed in Table 2, is mandatory** and all PREDICT personnel must follow the special precautions listed for handling highly hazardous materials.

Table 2: PPE required for laboratory tasks

Lab Task	Health or Safety Hazards	Required PPE	Precautions for Highly Hazardous Materials*
Handling all samples from animals and humans (body fluids, tissues, swabs)	Zoonotic disease potential	Lab coat, closed shoes, disposable nitrile gloves, eye protection and respirator (N95 minimum)	Use of Biosafety Cabinet Class II and eye protection for samples known to be highly infectious or use PPE kits.
Handling acids or chemicals that are irritants (i.e. formaldehyde)	Respiratory irritation, acid or alkaline burns	Lab coat, laboratory gloves, face mask, closed toe shoes.	Chemical fume hood
Operation of autoclaves	Burns	Appropriate gloves, eye protection, closed toe shoes.	Care in opening the door to avoid burns from escaping steam.
Dry ice, liquid nitrogen	Burns, asphyxiation risk	Appropriate gloves, eye protection, closed toe shoes, and use in well-ventilated room.	Dispose of any unused dry ice or liquid nitrogen in ventilated fume hood.
Centrifuges	Aerosolized fluids, zoonotic disease	Lab coat, facemask, appropriate gloves when handling samples or cleaning centrifuge.	Ensure proper balancing of centrifuge and contents. Do not open until rotor has stopped. Use closed-top swinger rotors to spin biological materials.
Hot plate	Possible burns	Appropriate gloves, closed toe shoes.	Do not leave unattended for extended periods.
Use of bleach to disinfect	Possible burns, respiratory irritation	Lab coat, gloves, closed toe shoes, and eye protection.	Use of chemical fume hood recommended when preparing bleach.
Disposing of needles, glass slides	Cuts, zoonotic disease	Gloves, sharps container, closed toe shoes.	Follow sharps safety procedures in this guide.
TRIzol Reagent (or Tri reagent; phenol solution)	Contact burns, systemic poisoning	In lab: Gloves, lab coat, close toe-shoes, eye goggles In field: Gloves, close toed-shoes, appropriate field PPE (e.g. coveralls, N95 mask, goggles per the task being performed – See Biosafety Guide)	Aliquot TRIzol for sampling in the field in a ducted biosafety cabinet or fume hood; Perform RNA extraction of samples collected into TRIzol in a biosafety cabinet

Definitions

***Highly hazardous materials** are chemicals, toxics and reactives that have the potential to cause immediate and permanent harm at feasible exposure levels. Chemicals that are highly toxic, are known to cause cancer or birth defects, have very low "permissible exposure limits," are highly reactive, or that react vigorously with common materials (such as water or air) should all be considered "highly hazardous materials." Chemicals that are under pressure, that can build up pressure, that can auto-ignite at possible temperatures, that burn vigorously and energetically, or that when burning cannot be extinguished with conventional methods, should be considered highly hazardous.

For a complete and updated list of Highly Hazardous Materials, visit the following OSHA link:
http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_id=9761&p_table=standards

****Personal Protective Equipment (PPE)** is specialized clothing or equipment worn by an employee for protection against infectious and other hazardous materials. The warranted components of PPE vary according to the tasks being performed by personnel. A basic PPE kit may include: gloves, gowns or other protective clothing (e.g., plastic apron), shoe and head covers, mask or respirator, and face or eye protection (e.g., goggles).

Review of Material Safety Data Sheets

PREDICT personnel must verify that a Material Safety Data Sheet (MSDS) for each product to be used during PREDICT activities is readily available, complete and updated (less than three years old).

Coordinators must ensure that personnel have read and understand the MSDS BEFORE using a chemical product.

Personnel must be familiar with the name of the chemical and understand the hazards, safe handling and storage, and specific emergency procedures BEFORE using a chemical product.

Copies of MSDSs for all chemicals used in the laboratory should be kept together in a binder and placed in an accessible location known to all laboratory personnel.

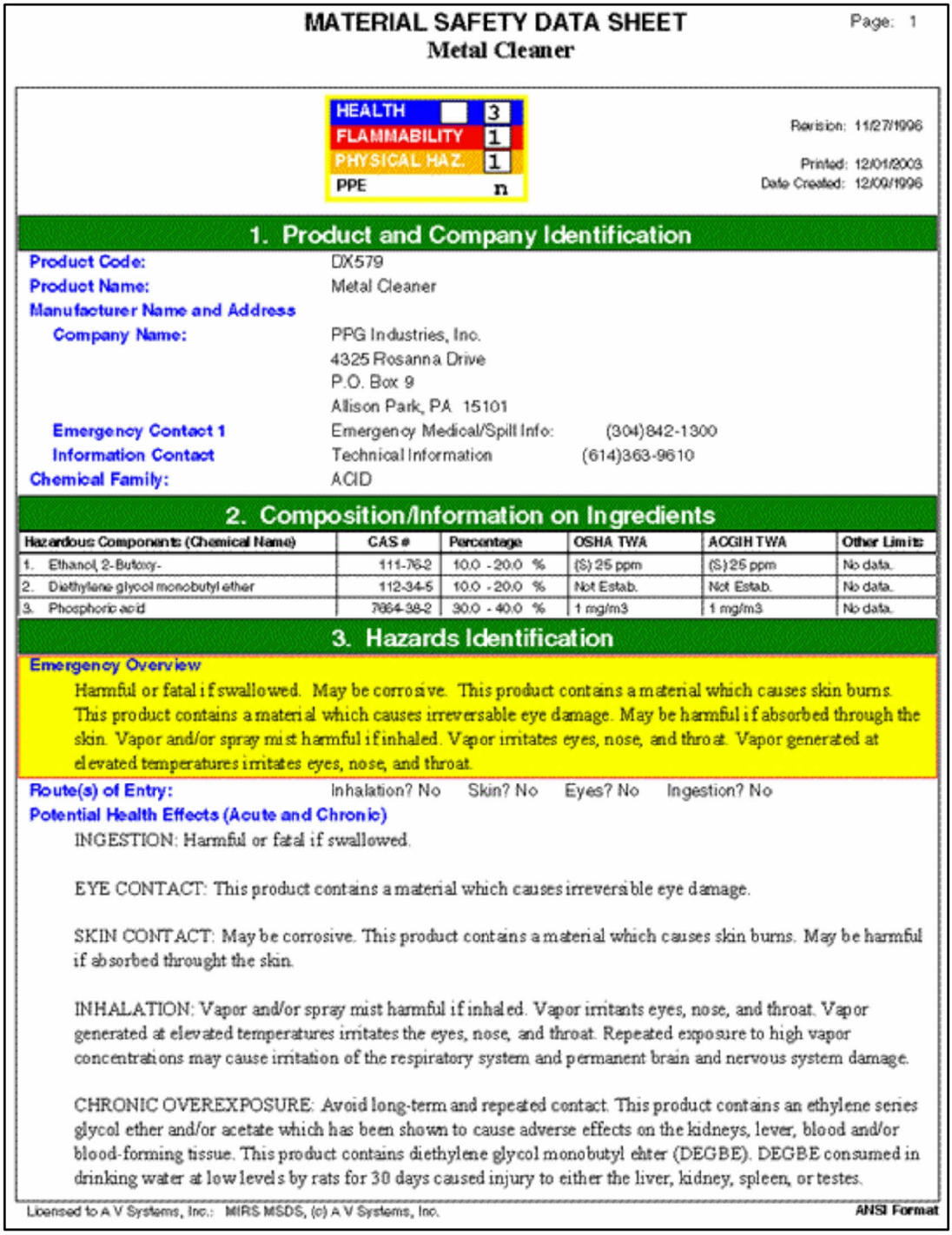
What is a Material Safety Data Sheet?

A MSDS is prepared by the supplier or manufacturer of the material and contains information on the potential hazards (health, fire, reactivity and environmental) and safe use of the chemical product. It is an essential information resource for all health and safety programs. The MSDS also contains information on the safe use, storage, handling and emergency procedures for all hazardous materials. The MSDS contains much more information about the material than found on the product label including what to do if accidents occur, and how to recognize and treat overexposure to the chemical product.

What information is on the MSDS?

The information of greatest concern to workers is featured at the beginning of the data sheet, including information on chemical composition and first aid measures. More technical information that addresses topics regarding the physical and chemical properties of the material and toxicological data appears later in the document. The 16-section MSDS is now recognized internationally. Each MSDS must include:

1. Identification (name, manufacturer and supplier names, address and emergency phone numbers)
2. Hazard(s) identification
3. Composition/information on ingredients
4. First-aid measures
5. Fire-fighting measures
6. Accidental release measures
7. Handling and storage
8. Exposure controls/personal protection
9. Physical and chemical properties
10. Stability and reactivity
11. Toxicological information
12. Ecological information
13. Disposal considerations
14. Transport information
15. Regulatory information
16. Other information



MATERIAL SAFETY DATA SHEET
Metal Cleaner

Page: 1

HEALTH	3
FLAMMABILITY	1
PHYSICAL HAZ.	1
PPE	n

Revision: 11/27/1996
Printed: 12/01/2003
Date Created: 12/09/1996

1. Product and Company Identification

Product Code: DX579
Product Name: Metal Cleaner
Manufacturer Name and Address
Company Name: PPG Industries, Inc.
4325 Rosanna Drive
P.O. Box 9
Allison Park, PA 15101
Emergency Contact 1 Emergency Medical/Spill Info: (304)842-1300
Information Contact Technical Information (614)363-9610
Chemical Family: ACID

2. Composition/Information on Ingredients

Hazardous Components (Chemical Name)	CAS #	Percentage	OSHA TWA	ACGIH TWA	Other Limits
1. Ethanol, 2-Butoxy-	111-76-2	10.0 - 20.0 %	(S) 25 ppm	(S) 25 ppm	No data.
2. Diethylene glycol monobutyl ether	112-34-5	10.0 - 20.0 %	Not Estab.	Not Estab.	No data.
3. Phosphoric acid	7664-38-2	30.0 - 40.0 %	1 mg/m3	1 mg/m3	No data.

3. Hazards Identification

Emergency Overview

Harmful or fatal if swallowed. May be corrosive. This product contains a material which causes skin burns. This product contains a material which causes irreversable eye damage. May be harmful if absorbed through the skin. Vapor and/or spray mist harmful if inhaled. Vapor irritates eyes, nose, and throat. Vapor generated at elevated temperatures irritates eyes, nose, and throat.

Route(s) of Entry: Inhalation? No Skin? No Eyes? No Ingestion? No

Potential Health Effects (Acute and Chronic)

INGESTION: Harmful or fatal if swallowed.

EYE CONTACT: This product contains a material which causes irreversible eye damage.

SKIN CONTACT: May be corrosive. This product contains a material which causes skin burns. May be harmful if absorbed throught the skin.

INHALATION: Vapor and/or spray mist harmful if inhaled. Vapor irritants eyes, nose, and throat. Vapor generated at elevated temperatures irritates the eyes, nose, and throat. Repeated exposure to high vapor concentrations may cause irritation of the respiratory system and permanent brain and nervous system damage.

CHRONIC OVEREXPOSURE: Avoid long-term and repeated contact. This product contains an ethylene series glycol ether and/or acetate which has been shown to cause adverse effects on the kidneys, lever, blood and/or blood-forming tissue. This product contains diethylene glycol monobutyl ehter (DEGBE). DEGBE consumed in drinking water at low levels by rats for 30 days caused injury to either the liver, kidney, spleen, or testes.

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Different jurisdictions have different content requirements for Material Safety Data Sheets. Despite the internationally recognized standard, a MSDS prepared in accordance with the United States OSHA Hazard Communication Standard is not necessarily acceptable in other countries. Check with local health authorities to ensure that your MSDSs are in compliance with local regulations.

Where to obtain MSDSs for chemical products?

A MSDS can be requested from the manufacturer or supplier of the product; in addition several MSDS databases exist online including:

SIRI MSDS index: http://siri.org/msds/index.php
MSDS online: http://www.msdsonline.com or http://www.msdsonfile.com/mctx/msds/msdsonfile.jsp
MSDS Hazard Communication Library: http://www.setonresourcecenter.com/MSDSs/comply1.htm

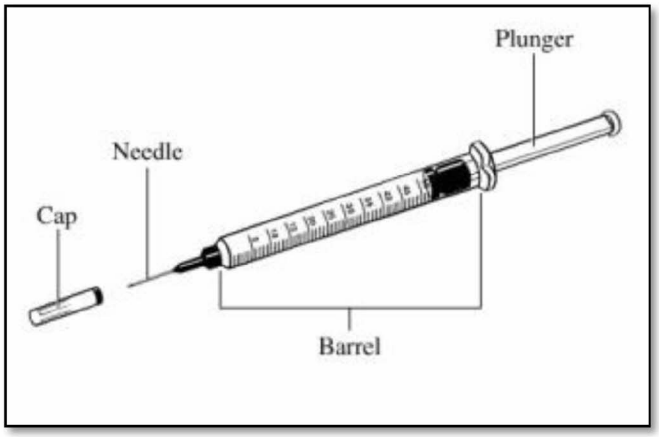
Needlestick Injury Prevention

Needlestick injuries are of concern in basic laboratory settings because they can result in the inoculation of personnel with infected materials. Additionally, skin breaks from needlesticks can act as portal of entry for environmental pathogens.

Most needlestick injuries occur during the following activities

- Recapping, bending, or breaking needles.
- Inserting a needle into a test tube or specimen container and missing the target.
- Carrying unprotected sharps.
- Leaving sharps in unexpected places, such as clothing.
- Handling or disposing of waste that contains used sharps.

Parts of a Syringe and Needle



Procedures to Prevent Needlestick Injuries

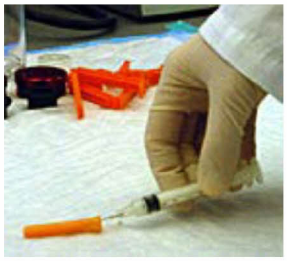
- Follow proper techniques when using needles and syringes.
- Be familiar with the different types and components of syringes and needles.
- When **uncapping a syringe needle**, pull the cap straight off to remove it and expose the needle.
- **Never leave an uncapped needle lying around.** A used syringe with the attached needle should be placed in a sharp disposal container immediately after use (a sharps disposal

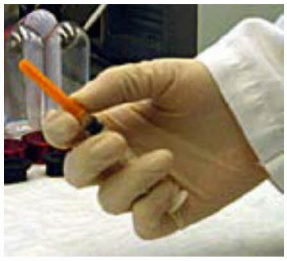
container is designed for safe containment of medical articles that may cause punctures or cuts to those handling them – see below).

- **Removal of the syringe needle** may be necessary for transfer of the sample to another container, or for disposal of only the needle in the sharp container. When removal of the needle is necessary:
- Make sure not to remove the cap--twist the entire needle to take it off the syringe along with the cap. Alternatively, the needle may be removed from the syringe by use of forceps.
- Uncapped needles should never be removed from the syringe by hand.
- **Syringes and needles** used on humans should never be recapped. However, when working with animals and in the field, it may be necessary to carefully recap a needle to avoid accidental sticks if a sharps container is not immediately available.

If you recap a needle, use the *ONE HAND METHOD*

1. Lay the cap on a table or on a flat surface.
2. Hold the syringe by the end.
3. Tilt the end of the syringe up, so that the needle inside the cap is point down onto the surface.
4. Insert the needle on the syringe into the cap.
5. "Fish" up the cap with the needle.
6. Use the same hand to recap the needle.
7. Apply enough pressure to set the cap onto the needle.





If a needlestick occurs, it must be reported to your local PREDICT Supervisor and a medical professional immediately.

Section 6.3.4. Biohazards of Zoonotic Pathogens

Investigators working with domestic and wild animals and humans or with animal and human samples are at risk of disease due to exposure to zoonotic pathogens (pathogens transmitted between animals to humans). The zoonotic disease risk varies depending on the animal species being handled, but is generally caused by direct contact (e.g., contaminated/dirty hands), through open cuts, contact with blood and other body fluids, or inhalation of contaminated materials.

When performing tasks with risk of exposure to zoonotic pathogens (such as handling live or dead animals or samples from humans, collecting, testing, or packaging samples), PREDICT personnel should always wear the appropriate PPE as warranted by the assessed risk. It is the responsibility of the supervising veterinarian or medical specialist to determine the required PPE components for specific activities, based on an established PREDICT protocol or based on a risk assessment. (*See **Section 4. Biosafety and PPE Use** for more information about determining the appropriate PPE.)*

In the event that any personnel believe they have been exposed to material from a person or animal, they should immediately report the exposure to their supervisor, and if warranted seek the appropriate medical attention and follow-up.

Species-Specific Biosafety Precautions

The PREDICT Program will conduct surveillance and sampling among several groups of species. This section discusses special biosafety considerations for some of the key groups of species (bats, rodents, and non-human primates) likely to be handled as part of PREDICT activities.

Rodents, bats, non-human primates and other wild species may harbor pathogens that are transmittable to, and highly pathogenic in, humans. When handling these rodents, bats or non-human primates, careful consideration needs to be given to conscientious use of PPE, good personal hygiene (i.e., hand washing), safety training, and application of good animal handling and sampling techniques to minimize exposure to infection or injury.

In the event of an injury while handling animals that pose risk of zoonotic pathogen exposure, appropriate first aid must be applied. The risk of infection can be significantly reduced with immediate and thorough scrubbing of the wound with soap or antiseptic.

Vaccination to prevent rabies infection: Personnel who are handling animals that are known reservoirs for rabies (e.g., bats and dogs) should be immunized against rabies virus according to World Health Organization and CDC recommendations.

Investigators should familiarize themselves with known biohazards specific to species under study and with the procedures for the isolation and control of zoonotic pathogens.
Specific considerations with regard to working with rodents, bats and non-human primates are discussed below:

Rodents

Wild rodents have the potential to carry a variety of zoonotic bacteria and viruses that can be passed on to those handling them. Because of the serious consequences of becoming infected, personnel must always follow good personal hygiene and animal handling procedures and use the provided PPE to protect against exposure.

Special Precautions:

- Wear the minimum PPE for handling rodents as specified in the PREDICT PPE Use Guide, this includes an N95 mask, eye-protection, gloves and coveralls, or clean dedicated clothing.
- Personnel who are handling animals should be immunized against rabies virus according to the World Health Organization and CDC recommendations.

Bats

Exposure to wild bat roosts (in caves or trees), handling of bats in the field or handling bat excreta (urine or feces) presents a potential for exposure to zoonotic pathogens. Rabies, Nipah virus, Ebola virus, and the fungal disease histoplasmosis are examples of zoonotic pathogens carried by some bat species. Bat bites, scratches and wound and mucous membrane exposure to bat saliva are the ways in which rabies can be transmitted. Spores of histoplasmosis can be present in soil and debris enriched with bird and bat droppings. When this dry soil is disturbed, spores can become airborne and cause infection by inhalation.

Special Precautions:

- When working around bats in enclosed spaces, such as in a cave, wear at a minimum an N95 respirator, goggles, gloves and Tyvek coveralls (or dedicated long-sleeved clothing).
- Personnel who are handling animals such as bats should be immunized against rabies virus and be aware of appropriate post exposure prophylaxis in the case of bites according to World Health Organization and CDC recommendations.

Non-Human Primates

Non-human primates may be infected with a number of potentially serious zoonoses. For example, all macaque monkeys and their fluids should be considered to be infected with **Herpes Simian B virus**. Marmosets, although they do not carry the herpes B virus, can carry other disease agents that affect humans such as lymphocytic choriomeningitis virus and *Trypanosoma cruzii,* the cause of Chagas' disease. It is critical that work with non-human primates be done while wearing the appropriate personal protective equipment and with the well-established safe protocols and procedures.

Special Precautions:

- Personnel must follow strict hygiene procedures. Frequent and thorough hand washing, although too often overlooked by the staff, is critical to physically remove bacterial contamination and prevent ingestion exposure.
- PREDICT personnel must wear the minimum PPE for handling non-human primates as specified in the PREDICT PPE Use Guide. This includes an N95 mask, eye-protection, gloves and coveralls or clean dedicated clothing.

Biosafety Levels and Practices

General

All laboratories handling biological agents must post signage indicating that the site is a potential biological hazard area, and identifying all agents in use. Supervisors shall ensure that employees are informed of biological hazards and that suitable biosafety controls are in place. Country Coordinators and lab and field supervisors managing surveillance and other field and laboratory activities should ensure that appropriate biosafety practices are implemented by personnel. Biological safety cabinets are to be certified annually.

It is important to know the biosafety level of the disease that you are working with before beginning work, so that the correct precautions can be taken.

Note: All samples collected for the PREDICT project are to be handled in a Class II Biosafety Laboratory.

Basics of Biosafety Level 1

Biosafety Level 1 (BSL1) practices represent a basic level of containment that relies on standard microbiological practices and basic safety equipment and lab design for laboratories that work with defined and characterized strains of viable microorganisms not known to consistently cause disease in healthy adult humans. However, many agents not ordinarily associated with disease processes in humans are opportunistic pathogens and may cause infection in the young, the aged, and immuno-deficient or immunosuppressed individuals.

BSL-1 Standard Microbiological Practices

1. Access to work areas is limited at the discretion of the supervisor.
2. Hands must be washed after handling biological materials, removing gloves, or before leaving the laboratory.
3. No eating or drinking is allowed in the laboratory.
4. Only mechanical devices are used for pipetting.
5. Safety devices such as self-protected injection syringe or non-sharps should be used as an alternative to sharps. Sharps used should be handled and disposed of properly.
6. Activities that are likely to create splashes, sprays, or aerosols should be minimized.
7. Work surfaces should be decontaminated with 10% bleach (70% ethanol for metal surfaces) at least daily (before and after work with infectious samples) and after any spills.
8. Waste materials should be disposed of properly.
9. Secondary containment should be used when transporting bio-hazardous materials outside of the laboratory. Avoid public areas during transport.

BSL-1 Safety Equipment (Primary Barriers)

1. BUTTONED lab coats should be worn to protect street clothes.
2. Barrier (preferably non-latex) gloves should be worn, particularly if hands have broken skin or a rash.
3. Appropriate eye/face protection (safety goggles as a minimum) should be worn if splashes or sprays are anticipated, or if wearing contact lenses during lab work.

BSL-1 Laboratory Facilities (Secondary Barriers)

1. The lab should have a sink for hand washing.
2. The lab should have an eye wash station.
3. The lab should have a door for access control.
4. The lab fixtures and floors should be easily cleaned and disinfected (no carpets or rugs); bench tops are to be impervious to water and resistant to both moderate heat and the chemicals used to decontaminate the work surface and equipment.

Note: BSL-1 is NOT APROPRIATE for PREDICT samples.

Basics of Biosafety Level 2

Biosafety Level 2 is more restrictive than BSL-1 and is suitable for work involving agents of moderate potential hazard to personnel and the environment. All PREDICT samples are to be handled in a Biosafety level 2 laboratory. It differs in that (a) laboratory personnel have specific training in handling pathogenic agents and are directed by trained technologists, (b) access to the laboratory is limited when work is being conducted, (c) extreme precautions are taken with contaminated sharp items, and (d) certain procedures in which infectious aerosols or splashes may be created are conducted in biological safety cabinets or other physical containment equipment. **All PREDICT samples are to be handled in Class II biological safety cabinets, in Biosafety level 2 laboratory.**

BSL-2 Standard Microbiological Practices

1. Personnel must wash their hands after they handle viable materials, after removing gloves, and before leaving the laboratory.
2. Eating, chewing gum, drinking, smoking, handling contact lenses, and applying cosmetics should not be permitted in the laboratory. Persons who wear contact lenses in laboratories should also wear goggles or a face shield. Food should be stored outside the work area in cabinets or refrigerators designated for this purpose only.
3. Only mechanical pipetting devices are used for pipetting.
4. Policies for safe handling of sharps (when non-sharps are not available) should be instituted.
5. All procedures should be performed carefully to minimize the creation of splashes or aerosols.
6. Work surfaces should be decontaminated with 10% bleach (70% ethanol for metal surfaces) at least once a day (before and after working with infectious samples) and after any spill of viable material.

7. All cultures, stocks, and other regulated wastes are disposed of in the biohazard trash by placing them in a durable, leak-proof container, closed for transport from the laboratory, and transferred to the designated receptacle for disposal. Materials to be decontaminated at off-site locations from the laboratory should be packaged in accordance with applicable local, state, and federal regulations, before removal from the facility.

BSL-2 Special Practices

1. Access to the laboratory is limited or restricted by the laboratory supervisor when work with infectious agents is in progress. In general, persons who are at increased risk of acquiring infection, or for whom infection may be unusually hazardous are not allowed in the laboratory. Persons who are immuno-compromised, immunosuppressed, pregnant or at higher risk of acquiring infections, should not be permitted in the laboratory.
2. The laboratory director establishes policies and procedures whereby only persons who have been advised of the potential hazard and meet specific entry requirements (e.g., immunization) enter the laboratory.
3. Laboratory personnel receive appropriate immunizations or tests for the agents handled or potentially present in the laboratory (e.g., hepatitis B vaccine or TB skin testing).
4. A high degree of precaution must always be taken with any contaminated sharp items, including needles and syringes, slides, pipettes, capillary tubes, and scalpels.
    - Only needle-locking syringes or disposable syringe-needle units (i.e., needle is integral to the syringe) are used for injection or aspiration of infectious materials. Used disposable needles must not be bent, sheared, broken, recapped, removed from disposable syringes, or otherwise manipulated by hand before disposal; rather, they must be carefully placed in conveniently located puncture-resistant containers used for sharps disposal. Non-disposable sharps must be placed in a hard-walled container for transport to a disposal area.
    - Broken glassware must not be handled directly by hand, but must be removed by mechanical means such as a brush and dustpan, tongs, or forceps. Containers of contaminated needles, sharp equipment, and broken glass should be decontaminated with 10% bleach before disposal, according to any local, state, or federal regulations.
5. Cultures, tissues, or specimens of body fluids are placed in a container that prevents leakage during collection, handling, processing, storage, transport, or shipping.
6. Laboratory equipment and work surfaces should be decontaminated with an appropriate disinfectant (such as 10% bleach) on a routine basis, before and after work with infectious materials is finished, and especially after overt spills, splashes, or other contamination by infectious materials. Contaminated equipment must be decontaminated according to any local, state, or federal regulations before it is sent for repair or maintenance or packaged for transport in accordance with applicable local, state, or federal regulations, before removal from the facility. Bleach (10%) can be used on all non-steel surfaces; however, 70% ethanol or other recommended disinfectant should be used when those chemicals are not available.

7. Spills and accidents that result in overt exposures to infectious materials should be reported immediately to the laboratory director. Medical evaluation, surveillance, and treatment should be provided as appropriate and written records should be maintained.

BSL-2 Safety Equipment (Primary Barriers)

1. **Properly maintained biological safety cabinets, Class II,** and other appropriate personal protective equipment or physical containment devices **should be used**.

Procedures with a potential for creating infectious aerosols or splashes are a hazard. These may include centrifuging, grinding, blending, vigorous shaking or mixing, sonic disruption, opening containers of infectious materials whose internal pressures may be different from ambient pressures, inoculating animals, and harvesting infected tissues from animals, eggs or cell cultures.

2. Face protection (goggles, mask, face-shield or other splatter guards) should be used for anticipated splashes or sprays of infectious or other hazardous materials to the face, when the microorganisms must be manipulated outside of the biosafety cabinet.
3. Protective laboratory coats, gowns, smocks, or uniforms designated for lab use should be worn while in the laboratory. This protective clothing should be removed and left in the laboratory before leaving for non-laboratory areas (e.g., cafeteria, library, administrative offices). All protective clothing should be disposed of either in the laboratory or laundered by the institution; it should never be taken home by personnel.
4. Gloves (nitrile or latex) should be worn when hands may contact infectious materials, contaminated surfaces or equipment. Wearing two pairs of gloves may be appropriate, if a spill or splatter occurs; the hand will be protected after the contaminated glove is removed. Gloves should be removed and disposed of when contaminated, removed when work with infectious materials is completed, and should not be worn outside the laboratory. Disposable gloves are not washed or reused.

BSL-2 Laboratory Facilities (Secondary Barriers)

1. Each laboratory should contain a sink for hand washing.
2. The laboratory is designed so that it can be easily cleaned and disinfected. Rugs in laboratories are not appropriate, and should not be used because proper decontamination following a spill is extremely difficult to achieve.
3. Bench tops are impervious to water and resistant to acids, alkalis, organic solvents, and moderate heat.
4. Laboratory furniture is sturdy, and spaces between benches, cabinets, and equipment are accessible for cleaning.
5. An eyewash facility is readily available.
6. The laboratory should be at negative pressure with respect to areas outside the lab. Hoods and biosafety cabinets should be positioned away from doors, supply vents and air conditioner airflow.

Biosafety Level 3

Biosafety Level 3 is applicable to working with indigenous or exotic agents, such as brucella and tuberculosis, that may cause serious or potentially lethal disease through the inhalation route of exposure. Laboratory personnel must receive specific training in handling pathogenic and potentially lethal agents, and must be supervised by scientists competent in handling infectious agents and associated procedures. All procedures involving the manipulation of infectious materials must be conducted within a BSC (preferably Class II or Class III), or other physical containment devices. A BSL-3 laboratory has special engineering and design features.

Biosafety Level 4

Biosafety Level 4 is required for work with dangerous and exotic agents, such as Ebola, that pose a high individual risk of aerosol-transmitted laboratory infections and life-threatening disease that is frequently fatal, for which there are no vaccines or treatments, or a related agent with unknown risk of transmission. Agents with a close or identical antigenic relationship to agents requiring BSL-4 containment must be handled at this level until sufficient data are obtained either to confirm continued work at this level, or re-designate the level. Laboratory staff must have specific and thorough training in handling extremely hazardous infectious agents. Laboratory staff must understand the primary and secondary containment functions of standard and special practices, containment equipment, and laboratory design characteristics. All laboratory staff and supervisors must be competent in handling agents and procedures requiring BSL-4 containment. The laboratory supervisor in accordance with institutional policies controls access to the laboratory.

Section 6.3.5. Medical Monitoring

The major purpose of medical monitoring is the early detection of disease or conditions for which treatment can prevent further illness. Medical monitoring is conducted to evaluate exposure to human and zoonotic diseases and unanticipated adverse health effects of exposure. It can also be a valuable tool for hazard control to monitor if initially effective control or work practice has lost effectiveness, or by detecting previously unknown exposures.

Medical consultations should take place:

- Whenever an injury occurs, such as a needlestick, or splash with contaminated material.
- Whenever an employee develops symptoms of exposure to a hazardous chemical or biological agent to which the employee may have been exposed in the laboratory.
- Whenever a spill, leak, explosion, or other occurrence results in the likelihood of an overexposure to a hazardous chemical or biological agent.
- When an employee requests a medical consultation due to health concerns related to assigned tasks and/or change in personal medical history, such as pregnancy, special medications, diagnosed hypersensitivities or other illnesses.
- When exposure monitoring results trigger medical surveillance requirements or when other regulations mandate medical consultations, such as for the use of respiratory protection.

Section 6.3.6. Medical Waste Management

Safe Sharps Disposal

The term "sharps" refers to any object that can cut or puncture the skin including, but not limited to, needles (hypodermic and suture), scalpels, lancets, broken vials or glass, broken capillary tubes, slides and coverslips, and exposed ends of contaminated wires. The primary cause of occupational exposure to blood-borne pathogens in field and laboratory personnel is injury from needlesticks or other sharp objects. At least 20 pathogens are known to have been transmitted following percutaneous exposure to blood. Infections with each of these pathogens are potentially life threatening – and preventable.

How to prevent sharp injuries:

- Do not bend, break, or cut sharps. Shearing or breaking of needles is prohibited.
- Concentrate on what you are doing and do not get distracted.
- Dispose of all sharps in an approved puncture-resistant container as soon after use as possible.
- Ensure this container is placed in the area where sharps are used.
- Ideally, needle and syringe should be disposed as one unit if possible. If a needle must be removed follow the directions on the **Removal of the syringe needle** section above.
- Do not recap needles unless absolutely necessary. If recapped, never use two hands, instead use the one-hand "scoop" technique (see **Removal of the syringe needle** section above).
- Do not overfill sharps disposal container. Seal the container and replace when it is ¾ full.
- Do not empty sharps containers. Dispose of whole container as one unit.
- Wear utility gloves when disposing of medical waste including sharps containers.
- To prevent sharp injuries during transport of medical waste, use a puncture-proof container that remain closed.

Sharps Disposal Containers

Never discard needles and sharps in waste bags, as personnel might be injured when they handle the bags.

Sharp containers are available commercially or can be adapted from some containers that comply with minimal safety standards.

Commercial sharp disposal container boxes)

Non-commercial sharp disposal containers (safety

There are four major criteria for sharps disposal container safety performance, functionality, accessibility, visibility, and accommodation:

Functionality: Containers should remain in a good state during their entire usage. They should be leak-resistant on their sides and bottoms and puncture-resistant until final disposal. Individual containers should have adequate volume and safe access to the opening.

Accessibility: Containers should be accessible to all workers who use, maintain, or dispose of sharp devices. Containers should be placed in all areas where sharps are used and, if necessary, be portable within the workplace or for fieldwork. Portable containers must have a lid to prevent spills and injuries during transport or while working in the field.

Visibility: Containers should be plainly visible to the workers who use them. Workers should be able to see the warning labels and the degree to which the container is full.

Accommodation: Container designs should be convenient, environmentally sound, and easy to store.

Medical Waste Disposal

Biological waste includes human and animal tissues, fluids and animal carcasses. These are generated along with the sharps and other biologically contaminated equipment that typically need to be discarded in all laboratories (e.g. pipette tips, gloves).

Animal carcasses should be bagged, sealed, and stored in freezers located in the facility until pick up for incineration.

All other biologically contaminated material should be placed in a red bag-lined medical waste box. When the medical waste box is full, it is the responsibility of the field and laboratory personnel to seal the bag, seal the box, and apply a label that contains information about the generating lab.

Medical waste container appropriate for storing and transporting biological waste

Inappropriate container and method for storing and transporting biological waste

Section 6.3.7. Special Chemical Storage and Handling Practices

Laboratory chemical storage and handling hazards can be effectively managed if you:

- Maintain good inventory control and purchase/use the least amount possible.
- Label all stored and in-process chemicals clearly and completely.
- Adopt safe handling practices.
- Use secondary containment and practice your spill response plan.
- Segregate incompatible chemicals and store them in separate appropriate cabinets or cold-storage.
- Develop special controls for highly hazardous materials.

Inventory Control

- Purchase chemicals only in the quantities needed and in containers of the smallest practical size. Although the cost may be higher, significant savings will be gained by reduced hazardous waste disposal or clean-up costs.

- Inventory your chemical supplies at least annually and actively share or distribute excess stocks with other departments to minimize waste. Dispose of all unused and outdated chemicals through appropriate hazardous waste programs.
- Products that could also be purchased for home use, such as soap, oil, or cleaning sprays, should be part of your chemical inventory and have an MSDS on file if the product will be used in an occupational setting and could cause a health exposure in the workplace.
- Before laboratory personnel leave the laboratory, all leftover chemicals should be inventoried and distributed or disposed of.

Labeling

Personnel should ensure that labels on containers of hazardous chemicals are not removed or altered, particularly the manufacturer's original label. Empty chemical containers must never be reused for another purpose, even if the labeling is changed as reactions with new liquid and residual chemical could be extremely dangerous. All bottles, containers, and other apparatus containing chemicals should be accurately and clearly labeled as to contents, hazards, and where practical, the appropriate precautions required when handling the chemical.

Avoid the use of grease pencils or other markers that will wear off.

There are three levels of complexity to labeling: original container, secondary transfer containers, and small container (vials, flask, beakers) for immediate, same-day use.

1. The manufacturer's original labels must contain the following information:
    - Name of chemical or solution
    - Manufacturer name and emergency telephone number
    - Hazard warning (health effect or target organs)

    When opening you must add:
    - Date received and opened
    - Initials

2. For laboratory-prepared solutions and when chemicals are transferred to secondary containers not intended for immediate use, labels should include:
    - Name (no abbreviations) of the chemical and its concentration.
    - For prepared solutions or any secondary containers: initial and date prepared.
    - Hazard warning on the most serious health or safety hazard posed (consult MSDS). Stickers can be applied indicating "corrosive," "carcinogen," "water-reactive," "flammable," etc.
    - If special precautions are critical, expand the hazard warning to include the target organ and the required protection (e.g., "Corrosive, esp. to skin and eyes. Use gloves and goggles").

3. Containers for immediate (same-day) use should have:
    - Chemical name and its concentration
    - Date
    - Initials

Safe Handling and Transfer

Hand-carried chemicals should be placed in unbreakable secondary containers such as bottle carriers or acid-carrying buckets. Wheeled carts used to transport chemicals should have side guards and lipped surfaces capable of containing a break, and sturdy wheels that move easily over uneven surfaces.

Staff should wear protective aprons, gloves, goggles and closed-toed shoes when transporting chemicals.

Class I flammable liquids (any liquid having a flash point below 37.7^{o}C should not be stored or transferred from one vessel to another in an exit access corridor, open plan building, or in an ancillary space unprotected from the exit access corridor.

Transfer of Class I liquids to smaller containers from bulk stock containers not exceeding 5 gallons in capacity should be performed in a laboratory hood, in an area provided with ventilation adequate to prevent accumulations of flammable vapor exceeding 25% of the lower flammable limit, or within an inside liquid storage area approved for dispensing.

Class I liquids should not be transferred between conductive containers of greater than 1.1 gallons, unless the containers are bonded and grounded (the process of providing an electrically conductive pathway - usually by clipping connecting wires - between a dispensing container and a receiving container [bonding], and the receiving container and an earth ground).

Secondary Containment and Spill Control

Liquid chemicals should be stored in corrosion-resistant trays or on spill pallets or other secondary containment to contain a break or leak.

Concentrated acids and bases should be stored in acid or caustic storage cabinets. If possible, keep corrosives stored in their original (e.g. Styrofoam cubes) shipment containers.

In the event of a chemical spill, try to turn off all reaction apparatus, especially heat sources, notify supervision immediately and follow the response steps in your facility.

Cabinet and Shelf Storage – General Precautions

Cabinets and other storage areas should be marked with the general class of chemical stored, and any other pertinent warnings.

Storage areas should have good general ventilation and be well lighted.

On shelves, containers should be staggered for easy access, with labels facing out. DO NOT ALPHABETIZE STORED CHEMICALS; SEPARATE BY COMPATIBILITY (see next section).

Heavy and large containers are to be placed on bottom shelves. Chemicals, especially liquids, should be stored below eye level. Larger containers should be stored on lower shelves. Exposure to heat or direct sunlight should be avoided. Avoid storing chemicals on the floor unless in approved shipping containers. Minimize open shelf or bench top storage, except for those chemicals currently being used, to prevent accidental spills and reduce the risk of fires.

Cabinets specifically for corrosives (either acids or bases) should have corrosion-resistant paint. Flammable storage cabinets should provide an airtight seal; vent holes should be kept covered and flame-arrestor kept in place.

Oxidizers MUST be stored in separate cabinets from flammables and combustibles. Oxidizers, explosives, and organic peroxides must be separated from combustibles and placed in a metal cabinet, or in an approved dry, cool, and well-ventilated location.

If acids and bases must be stored together in the same cabinet, place each in separate secondary containers (non-reactive trays) on opposite sides of the cabinet to minimize intermingling in case of a spill or drip (in other words, do not store all the acids on one shelf, and all the bases on the shelf below).

Initially assign each chemical to broad hazard classes, for example: flammable, corrosive (acids and bases), reactive oxidizer or reducer, special hazard (air/water reactive, peroxide forming chemical, store at reduced temperature or under an inert atmosphere, highly toxic).

Chemicals that possess more than one hazard (i.e., oxidizer and corrosive) are assigned to the class that represents the greater hazard for that laboratory.

Post incompatibility lists (from your MSDSs) for reference.

Hazardous chemicals should be disposed of in clearly labeled containers, and as with storage, separated by class. For example, acids should not be disposed of with bases but should be separated. The same is true for corrosives and flammables.

Refrigerators and Freezers – Flammable Storage

All refrigerators or freezers should be distinctly marked as to whether they are suitable for the storage of flammable liquids.

Standard household-variety refrigerators should not be used to store flammable liquids.

Flammable liquids stored in refrigerated equipment should be in closed containers.

Storage of Chemicals by Class

Flammables and Combustibles

Flammables are chemicals that have a flash point less than 37°C (100°F). Combustible chemicals have flash points that are 37-93°C. If stored or used improperly, flammables and combustibles can be a fire hazard.

Examples of flammable liquids include benzene, alcohols, acetone, ethers, organic acids (i.e., glacial acetic acid).

The quantity of flammable/combustible hazardous chemicals within a laboratory unit or in a laboratory work area, that is stored in the open, shall be limited to the minimum necessary to perform required tasks.

Bulk supplies of alcohol (such as 95% EtOH in drums) should be stored in an approved flammable liquids storage room.

To the greatest degree possible, the storage of flammable liquids in a laboratory work area, outside of an approved flammable liquids cabinet, or storage room should be limited to what is needed for a single day's use. Otherwise, flammable liquids should be stored within an approved flammable liquids cabinet when not in use.

Corrosives: Acids

Acids are corrosive and react violently with bases. There are two main groups of acids: organic acids, and inorganic (mineral) acids. Some inorganic (mineral) acids are oxidizers and will react with organics, increase burning rate of combustibles and contribute an oxygen source to a combustion reaction. Therefore, inorganic (mineral) acids should be stored separately from organic acids.

Examples of inorganic OXIDIZING acids: perchloric acid (particularly dangerous at elevated temperature), chromic acid, nitric acid, sulfuric acid (particularly dangerous at elevated temperature).

Examples of inorganic MINERAL acids: hydrochloric acid, hydrofluoric acid, phosphoric acid.

Examples of organic acids: acetic acid, formic acid, butyric acid, propionic acid, picric acid, acrylic acid.

Oxidizing inorganic acids should be segregated from organic acids, flammable and combustible materials. Most mineral acids can be stored together, except perchloric acid (see below):

Nitric acid shall be stored separate from other acids.

Segregate acids from bases and active metals such as potassium and magnesium.

Segregate acids from chemicals that could generate toxic gases upon contact, such as sodium cyanide.

Segregate acids from solvents such as toluene and xylene.

Organic acids (e.g., glacial acetic acid) are combustible and should be stored separately or with flammables rather than with inorganic acids. Several inorganic acids are oxidizers and are therefore incompatible with organics.

Corrosives: Bases
Bases are corrosive and react violently with acids.

Examples: ammonium hydroxide, sodium hydroxide, calcium hydroxide, organic amines.

Segregate bases from acids. Bases are also corrosive to skin and tissue. Pay meticulous attention to PPE when using bases.

Reactive: Oxidizers
Oxidizers react vigorously with reducing materials. The reaction can lead to fires or explosions. Oxidizers will increase the burning rate of combustible materials and contribute oxygen to a combustion reaction.

Examples: halogens, ammonium persulfate, hydrogen peroxide, sodium dichromate, potassium permanganate, perchloric acid; at elevated temperature, ammonium nitrate (and other nitrate salts).

Keep oxidizers away from flammables, combustibles (such as paper, wood) and other reducing agents.

Reactive: Reducers
Reducing materials react vigorously with oxidizers. The reaction can lead to fires or explosions.

Examples: ammonia, carbon, metals, metal hydrides, phosphorus, silicon, sulfur.

Store reducing materials away from oxidizers.

Water-reactive Chemicals
Water reactive materials react with water, water solutions, moisture, or humidity in the air to produce heat and/or flammable gases, which can ignite.

Examples: sodium (elemental), potassium (elemental), calcium carbide, phosphorous pentachloride.

Store water reactives away from any sources of water or moisture. Review manufacturer's recommendations for special storage conditions, such as under an inert atmosphere or, as in the case of elemental sodium, under mineral oil.

Peroxide Forming Chemicals

Potentially explosive peroxides are formed by a free-radical reaction of hydrocarbons with molecular oxygen. Distillation, evaporation or other concentration of the peroxide can cause an explosion in contaminated hydrocarbons.

Examples: diethyl ether, tetrahydrofuran, acetaldehyde, isopropyl ether.

Store peroxide-forming chemicals away from light and heat. Carefully label all containers with the date received and the date opened. Monitor container dates and avoid keeping peroxide-forming chemicals on hand for more than a year after receipt and 6 months after opening.

Highly Hazardous Chemicals

Highly hazardous chemicals are defined as chemical carcinogens, reproductive toxins, acutely toxic substances, and highly reactive materials (ex. Ethidium bromide used in molecular laboratories).

Designate a Restricted Work Area. Conduct all transfers and work with these substances in a "controlled area" (i.e., a restricted access hood, glove box, or portion of a lab designated for use of highly-toxic substances) for which all personnel with access are aware of the substances being used and the necessary precautions that must be taken. Only trained and authorized personnel should work in or have access to controlled areas.

Signs and labels. Assure that the controlled area is conspicuously marked with restricted access and warning signs, such as, "WARNING: Highly-Toxic Substance in Use: Authorized Personnel Only" or "WARNING: Cancer-Suspect Agent: Authorized Personnel Only." All containers of these substances must be appropriately labeled with identity and warning such as, "Warning: High Chronic Toxicity or Cancer Suspect Agent."

Storage. Store containers of these chemicals in a ventilated, limited access area in appropriately labeled, unbreakable, chemically resistant, secondary containers.

Establish Decontamination Procedures. The need for routine decontamination of designated work area, equipment, or personnel depends on the laboratory circumstances.

Medical surveillance. When using a highly toxic substance on a regular basis (e.g., 3 times per week), consult with your supervisor concerning medical surveillance or other health concerns you may have.

Cleanup and Waste Disposal. Use chemical decontamination whenever possible. Use a vacuum cleaner equipped with a High Efficiency Particulate Air (HEPA) filter, instead of dry sweeping

when the toxic substance is a dry powder. A wet mop may also be used when the chemical is not water reactive or otherwise incompatible with water. Ensure that all vacuum filters, bag debris, mop heads or cleaning rags, as well as waste chemicals are transferred from the designated control according to a hazardous waste disposal container. Ensure that contingency plans, equipment, and materials are available to minimize exposures to personnel and property in the event of an accident. Do not ask/expect custodial staff to clean hazardous materials spills, unless they are already members of the facility's trained response team.

Hazardous Waste Disposal and Spill Control

Each container of hazardous waste is to be labeled with the following legends:

"HAZARDOUS WASTE"
Contents (be specific as to chemical):
Accumulation start date:

If a reagent container label has been removed or becomes illegible, and the identity of the contents is unknown, the container must be disposed of as soon as possible by arrangement with the facility hazardous waste coordinator.

Prior to the departure of staff, chemicals for which that person was responsible should be inventoried and discarded or returned to storage.

Pouring hazardous waste chemicals down the drain, adding them to regular trash, or evaporating them in a local exhaust hood could be illegal actions!

Section 6.3.8. Training in Basic Laboratory Procedures and Protocols

Training and education in laboratory safety need to be an ongoing process, not just an annual presentation. The most effective way to reinforce good work practices is to involve all personnel from principal researchers to volunteers in regular, periodic reviews and updates of this Basic Laboratory Safety Guide. Documentation of all forms of training is to be maintained in the laboratory as well as reported to the facility safety coordinator.

INITIAL BASIC LAB HAZARD AWARENESS TRAINING **is mandatory for all staff** and must be provided to all employees doing field and laboratory work prior to actual lab and field work, and prior to assignments involving new potential exposures. Information provided during trainings should include:

The location and availability of the Laboratory Safety Plan, chemical inventory, Material Safety Data Sheets (MSDSs), applicable regulatory exposure limits, and other reference material regarding the safe handling, storage, and disposal of hazardous chemicals (or hazardous collections) in the lab.

Signs and symptoms associated with exposures to hazardous chemicals and biological agents used in the laboratory, as well as the health hazards themselves.

Methods that may be used to detect the presence or release of a hazardous chemical. This could include industrial hygiene monitoring, the use of continuous monitoring devices, visual appearance, or odors of chemicals.

Methods employees can take to protect themselves from hazards, including work practices, personal protective equipment and emergency procedures listed in the LSP. This should include a discussion of the proper use and limitations of engineering controls and safety devices, including chemical and biological hoods.

Emergency response plans established by each facility's Emergency/Disaster Response Plan, any medical or first aid response specifically recommended, extinguishment of clothing fires (Stop, Drop, and Roll), and Chemical Spill Response Plans established by each facility.

Section 6.3.9. Basic Standards and Guide Checklists

- [ ] Coordinators should provide a "Useful Contacts" list with address and numbers of local medical and emergency response services.
- [ ] Personnel should know the locations of the emergency supplies (fire extinguishers, first aid kits, spill kits, safety showers and eye wash stations), phone numbers of supervisor and exits.
- [ ] Coordinators must verify that a Material Safety Data Sheet (MSDS) for each product to be used during PREDICT activities is readily available, complete and updated.
- [ ] Personnel should know where the MSDSs are located.
- [ ] Coordinators must ensure that personnel have read and understood the MSDS before using a chemical product
- [ ] Coordinators must have MSDS data available for emergency responders.
- [ ] Individuals that have been exposed to any hazardous chemical or biological agent should immediately report the exposure to medical authorities and supervisor.
- [ ] A complete list with the contents of the PPE kit should be available to the personnel.
- [ ] Personnel should wear appropriate PPE (lab-coat, protective glasses, gloves, closed toed shoes) for laboratory procedures.
- [ ] Inspect your PPE to ensure that it is in proper working condition before use (goggles, gloves, etc.).
- [ ] If you are working with PPE kits, ensure that the kit is stocked and material has not expired.
- [ ] Personnel must use a chemical, fume or laminar flow hood when indicated.
- [ ] All needles, scalpel blades and any other sharp instruments should be used and disposed of in a manner that prevents accidental human injury.
- [ ] All stored and in-process chemicals should be labeled clearly and completely.
- [ ] Segregate incompatible chemicals and store in appropriate cabinets or special cold-storage.
- [ ] Develop special controls for highly hazardous materials.
- [ ] Purchase chemicals only in the quantities needed and in containers of the smallest practical size.
- [ ] Inventory your chemical supplies at least annually and actively share or distribute excess stocks with other departments.
- [ ] Dispose of all unused and outdated chemicals through appropriate hazardous waste programs and NOT down the drain or by adding them to regular trash.
- [ ] Sinks and eye wash stations should be kept clear and in proper working condition.
- [ ] Staff should wash their hands and forearms after they have removed and disposed their PPE or after removing gloves.
- [ ] Food and beverages are NOT allowed in any of the labs.
- [ ] Report any lab failure (equipment, facilities, etc.) to the supervisor.
- [ ] Staff should keep BUTTONED lab coats at all times when working in the laboratory.
- [ ] All human and animal tissues, fluids and excrement should be handled in a Class II Biosafety Cabinet so that the potential for human exposure is minimized.
- [ ] Specific Biosafety levels 1 and 2 practices should be followed by personnel as warranted.
- [ ] Personnel must be familiar with hazard controls and safe operating procedures.

Section 6.3.10. List of Equipment and Supplies

- [ ] Lab-coat
- [ ] Nitrile gloves ideal, latex if not available
- [ ] Face-mask
- [ ] Goggles
- [ ] Face-shield
- [ ] Closed toed shoes
- [ ] Disposable (Tyvek) suit
- [ ] Sharp-container
- [ ] Medical waste box
- [ ] Respirator
- [ ] PPE Kits or Supplies
- [ ] Eyewash station
- [ ] Liquid nitrogen gloves

Section 6.3.11. References

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Section 3. Emergency Preparedness

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Objective: To provide guidance for PREDICT personnel to prepare for and respond to field emergencies.

This document was made possible by the generous support of the American people through the United States Agency for International Development (USAID) Emerging Pandemic Threats PREDICT program. It was drafted to support activities conducted under PREDICT and is intended for an audience of qualified professionals trained in standard, associated best practices. This guide is not intended for use by untrained individuals.

For more information about the contents of this guide, please contact predict@ucdavis.edu.

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Table of Contents: Emergency Preparedness

Section 3.1. Overview and Resources

This material is intended to supplement other PREDICT guides and protocols that detail safety and protection measures for field situations. Namely it is imperative that all personnel are thoroughly familiar with the PREDICT guides relevant to their job tasks (e.g., PREDICT guides for ***Safe Animal Capture and Handling (Section 5.2.5.)***, ***Human Biological Sampling (Section 5.4.2.)***, ***Biosafety and PPE Use (Section 4.)***, ***Basic Laboratory Safety Guides (Section 6.3.)***, as well as the relevant sampling guides for specific taxa. This document is intended to provide guidance and a collection of materials and resources for personnel use.

In performing fieldwork in their role for PREDICT, personnel may encounter a wide variety of hazards that they should be prepared for ahead of time. These hazards and the risks associated with them will vary and depend on many factors. This guide is intended to help personnel identify and prepare for the hazards, emergencies, and accidents they are most likely to encounter and that are not otherwise well-covered in PREDICT materials. It must be understood that the risk of accidents and emergencies can never be eliminated, but that careful planning and good preparation can minimize many of the most serious risks and resulting negative outcomes.

Emergency and accident preparedness encompasses a large body of information and materials beyond the scope of this guide. Personnel seeking further information on topics relating to emergency preparedness for disasters, general building operations, laboratory procedures, and related activities are advised to seek information on what are generally referred to as 'emergency action plans' (EAP) or 'accident preparedness plans' (APP). Additional information on those topics can be found at the following links:

Emergency Action Plans

- http://www.nuc.berkeley.edu/sites/default/files/resources/safety-information/Building%20Emergency%2007%20FINAL.pdf
- http://www.lni.wa.gov/Safety/TrainingPrevention/Programs/?F=SHPN
- www.osha.gov/SLTC/etools/evacuation

General Disaster Preparedness:

- http://multimedia.peacecorps.gov/multimedia/pdf/library/T0123_dpm_pst.pdf
- http://www.redcross.org/prepare/disaster

Section 3.2. Confirmation of Knowledge

When you are familiar with the information in this guide, take the PREDICT quiz in ***Section 8.4.2. Emergency Preparedness***.

Section 3.3. Plan for Field Emergencies

Accidents and emergencies are inherently unplanned events, but many of them can be anticipated and prepared for. Being prepared for emergencies requires planning. Good planning is particularly important when working with field teams and in remote locations.

A basic process for emergency planning should include the following steps (adapted from the Global Safe Haven Network, which is targeted to individual student travel planning but has useful resources; www.globalsafehaven.org):

1. **Understand the hazards** and issues you may face. Consider the following categories of hazards: health, security, travel requirements, weather environment, transportation, legal, financial, communications, culture, language. (See following section for more information.)
2. **Evaluate the risks**.
3. **Communicate** with all field team members and supervisors to make sure everyone understands, is comfortable with, and is prepared for identified risks.
4. **Address and mitigate each issue** to your team's comfort level. Most risk mitigation strategies have inherent financial costs. Regardless of whatever else is addressed, develop an emergency communication plan.
5. **Monitor the local situation** in the event something changes.
6. **Respond to any change** or incident as necessary by preplanning.

More details can be found at: http://www.globalsafehaven.org/downloads/step_broch.pdf

Identify Hazards

The types of hazards and emergencies that any team may encounter will depend on many variables. Some will be consistent with all field activities while others may depend on site or time specific field activities. Therefore, hazards should be identified and evaluated before each field activity, and plans should be developed appropriately.

The following list (with worksheet in ***Appendix I***) is provided in order to assist field teams to compile appropriate lists for their specific activities and sites.

Some Potential Field Hazards and Issues

1. Health
   a. Exposure to infectious diseases not associated with the project (malaria, dengue fever, cholera, etc.)
   b. Pharmacy availability
   c. Access to emergency medical care
   d. Handled animal bite/scratch/goring
   e. Non-target animal bite/scratch/goring (including snakebite)
   f. Staff anesthetic exposure
   g. Other toxic exposure

   h. PPE breach/infectious disease exposure (needlestick, scalpel cut)
   i. Burn, chemical injury
   j. Fall/trauma
   k. Spontaneous (heart attack, appendicitis, heatstroke, hypoglycemic crisis)
   l. Accidental gunshot wound
2. Security
   a. Robbery, car jacking
   b. Coup, riot, political uprising
   c. Passport lost or stolen
3. Travel requirements
   a. Insufficient visa/entry paperwork for any/all staff
   b. Improper vehicle paperwork
4. Weather and environment
   a. Extreme temperature or conditions
   b. Flood
   c. Severe storm
   d. Earthquake
5. Transportation
   a. Auto accident
   b. Vehicle breakdown
   c. Inability to refuel
6. Legal
   a. Police/military detainment (warranted or unwarranted)
   b. Insufficient permits for samples, supplies (including dart guns), chemicals
7. Financial
   a. Unexpected expenses (including bribes)
   b. Access to cash (ATMs, banks, etc.)
   c. Emergency evacuation costs
8. Communications
   a. Lack of mobile phone coverage
   b. Loss of primary communications (dead phone battery, robbery)
9. Culture
   a. Lack of local permission to perform activities
   b. Lack of cooperation (suspicion, lack of communication)
10. Language
   a. Inability to communicate with local population in event of emergency

Once hazards are identified, addressed, and discussed, field teams should reach a consensus on appropriate measures to take and plan accordingly. In addition to those measures, field teams should always prepare at least the two types of documents described below for each field site.

Prepare "Emergency Communications Plan" *(template provided in **Appendix II**).*
The purpose of an Emergency Communications Plan is to make sure that field teams can access necessary resources in the event of an emergency. Critical to this planning is having a well-informed understanding of what communications will be available at the field site. In many regions mobile phone coverage may not exist and/or be limited to only certain carriers. Field teams should always have a basic or back-up plan for how to communicate if an emergency arises whether directly from a field site or by reaching the nearest resource. In many cases the team may have only one vehicle, which poses a risk if the vehicle breaks down and there is no local communication. It is recommended that each field team have a satellite phone to secure communication capacity for the field team.

Prepare "Field Personnel Emergency Information Records" *(template provided in **Appendix III**).*
The purpose of Personnel Emergency Information Records is to make sure that critical information about each team member is known and readily available in case of emergency. Emergency planning should consider worst-case scenarios and in this context a team member may be unconscious or otherwise unable to communicate. The information gathered for this type of documentation may be imperative for emergency responders and other medical authorities. It should be noted that 'emergency responders' may not always (or even usually) be available and that those responsibilities would then fall upon other team members until medical services can be engaged.

Emergency Planning Checklist:
A checklist for emergency planning is provided as Appendix IV and should be supplemented and edited as needed.

Section 3.4. First Aid

A comprehensive presentation of First Aid is beyond the scope of this document and personnel are referred to any recently published First Aid manuals, booklets, or guides. Those seeking further information may find the subcategory of First Aid referred to as "Wilderness First Aid" particularly useful because it deals with emergencies in remote settings. The Wilderness Medical Society has a number of resources, including guides and bibliographies, at their website: **www.WMS.org**.

Field teams should all have at least two members who are properly trained in basic First Aid techniques including cardiopulmonary resuscitation (CPR)[1] and wound management.

Personnel should also always operate under the basic tenets of First Aid: preserve life, prevent further harm, and promote recovery. Field teams must also always have a First Aid Kit available (see below). *It is the responsibility of the Country Coordinator to seek training for personnel and ensure field teams follow this basic premise.*

[1] *Note: most CPR training certificates must be renewed every 12 months.*

If no other resources are available, the following basic online First Aid resources can be consulted: http://www.redcross.org or http://www.firstaidweb.com.

While PREDICT field teams will typically be equipped with extensive medical supplies for field anesthesia of wildlife, sampling and diagnostics, they should also carry basic First Aid kits (best kept in waterproof containers) with dedicated materials for personnel emergencies.

Below is a basic First Aid kit list to which you can add on as the length and remoteness of your trip dictates:

- 10 pairs of nitrile gloves (medium and large)
- 1 CPR mask (with one-way valve)
- 4 absorbent compress dressings (5 x 9 inches)
- 25 adhesive bandages (assorted sizes)
- 1 adhesive cloth tape (10 yards x 1 inch)
- 5 antibiotic ointment packets (approximately 1 gram)
- 5 antiseptic wipe packets
- 2 packets of aspirin (81 mg each) (within the expiration date)
- 2 packets of ibuprofen (within the expiration date)
- 4 packets of anti-diarrheal tablets such as loperamide
- 1 blanket (space blanket)
- 1 instant cold compress
- 2 hydrocortisone ointment packets (approximately 1 gram each)
- 2 antibiotic ointment packets (approximately 1 gram each)
- Scissors
- 1 roller bandage or vet wrap (3 inches wide)
- 1 roller bandage or vet wrap (4 inches wide)
- 5 sterile gauze pads (3 x 3 inches)
- 5 sterile gauze pads (4 x 4 inches)
- Oral thermometer (non-mercury/non-glass)
- 2 triangular bandages
- Compression wrap for supporting ankles or knees
- Tweezers
- First aid instruction booklet
- Headlamp or other light source
- +/- EpiPen for life-threatening allergic reactions to be administered by trained personnel. A training video can be found here: http://www.epipen.ca/en/about-epipen/how-to-use-epipen Print out instruction form found here and include in kit: http://www.epipen.ca/sites/default/files/pdf/en/Instruction_Sheet.pdf. EpiPen users must observe the expiration date of the individual pens and replace accordingly. Expired EpiPens are considered hazardous waste and must be returned to the pharmacy where they were purchased for proper disposal.

Section 3.5. Employee Health

Personnel safety is covered in the PREDICT guides for ***Safe Animal Capture and Handling (Section 5.2.5.)***, ***Human Biological Sampling (Section 5.4.2.)***, and for ***Biosafety and PPE Use (Section 4.)***. This section supplements that information and refers specifically to practices relating to institutional occupational health and safety programs.

In the United States, the Occupational Safety and Health Administration mandates that employers "assure safe and healthful working conditions" for employees, and that medical testing is available to employees exposed to potential hazards to determine whether the health of such employees is adversely affected by such exposure" (Occupational Safety and Health Act 1970). All PREDICT partner institutions are assumed to be appropriately managing general occupational health programs for their staff both domestically and abroad.

With an understanding that institutional practices may vary, the following recommendations apply to all PREDICT field personnel:

General Practices

1. Individuals with known allergies associated with animals, with immune deficiency diseases, or who are on immunosuppressant therapy, should not engage in studies involving the handling of animals and sick people.
2. Pre-exposure screening for tuberculosis is required for personnel who will be handling non-human primates. Tuberculosis screening and interpretation of results should only be conducted by a human health professional.
3. If within institutional capacity and guidelines, it is advised that periodic (annual) blood/serum samples be collected from all staff and banked.
4. All accidents, injuries and medical emergencies should be recorded and reported to direct supervisors immediately (see following section and report templates in Appendices VII a, b, and c).

Immunizations

1. The Country Coordinator or field supervisor should ensure that personnel have consulted with a human health professional with regard to the immunizations required prior to travel or participating in fieldwork that involves handling animals, human and animal samples. Required vaccines and immunizations will vary depending on the geographical area, animal species to be handled, whether staff member will be conducting human sampling, and personal medical history. Only a human health professional can recommend and provide vaccination and immunizations to personnel.
2. Due to the significant risks of rabies exposure when working with wild mammals (bats, carnivores, etc.), pre-exposure rabies vaccination is required for all personnel handling these species.
3. Tetanus immunization is also required for all personnel.

Health Records

All personnel health records must be guarded with the strictest confidentiality as directed by institutional requirements. Templates for employee medical history and vaccinations are provided in Appendix V and VI.

Section 3.6. Incident or Accident Reporting

It is important that any on the job accident or injury requiring even basic medical attention, including self-treatment, is documented and reported. PREDICT field personnel are presumed to be operating in environments often characterized by unhygienic conditions and with many known and unknown hazards (infectious agents, animals, human samples, scalpels, needles, darts, chemicals, etc.). Not all consequences of even the most minor injuries can always be foreseen and even minor cuts or abrasions can lead to life-threatening infection with pathogenic, treatment-resistant agents, especially in remote settings. Basic information collected at the time of injury can help to identify health hazards for future preventative actions and may also be critical for future treatment, clinical interventions, or even legal proceedings.

Accident and incident reporting may be mandated by each PREDICT partner institution. In the absence of other guidelines, very basic template accident reporting forms, provided in Appendix VII, can be used as-is or edited as needed. These templates include formats for both personal injury as well as motor vehicle accidents.

Section 3.7a. Appendix I. Hazard Identification Worksheet

Field Activity: _____
Date: _____
Location: _____
Team Leader: _____

A. Health *(e.g., animal injuries, human sampling, traumas, toxins)*

a. _____
b. _____
c. _____
d. _____
e. _____
f. _____

B. Security *(e.g., robbery, unrest)*

a. _____
b. _____
c. _____

C. Travel Requirements *(e.g., visas, permits)*

a. _____
b. _____
c. _____

D. Weather and Environment *(e.g., storms, natural disasters)*

a. _____
b. _____
c. _____

E. Transportation *(e.g., auto accident, breakdown, fuel)*

a. _____
b. _____
c. _____

F. Legal *(e.g., detainment, permits)*

a. _____
b. _____
c. _____

G. Financial *(e.g., extra expenses, evacuations)*

a. _____
b. _____
c. _____

H. Communications *(e.g., loss of primary form of communication)*

a. _____
b. _____
c. _____

I. Culture *(e.g., lack of local cooperation)*

a. _____
b. _____
c. _____

J. Language *(e.g., inability to communicate with locals)*

a. _____
b. _____
c. _____

Section 3.7b. Appendix II. Emergency Communications Plan Template

Planned Activity Date(s): _____

Team Leader: Name: _____ Phone: _____

Team Members

Name:_____ Phone: _____
Name:_____ Phone: _____
Name:_____ Phone: _____
Name:_____ Phone: _____

Satellite phone number: _____

Local or Regional Supervisor or Contact (not with team):
Name:_____ Phone:_____,_____,_____

International Emergency Supervisor or Contact
Name:_____ Phone:+_____,_____,_____

Field Site:_____
Country:_____ Region, Province,
State:_____
City/Village/Local: _____
GPS Coordinates: _____, _____ Reference: _____
EXPECTED MOBILE PHONE SERVICE: _____

Local Point(s) of Contact: Name: _____
Phone:_____ Address: _____

Local Emergency Number, if any (e.g., 911 service) _____

Nearest Hospital and Contact Info: _____

Nearest Clinic, Dispensary and Contact: _____

Nearest Airport: _____

Nearest Phone Line: _____

Local Police: _____ **National Police:** _____

Other Emergency Contacts (fire, ambulance): _____

Local Authority (mayor, district supervisor, district authority):
_____

Legal Contact or Lawyer: _____

Embassy, Consulate Mission Contacts: _____

Section 3.7c. Appendix III. Field Team Emergency Information Template

Name	Date & place of birth	Passport info (Country, #)	Personal/family emergency contact information	Health insurance (provider, policy, primary physician)	Med-evac insurance (provider, policy)	Blood type	Medical conditions	Known allergies

Section 3.7d. Appendix IV. Emergency Checklist for PREDICT Field Activities

___ Copy of emergency contact list/communications plan to accompany team (originals should be stored in office files).

___ Copy of field team personnel info data to accompany team

___ Copies of above documents accessible in office and/or with emergency contacts

___ First aid kit

___ Primary communications equipment (cell phone, sat phone, two-way radio)

___ Back-up communications equipment

___ Vehicle emergency equipment (spare tires, triangles, fire extinguisher, extra food and water, etc)

___ Printed current maps of field location and surrounding areas

___ GPS unit

___ Emergency funds

- Local cash
- 'Hard' currency (dollars, Euros, pounds sterling)
- Internationally accepted credit cards

___ Original and/or photocopies of passports, permits, and insurance cards

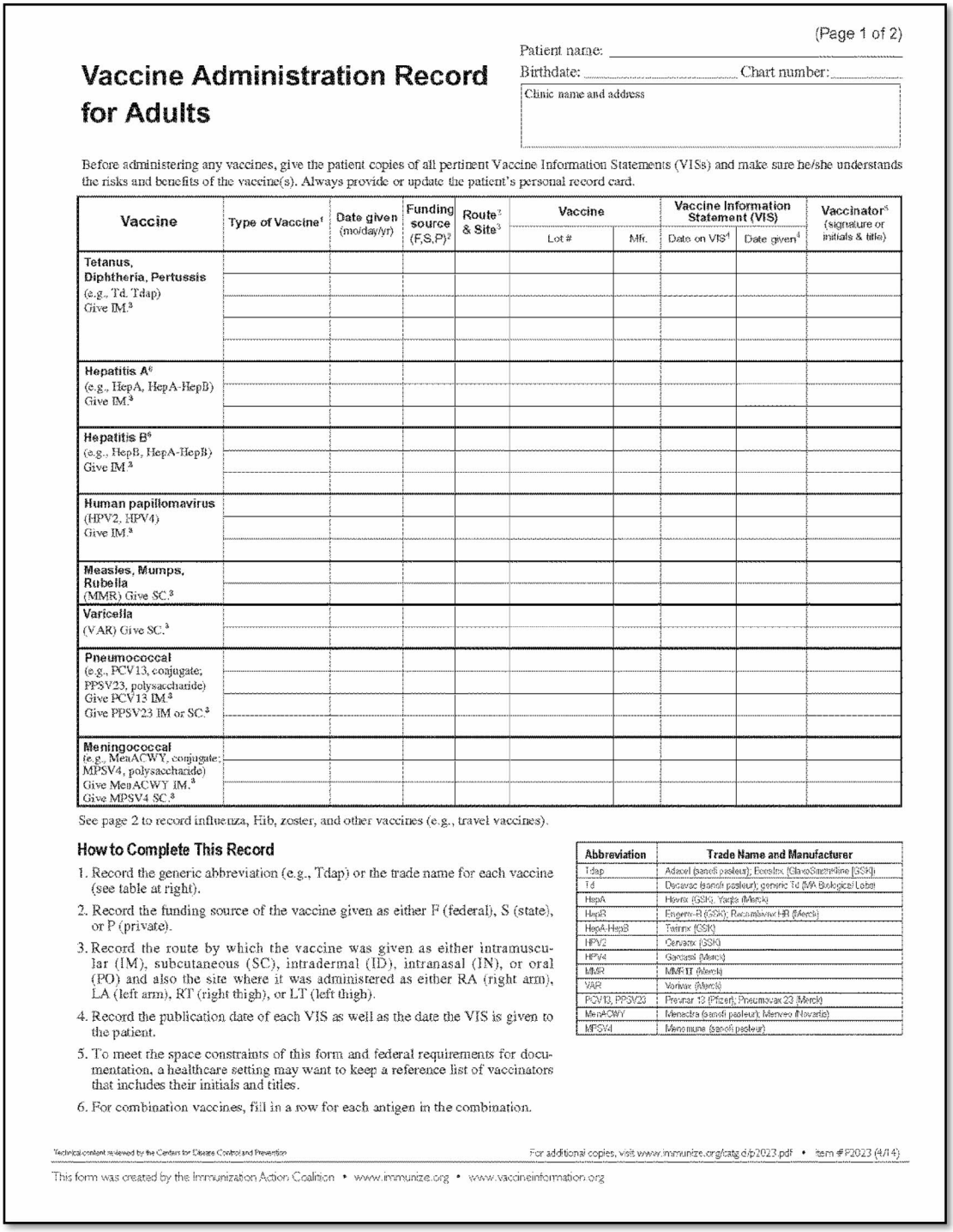
___ Spare batteries, car/DC charger adapter

___ Flashlights

___ Emergency kits for expected procedures (e.g., Ebola or B virus exposure kits)

Section 3.7e. Appendix V. Adult Vaccine Record

CDC Format



(Page 1 of 2)

Patient name: _____

Birthdate: _____ Chart number: _____

Clinic name and address

Vaccine Administration Record for Adults

Before administering any vaccines, give the patient copies of all pertinent Vaccine Information Statements (VISs) and make sure he/she understands the risks and benefits of the vaccine(s). Always provide or update the patient's personal record card.

Vaccine	Type of Vaccine[1]	Date given (mo/day/yr)	Funding source (F,S,P)[2]	Route[3] & Site[3]	Vaccine		Vaccine Information Statement (VIS)		Vaccinator[5] (signature or initials & title)
					Lot #	Mfr.	Date on VIS[4]	Date given[4]	
Tetanus, Diphtheria, Pertussis (e.g., Td, Tdap) Give IM.[3]									
Hepatitis A[6] (e.g., HepA, HepA-HepB) Give IM.[3]									
Hepatitis B[6] (e.g., HepB, HepA-HepB) Give IM.[3]									
Human papillomavirus (HPV2, HPV4) Give IM.[3]									
Measles, Mumps, Rubella (MMR) Give SC.[3]									
Varicella (VAR) Give SC.[3]									
Pneumococcal (e.g., PCV13, conjugate; PPSV23, polysaccharide) Give PCV13 IM.[3] Give PPSV23 IM or SC.[3]									
Meningococcal (e.g., MenACWY, conjugate; MPSV4, polysaccharide) Give MenACWY IM.[3] Give MPSV4 SC.[3]									

See page 2 to record influenza, Hib, zoster, and other vaccines (e.g., travel vaccines).

How to Complete This Record

1. Record the generic abbreviation (e.g., Tdap) or the trade name for each vaccine (see table at right).
2. Record the funding source of the vaccine given as either F (federal), S (state), or P (private).
3. Record the route by which the vaccine was given as either intramuscular (IM), subcutaneous (SC), intradermal (ID), intranasal (IN), or oral (PO) and also the site where it was administered as either RA (right arm), LA (left arm), RT (right thigh), or LT (left thigh).
4. Record the publication date of each VIS as well as the date the VIS is given to the patient.
5. To meet the space constraints of this form and federal requirements for documentation, a healthcare setting may want to keep a reference list of vaccinators that includes their initials and titles.
6. For combination vaccines, fill in a row for each antigen in the combination.

Abbreviation	Trade Name and Manufacturer
Tdap	Adacel (sanofi pasteur); Boostrix (GlaxoSmithKline [GSK])
Td	Decavac (sanofi pasteur); generic Td (MA Biological Labs)
HepA	Havrix (GSK); Vaqta (Merck)
HepB	Engerix-B (GSK); Recombivax HB (Merck)
HepA-HepB	Twinrix (GSK)
HPV2	Cervarix (GSK)
HPV4	Gardasil (Merck)
MMR	M-M-R II (Merck)
VAR	Varivax (Merck)
PCV13, PPSV23	Prevnar 13 (Pfizer); Pneumovax 23 (Merck)
MenACWY	Menactra (sanofi pasteur); Menveo (Novartis)
MPSV4	Menomune (sanofi pasteur)

Technical content reviewed by the Centers for Disease Control and Prevention

For additional copies, visit www.immunize.org/catg.d/p2023.pdf • Item #P2023 (4/14)

This form was created by the Immunization Action Coalition • www.immunize.org • www.vaccineinformation.org

Patient name: _____

Birthdate: _____ Chart number: _____

Clinic name and address

Vaccine Administration Record for Adults

Before administering any vaccines, give the patient copies of all pertinent Vaccine Information Statements (VISs) and make sure he/she understands the risks and benefits of the vaccine(s). Always provide or update the patient's personal record card.

Vaccine	Type of Vaccine[1]	Date given (mo/day/yr)	Funding Source (F,S,P)[2]	Route[3] & Site[3]	Vaccine		Vaccine Information Statement (VIS)		Vaccinator[4] (signature or initials & title)
					Lot #	Mfr.	Date on VIS[4]	Date given[4]	
Influenza (e.g., IIV3, trivalent inactivated; IIV4, quadrivalent inactivated; RIV, recombinant inactivated; LAIV4, quadrivalent live attenuated) Give IIV and RIV IM.[3] Give LAIV IN.[3]									
Hib Give IM.[3]									
Zoster (Zos) Give SC.[3]									
Other									

See page 1 to record Tdap/Td, hepatitis A, hepatitis B, HPV, MMR, varicella, pneumococcal, and meningococcal vaccines.

How to Complete This Record

1. Record the generic abbreviation (e.g., Tdap) or the trade name for each vaccine (see table at right).
2. Record the funding source of the vaccine given as either F (federal), S (state), or P (private).
3. Record the route by which the vaccine was given as either intramuscular (IM), subcutaneous (SC), intradermal (ID), intranasal (IN), or oral (PO) and also the site where it was administered as either RA (right arm), LA (left arm), RT (right thigh), or LT (left thigh).
4. Record the publication date of each VIS as well as the date the VIS is given to the patient.
5. To meet the space constraints of this form and federal requirements for documentation, a healthcare setting may want to keep a reference list of vaccinators that includes their initials and titles.

Abbreviation	Trade Name and Manufacturer
LAIV (Live attenuated influenza vaccine)	FluMist (MedImmune)
IIV (Inactivated influenza vaccine), RIV (recombinant influenza vaccine)	Afluria (CSL Biotherapies); Agriflu (Novartis); Fluarix (GSK); Flublok (Protein Sciences Corp.); Fluzeva (Novartis); Fluleval (GSK); Fluvirin (Novartis); Fluzone; Fluzone Intradermal; Fluzone High-Dose (Sanofi pasteur)
Hib	ActHIB (Sanofi pasteur); Hiberix (GSK); PedvaxHib (Merck)
ZOS (shingles)	Zostavax (Merck)

Technical content reviewed by the Centers for Disease Control and Prevention

For additional copies, visit www.immunize.org/catg.d/p2023.pdf • Item #P2023 (9/14)

This form was created by the Immunization Action Coalition • www.immunize.org • www.vaccineinformation.org

Section 3.7f. Appendix VI. USAID Medical History and Examination Form

USAID
FROM THE AMERICAN PEOPLE

Bureau for Economic Growth, Agriculture And Trade
Office of Education

MEDICAL HISTORY AND EXAMINATION FOR FOREIGN APPLICANTS

(Medical History To Be Completed By Applicant)

1. LAST NAME – FIRST NAME – MIDDLE NAME			2. DATE OF BIRTH (MO/DAY/YR)
3. NATIONALITY	4. SEX ☐ Male ☐ Female	5. Contact information for monitoring contractor or implementing partner who can be contacted related to medical claims in your absence	
6. TRAINING LOCATION *(City, State for U.S. training) (Country for third country training)*		7. LENGTH OF TRAINING *(Weeks, Months, Years)*	8. ESTIMATED DATE TO BEGIN TRAINING *(Month/Year)*

IMPORTANT NOTICE

Before You Complete The Medical History Questionnaire, You Are Hereby Notified That:

- USAID does not provide medical insurance for dependents that accompany or join the applicant.
- A Medical condition resulting from an undisclosed pre-existing condition will not be covered by the USAID HAC insurance and may result in termination of your training program. Likewise, a medical condition resulting from a previously undiagnosed condition may not be covered by the USAID HAC insurance and may become the responsibility of the applicant. Your training program may be terminated if it is determined that your condition will significantly impact on your program, or if you cannot cover the cost of the medical care. Public funds may not be used to cover the cost of medical care.
- I understand that by accepting USAID sponsorship I hereby waive any privacy rights that I have to such medical claims and agree to permit my insurance provider or its authorized representatives to release all information related to such claims to USAID. Such notification will include the date of the claim, the nature of the claim and copies of all documentation related to the claim. USAID shall use such claims information for reviewing its entire insurance program. I understand that I have the right to revoke this authorization by providing written notice to USAID. Such revocation will result in automatic termination of USAID's sponsorship of the program, unless USAID otherwise agrees in writing.

9. I Understand And Accept The Terms Of This Notice. ☐ Yes ☐ No

10. CHECK EACH ITEM "YES" OR "NO," EVERY ITEM CHECKED "YES" MUST BE FULLY EXPLAINED IN BLANK SPACE ON RIGHT

YES	NO		
☐	☐	a. Have you ever had any significant or serious illness or injury? *(If hospitalized, give place & dates)*	
☐	☐	b. Have you had any surgery or been advised by a physician to have surgery? *(Give place & dates)*	
☐	☐	c. Do you currently use any drugs for treatment of a medical condition? *(Give name of & dose)*	
☐	☐	d. Have you ever been a patient in a mental hospital or sanitarium or treated by a Psychiatrist? *(Give place & dates)*	

11. DO YOU NOW HAVE, OR HAVE YOU EVER HAD THE CONDITIONS LISTED BELOW? *(Indicate "Yes" or "No" To Each Item)*

YES	NO	*(Check Each Item)*	YES	NO	*(Check Each Item)*
☐	☐	a. Epilepsy, convulsions, "fits"	☐	☐	m. Tropical disease (malaria, bilharzias, amoebas, leprosy, filariasis, yaws, etc.)
☐	☐	b. Eye disease, vision defect in both or either eye	☐	☐	
☐	☐	c. Tooth or gum disease (periodontal disease)	☐	☐	n. Depression, excess worry, attempted suicide, or other psychological symptoms
☐	☐	d. Asthma, emphysema, or other lung conditions	☐	☐	
☐	☐	e. Tuberculosis or live with anyone who has tuberculosis	☐	☐	o. Drug or narcotic habit such as marijuana, cocaine, heroin, LSD, or any derivatives
☐	☐	f. High blood pressure, heart disease	☐	☐	
☐	☐	g. Stomach, liver (hepatitis), gallbladder disease	☐	☐	p. Bleeding disorder, blood disease (sickle cell anemia)
☐	☐	h. Hernia (rupture)	☐	☐	q. Acquired Immune Deficiency Syndrome (AIDS)
☐	☐	i. Kidney or bladder disease, stone or blood in urine	☐	☐	r. Tumor, abnormal growth, cyst, or cancer
☐	☐	j. Diabetes (sugar in the urine)	☐	☐	s. Skin disorder, growths, psoriasis
☐	☐	k. Joint disease or injury, swollen or painful joints	☐	☐	t. Female disorder, growths, psoriasis
☐	☐	l. Back pain, wear a back brace or support	☐	☐	u. Pregnancy

I CERTIFY THAT I HAVE READ THE ABOVE INSTRUCTIONS AND ANSWERED ALL QUESTIONS TRUTHFULLY AND TO THE BEST OF MY KNOWLEDGE.

12. PRINTED NAME OF APPLICANT	13. DATE	14. SIGNATURE OF APPLICANT

NOTE For the Examining Physician: Please review this Medical History and make appropriate remarks on the Physician's Examination Form for any boxes checked yes. Any additional tests must be indicated on the Examination Form. Any test result s that indicate a pre-existing condition(s) must be noted and explained.

AID 1382-1 (1/2010) Page 1 of 3

REPORT OF MEDICAL EXAM FOR FOREIGN APPLICANTS

(To Be Completed By The Examining Physician)

15. NAME OF PARTICIPANT — Photo

16. HEIGHT	17. WEIGHT	18. BLOOD PRESSURE	19. CORRECTED VISION L20: R20:

20. URINALYSIS (Sugar, blood, etc.)	21. BLOOD SEROLOGY TEST FOR SYPHILIS (optional) ☐ Positive ☐ Negative	22. CHEST X-RAY REPORT (Date)
23. PREGNANCY TEST (HCG) (optional) ☐ Positive ☐ Negative	24. ELECTROCARDIOGRAM REPORT *(if indicated by history or physical)*	

25. CLINICAL EVALUATION: (EVERY ITEM CHECKED "ABNORMAL" MUST BE FULLY EXPLAINED IN BLANK SPACE ON RIGHT)

NORMAL	(CHECK EACH ITEM)	ABNORMAL	DESCRIBE ABNORMAL FINDINGS
☐	Head, Nose, Mouth	☐	
☐	Ears, Hearing Acuity	☐	
☐	Lungs and Chest	☐	
☐	Heart, Rhythm & Sounds	☐	
☐	Vascular System, Varicosities	☐	
☐	Abdomen, Hernia, etc.	☐	
☐	Hemorrhoids, Fistula Prostate	☐	
☐	Urinary System	☐	
☐	Spine, Arms, Legs, etc.	☐	
☐	Skin, Lymph Nodes, Scars	☐	
☐	Neurological	☐	
☐	Emotional Stability	☐	

26. THE PHYSICIAN MUST COMMENT ON ALL ITEMS MARKED "YES" IN THE HISTORY AND COMMENT ON ANY CONDITION DISCOVERED DURING THE EXAMINATION. ADDITIONAL TESTS MUST BE IDENTIFIED. ANY TEST THAT INDICATES A PRE-EXISTING CONDITION(S) MUST BE DOCUMENTED AND BROUGHT TO THE ATTENTION OF THE USAID APPROVING OFFICER.

27. SUMMARY OF ANY DEFECTS AND DIAGNOSIS	RECOMMENDATION ☐ Medically Qualified for Training ☐ Not Medically Qualified for Training
28. NAME AND ADDRESS OF EXAMINING PHYSICIAN (Please Print or Type)	
29. SIGNATURE OF EXAMINING PHYSICIAN	30. DATE OF EXAMINATION

AID 1382-1 (1/2010) Page 2 of 3

ADMINISTRATIVE REVIEW OF MEDICAL EXAMINATION
(For Use By Post Training Office)

1. NAME OF CANDIDATE: *(Last, First, Middle)*

MEDICAL CLEARANCE ACTION

ACTION BY SPONSORING UNIT OR DESIGNEE

☐ Recommend Approval of Applicant's Entry Into Training Program

☐ Recommend Disapproval of Applicant's Entry Into Training Program

☐ Recommend waiver of Applicant's medical ineligibility for the following reasons. Health cost liability for pre-existing medical conditions will be assumed by the Mission or Bureau. (USAID signature located at bottom of this page)

☐ Health cost liability for pre-existing medical conditions will be assumed by the responsible party noted below:

REASON FOR REJECTION / WAIVER OF INELIGIBILITY

SIGNATURE	PRINTED NAME	DATE

REVIEWED BY:

SIGNATURE	PRINTED NAME

MISSION/BUREAU MEDICAL WAIVER ACTION

Applicants rejected for training because of medical problems may be re-evaluated for training with a waiver of HAC coverage for specified pre-existing condition.

The USAID Mission/Bureau may determine to grant a waiver when:

1. It is felt that the period of training will be of short duration and medical condition is unlikely to be activated or aggravated during that period; or

2. The training is considered essential to the program objective.

By granting this waiver request, the USAID Mission/Bureau accepts full responsibility to ensure payment of all claims arising from waived conditions. This determination by the USAID Director or U.S. officer designee must be obtained prior to further processing of the applicant.

Waived Condition(s):

SIGNATURE	DATE

PRINTED NAME	POSITION TITLE

AID 1382-1 (1/2010) Page 3 of 3

Section 3.7g. Appendix VII. OSHA Form for Injury and Illness Report

Version A

OSHA Form 301- Injury and Illness Incident Report

Case #_____
Recordable ☐ Non- recordable ☐
To be completed by EH&S

Information about the injured person

1) Full name: _____
2) Street _____
City _____ State _____ Zip _____
3) Injured persons "A" #_____
4) Date of birth _____ Date hired _____
5) Male ☐ Female ☐
6) Employee ☐
Job title_____
Hrs/day_____ Days/Wk_____
Student ☐
Visitor ☐
7) Program area _____ Phone #_____
8) Injured persons Signature _____
9) Supervisor_____ Phone #_____
Signature _____ Date _____

Information about the Medical Treatment

10) Extent of treatment: None ☐ First Aid ☐ Medical Treatment ☐
11) If treatment was given away from the worksite, where was it given?
Dr. Name _____
Facility _____
Street _____
City_____ State WA Zip _____
12) Was the injured person treated in an emergency room?
Yes ☐ No ☐
13) Was the injured person hospitalized overnight as an in-patient?
Yes ☐ No ☐

Information about the case

14) Date of injury or illness _____
15) Time of event:_____ AM ☐ PM ☐ Unknown ☐
16) Time injured person began work_____ AM ☐ PM ☐
17) Dates lost from work: _____ to _____
18) Dates on restricted duty: _____ to _____

Completed by:_____
Title: _____
Phone: _____
Date: _____

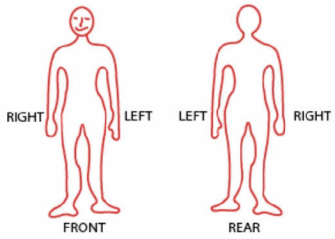
Attention: This form contains information relating to injured persons health and must be used in a manner that protects the confidentiality of the information while being used for occupational safety and health purposes to the extent possible.

19) Did injured person file a Labor & Industries report? Claim #_____
Yes ☐ No ☐
20) If the injured person died, Date of death: _____
21) Location _____
22) Witness: _____
23) What was the injured person doing just before the incident occurred? Describe the activity, as well as the tools, equipment, or material the injured person was using. Be specific. Examples: "climbing a ladder while carrying roofing materials"; "spraying chlorine from hand sprayer"; "daily computer key-entry.

24) What happened? Tell us how the injury occurred. Examples: "When the ladder slipped on wet floor, worker fell 20 feet"; "Worker was sprayed with chlorine when gasket broke during replacement"; "Worker developed soreness of wrist over time."

25) What was the injury or illness? Tell us the part of the body that was affected and how it was affected; be more specific than "hurt," "pain," or "sore." Examples: "strained back"; "chemical burn, hand"; "carpal tunnel syndrome."

26) What object or substance directly harmed the injured person? Examples: "concrete floor"; "chlorine"; "radial arm saw". If this question does not apply to the incident, leave it blank.



Mark part of body injured on diagram above

Complete this form for all injuries and illnesses. When complete, print form, get necessary signatures, & make two photocopies. Forward the original to the EH&S Coordinator in 1254 LABII and forward a photocopy to Business Services L 1125. The affected person keeps the remaining photocopy. This form should be completed within 24 hours of the incident.

www.evergreen.edu/facilities/docs/accidentreport.pdf

Section 3.7h. Appendix VIII. United States General Services Administration Motor Vehicle Accident Report Form

MOTOR VEHICLE ACCIDENT REPORT	Please read the Privacy Act Statement on Page 3	INSTRUCTIONS: Sections I through IX are filled out by the vehicle operator. Section X, items 72 thru 82c are filled on by the operator's supervisor. Section XI thru XIII are filled out by an accident investigator for bodily injury, fatality, and/or damage exceeding $500.

SECTION I - FEDERAL VEHICLE DATA

1. DRIVER'S NAME (Last, first, middle)	2. DRIVER'S LICENSE NO./STATE/LIMITATIONS	DATE OF ACCIDENT

4a. DEPARTMENT/FEDERAL AGENCY PERMANENT OFFICE ADDRESS	4b. WORK TELEPHONE NUMBER

5. TAG OR IDENTIFICATION NUMBER	6. EST. REPAIR COST	7. YEAR OF VEHICLE	8. MAKE	9. MODEL	10. SEAT BELTS USED
	$				☐ YES ☐ NO

11. DESCRIBE VEHICLE DAMAGE

SECTION II - OTHER VEHICLE DATA (Use Section VIII if additional space is needed)

12. DRIVER'S NAME (Last, first, middle)	13. SOCIAL SECURITY NO./ TAX IDENTIFICATION NO.	14. DRIVER'S LICENSE NO./STATE/LIMITATIONS

15. a DRIVER'S WORK ADDRESS	15b. WORK TELEPHONE NUMBER
16a. DRIVER'SHOME ADDRESS	16b. HOME TELEPHONE NUMBER
17. DESCRIPTION OF VEHICLE DAMAGE	18. ESTIMATED REPAIR COST
	$

19. YEAR OF VEHICLE	20. MAKE OF VEHICLE	21. MODEL OF VEHICLE	22. TAG NUMBER AND STATE

23a. DRIVE'S INSURANCE COMPANY NAME AND ADDRESS	23b. POLICY NUMBER
	23c. TELEPHONE NUMBER

24. VEHICLE IS	25a. OWNER'S NAME(S) (Last, first, middle)	25b. TELEPHONE NUMBER
☐ CO-OWNED ☐ RENTAL ☐ LEASED ☐ PRIVATELY OWNED		

26. OWNER'S ADDRESS(ES)

SECTION III - KILLED OR INJURED (Use Section VIII if additional space is needed)

	27. NAME (last, first, middle)	28. SEX	29. DATE OF BIRTH
	30. ADDRESS		

A	31. MARK "X" IN TWO APPROPRIATE BOXES	32. IN WHICH VEHICLE	33. LOCATION IN VEHICLE	34. FIRST AID GIVEN BY
	☐ KILLED ☐ DRIVER ☐ PASSENGER ☐ INJURED ☐ HELPER ☐ PEDESTRIAN	☐ FED ☐ OTHER (2)		

35. TRANSPORTED BY	36. TRANSPORTED TO

	37. NAME (last, first, middle)	38. SEX	39. DATE OF BIRTH
	40. ADDRESS		

B	41. MARK "X" IN TWO APPROPRIATE BOXES	42. IN WHICH VEHICLE	43. LOCATION IN VEHICLE	44. FIRST AID GIVEN BY
	☐ KILLED ☐ DRIVER ☐ PASSENGER ☐ INJURED ☐ HELPER ☐ PEDESTRIAN	☐ FED ☐ OTHER (2)		

45. TRANSPORTED BY	46. TRANSPORTED TO

47. Pedestrian	a. NAME OF STREET OR HIGHWAY	b. DIRECTION OF PEDESTRIAN (SW corner to NW corner, etc.) FROM	TO

c. DESCRIBE WHAT PEDESTRIAN WAS DOING AT TIME OF ACCIDENT *(crossing intersection with signal, against signal, diagonally; in roadway playing, walking, hitchhiking, etc.)*

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Previous edition not usable

STANDARD FORM 91 (2/2004)
Prescribed by GSA-FMR 102-34.295

SECTION IV - ACCIDENT TIME AND LOCATION (Use section VII if additional space is needed.)

48. DATE OF ACCIDENT	49. PLACE OF ACCIDENT (Street address, city, state, ZIP Code; Nearest landmark; Distance nearest intersection; Kind of locality (industrial, business, residential, open country, etc.); Road description).
50. TIME OF ACCIDENT ☐ AM ☐ PM	

51. INDICATE ON THIS DIAGRAM HOW THE ACCIDENT HAPPENED

Use one of these outlines to sketch the scene. Write in street or highway names or numbers

a Number Federal vehicle as 1, other vehicle as 2, additional vehicle as 3 and show direction of travel with arrow

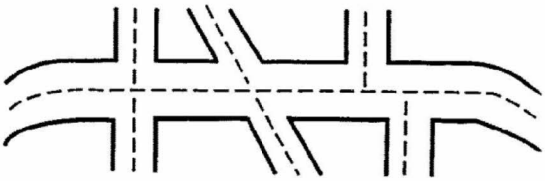
Example. → [1] [2] ←

b Use solid line to show path before accident → [2] *and broken line after the accident* ····· [2]

c Show pedestrian by → ○

d Show railroad by ++++++++++

e Place arrow in this circle to indicate NORTH ○



52. POINT OF IMPACT (Check one for each vehicle)

FED	2	AREA
		a. Front
		b. R. Front
		c. L. Front
		d. Rear
		e. R. Rear
		f. L. Rear
		g. R. Side
		h. L. Side

53. DESCRIBE WHAT HAPPENED (Refer to vehicles as "Fed", "2", "3", etc. Please include information on posted speed limit, approximate speed of vehicles, road conditions, weather conditions, weather conditions, driver visibility, condition of accident vehicles, traffic controls (warning light, stop signal,etc.), condition of light (daylight, dusk, night, dawn, artificial light, etc.), and driver actions (making a U-turn, passing, stopped in traffic, etc.)

SECTION V - WITNESS/PASSENGER (Witness must fill out SF 94, Statement of Witness) (Continue in Section VIII.)

A	54. NAME (Last, first, middle)	55. WORK TELEPHONE NUMBER	56. HOME TELEPHONE NUMBER
	57. WORK ADDRESS	58. HOME ADDRESS	
B	59. NAME (Last, first, middle)	60. WORK TELEPHONE NUMBER	61. HOME TELEPHONE NUMBER
	62. WORK ADDRESS	63. HOME ADDRESS	

SECTION VI - PROPERTY DAMAGE (Use Section VIII if additional space is needed.)

64a. NAME OF OWNER (Last, first, middle)	64b. WORK TELEPHONE NUMBER	64c. HOME TELEPHONE NUMBER
64d. WORK ADDRESS	64e. HOME ADDRESS	
65a. NAME OF INSURANCE COMPANY	65b. TELEPHONE NUMBER	65c. POLICY NUMBER
66. ITEM DAMAGED	67. LOCATION OF DAMAGED ITEM	68. ESTIMATED COST

SECTION VII - POLICE INFORMATION

69a. NAME OF POLICE OFFICER	69b. BADGE NUMBER	69c. TELEPHONE NUMBER
70. PRECINCT OR HEADQUARTERS	71a. PERSON CHARGED WITH ACCIDENT	71b. VIOLATION(S)

STANDARD FORM 91 (2/2004) PAGE 2

SECTION VIII - EXTRA DETAILS

SPACE FOR DETAILED ANSWERS. INDICATE SECTION AND ITEM NUMBER FOR EACH ANSWER. IF MORE SPACE IS NEEDED, CONTINUE ITEMS ON PLAIN BOND PAPER.

PRIVACY ACT STATEMENT

The information on this form is subject to the Privacy Act of 1974 (5 U.S.C. section 552a). Authority to collect the information is Title 40 U.S.C. Section 491 and the title 31 U.S.C. Section 7701. The formation is required by federal Government agencies to administer motor vehicle programs, including maintaining records on accidents involving privately owned and Federal fleet vehicles,and collecting accident claims resulting from accidents. Federal employees, and employees under contract, will use the information only in the performance of their official duties. Routine uses of the collected information may include disclosures to: appropriate Federal, State, or local agencies or contractors when relevant to civil, criminal, or regulatory investigations or prosecutions; the Office of personnel Management and the General Accounting Office for program evaluation purposes; a Member of Congress or staff in response to a request for assistance by the individual of record; another Federal agency, including the Department of Treasury and Justice, or a court under judicial proceedings; agency Inspectors General in conducting audits; private insurance and the collection agencies (including agencies under contract to Treasury to collect debt), and to other agency finance offices for federal management and debt collection. Furnishing the requested information is mandatory, including the Social security Number or Taxpayer's Identification Number(TIN) for use as a unique identifier to ensure accurate identification for individuals or firms in the system.

SECTION IX - FEDERAL DRIVER CERTIFICATION

I certify that the information on this form *(Sections I thru VII)* is correct to the best of my knowledge and belief.

72a. NAME AND TITLE OF DRIVER	72b. DRIVER'S SIGNATURE AND DATE

SECTION X - DETAILS OF TRIP DURING WHICH ACCIDENT OCCURRED

73. ORIGIN	74. DESTINATION

75. EXACT PURPOSE OF TRIP

	DATE	TIME *(Include AM or PM)*		DATE	TIME *(Include AM or PM)*
76. TRIP BEGAN			77. ACCIDENT OCCURRED		

78. AUTHOURITY FOR THE TRIP WAS GIVEN TO THE OPERATOR	79. WAS THERE ANY DEVIATION FROM DIRECT ROUTE?
☐ ORALLY ☐ IN WRITING *(Explain)*	☐ NO ☐ YES *(Explain)*
80. WAS THE TRIP MADE WITHIN ESTABLISHED WORKING HOURS?	**81. DID THE OPERATOR, WHILE ENROUTE, ENGAGE IN ANY ACTIVITY OTHER THAN THAT FOR WHICH THE TRIP WAS AUTHORIZED?**
☐ YES ☐ NO *(Explain)*	☐ NO ☐ YES *(Explain)*

82. COMPLETED BY DRIVER'S SUPERVISOR	a. DID THIS ACCIDENT OCCUR WITHIN THE EMPLOYEE'S SCOPE OF DUTY ☐ YES ☐ NO	b. COMENTS

83a. NAME AND TITLE OF SUPERVISOR	83b. SUPERVISOR'S SIGNATURE AND DATE	83c. TELEPHONE NUMBER

STANDARD FORM 91 (2/2004) PAGE 3

SECTION XI - ACCIDENT INVESTIGATION DATA

84. DID THE INVESTIGATION DISCLOSE CONFLICTING INFORMATION. ☐ NO ☐ YES (If checked, explain below.)

85. PERSONS INTERVIEWED

NAME	DATE	NAME	DATE
a.		c.	
b.		d.	

86. ADDITIONAL COMMENTS (Indicate section and item number of each comment).

SECTION XII - ATTACHMENTS

87. LIST ALL ATTACHMENTS TO THIS REPORT

SECTION XIII - COMMENTS/APPROVALS

88. REVIEWING OFFICIAL'S COMMENTS

89. ACCIDENT INVESTIGATOR			90. ACCIDENT REVIEWING OFFICIAL		
a. SIGNATURE		b. DATE	a. SIGNATURE		b. DATE
c. NAME (First, middle, last)			c. NAME (First, middle, last)		
d. TITLE			d. TITLE		
e. OFFICE			e. OFFICE		
f. OFFICE TELEPHONE NUMBER			f. OFFICE TELEPHONE NUMBER		
AREA CODE	NUMBER	EXTENSION	AREA CODE	NUMBER	EXTENSION

STANDARD FORM 91 (2/2004) PAGE 4

EMERGING DISEASE INSIGHTS

Research from the PREDICT Modeling & Analytics team

Distribution and Seasonality of Potential Ebola Bat Reservoirs

Identification of the natural Ebola virus (EBOV) reservoir has remained elusive. Thirty-five mammalian species in Africa and Asia, including wild primates, rodents, carnivores, and ungulates, have tested positive via PCR or serology for at least one of the five different viral strains of Ebola virus (Bundibugyo, Cote d'Ivoire/Tai Forest, Reston, Sudan, Zaire)[1]. Bats likely play a key role in EBOV ecology, with 23 species found positive or seropositive. Ten of these species occur in Africa (Table 1), where all human EBOV cases have originated.

To better understand spatial risk of EBOV spillover, the PREDICT-2 Modeling & Analytics team used ecological niche models to predict the spatial occurrence of these ten African bat species. In addition, to examine seasonal changes in spillover risk, we conducted a thorough literature review for these species to better understand the role of life history traits (Table 1) and reproductive seasonality (Table 2) in Ebola disease dynamics.

Table 1: Life-history traits of the ten potential African Ebola bat hosts.

group	species	diet	birth periods	strain	source
Megachiroptera	*Eidolon helvum*	fruits	one	Reston, Sudan, Zaire	2,3
	Epomops franqueti	fruits	two	Zaire	4,5
	Epomorphus gambianus	fruits	two	Reston, Zaire	6
	Hypsignathus monstrosus	fruits	two	Zaire	4,5
	Micropteropus pusillus	fruits	two	Zaire	4
	Myonycteris torquata	fruits	two	Zaire	4,5
	Rousettus aegyptiacus	fruits	two	Zaire	4
	Nanonycteris veldkampii	fruits	two	Reston/Zaire	6
Microchiroptera	*Mops condylurus*	insects	two	Zaire	4
	Hipposideros gigas	insects	one	Zaire	4

GEOGRAPHY OF EBOV SPILLOVER RISK

An aggregate ecological niche model (ENM) for the ten potential bat EBOV reservoir species is shown in Figure 1. Pigott et al. (2014) modeled the zoonotic niche of EBOV using occurrence

January 8, 2016

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data of three EBOV reservoirs: *E. franqueti*, *H. monstrosus*, and *M. torquata* as one component. We expanded this to include all known African EBOV-positive bat species and used an ensemble approach to minimize model uncertainty.

Gatherer (2014) proposed that the ranges of *H. monstrosus* and *M. torquata* overlapped Meliandou village in the Guéckédou Region of Guinea (location of the index for the 2014 Ebola outbreak)[8]. Thirteen species of bats have been captured in southeastern Guinea near this village, including four known EBOV hosts*: E. helvum*, *N. veldkampii*, *M. condylurus*, and *M. torquata*[9]. Our ENMs confirm the presence of three of these species, *E. helvum*, *N. veldkampii*, *M. torquata,* and suggested that *H. gigas* likely occurs there (Fig. 2).

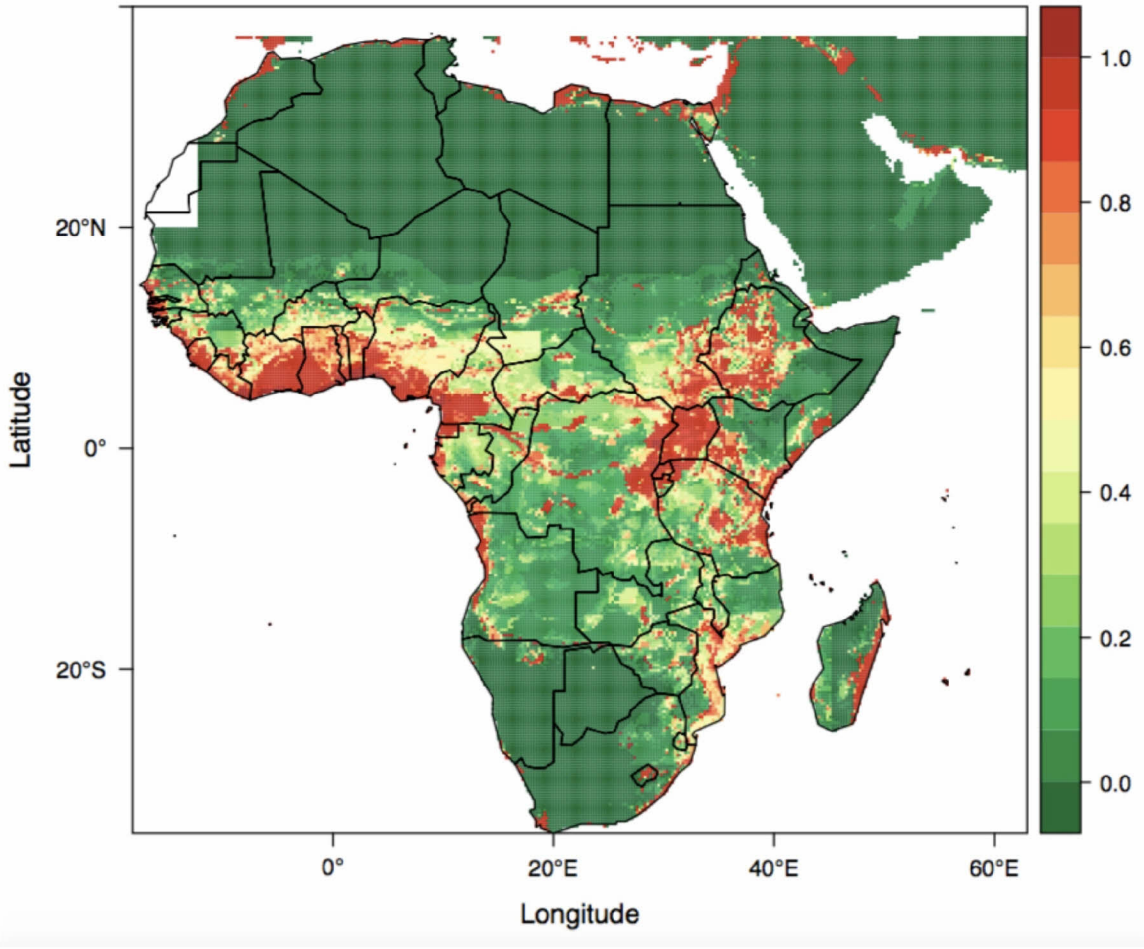

Figure 1. Stacked ecological niche models for the ten African bat species that potentially harbor the Ebola virus.

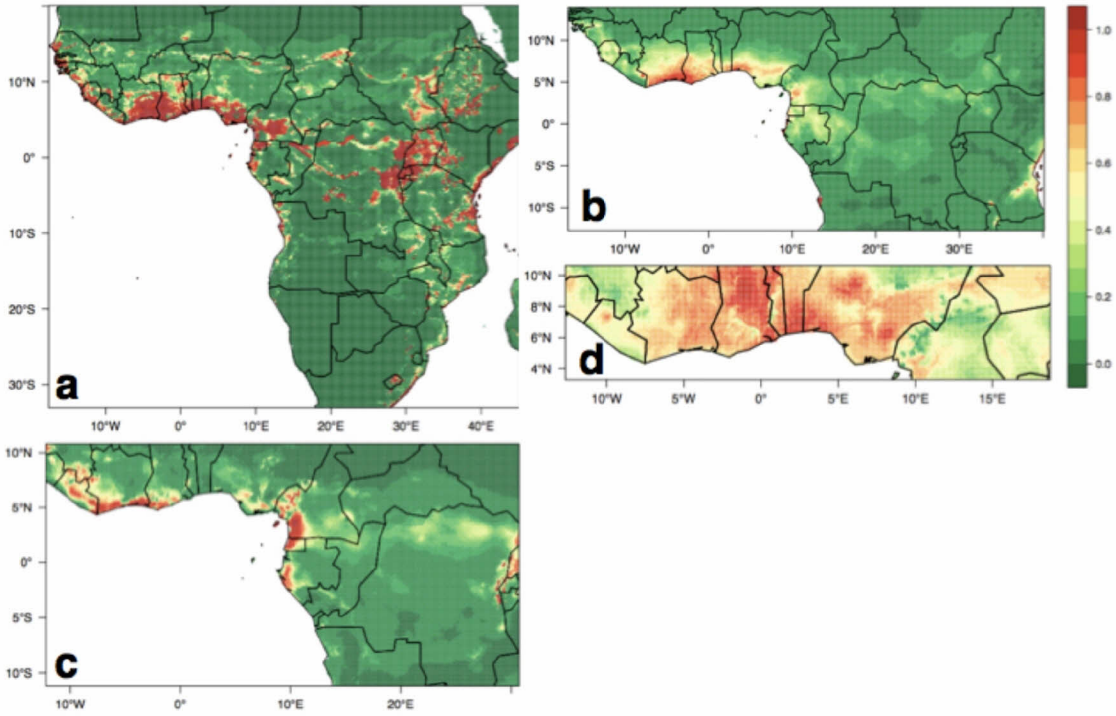

Figure 2. Ecological niche models for the four bats (a. E. helvum, b. H. gigas, c. M. torquata, d. N. veldkampii) whose suitable range include Meliandou village in Guinea, the index case of the 2014 EBOV outbreak.

POTENTIAL FOR SEASONALITY OF EBOV SPILLOVER RISK

Previous work has shown seasonal pulses of human Marburg virus cases, and of viral prevalence within the bat *R. aegyptiacus*. It is therefore logical that EBOV may also exhibit seasonal pulses within its bat reservoir hosts, tied to their life history traits. Bats have highly synchronous mating strategies, with the most energetically costly periods (late pregnancy and early lactation) occurring during the wet season, when food sources are most abundant[10]. This provides two potential drivers for EBOV spillover: 1) population pulses of recently emerged susceptible juveniles may increase risk of viral transmission[11]; and 2) abundant fruit in the wet season may increase the potential interface between humans and bats. Analysis of the literature for all likely EBOV bat reservoirs show that the reproductive cycles of West African bats exhibit birth periods from February-to-April and August-to-October, at the onset of the wet seasons (Table 2). Weaning and first flight of juvenile bats is most often during peak rainfall of May – June. These patterns suggest that there is a reasonable likelihood that seasonal patterns of EBOV spillover risk occur, perhaps with two peaks per year, at the time when maternal antibodies wane in juvenile bats, a few weeks after birth. PREDICT surveillance plans will need to include multiple field visits each year to analyze the change in viral spillover risk over time and identify peak seasonal risk.

CONCLUSIONS

1. Ensemble Ecological Niche Modeling of all 10 likely EBOV bat reservoirs suggests widespread risk of future EBOV spillover across West and Central Africa, and provides fine scale risk maps to target surveillance.

2. Analysis of life history traits for all likely EBOV bat reservoirs reveals evidence of seasonality that could drive seasonal spikes of EBOV spillover risk, perhaps with two peaks each year. Surveillance of EBOV in bats will therefore need to be planned to examine these seasonal fluctuations.

Table 2: Reproductive cycles of the West African bats that have demonstrated evidence of EBOV exposure. *Key*: G, gestation; P, parturition; L, lactation; W, weaning. Blue fill shows the wet seasons for West Africa.

Species	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
E. helvum[12]	G	G	GP	PL	L	W			G	G	G	G
E. gambianus[13,14]	G	G	GL	PL	PL	GW	GW	G	G	PL	G	G
H. gigas[15]	L	L	L	L	LW	W	G	G	G	GP	L	L
H. monstrosus[16]	G	GP	PL	L	W	G	G	GP	PL	L	W	G
M. pusillus[13]	G	P	PL	L	GL	GW	G	P	PL	L	GL	G
M. torquata[17]	G	P	PL	L	GW	GW	G	P	PL	L	GW	GW
N. veldkampii[14,18]	GL	G	G	G	P	PL	L	G	G	G	GP	PL

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EMERGING DISEASE INSIGHTS

Research from the PREDICT Modeling & Analytics team

Market Size and Avian Influenza Strain Spillover Risk

CHALLENGE

Resources to conduct biosurveillance are limited. Examining past research and computational models helps determine where it is best to conduct surveillance for diverse strains of avian influenza virus that might spillover to people. The risk of spillover, and the drivers of viral evolution likely change significantly along the animal value chain. It would be useful to identify which of the following sampling locations has the highest likelihood of generating a successful spillover so that it can be preferentially targeted:

- large market hubs
- small markets
- in the field (e.g., where poultry interacts with wild birds)
- a combination of the above locations

APPROACH

A typical live bird market with 500 animals was modeled. The species diversity from just 3 species (below average) to over 40 was varied and compared against the introduction of a novel virus of a single genotype, in one specific host in the 'virtual' market. The model assumes that the virus does not yet have a great enough transmission rate or virulence to create an epidemic, but a transmission rate that is close to the epidemic threshold (i.e., R_0 is just less than 1). Each time this virus infects a new host, a new genotype is generated, based on random change from the infecting genotype. Lastly, Neutral Theory is used to specify the species distribution in the market, for a given total number of species and total abundance of animals.

RESULTS

The figure below illustrates how the risk of zoonotic spillover (transmission of avian influenza from animals to people) and epidemic failure (inability of the novel virus to spread among animals within the markets) changes as we move from a market with low species diversity to one with high diversity.

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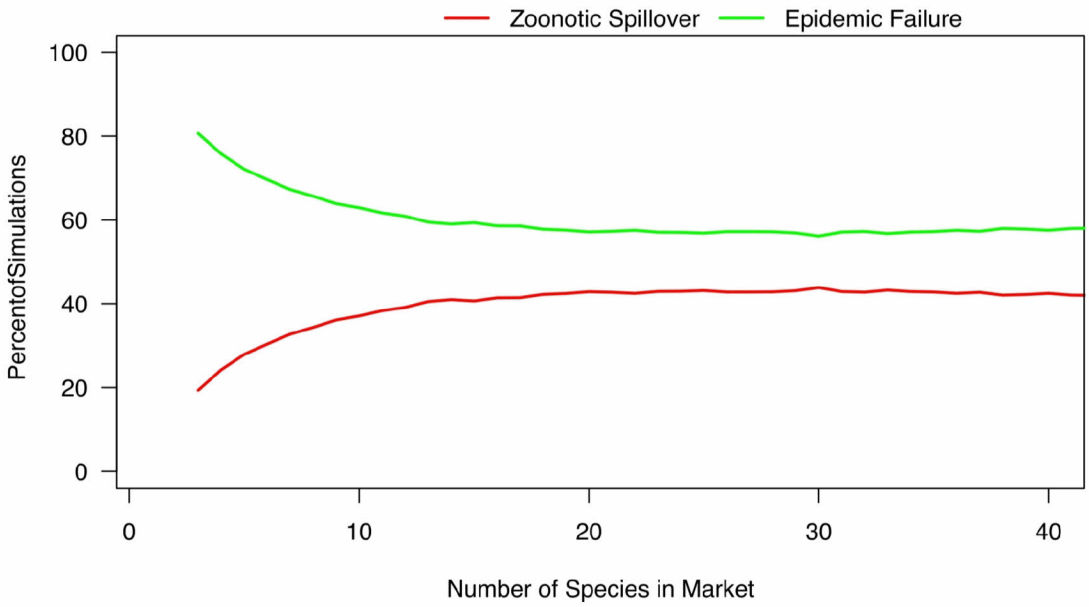

CONCLUSIONS

As diversity increases from 3 to 20 species in a wet market, the risk of zoonotic spillover doubles (from 20% to 40%), and the efficiency of transmission among the animals within the market increases similarly. Based on the results of the model, and consistent with market studies, surveillance for avian influenza diversity and potential for generation of novel strains change should be conducted in areas where the diversity of animal species is higher, e.g.: sites where wild birds and poultry comingle, in markets near wetlands, and in markets with high species diversity, regardless of market size. In contrast, targeting surveillance to large markets that have three or less species (e.g. those with only ducks and chickens) is less likely to identify likely origins of future pandemics. Finally, it's important to note that this is a preliminary study and will be improved significantly with the surveillance of a diversity of markets during EPT2.

EMERGING DISEASE INSIGHTS

Research from the PREDICT Modeling & Analytics team

Simulating Outbreak Scenarios: Novel Bat Coronavirus from Guano Harvest

This hypothetical scenario examines 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 [1]. 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.

SIMULATING EMERGENCE, SPREAD AND CONTROL

We assume that the initial spillover to people occurs through environmental exposure to the pathogen in bat guano harvested for use as fertilizer. Once spillover occurs, we assume the virus is pathogenic in humans in the absence of control measures, and spreads via a respiratory pathway with an R_0 greater than 1 (i.e., each person infects more than one additional person).

We developed a base scenario where an epidemic starts via random spillover events in locations where humans have contact with bat guano and then spreads through a network of human population centers (Figure 1). We compared this base scenario against those with different possible interventions designed to reduce viral spillover.

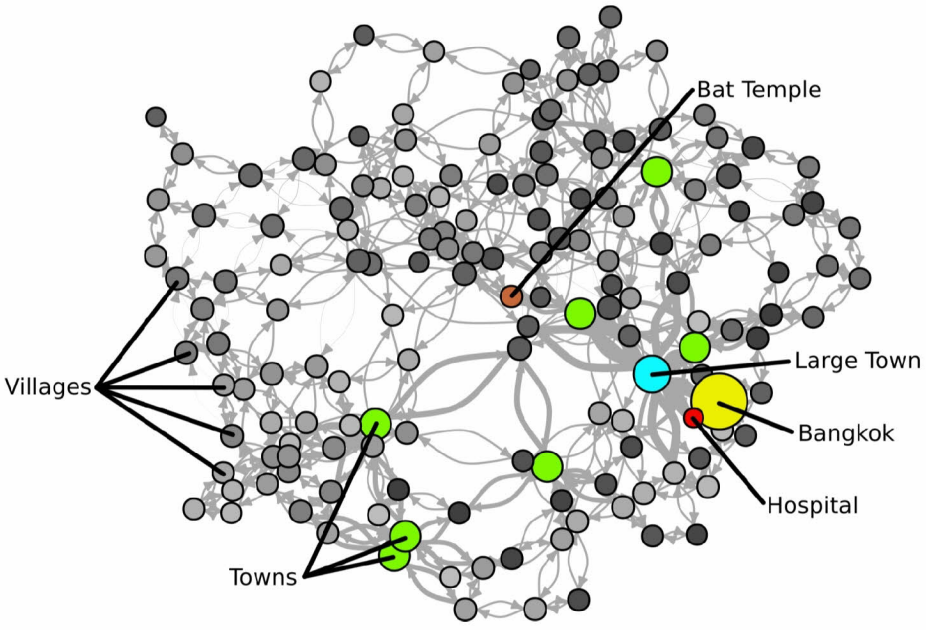

Figure 1: One instance of the human population networks used for epidemic simulations. Random networks were generated for each simulation based on available real data on the distribution of villages, towns, and major centers. Circle sizes are based on the log population size of cities, and arrow widths represent travel rates between cities.

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We simulated intervention scenarios which either reduced worker exposure to guano via personal protective equipment (PPE) or hygiene practices, via reducing the harvesting and use of guano for fertilizer, or via culling of bats. Table 1 summarizes the outcome of the base scenario and scenarios with these interventions. The percent of computer simulations where spillover and subsequent epidemic spread occurs provides an estimate of the *relative* probability of an epidemic occurring in reality.

Table 1: Probabilities of spillover and epidemic spread for the seven scenarios examined. Percentages marked with an asterisk (*) are significantly different from the base scenario.

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%

The variation among the scenarios relates to the relative *likelihood or probability* of spillover and an epidemic occuring rather than the average *number of people infected* in an epidemic. The most effective interventions are those that reduce the exposure of workers to guano via PPE and hygiene during guano harvest and use. These reduced risk by between 64% and 88%. Reducing the amount of guano harvested or culling bats resulted in no statistical change in risk of spillover and epidemic spread. This is because even a small number of workers or a small guano harvest can still entail significant spillover risk when workers are unprotected.

INTERNATIONAL SPREAD

We predicted how this hypothetical virus could spread globally via air travel. Using methods we have previously published that analyze global flight data [2], we estimated the relative time it would take the virus to arrive in different countries. This provides a ranking that can be used for prioritizing surveillance from an outbreak. We assumed the the virus arrives in Bangkok via overland travel, and enters the air travel network from there. There are 60 countries that can be reached via direct flights from Bangkok, and 157 that can be reached by including two flight legs. Based on typical passenger numbers, the 12 countries with the earliest expected arrival of an infected person are (from earliest to latest): Singapore, India, China, South Korea, Japan, Bangladesh, Vietnam, United States, Australia, Philippines, Germany, and the United Arab Emirates.

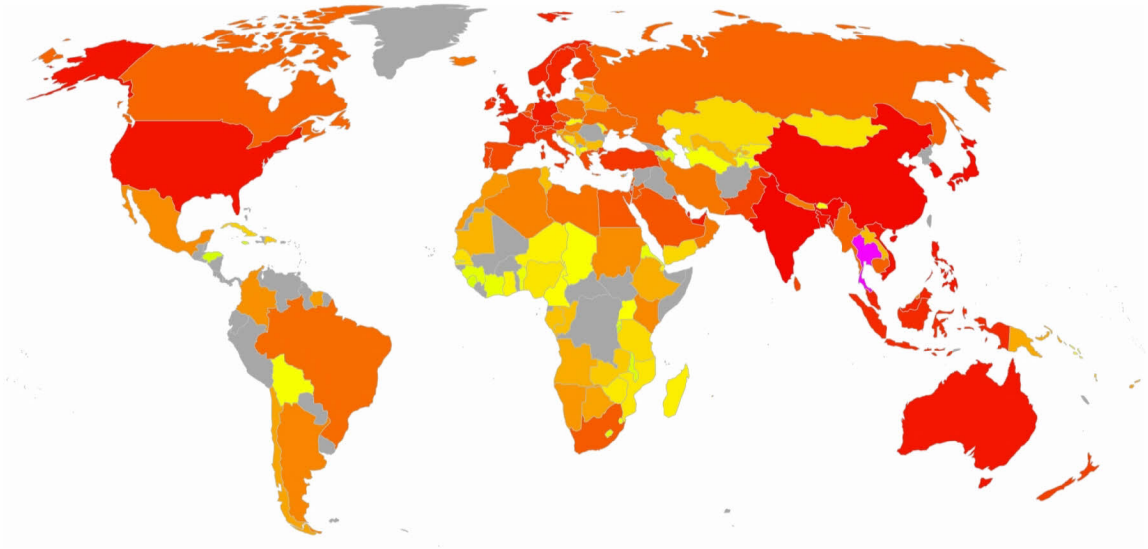

Figure 2: Rank arrival time of the virus via air travel from Thailand (purple). Early-arrival countries in red, medium in orange, and late in yellow .

DISCUSSION

This scenario demonstrates that by modeling the disease spillover process of newly discovered viruses, strategies to reduce impact can be explored even before potential outbreaks begin. Our results show that reducing exposure during bat guano harvesting and use is more effective in preventing possible outbreaks than reducing the amount of bat guano harvesting. This is the case because in our scenario, the high spillover potential and pathogenicity of the virus make even small numbers of exposed workers likely to spread the disease.

We modeled hygiene practices to reduce worker exposure to guano, and common practices (PPE, good sanitation) can reduce exposure broadly. The best methods to reduce human exposure, though, will require a greater understanding of viral transmission processes at this interface. For instance, understanding seasonality of load in guano, the dosage require for human infection, and viral survival under different conditions (temperature ranges and wet/dry guano storage) could enable efficient targeting of policy.

It is important to note that all of the interventions we examined aim to reduce the spillover rate of virus into humans, rather than mitigate spread within the human population. These interventions can therefore reduce the risk of viral spillover, but may not reduce impacts once spillover has occurred.

Finally, while in this case we modeled a scenario based in Thailand, the potential for viral emergence in bat guano harvesting is not specific to that country, and these methods may be applied in other locations where this activity occurs.

CONCLUSIONS

- Reducing human exposure to bat guano, through hand washing and other hygiene practices, or through personal protective equipment is likely to be the most successful intervention to prevent spillover of novel Coronaviruses carried by bats and excreted in their guano.

- Reducing the cultural practice of guano use as fertilizer or traditional medicine, or culling wildlife is predicted to have little effect on disease spillover risk.
- Air travel data can be used to predict international spread of viral disease to inform global surveillance during early stages of an outbreak.
- Further surveillance and research should include other interfaces where people have contact with bat guano.

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EMERGING DISEASE INSIGHTS

Research from the PREDICT Modeling & Analytics team

Mapping Hotspots of Emerging Zoonoses

Emerging diseases originating from wildlife represent a significant threat to global health, security and economic growth. Efforts to identify the geographic origins and underlying causes of disease emergence are essential to focus surveillance, prevention, and control programs so that we can contain these diseases at source and more effectively limit their spread and socioeconomic impacts. [1]

Previous work by the PREDICT team modeled the global occurrence of zoonotic diseases from wildlife species and non-wildlife species, drug-resistant infections, and vector-borne diseases [2]. This work showed that all types of emerging infectious diseases (EIDs) are associated with human population density, but that those emerging from wildlife correlate with the diversity of wildlife on our planet. It also identified hotspots for emerging diseases in largely tropical, developing countries.

Here, the PREDICT-2 Modeling & Analytics team advances this previous work, focusing on the mechanisms driving emergence of zoonoses from wildlife (these are the diseases most often responsible for pandemic risk). We 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.

MAPPING DISEASE EMERGENCE RISK

Figure 1 shows the calculated relative risk of wildlife-origin zoonotic disease emergence. Regions with the largest areas of high relative risk include South and Southeast Asia, West and East-Central Africa. Smaller hotspots of high risk can be found in Europe and the Americas.

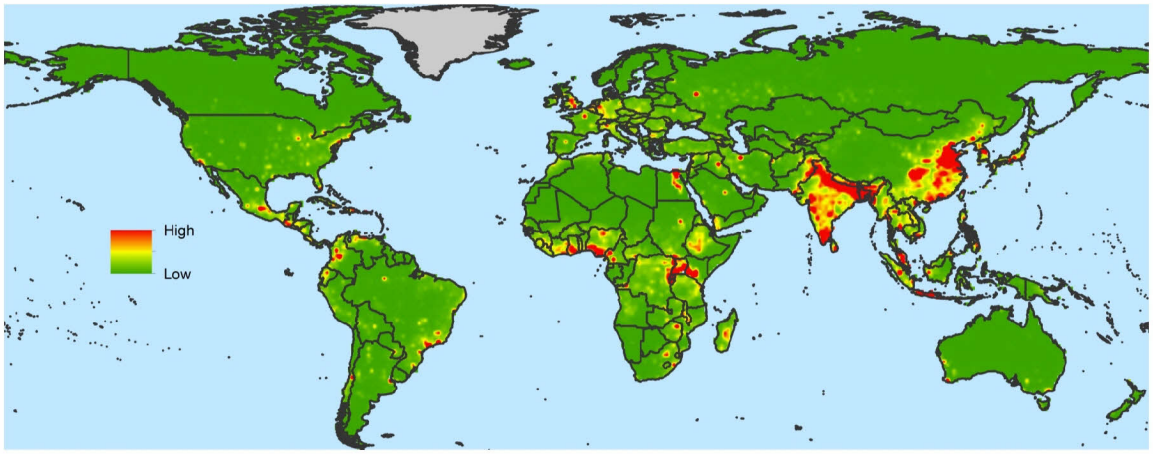

Figure 1: Heat map of predicted relative risk of zoonotic EID events, taking into account bias and under-reporting. Green indicates lowest risk, yellow mid-level risk, and red is the highest.

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UNDERSTANDING THE DRIVERS OF EMERGENCE

Biodiversity, land cover and land use were the most important factors determining where future emerging disease will originate, after accounting for observation bias and the baseline distribution of the human population (Figure 2). We found that disease emergence was more likely in areas of high mammal biodiversity and heavily forested areas. Weaker, but still important, factors included high levels of urbanization, and either very high or very low rates of land conversion to pasture (Figure 3).

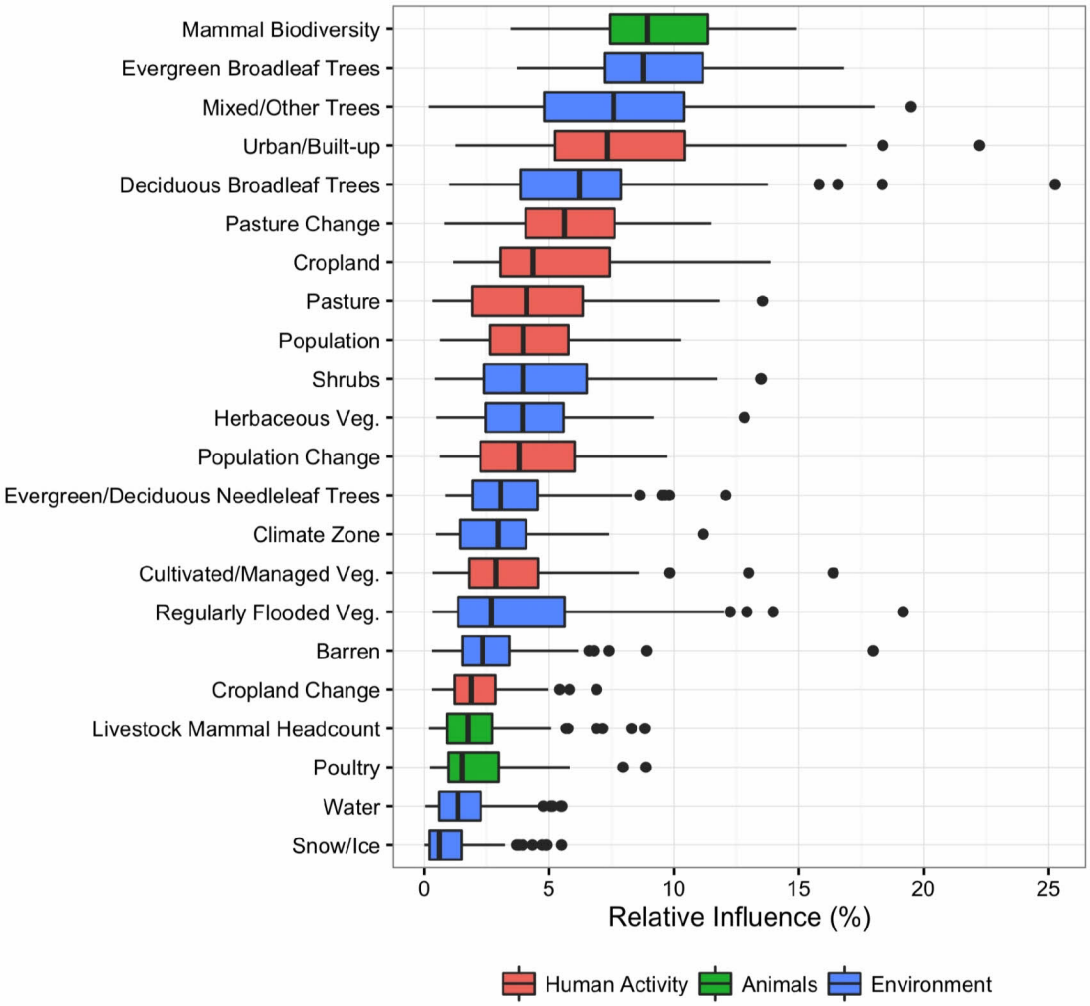

Figure 2: The relative influence of different variables on the likelihood that an emerging disease event might occur. The colored boxes show the range of relative influence to account for uncertainty in the locations of reported EID events.

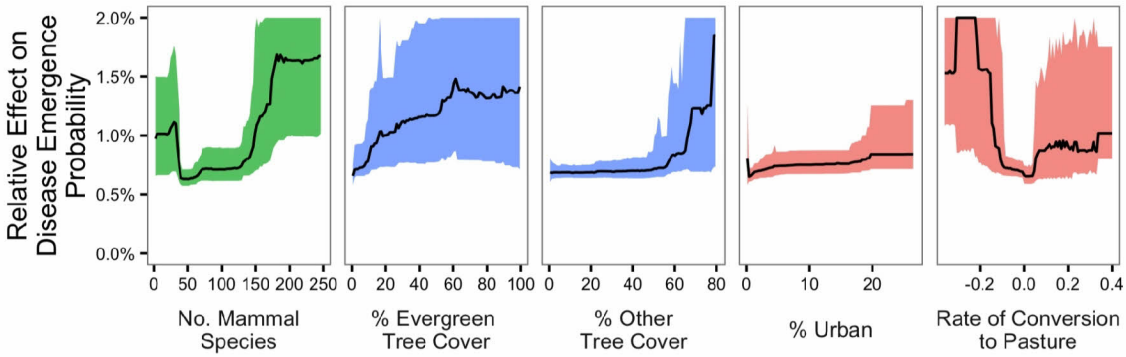

Figure 3: How key drivers influence the risk of new zoonotic disease emergence. Vertical axes show the relative importance of each factor on the risk of disease emergence and horizontal axes show the range of each driver. Graphs 1-4 show increasing risk of disease emergence with increasing levels of each driver. In graph 5, risk of disease emergence is highest at very high rates of land conversion to pasture (right of center), and high rates or from pasture (usually reforestation – left of center. Black lines show the average (median) effect on probability and coloured areas show the range of the calculated effects within 95% confidence intervals.

DISUSSION

Our analysis and our 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. These regions should be targeted for programs such as PREDICT and USAID's Emerging Pandemic Threat program that aim to identify novel pathogens in wildlife, and target high risk groups of people to develop mitigation programs that stop these new pathogens from emerging and spreading [3]. These programs will be most cost effective if they are targeted geographically to EID hotspots.

[1] S. Morse, Factors in the Emergence of Infectious Diseases. Emerg. Infect. Dis. 1 (1995) 7–15. doi:10.3201/eid0101.950102.

[2] K.E. Jones, N.G. Patel, M.A. Levy, A. Storeygard, D. Balk, J.L. Gittleman, et al., Global Trends in Emerging Infectious Diseases. Nature. 451 (2008) 990–993. doi:10.1038/nature06536.

[3] S.S. Morse, Public Health Surveillance and Infectious Disease Detection. Biosecurity and Bioterrorism: Biodefense Strategy, Practice, and Science. 10 (2012) 6–16. doi:10.1089/bsp.2011.0088.

EMERGING DISEASE INSIGHTS

Research from the PREDICT Modeling & Analytics team

MERS-CoV Surveillance in Africa

January 8, 2016

For details on methods or analysis contact: PREDICTmodeling@ecohealthalliance.org

Almost all human Middle East Respiratory Syndrome (MERS) cases have originated in the Arabian Peninsula, where the MERS-CoV has been found camels, the most probable source of virus for primary infections (Alagaili et al. 2014). Antibodies to MERS-CoV (or closely related viruses) are also widespread in camels in Egypt, Kenya, Somalia, Ethiopia, and Tunisia and the virus has been detected in camels in Egypt and Nigeria. In some areas in Africa, MERS-CoV appears to have been circulating for several decades in camels. **However, to date, no primary human MERS cases have been reported to have arose in African countries.** This may be due to biological differences in the strains of MERS-CoV circulating in Africa, variation in human susceptibility, differences in camel husbandry and trade, or lack of surveillance and reporting.

The PREDICT-2 Modeling and Analytics team collated previous evidence of MERS-CoV circulation in camels, and data on camel and human population densities, to estimate the potential human MERS burden in these countries. **We expect there to be potentially thousands of undiagnosed MERS cases in people in Africa, with varying numbers by country**, and with the potential for high burdens in Kenya, Nigeria, the former Sudan (current S. Sudan and Sudan) and Somalia (**Fig. 1**).

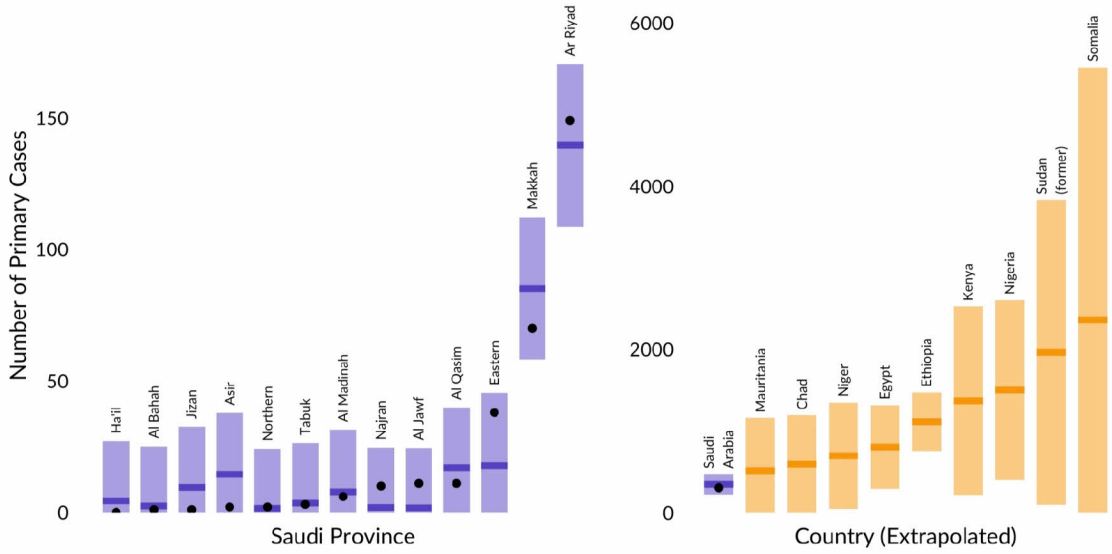

Figure 1 -- Missing MERS cases in Africa: A preliminary model based on regional data in Saudia Arabia (*left*) suggests that the number of primary MERS cases (black dots) can be predicted by the interaction of human and camel populations (prediction ranges in purple). Extrapolating to African countries (*right*, extrapolated ranges in orange) suggests that MERS-CoV would cause many thousands of human cases if it behaved similarly in Africa as in the Arabian peninsula.

We have now developed a model of MERS-CoV circulation dynamics in camel herds (**Fig. 2**). It suggests that active MERS-CoV infections are most likely to be found in (A) **juvenile camels**, (B) in the months **during and immediately after the calving season**, and (C) **at markets, trade points, and slaughterhouses** where young camels from small herds aggregate. These findings are largely supported by the scant reports from surveillance programs. Collection of additional data would allow us to parameterize these models robustly

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and to quantify and forecast disease spillover risk more accurately.

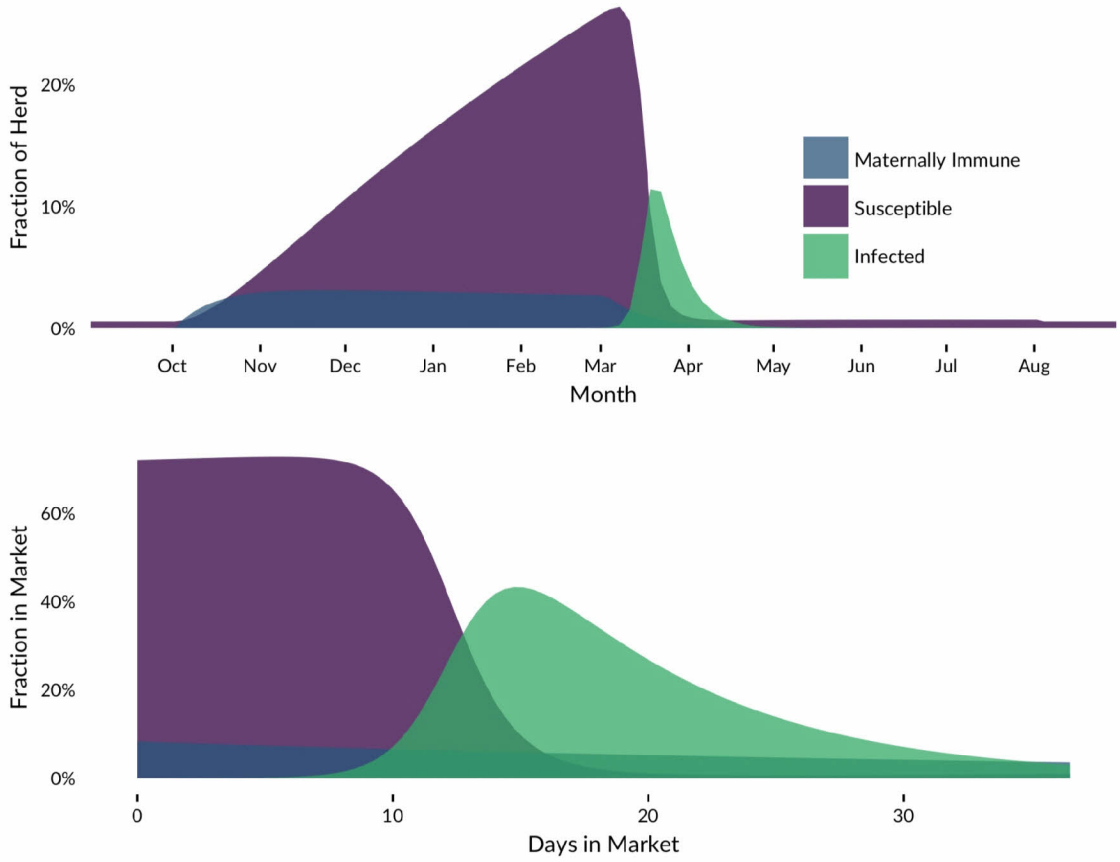

Figure 2 -- Preliminary MERS dynamic modeling: Our model indicates that the fraction of juveniles infected with MERS will spike shortly after the calving season (Oct-Feb, *top*), when enough naive juveniles have been born to cause small epidemics within herds. These dynamics are highly sensitive to herd 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.

These analyses suggest surveillance of both camel herds and humans workers in contact with camels should be prioritized to:

- African countries with large camel populations (Egypt, Ethiopia, Kenya, Nigeria, Sudan, and Somalia);
- Markets, slaughterhouses, and trade points where camels originating from different herds mix;
- During calving season (which varies by country), and the months immediately afterwards.

In addition to MERS-CoV screening in camel and human populations, including the following measurements with disease surveillance programs would be valuable:

- camel herd sizes, distribtions and demographic make-up,
- rates of off-take of camels from herds for both sale and slaughter,
- size and demographic make-up of camels sent to market, and

- behavioral surveillance of human-camel contact.

These data will support better modeling the circulation of MERS-CoV in camel populations so as to more precisely identify the locations, periods, and conditions that result in high spillover risk.

REFERENCES

Alagaili, A. N., T. Briese, N. Mishra, V. Kapoor, S. C. Sameroff, E. de Wit, V. J. Munster, et al. 2014. "Middle East Respiratory Syndrome Coronavirus Infection in Dromedary Camels in Saudi Arabia." *mBio* 5 (2). American Society for Microbiology: e00884–14–e00884–14. doi:10.1128/mbio.00884-14.

Section 8.1. QGIS Users Guide

Prepared by
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Objective:

- To understand basic GIS terminology and theory.
- To learn the geographic user interface for QGIS.
- To learn how to import files and make layers in QGIS.
- To produce and export high quality maps for presentations and publications.

This document was made possible by the generous support of the American people through the United States Agency for International Development (USAID) Emerging Pandemic Threats PREDICT program. It was drafted to support activities conducted under PREDICT and is intended for an audience of qualified professionals trained in standard, associated best practices. This guide is not intended for use by untrained individuals.

For more information about the contents of this guide, please contact predict@ucdavis.edu.

Suggested Citation Form: PREDICT One Health Consortium 2016. PREDICT Operating Procedures: QGIS Users Guide.

Table of Contents: QGIS User Guide

Section 8.1.1. Introduction to GIS

Geographic Information Systems (GIS) are the combination of computer hardware, software, data, and personnel, which makes it possible to describe and characterize the earth and other geographies for the purpose of visualizing and analyzing spatially referenced information. Broken down, the components of GIS are:

Geographic: a location at various levels of aggregation, e.g. a country, city, or a protected national forest.

Information: information about the location, e.g. population, number of sick or healthy people, species of animals sampled, etc.

Systems: helps capture, store, manipulate, analyze, manage, and present the above.

In short, GIS combines geographic data (latitude and longitude) and non-geographic information about the location (attributes like population or land use) with the help of software like ArcGIS, QGIS, GRASS, etc. This tutorial is designed to introduce you to QGIS, which is a free, open-source software. You will gain an understanding of some basic processes that can be executed using QGIS, like opening digital maps on your computer, creating new spatial information to add to a map, and creating printed maps customized to your needs.

Before you get started, it will be helpful to acquaint yourself with some basic GIS concepts.

A common function of GIS Applications is to display **map layers**, which are spatial data representing something in the real world — a roads layer for example will have data about the street network. Map layers mainly consist of two types of spatial data to represent their information:

1. **Vector data** represent information as points, lines, and areas and are most appropriate when used to represent discontinuous data, e.g. houses, rivers, national parks, etc.

2. **Raster data** represent space as a continuous field consisting of squares (called pixels) of a standard size, and are most appropriate when used to represent continuous data, e.g. land cover, soil maps, etc.

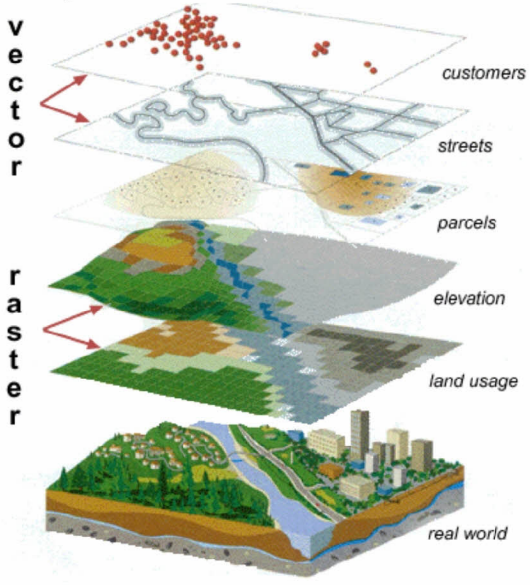


Fig1. Different GIS information layers, stacked together.Source: National Coastal Data Development Centre (NCDDC), National Oceanic and Atmospheric Administration (NOAA), USA

Every GIS dataset has a **coordinate system**, which is a reference system used to represent the locations of geographic features, imagery, and observations such as GPS locations within a common geographic framework. Put simply, a coordinate system helps enable every location on the earth to be specified by a set of coordinates of known location (latitude and longitude) on a grid. Data is represented using either a geographic coordinate system or a projected coordinate system:

1. A **Geographic coordinate system (GCS)** uses a three-dimensional spherical surface to define locations on earth via latitude and longitude values.

   Horizontal lines of latitude run parallel to the equator. Lines of latitude in the northern hemisphere are positive ranging from 0 degrees at the equator to 90 degrees at the North Pole. Lines of latitude in the southern hemisphere are negative ranging from 0 degrees at the equator to -90 degrees at the South Pole. Vertical lines of longitude are parallel to the prime meridian, ranging from 0 degrees (at the Prime Meridian) to a positive 180 degrees in the eastern hemisphere and 0 to -180 degrees in the western hemisphere.

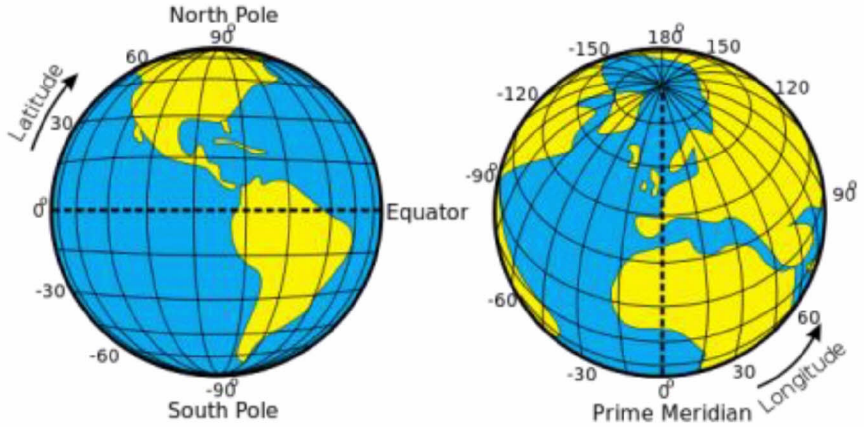


Fig 2. The geographic coordinate system.
(Source: **http://www.plux.co.uk/converting-radians-in-degrees-latitude-and-longitude/**)

2. A **projected coordinate system** is defined on a flat, two-dimensional surface. Unlike a geographic coordinate system, a projected coordinate system has constant lengths, angles, and areas across the two dimensions. This enables accurate measurements of distance, angles, and areas.

   Since projected coordinate systems are based on a sphere that is projected onto a flat plane, the coordinate system defines, with the help of coordinates, how the two-dimensional, projected map in your GIS is related to real places on the earth.

Projected coordinate systems are often referred to as projections, and the choice of which coordinate system to use (there are many options, common ones being Universal Transverse Mercator (UTM), Lambert Conformal Conic, and Albers Equal Area) depends on the regional extent of the area your work is in and on the analysis you want to conduct. A discussion about the different types of projected coordinate systems is beyond the scope of this basic introductory section; for more information, refer to the glossary and helpful links sections of this tutorial. **It is important to understand, however, that a projected coordinate system is always based on a geographic coordinate system that is based on a sphere or spheroid (which represents earth).**

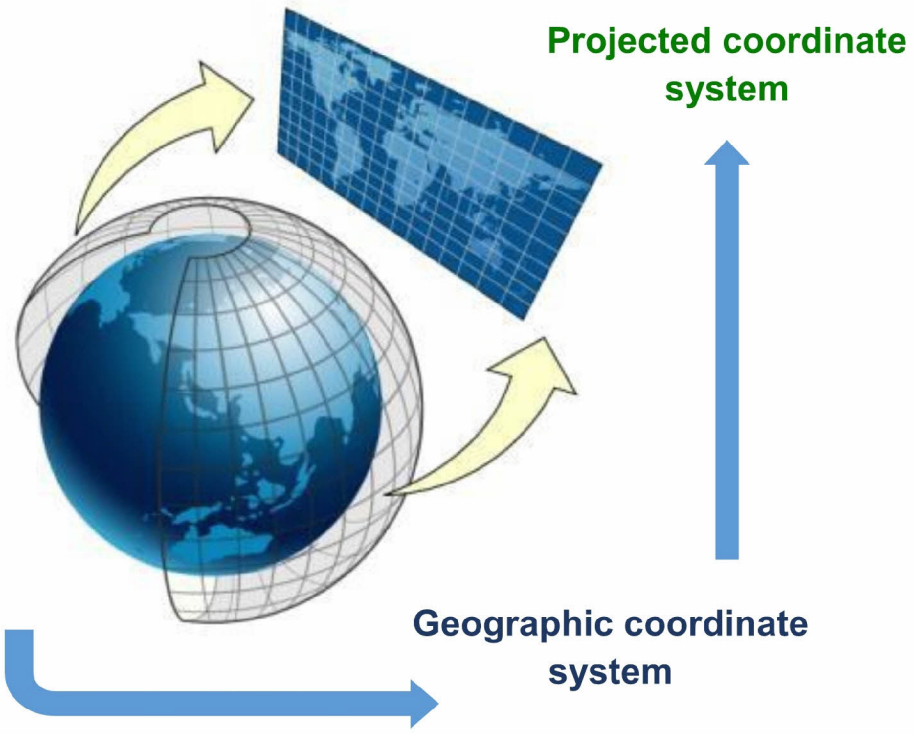


Fig 3. Mapping spherical data to a flat surface.
(Adapted from: https://developer.apple.com, "Displaying Maps")

Uses of GIS:

GIS has been widely employed in government, business and commerce, transportation, health, and natural resource sectors. It has been used for urban planning, resource allocation, surveying, emergency and disaster management, and tracking the occurrence and spread of disease.

Apart from displaying geographic data, one of its most notable functions is the ability to synthesize or combine geographic information to analyze and understand underlying patterns that may not be obviously apparent. This process of finding patterns and trends to inform decision-making is called spatial analysis.

Using GIS, we can:

- Summarize data associated with geographic features.
- Find locations that meet specified criteria.
- Identify, quantify and visualize spatial patterns.
- Combine geographic data for further analysis.

Section 8.1.2. QGIS Official Training Guides

The official training and user guides for QGIS are very detailed in all aspects of using QGIS. Listed below are links to User Guides and Training Manuals in different languages that may be helpful for you if you wish to further your knowledge about everything QGIS has to offer. *Note: these guides are for QGIS Version 2.6; however, will still be useful in version 2.8 as the user interface has not changed.*

Brazilian Portuguese: User Guide - http://docs.qgis.org/2.6/pdf/pt_BR/QGIS-2.6-UserGuide-pt_BR.pdf
Training manual - http://docs.qgis.org/2.6/pdf/pt_BR/QGIS-2.6-QGISTrainingManual-pt_BR.pdf
English: User Guide - http://docs.qgis.org/2.6/pdf/en/QGIS-2.6-UserGuide-en.pdf
Training Manual - http://docs.qgis.org/2.6/pdf/en/QGIS-2.6-QGISTrainingManual-en.pdf
French: User Guide - http://docs.qgis.org/2.6/pdf/fr/QGIS-2.6-UserGuide-fr.pdf
Training manual - http://docs.qgis.org/2.6/pdf/fr/QGIS-2.6-QGISTrainingManual-fr.pdf
Hindi: User Guide - http://docs.qgis.org/2.6/pdf/hi/QGIS-2.6-UserGuide-hi.pdf
Training manual - http://docs.qgis.org/2.6/pdf/hi/QGIS-2.6-QGISTrainingManual-hi.pdf
Indonesian: User Guide - http://docs.qgis.org/2.6/pdf/id/QGIS-2.6-UserGuide-id.pdf
Training manual - http://docs.qgis.org/2.6/pdf/id/QGIS-2.6-QGISTrainingManual-id.pdf
Spanish: User Guide - http://docs.qgis.org/2.6/pdf/es/QGIS-2.6-UserGuide-es.pdf
Training manual - http://docs.qgis.org/2.6/pdf/es/QGIS-2.6-QGISTrainingManual-es.pdf

Note: When you download and install QGIS, 6 different programs will be downloaded. They are:

QGIS Desktop: *This is the program you will be using for this guide. Here you can create, edit, visualize, analyze, and publish geospatial information. QGIS Desktop can be downloaded on Windows, Mac, Linux, BSD, and Android devices.*

QGIS Browser: *This program allows you to browse and preview your data and metadata (data that describes and summarizes basic information about other data).*

GrassGIS: *This is another free and open source GIS software program. We will not be using this; however, QGIS does have the ability through the tool box to use layers and tools GRASS has to offer.*

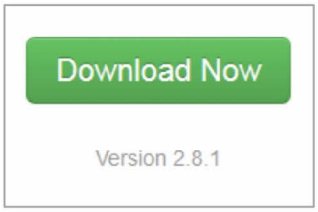
MSYS: *This program allows the building of applications; we will not be using this program in this guide.*

OSGeo4Shell: *This is a package of open-source geospatial tools for Windows; we will not be using this program.*

Saga GIS: *This is another free and open source GIS software program; we will not be using this software in this guide.*

Section 8.1.3. Download QGIS

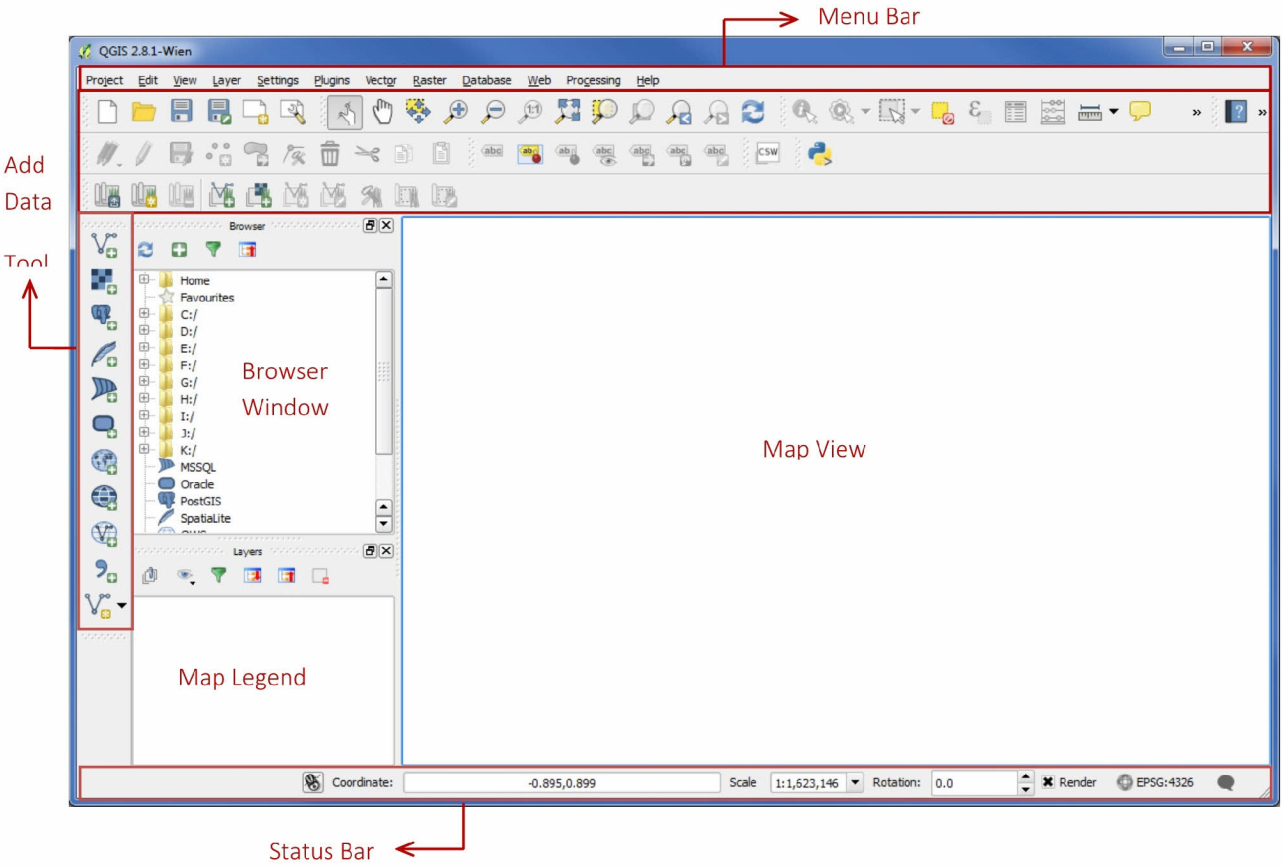
1. Go to the QGIS website to download the software.
   a) http://www.qgis.org/en/site/
      i) Click the "**Download Now**" button
      ii) Choose your platform (i.e. Windows or Mac)
         (1) **For Windows**
            (a) Choose the **QGIS Standalone Installer Version 2.8.1 (32 bit)** OR **QGIS Standalone Installer Version 2.8.1 (64 bit)** (or current version) depending on your operating system.
            (b) Save the .exe file to your computer.
         (2) Double click on the .exe you just downloaded and follow the instructions given for installing the software.
         (3) **For Mac**
            (a) Click on the **KyngChaos QGIS download page**
            (b) Click on **GDAL Complete 1.11 framework package**
               (i) Click on the **GDAL 1.11 Complete [39.0 MiB] 2015-3-4** version (or current version) to download the file. Open the file you just saved.
               (ii) Double click on the **GDAL Complete.pkg** file and follow the instructions to install it on your computer.
            (c) Go back to the **KyngChaos QGIS download page**
            (d) Click on **Matplotlib Python module**
               (i) Go down the page and click on **matplotlib 1.3.1-2 [35.8 MiB] (Lion+)** to download the file. Open the file you just saved.
               (ii) Double click on the **matplotlib.pkg** file and follow the instructions to install it on your computer.
            (e) Go back to the **KyngChaos QGIS download page**
               (i) Click on **QGIS 2.8.1-1 [163.8 MiB]** to download the file. Open the file you just saved.
               (ii) Double click on **Install QGIS.pkg** and follow the instructions to install it on your computer.



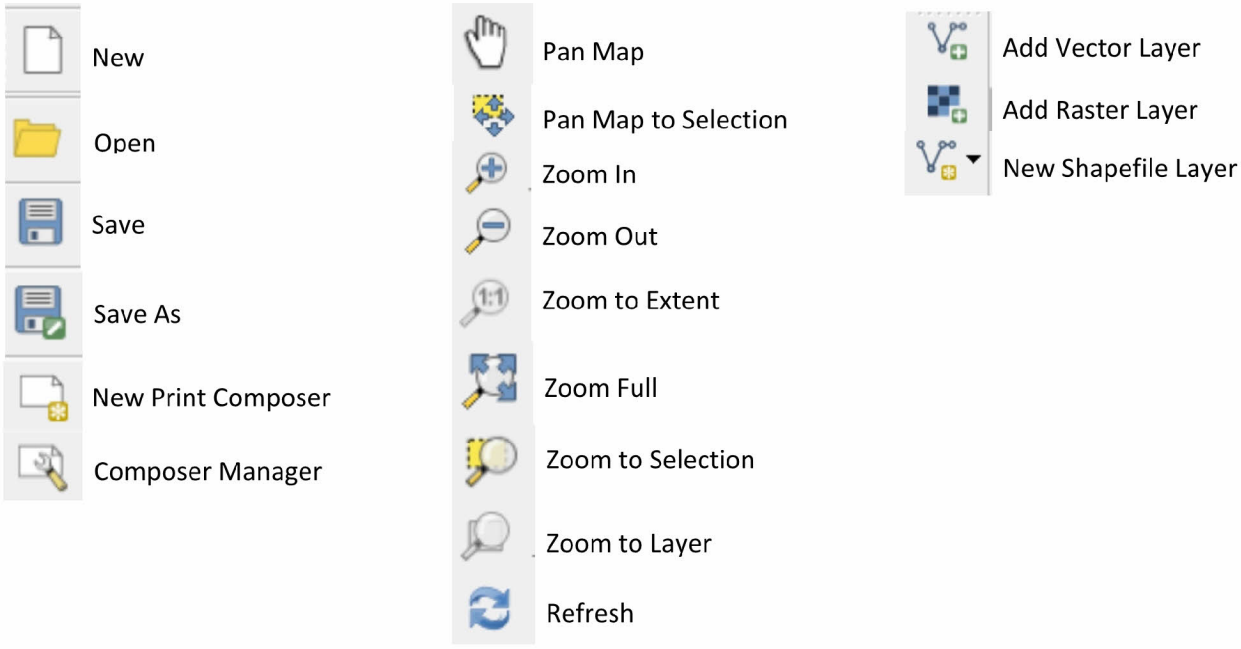
Visit the following YouTube link for a step by step video guide for installing QGIS on a Mac: **https://www.youtube.com/watch?v=AocxUop1RTE**

Section 8.1.4. Introduction to QGIS Interface

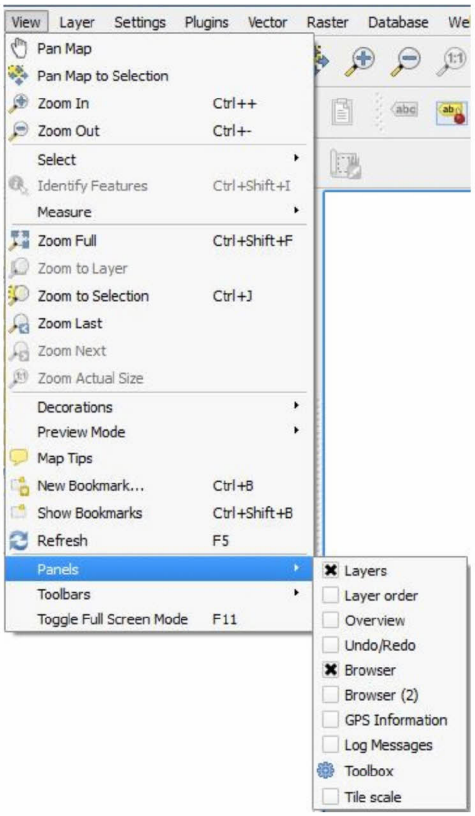
1) Open **QGIS Desktop** by clicking the icon added to the desktop, through the Start menu in Windows, or through the Application folder on the Mac. *Note: All screen grabs in this guide are from the Windows platform, there may be some minor differences in the Mac version of the software.*
   a) Components of the Geographic User Interface (GUI) when you open QGIS.



b) Some important and useful tool icons.



c) The pull-down menus in the **Menu Bar** have the same tools as listed above plus more. If, however, you happen to close the **Map Legend** or **Browser Window,** you can reopen them by going to **View/Panels** and then click the box next to the panel you would like to open.



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Section 8.1.5. Data File Organization

For the remainder of the user guide, you will be using data which is provided with this guide. You will want to unzip the folder called *QGIS_Training_Data*. Within the *Data* folder you will find an Excel file and two folders, *Rasters* and *Vectors*, containing layers which you will be adding to QGIS Desktop for the final goal of producing a map export. ***Note: Data provided with this guide is for the purpose of teaching the user QGIS and in no way represents sampling locations in Uganda for the PREDICT project. Rasters (land use layers) and shapefiles (Uganda district and protected areas) are publicly available and website addresses can be found in Section 8. Data Download of this guide. The Rodent_Sampling_Sites.xlsx contains 4 points haphazardly chosen and in no way represents sampling locations in Uganda.***

QGIS_Training_Data
Rodent_Sampling_Sites.xlsx

Raster folder:

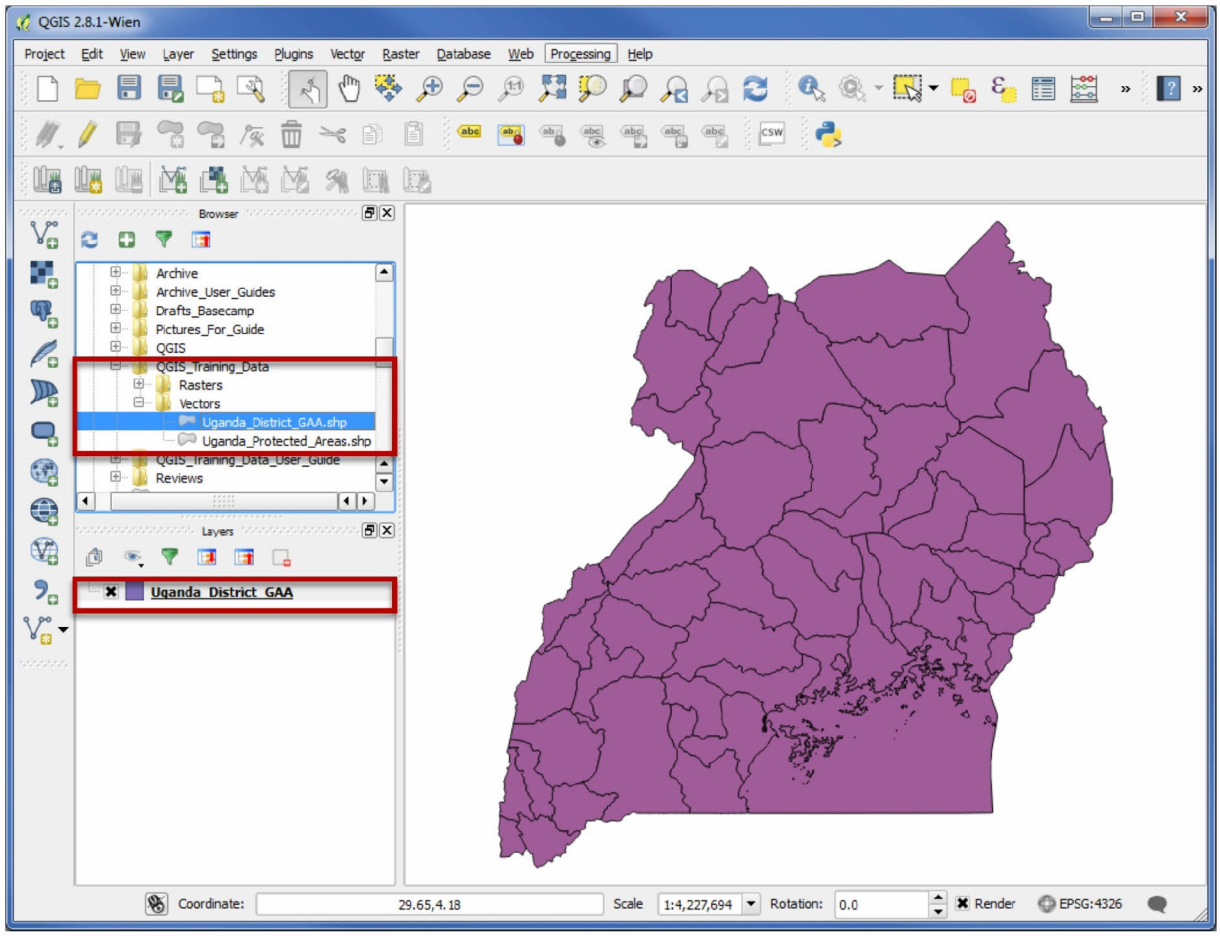
1. Four land use layers (*Africa_LandUse_31, _32, _43, and _44*) for Uganda from the International Steering Committee website. Each layer consists of the following components:
    a. .tfw: contains the geographic information
    b. .tif: image file
    c. .xml: contains metadata for the file
2. *International Steering Committee Website.doc:* explains the symbology of the land use layers

Vector folder:

1. *Uganda_District_GAA* (downloaded from the Global Administrative Areas website) Components of the *Uganda_District_GAA* shapefile includes:
    a. .dbf – attribute format; columnar attributes for each shape
    b. .prj – projection format; the coordinate system and projection information
    c. .sbn – a spatial index of features
    d. .sbx – a spatial index of features
    e. .shp – shape format; contains the feature geometry
    f. .xml – geospatial metadata in XML format
    g. .shx - shape index format; positional index of the feature geometry
2. *Uganda_Protected_Areas* (downloaded from the Protected Planet website) Components of the *Uganda_Protected_Areas* shapefile includes:
    a. .dbf – attribute format; columnar attributes for each shape
    b. .prj – projection format; the coordinate system and projection information
    c. .sbn – a spatial index of features
    d. .sbx – a spatial index of features
    e. .shp – shape format; contains the feature geometry
    f. .shx - shape index format; positional index of the feature geometry

Section 8.1.6. Vectors

1. **Adding vector layers to your map:** There are two different ways you can add vector layers in QGIS, either by going through the Browser Window or using the Add Vector Layer button on the side of the QGIS screen.
   a) Browser window in QGIS – Browse to where you saved the *QGIS_Training_Data* folder, open the *Vector* folder, and double click on *Uganda_Districts_GAA.shp*. Notice the file is now listed in the **Map Legend** window and visualized in the **Map View** window. *Note: The color of Uganda (or any vector file) will probably be different on your screen. We will discuss how to change the symbology (color) later in this guide.*



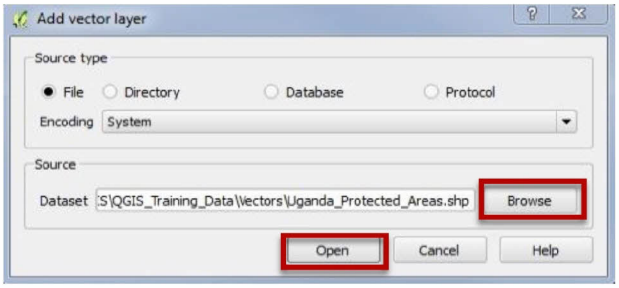
b) Add vector button**:** click the **Add Vector Layer** button *Note: you can also get to the Add Vector Layer interface by going to the **Layer menu, Add Layer, Add Vector Layer**.*

i) Click the **Browse** button

ii) In the browse window **Navigate** to the *QGIS_Training_Data* folder, open the *Vector* folder, and select *Uganda_Protected_Areas.shp*

iii) Hit the **Open** button

iv) On the **Add Vector Layer,** click the **Open** button.



v) *Uganda_Protected_Areas.shp* should now be added to the **Map View** and **Map Legend** window.

vi) Hit the **Save** button to save the changes you have made to the project.

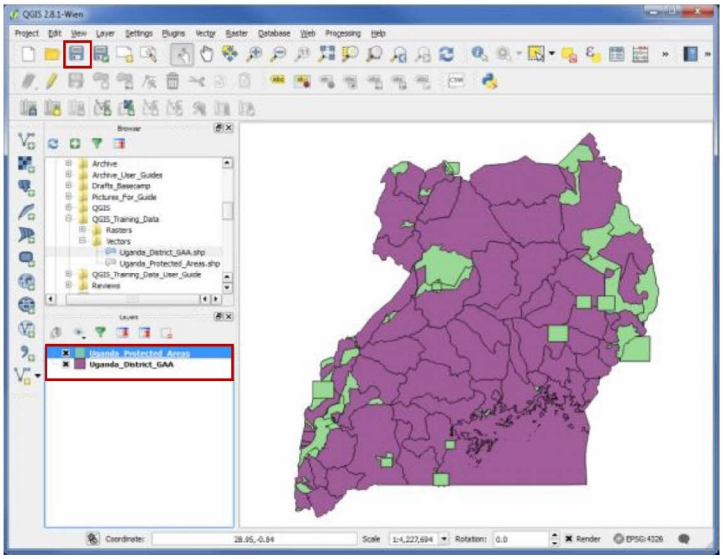
c) **Saving a project:** Now that you've added a layer let's **Save** the project. *Note: It is a good habit to get into saving your project often as you work. QGIS has been known to crash, causing you to lose work you have completed from the last time you saved.*

i) Click the **Save As** button and browse to the location where you would like to save your project.

ii) **File Name** – Give your QGIS project a name

iii) Click **Save**

iv) After the first time saving your project, if you close QGIS it will ask you if you would like to save any changes you have made.



d) **Opening a project:** Opening an existing QGIS project after closing the project

i) Click the **Open** icon in QGIS and

ii) Or go to the Project drop-down menu and click open

iii) You can also **double click** on the **project** (.qgs) from within **Windows Explorer**.

2. Making a new vector file

e) Select the **New Shapefile Layer** button

f) The **New Vector Layer** window will appear

i) Choose the **Type** of file you would like to make (point, line, or polygon). For this example for **Type** choose **Point.** *Note: A vector file can only support one type of data at a time. So, for example, if you make a point file you cannot add lines or polygons within that layer, but will have to make a new layer.*

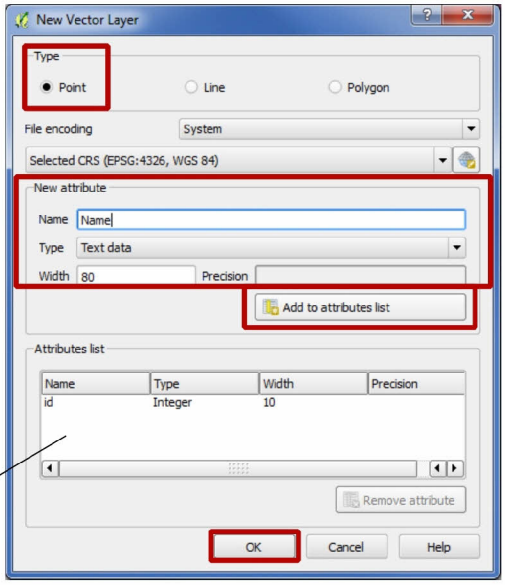
ii) Under **New Attribute**

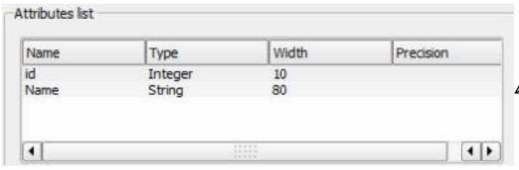
(1) Next to **Name** type "**Name**"

(2) **Type** should be **"Text Data"**

(3) **Width** should be "**80**"

(4) Hit the **Add to Attributes List** button *Note: Once you do this you will notice that the Name attribute now appears in the list under **Attributes list.*** This adds a column in the attribute table so you can name your points when you make them.





(5) Now make a column that allows you to input the number of bats sampled at a location. Under **New Attribute,** next to **Name** type **"NumberBats"**

(6) **Type** should be set to "**Whole number**"

(7) Accept the default for **Width** which should be **"10"**

(8) Hit the **Add to Attributes List** button

(9) Hit the **OK** button

(a) Browse to the *Vector* folder in *QGIS_Training_Data* and **Name** the file *BatSamplingLocations***.** You have now made a file to which you can add your sampling locations (which we will do in the next section about editing vector files).

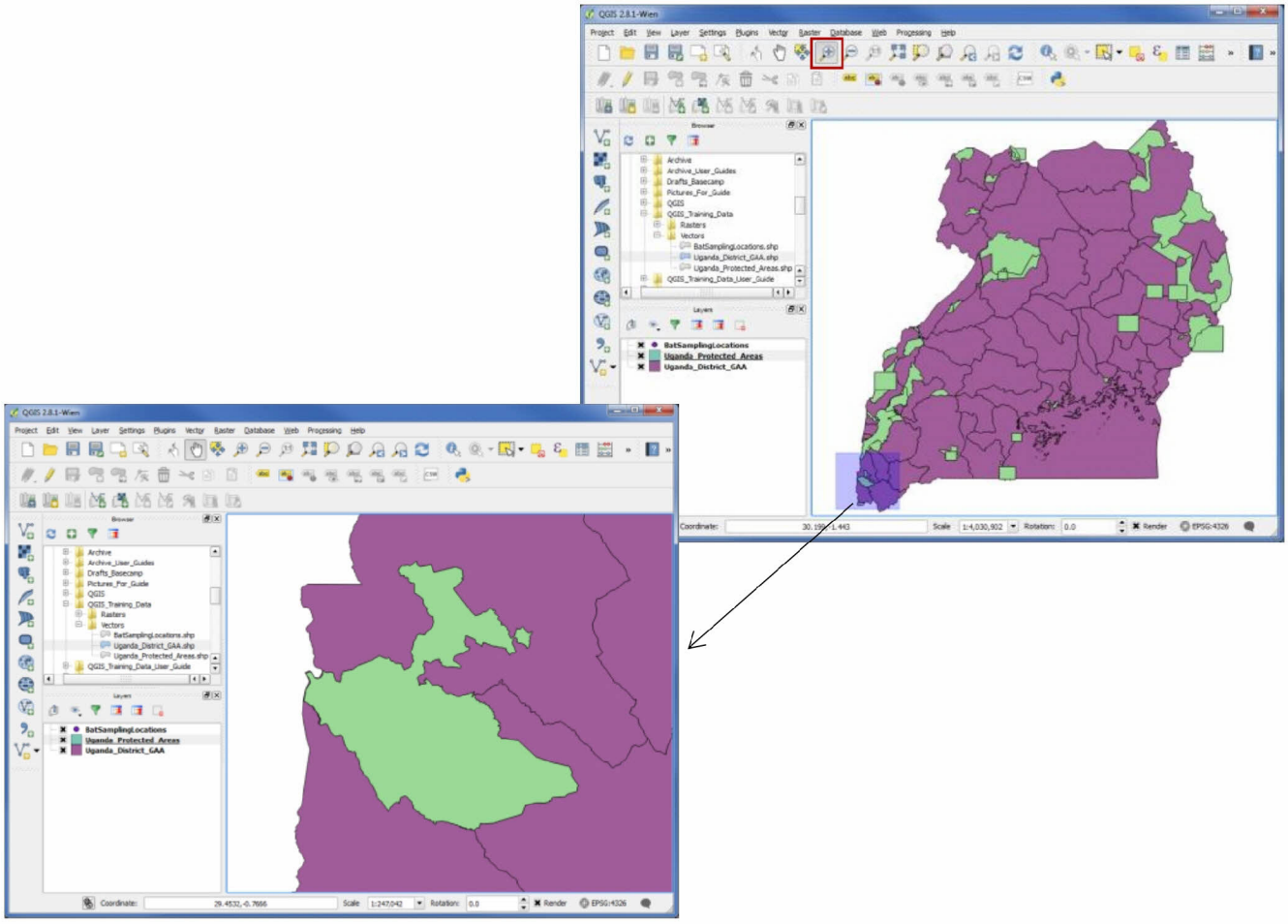
3) Editing a Vector file

g) Before we start editing, zoom into the southwest corner of Uganda to the Bwindi Impenetrable National Park. There are a couple of different ways to zoom to an area.

i) You can use the **Zoom In** tool which allows you click on the image and the image will zoom into that area at a set interval **OR** you can click and hold down the button to draw a box around the area you want to zoom into.

ii) You can also zoom in and out of the image by using the wheel of the mouse. *Note: The zoom function with the wheel of the mouse is always active, meaning it can happen at any time unintentionally. It seems to happen a lot more easily with the Mac mouse than with the traditional wheel mouse for windows. To turn this function off go to the **Settings** pull-down menu and choose **Options**. Choose **Map Tools** and under **panning and zooming** change **Mouse wheel action** to **Nothing** if you don't want anything to happen or you can choose another option and slow down the zoom by changing the **Zoom Factor to 1.1** (this is the slowest setting).*

iii) You can zoom to a specific layer by right clicking on the layer in the **Map Legend** window and choose **Zoom to layer**.

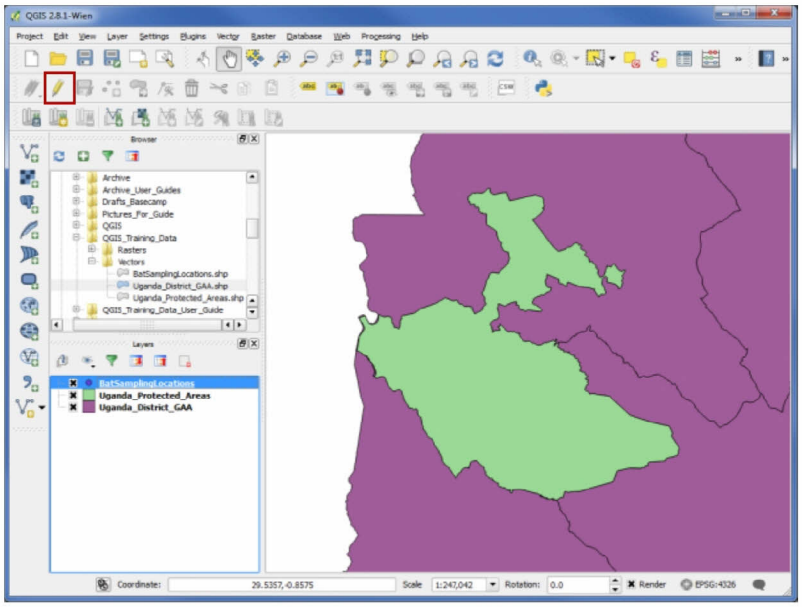


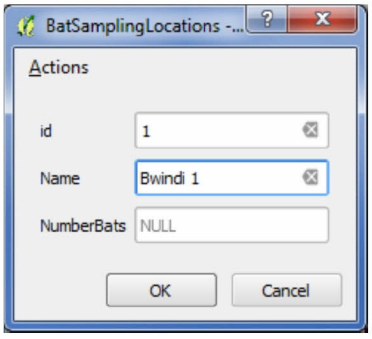
h) In the **Map Legend** window highlight the point vector file just created (*BatSamplingLocations*) and the click the **Toggle Edit** button.

i) Select the **Add Feature** button to the right of the Toggle Edit button

j) **Click on the map** within the Bwindi Forest where you would like to add a point

k) A box will appear giving you the opportunity to fill in the attributes for that point (these are the attributes you specified when you created the point file).

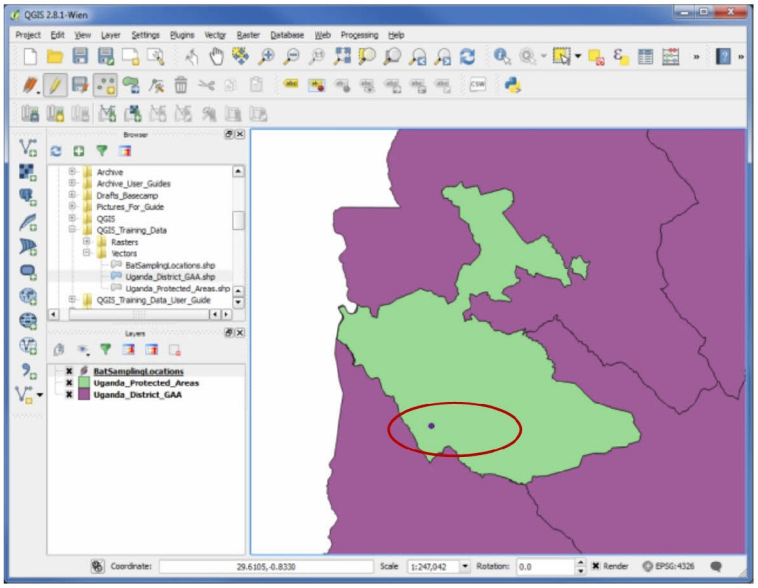




i) **ID:** This should be a unique number for the point, so start with 1 and continue from there as you add points.

ii) **Name:** Name of the site – For now, name it *Bwindi 1* since the point is inside the park.

iii) **NumberBats:** Keep this blank for now. We will go in and add the data later.



iv) Hit the **OK** button and notice the point shows up on the map. If you cannot see it, make sure that the *BatSamplingLocations* layer is the top file in the **Map Legend** window. If it is not the top layer, just select it and drag it up.

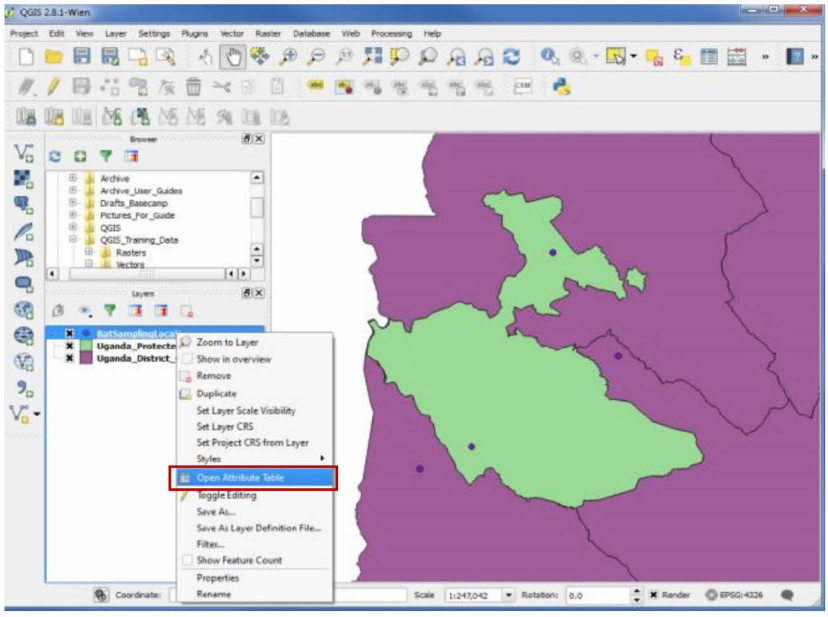
v) Add one more point in the park and 2 outside the park. Give the points a unique ID numbers and names. We will enter the number of bats at a later time so for now just click **OK**.

vi) **Click** the **Save Layer Edits** button (this does not stop the editing but just saves what you have done).

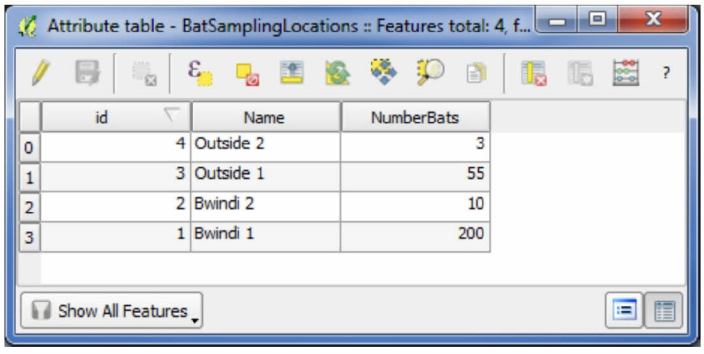
vii) If you realize that a point is in the wrong place, you can move that point using the **Move Feature(s)** button.

(a) After clicking the button, click, and drag the point you wish to move (be sure to save your edits!).

l) To edit data in the attribute table, right click on the name of the file in the **Map Legend** window and select **Open Attribute Table.**



i) Once the attribute table is open you can change or delete any information. Here you can add numbers for **NumberBats** attribute. *Note: You have to be in **Editing** mode to make changes in the attribute table.*



	id	Name	NumberBats
0	4	Outside 2	3
1	3	Outside 1	55
2	2	Bwindi 2	10
3	1	Bwindi 1	200

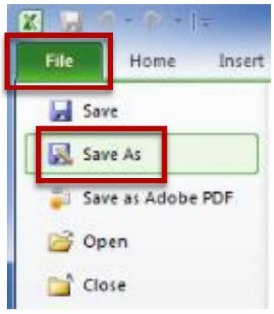
ii) Be sure to save the changes, and then close the attribute table

m) When done editing, click the **Toggle Editing** button again to close the editing tool. When closing the **Toggle Editing** button it should ask you to save your edits if you didn't save before closing. Click **Yes**.

4) **Import an Excel file into QGIS:** This section explains how to bring an Excel file containing your data into QGIS. You can use the *Rodent_Sampling_Sites.xlsx* file in the *QGIS_Training_Data* folder for this example.

a) Before you import an Excel file it must be saved as a comma delimited file (.csv). Steps for that follow:

i) Open the *Rodent_Sampling_Sites.xlsx* Excel file in the *QGIS_TrainingData* folder. Go to the **File** menu and click **Save As.**



ii) The **Save As** window will open,

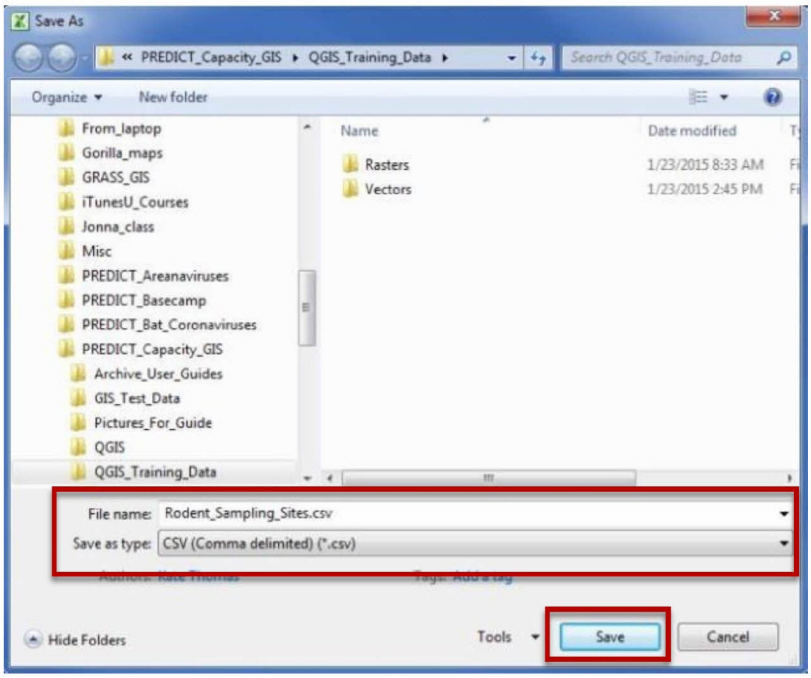
Save as type: Chose CSV (Comma delimited) ***Important!*** *for **Mac** choose **Windows Comma Separated (CSV)**.*

(1) **Name: Name** the file if it didn't retain its name (in this case, it is already named *Rodent_Sampling_Sites*).

(2) Hit the **Save** button

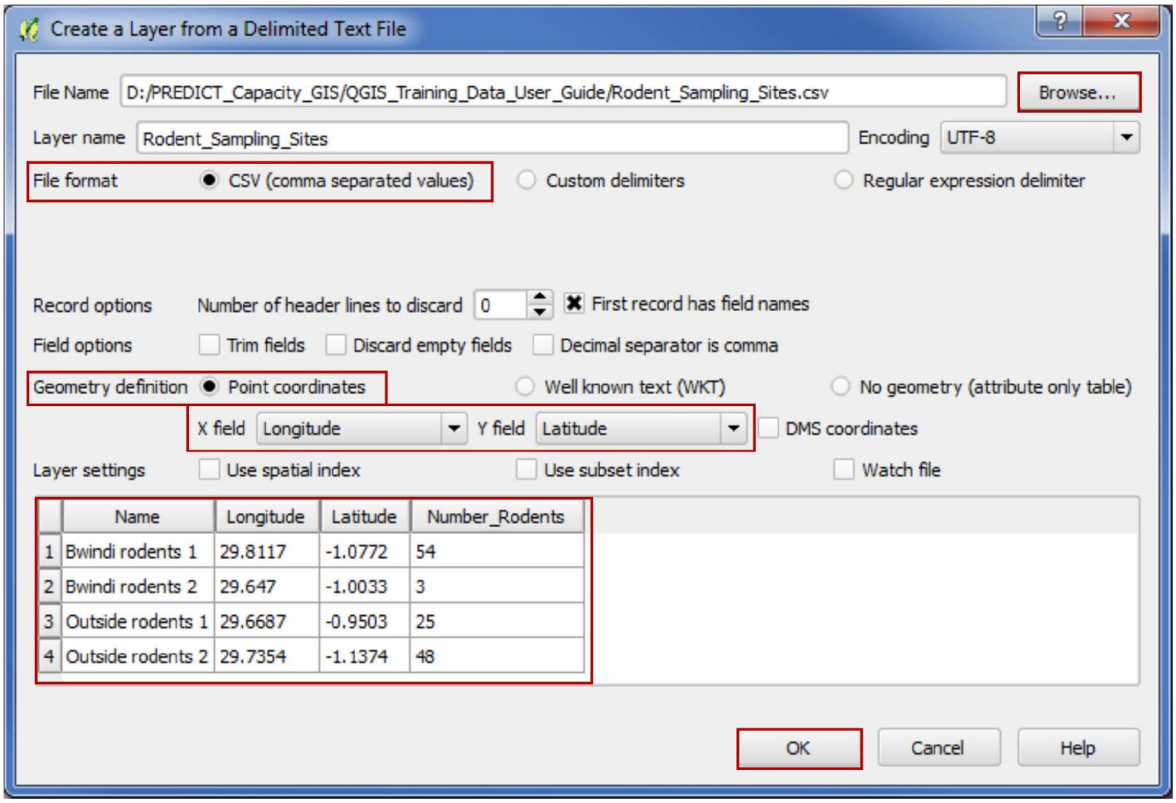
(a) Click **OK** to "The selected file type does not support workbooks that contain multiple sheets" warning.

(b) Click **Yes** to the next warning "Rodent_Sampling_Sites.csv may contain features that are not compatible with CSV (Comma delimited). Do you want to keep the workbook in this format?"

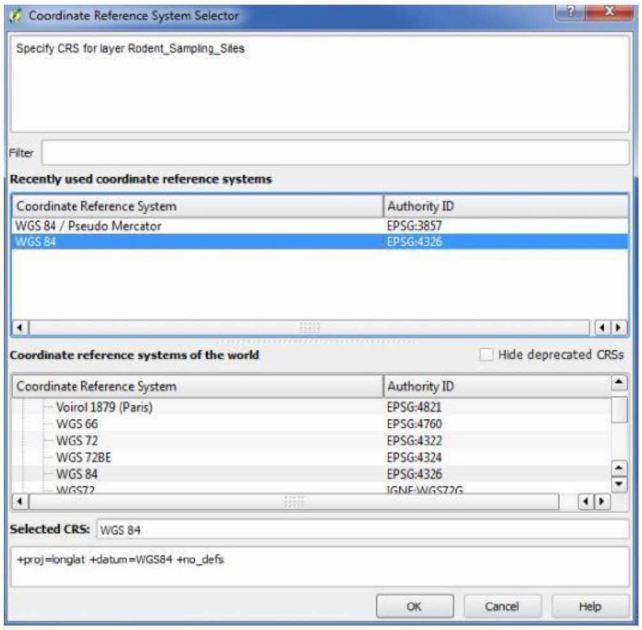


(3) Go back into QGIS.

b) Back in QGIS Desktop click the **Add Delimited Text Layer** button.
   i) The **Create a Layer from a Delimited Text File** box will pop up.
   ii) Browse to the .csv you saved. Once you add the file, double check that information in the other boxes (i.e. X and Y fields, and data from the Excel file) automatically got filled in. If not, activate the circle next to **CSV (comma separated values).**
      (1) Double check that under the heading **Geometry definition**:
         (a) **Point coordinates** is activated.
         (b) **X Field** = **Longitude.**
         (c) **Y Field** = **Latitude.**
         *Note: If you are using Degrees Minutes Second instead of Decimal degrees be sure to activate the box next to **DMS coordinates.***
         (d) Once you have checked your settings and data, click **OK.**

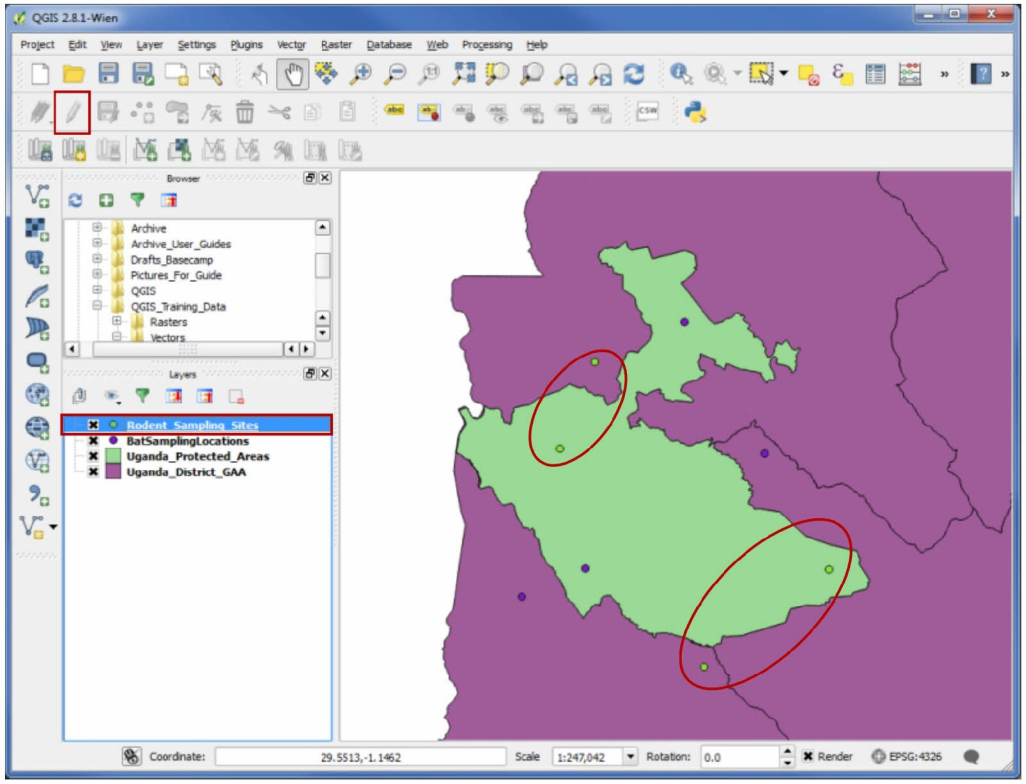


(e) Next, you will be asked to choose your coordinate system for the file. If the coordinate system you are using is under **Recently used coordinate reference systems** you can highlight it there and click **OK.** If not, choose the correct coordinate system under **Coordinate reference systems of the world**. For this exercise, we will use WGS 84.

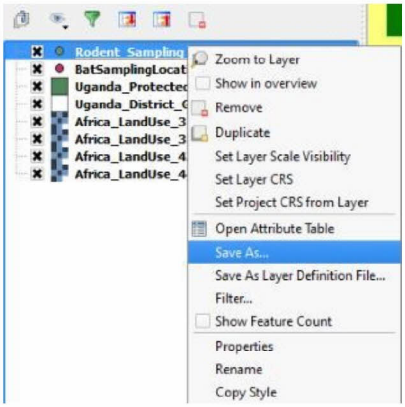


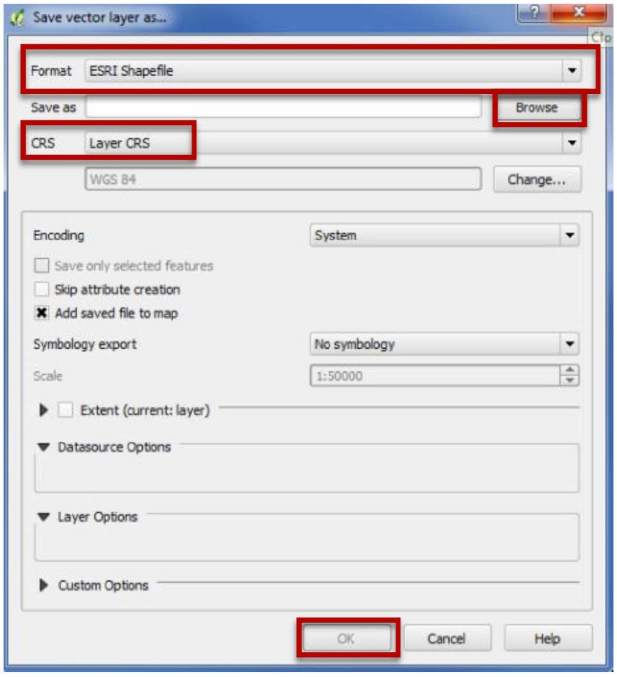
(f) Click **OK.**

(g) Your data points should show up in the **Map View** window and the file should now be listed in the **Map Legend** window. *Note: This file cannot be edited (toggle edit button is grayed out), and therefore must be saved as a shapefile.*

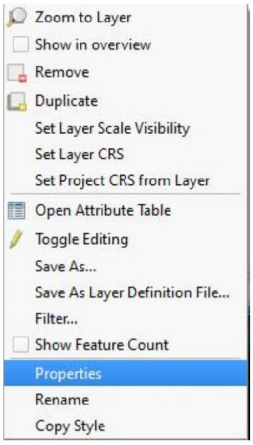


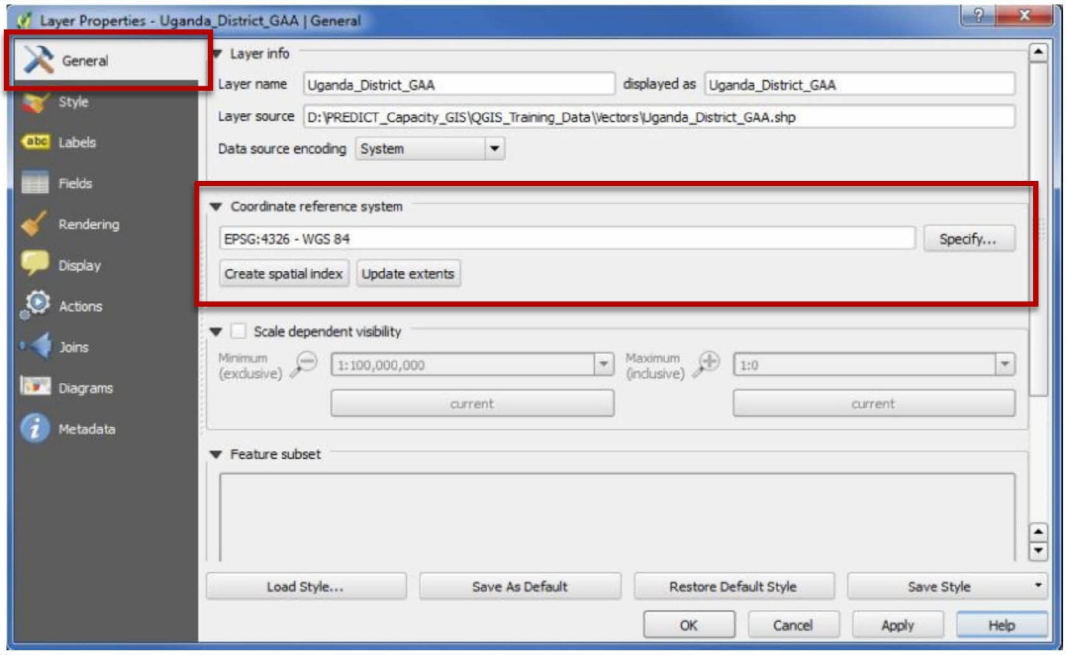
5) **Convert an imported .csv layer into a shapefile:**
   a) Right click on the .csv layer you just imported into QGIS (*Rodent_Sampling_Sites*) and select **Save as.**
   b) The **Save vector layer as…**box will appear.
      i) **Format** = **ESRI shapefile**.
      ii) **Save as** – Click the **Browse** button and browse to the location you would like to save the file. Be sure to name the file and click **Save.**
      iii) **Set the CRS (coordinate reference system)** to **Layer CRS** if you specified the coordinate system when importing the .csv.
      iv) Accept all other defaults and click **OK.** *Note: There are now 2 files called Rodent_Sampling_Sites. The one on the top is the new shapefile. You can remove the second one by right clicking and choosing* ***Remove****. Notice that when you now click on the shapefile just added to the* ***Map Legend*** *window, the* ***Toggle Edit*** *button is now selectable. You can now make edits to the point locations and attribute table the same way as listed above.*



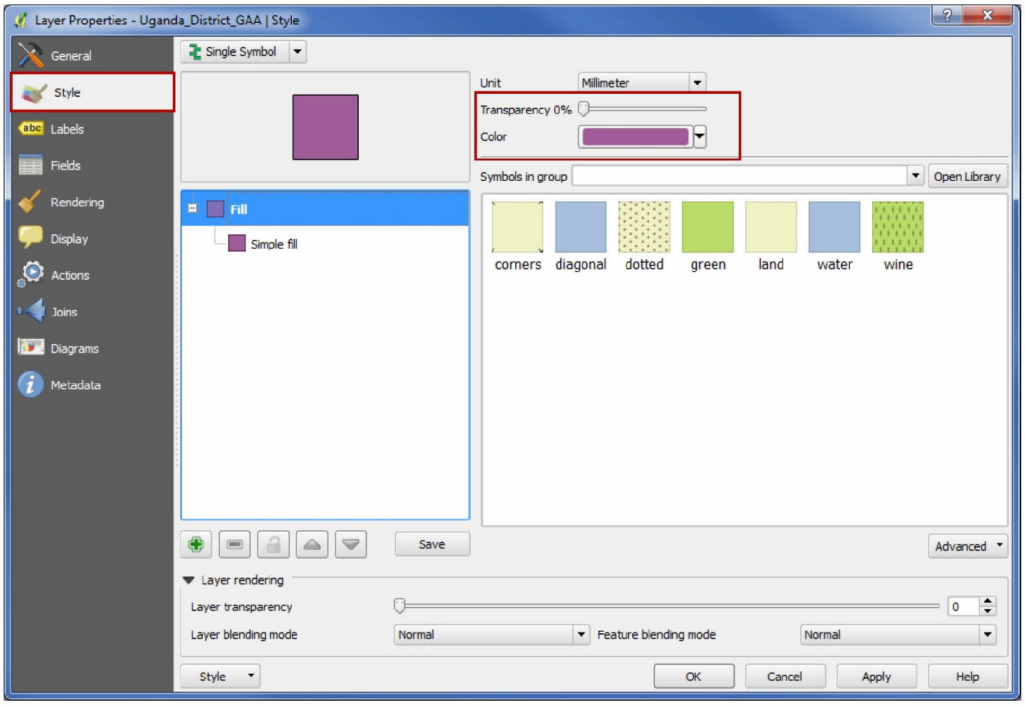


6) **Properties of a vector layer:** Once you add a vector you can change the symbology (i.e. color), coordinate system, and label features for a file by going to the **Properties** menu.
   c) In the **Map Legend** window right click *Uganda_District_GAA* and choose **Properties** from the popup menu**.** Below are descriptions of some of the tabs which might be useful.
      i) **General** tab: Here you can see the layer name, location, and coordinate system (which you can change by clicking **Specify**)

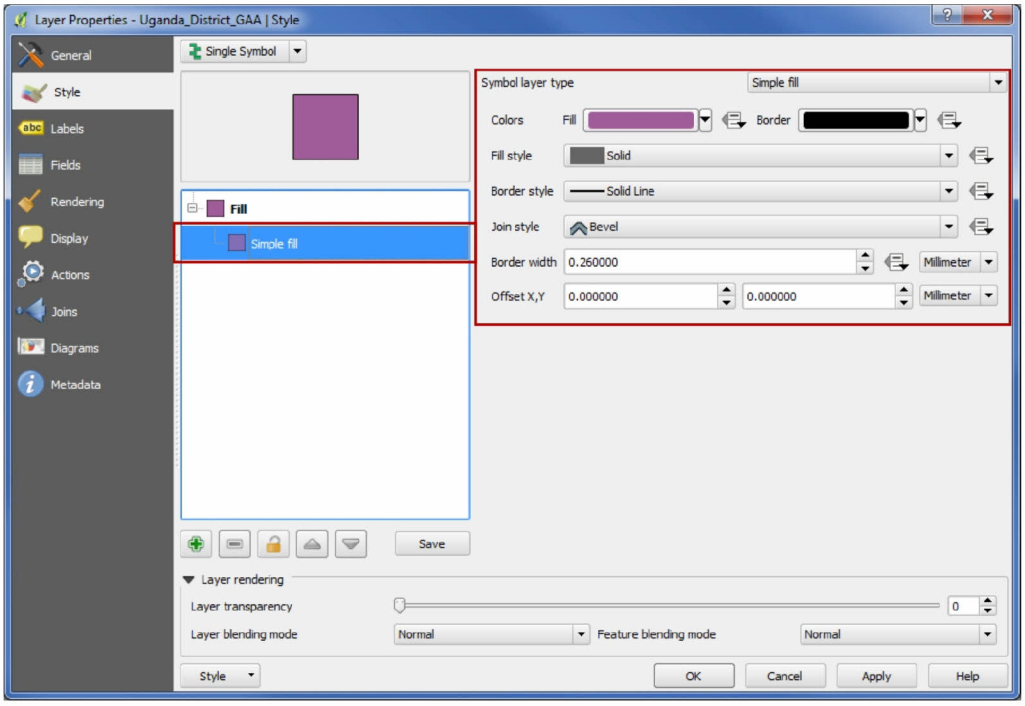




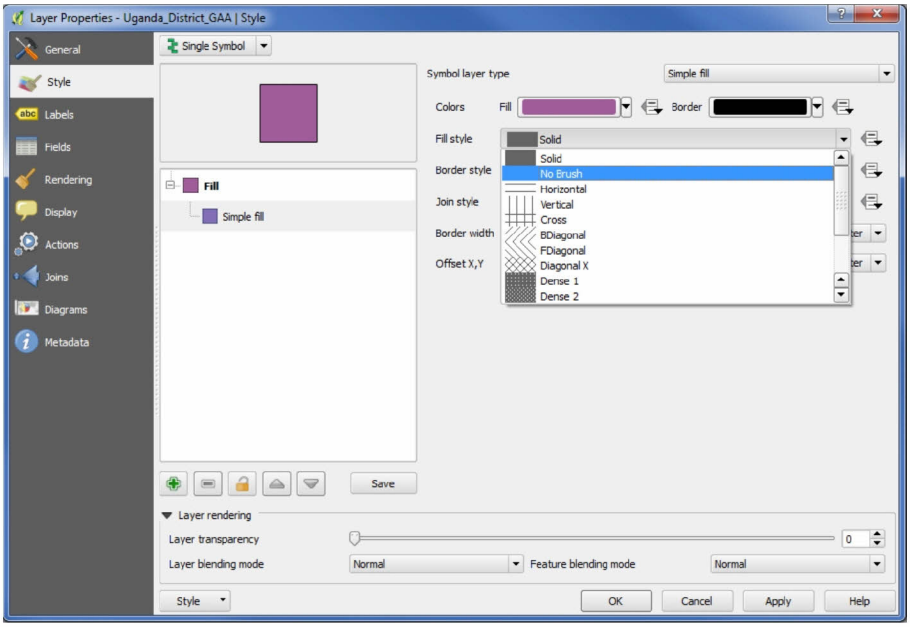
ii) **Style** tab: Here you can change the symbology (i.e. color and transparency) of the layer. While here we are going to change the **Fill** for this layer.

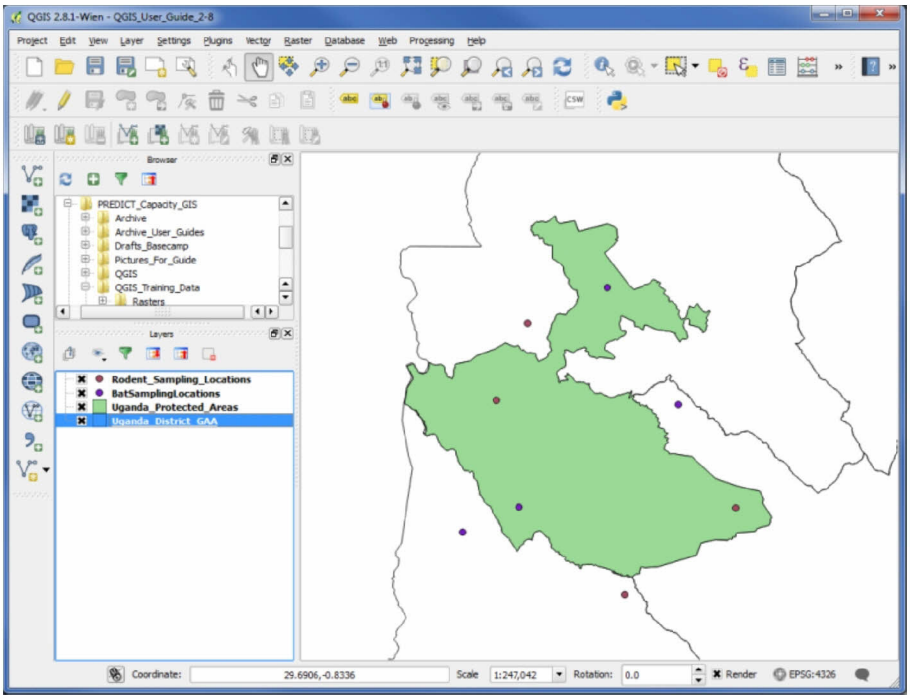


(1) Click on **Simple Fill** (you will notice the options on the right side of the screen will change).



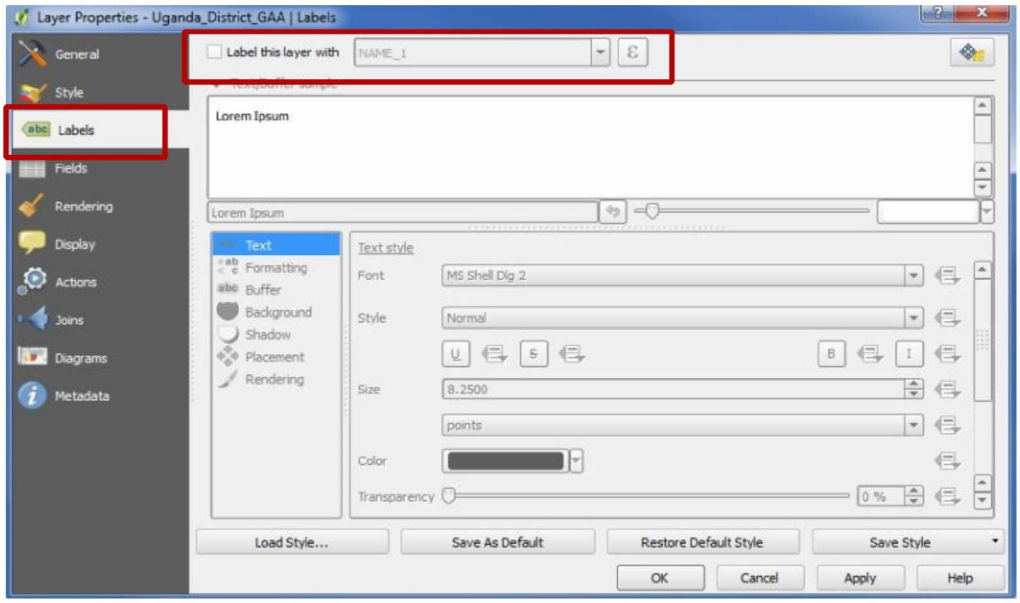
(2) On the right side of the screen click the arrow next to **Fill style** and choose **No Brush.** Click Ok**.** Notice in the **Map View** window you now only see the lines from the *Uganda_Districts_GAA* layer; any color is visualizing the *Uganda_Protected_Areas* layer.



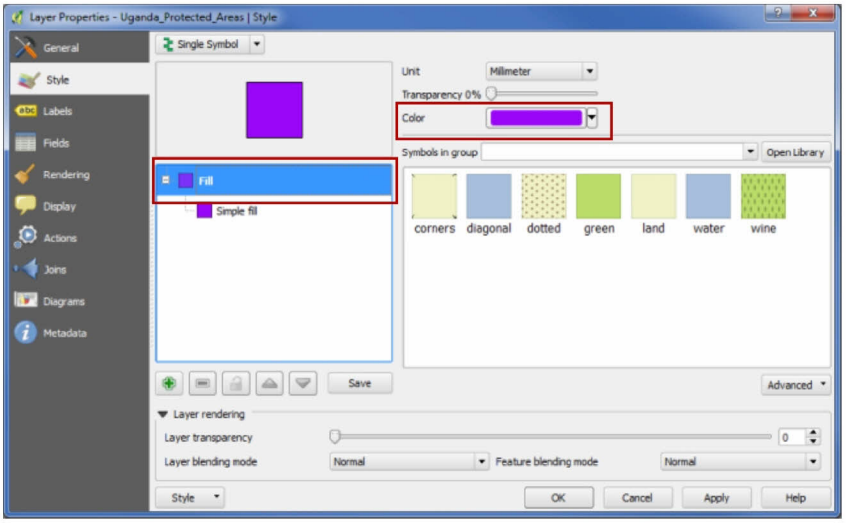


iii) **Labels** tab: Open the Properties tab again for *Uganda_District_GAA* as described on page 21, and select the **Labels** tab. Here you can add labels based on an attribute by activating the **Label this layer with** and then choosing the attribute in the pulldown menu.

(1) Click on the box next to **Label this layer with.** Choose **"NAME_1"** from the pull down menu. Hit **Apply**. Notice that the names of the districts are now visualized on the map. You can then change font, color, etc. of the label as well. Deactivate **Label this layer with** by clicking on the box in front of it before proceeding.

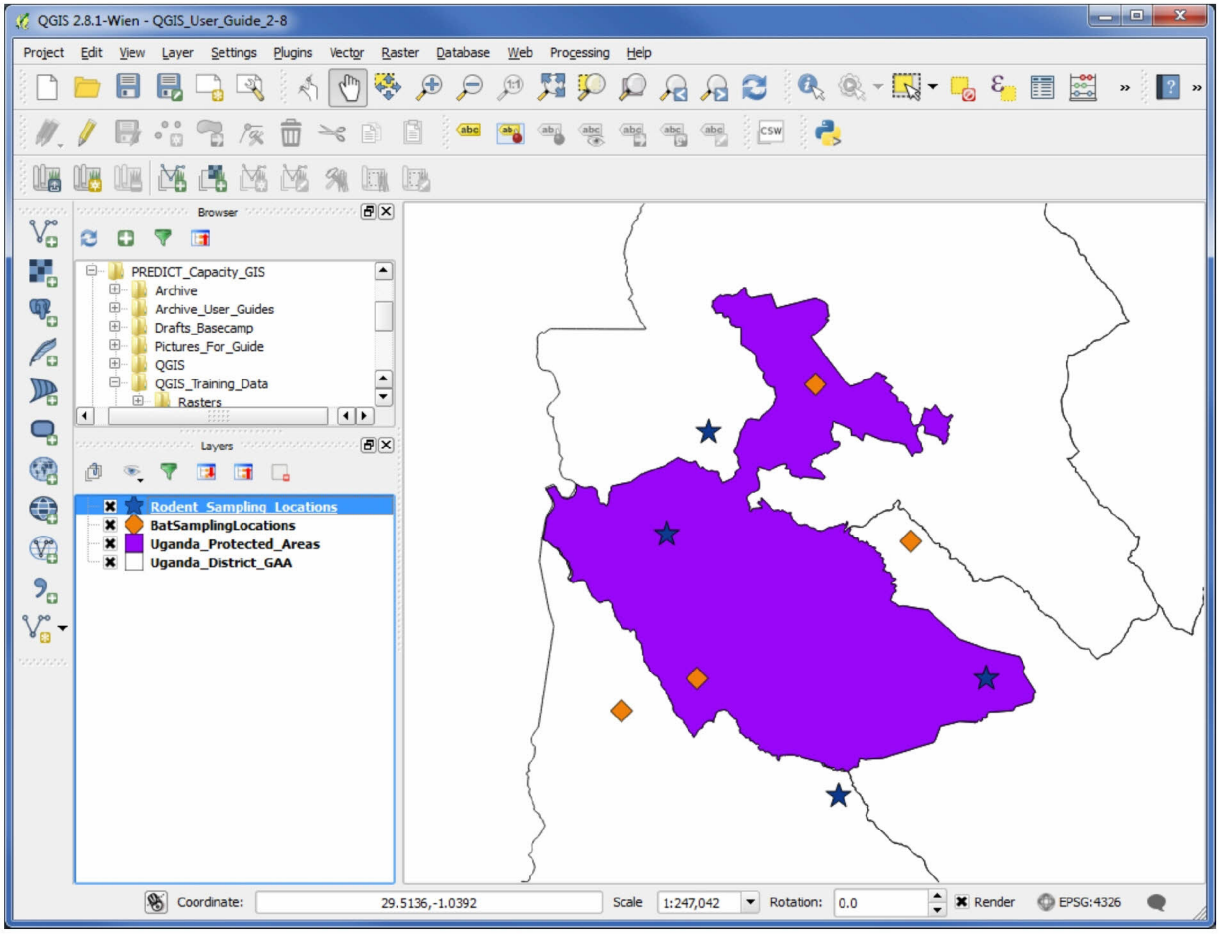


iv) Now change the symbology for *Uganda_Protected_Areas, BatSamplingLocations, and Rodent_Sampling_Locations.* This time, however, since we want the *Uganda_Protected_Areas* and sampling locations to have color you can simply choose a different color without choosing **Simple Fill.**



v) For the point locations feel free to choose different colors, symbols, and sizes, all of which can be found in the on the Style tab as well.

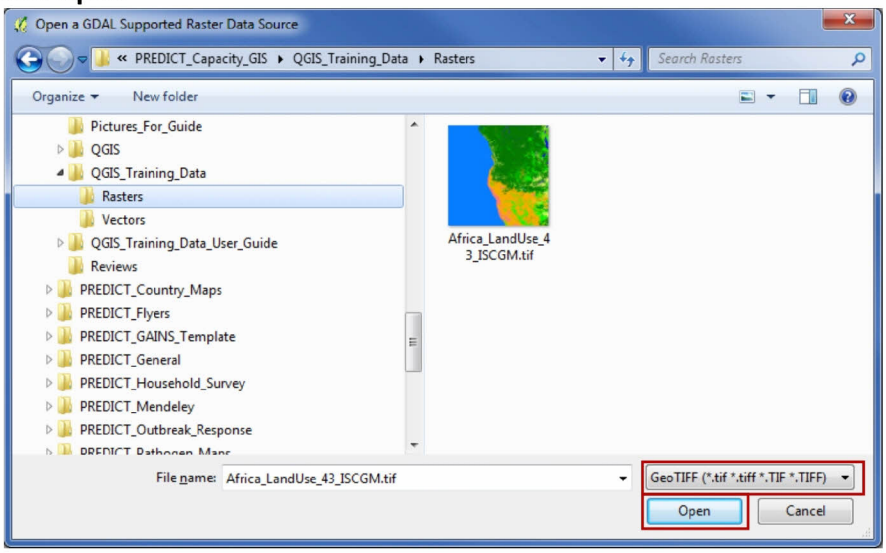
vi) Save your project if you haven't recently. *Note: From this point on the images in this guide might differ a little visually depending on the symbols you have chosen to represent your data.*



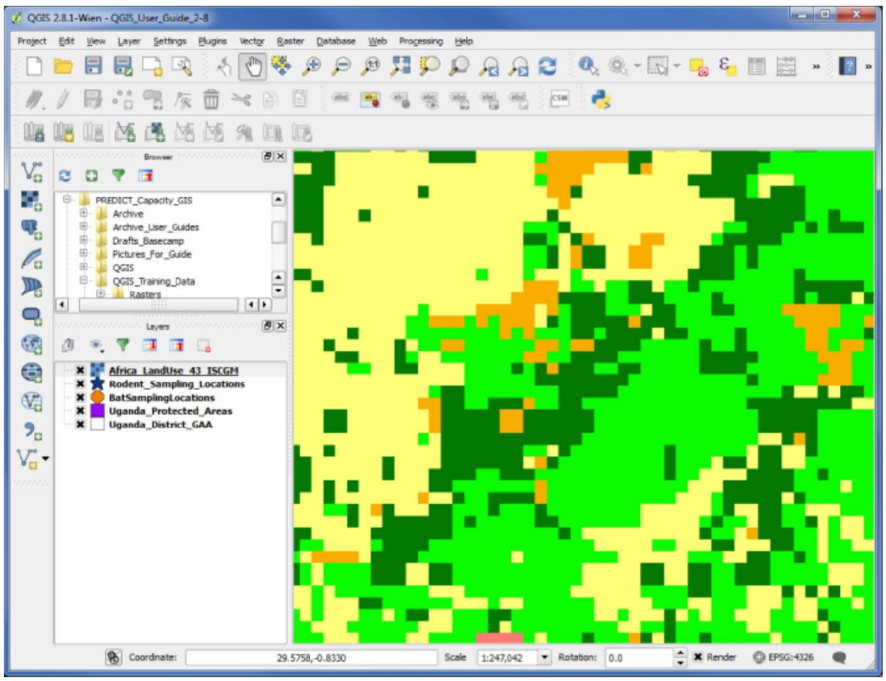
Section 8.1.7. Rasters

1) Adding a Raster**:** Click the **Add Raster Layer** button

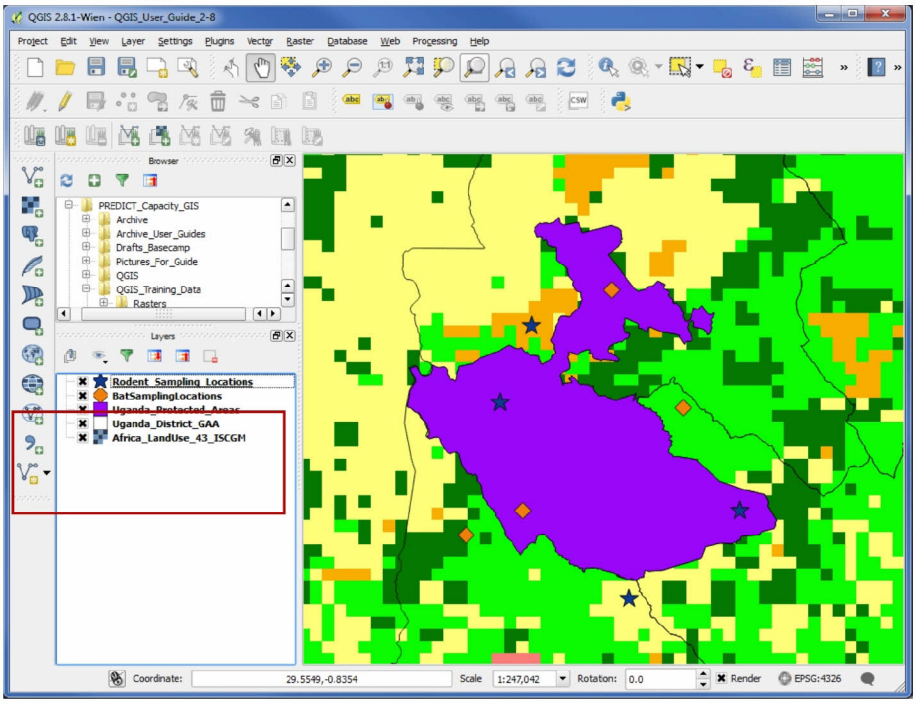
   a) We are going to add land use layers for Uganda. Browse to the *Raster* folder within the *QGIS_Training_Data* folder.
      i) Next to **File Name** (where it says **All files**) click the arrow and choose **GeoTIFF**
      ii) Select the file *Africa_LandUse_43_ISCGM.tif*
      iii) Click **Open**



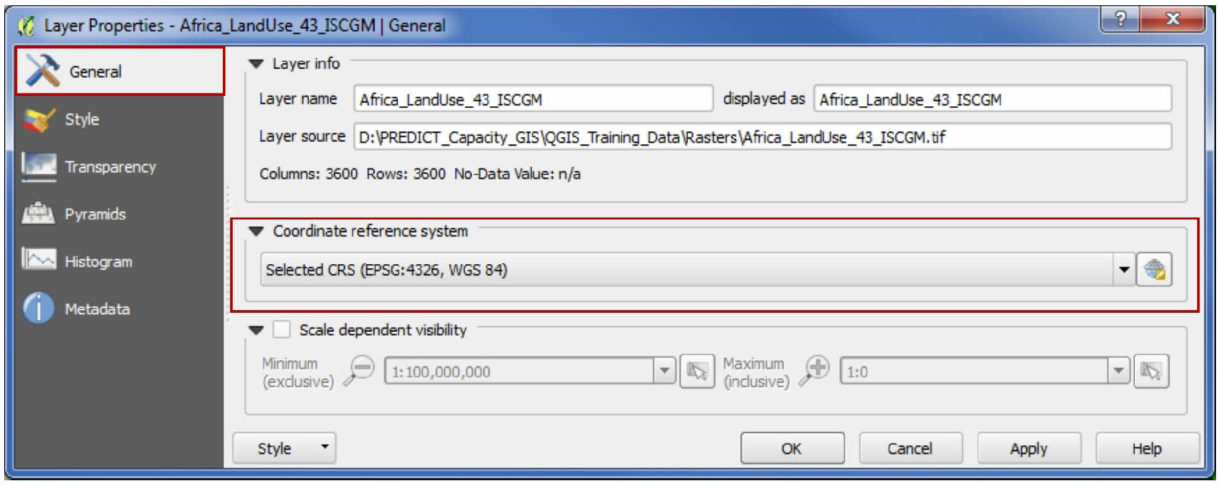
      iv) The file should be added to the **Map View** and **Map Legend** windows



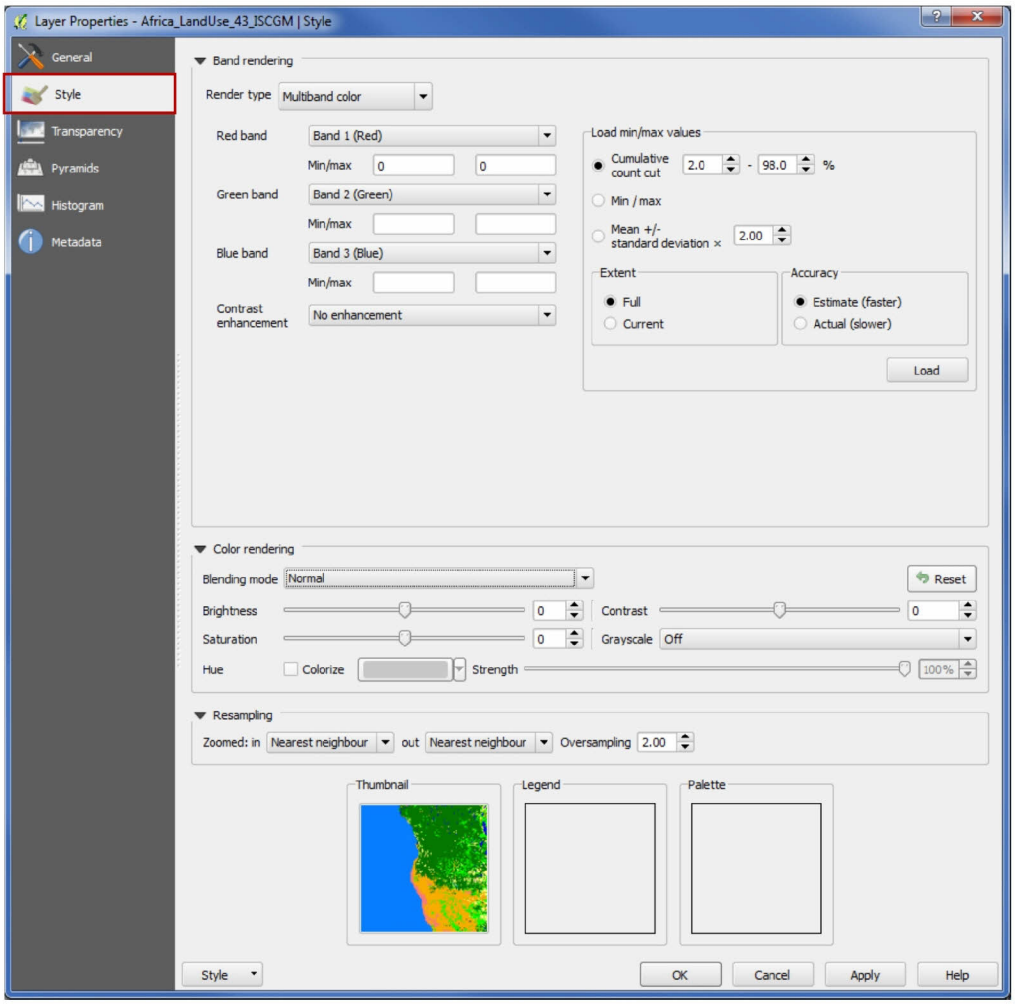
v) We now want to move the land use raster to the bottom of the list so you can still see all the vectors which you already added. Select the raster in the **Map Legend** window and drag it below the *Uganda_District_GAA* layer. *Note: You can expand the Map Legend window to make it easier to drag the files if needed.*



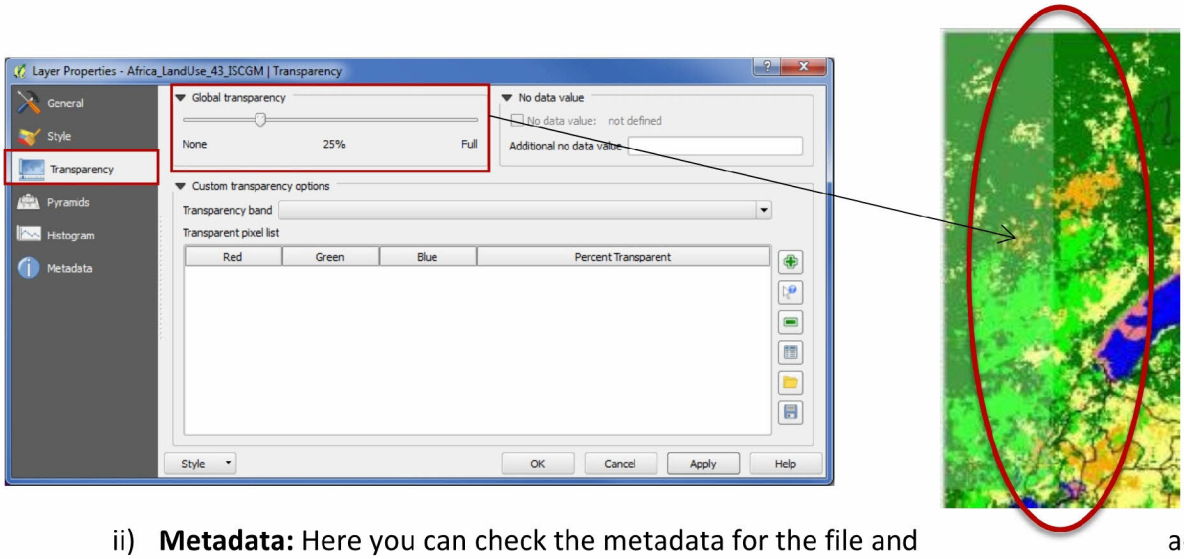
2) **Properties of a Raster layer:** Once you add a raster you can change the symbology, coordinate system, and metadata for that file by going to its **Properties.**
   a) Right click on *Africa_LandUse_31_ISCGM* and select **Properties.**
      i) **General** tab: Here you can see the layer name, location, and coordinate system (which you can change by clicking **Specify**).



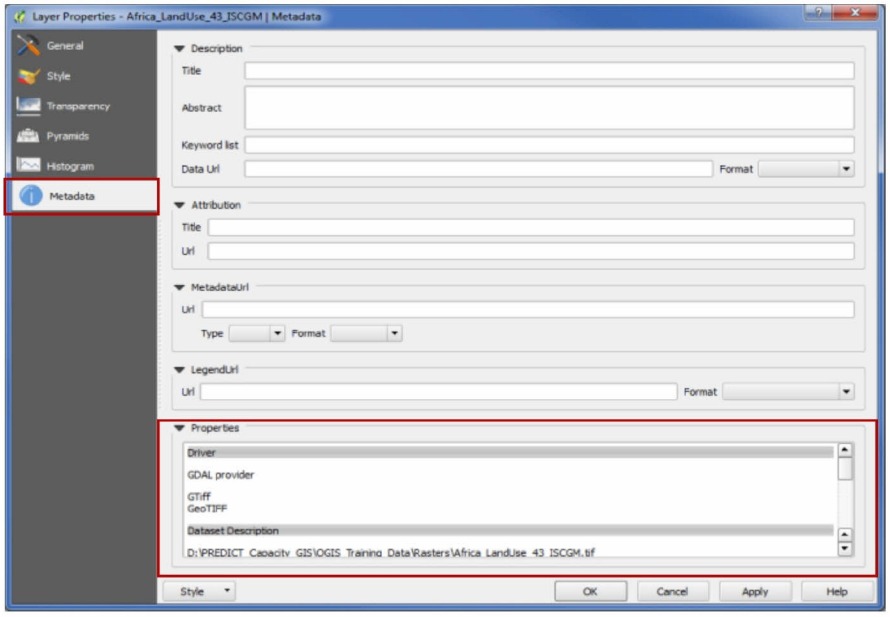
iii) **Style** tab: Here you can make changes to how the raster is visualized, although we recommend staying with the defaults unless your raster is visualized in only one color.



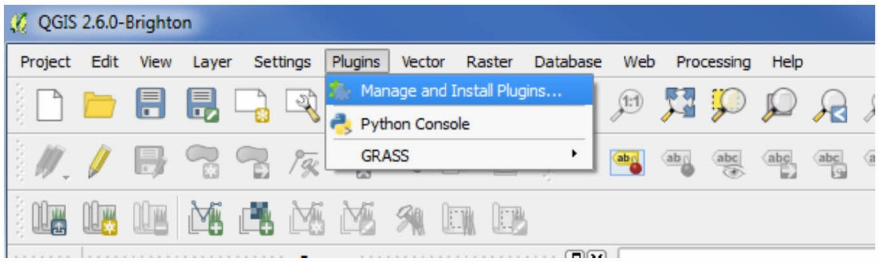
i) **Transparency** tab – Here you can change the transparency of the layer so you can see more or less of the layers underneath. Change the transparency to 25% and see the difference between the layers.



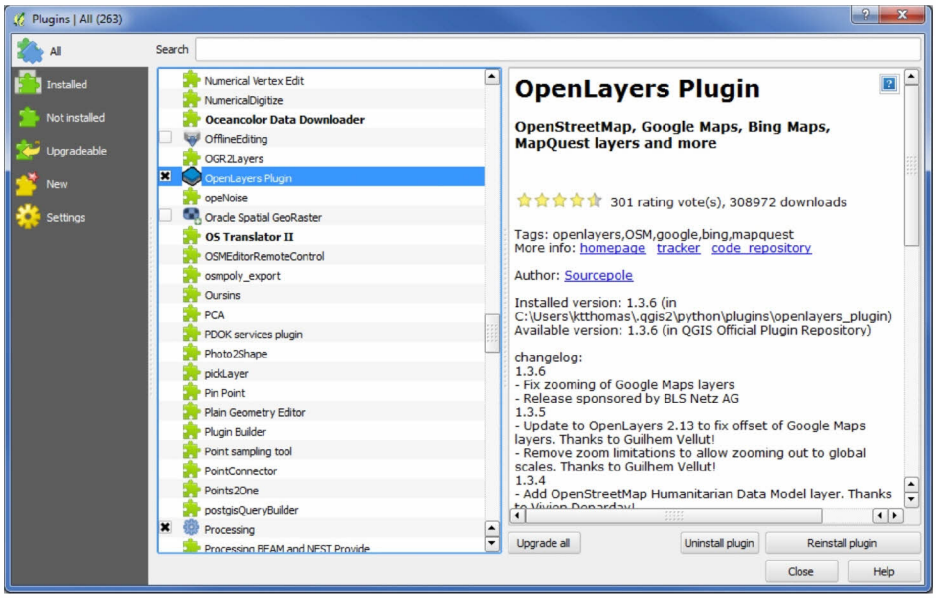
ii) **Metadata:** Here you can check the metadata for the file and add more information if needed. If you scroll down to the **Properties** tab and scroll in that window you will see the metadata which was entered by the Global Administrative Areas website (GAA) when they made the file. *Note: It's a good idea if you are going to be sharing your file with others that you fill out the metadata with some information so other users know specifics about the file such as coordinate systems, what the data represents, version of the file, etc.* Close the **Properties** box before proceeding.



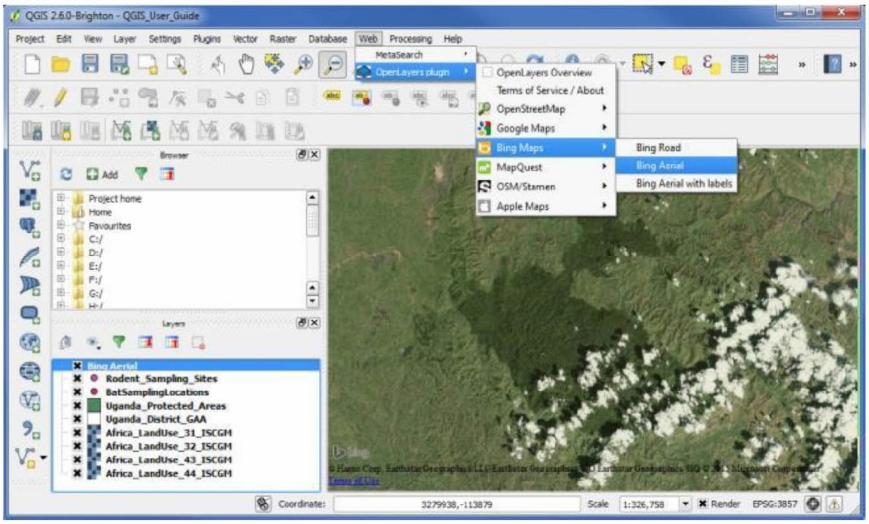
3. **Adding Background Maps:** In order to add a background map such as a street map or satellite image, you will need to add a plugin called OpenLayers.
   a) Go to the **Plugins** menu.
      i) Select **Manage and Install Plugins.**



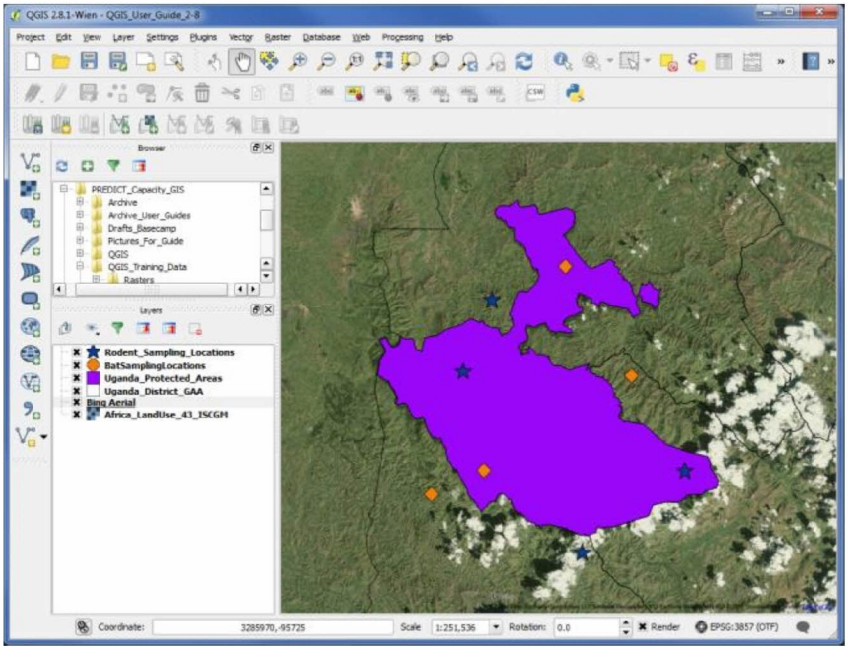
      ii) Scroll down and highlight the **OpenLayers Plugin** and hit the **Install plugin** button.
      iii) Once installed close the **Plugin** window. *Note: Once you add the Plugin you shouldn't have to add it again.*



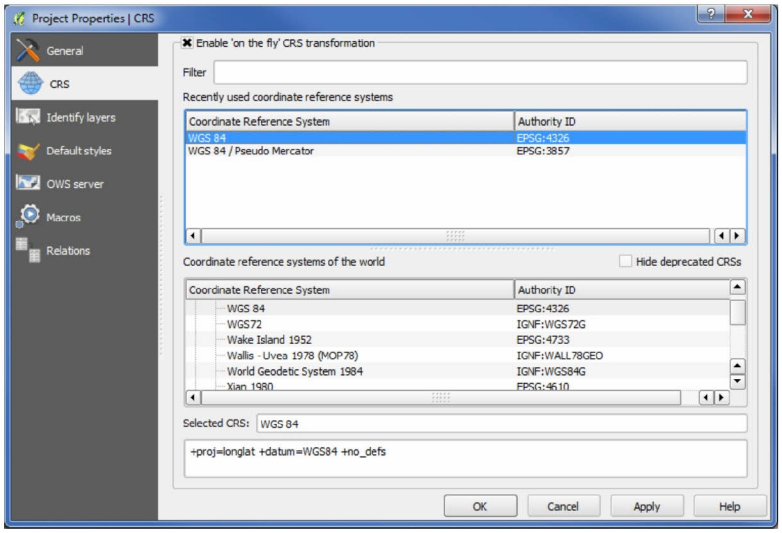
a) To add a background to your map, go the **Web** menu and select the **OpenLayers** plugin. You will notice that you can select background maps from OpenStreetMap, Google Maps, Bing Maps, etc. For Now let's add the **Bing Aerial Map.**
Note: Although you can add the map to your project, not all of these maps can be exported when making maps for presentations or publications. You might have to test which maps you are allowed to export.



b) When you add a new layer to the map you will notice that the layer will be placed at the top of the list and will cover up all other layers. In the **Map Legend** window click on the background layer and drag it to the bottom of the list. Your data will now be on top of the background map. You will need to deselect the land use layers in order to see the satellite image.

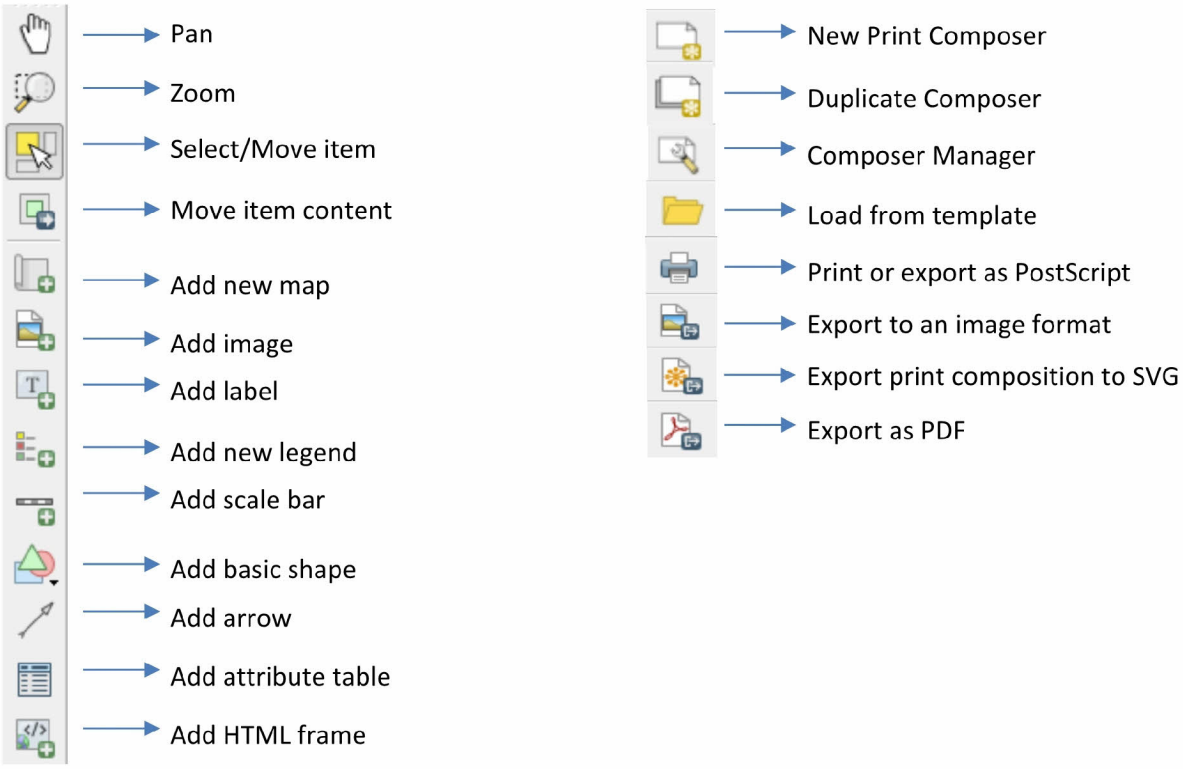


a) It is possible that by adding the background image it changed your project's coordinate system.
   i) To check this go to the **Project** file menu and choose **Project Properties**.
   ii) Choose **CRS** and make sure the *WGS 84* and not the WGS 84/Pseudo Mercator is chosen.



Section 8.1.8. Making Maps for Presentations & Publications

1. **Open the New Print Composer button** (you can also do this from the Project menu).
   a) Give a name to this layout (**Composer title**), click **OK.**
   b) The **New Print Manager** window will open. Listed below are some useful icons.



c) On the right side of the window there are 5 tabs. *Note: In the Mac version you may only see the Items, Composition, and Items Properties. If you would like to add the other panels go to the* ***View*** *pull-down menu, choose* ***Panels****, and then* ***add Command History and Atlas generation****.*

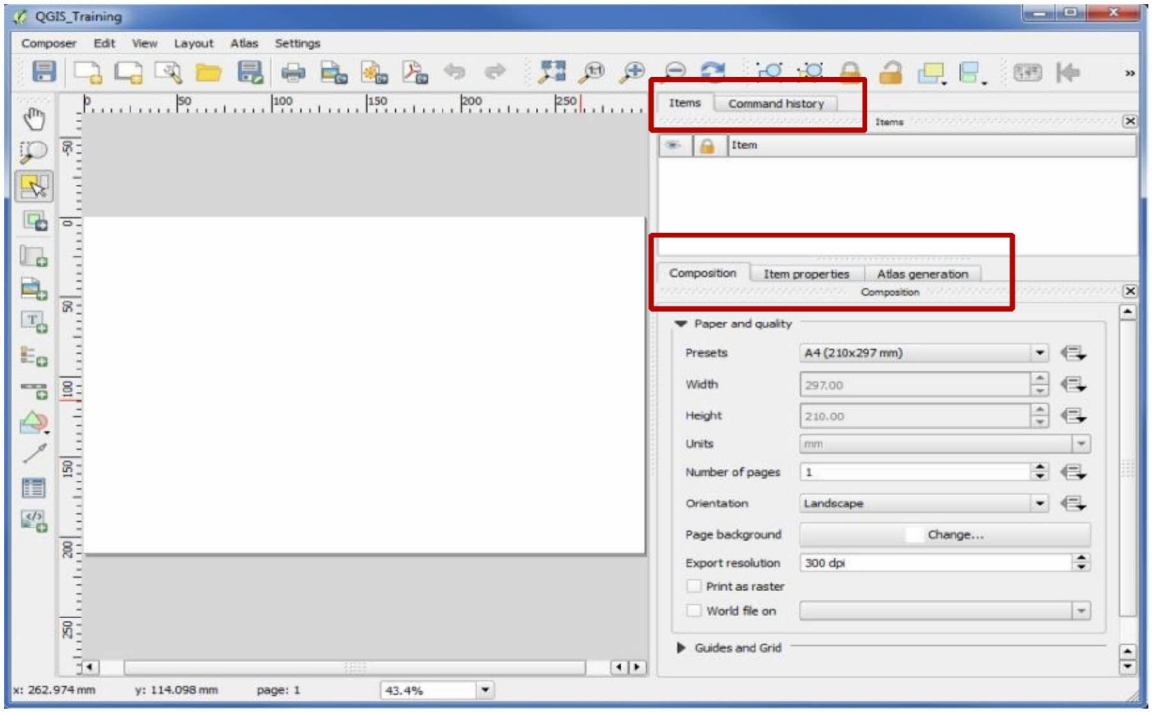
i) **Items**: provides a list of items added to the canvas.

ii) **Command history**: history of all changes applied to the Print Composer layout. Here you can undo and redo layout steps performed.

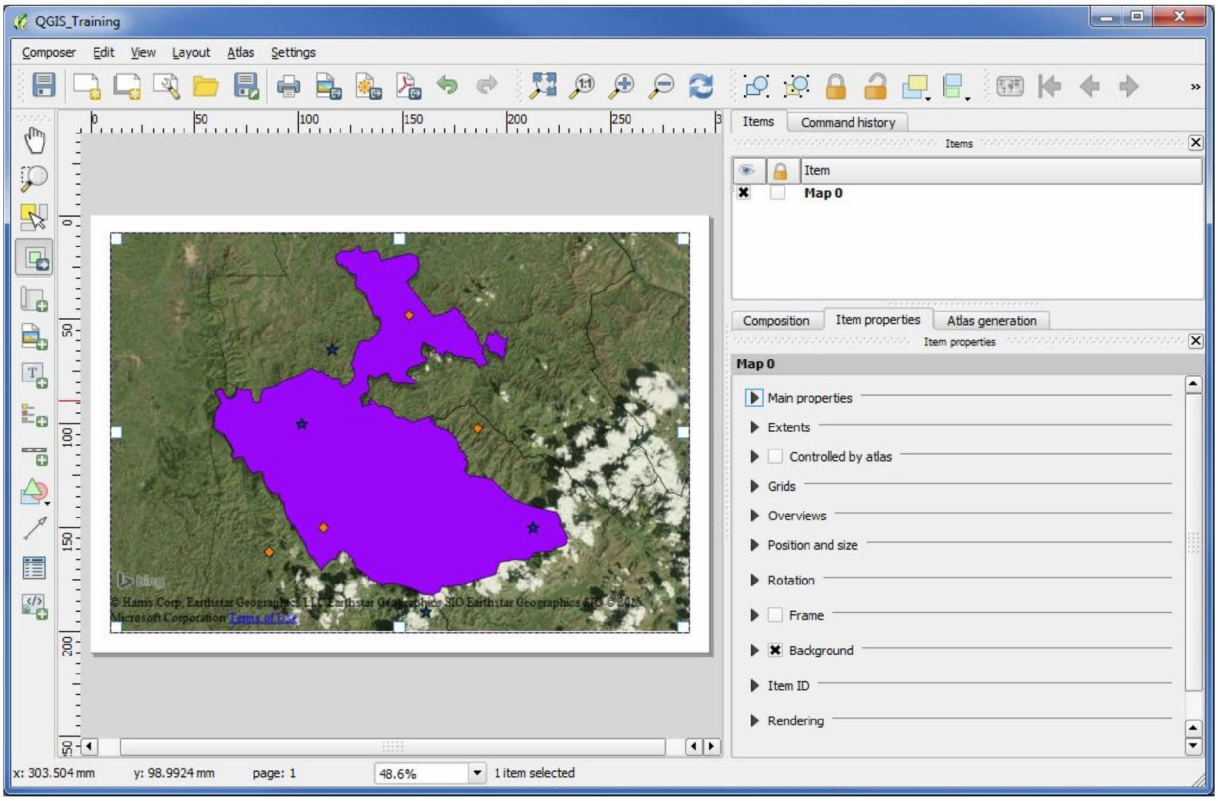
iii) **Composition**: here you can set paper size, orientation, page background, number of pages, and print quality.

iv) **Item properties**: displays the properties for the selected item and customizes settings for items like scale bars or labels.

v) **Atlas generation**: allows you to enable the generation of an atlas (map book) for the current Composer and gives access to its parameters.

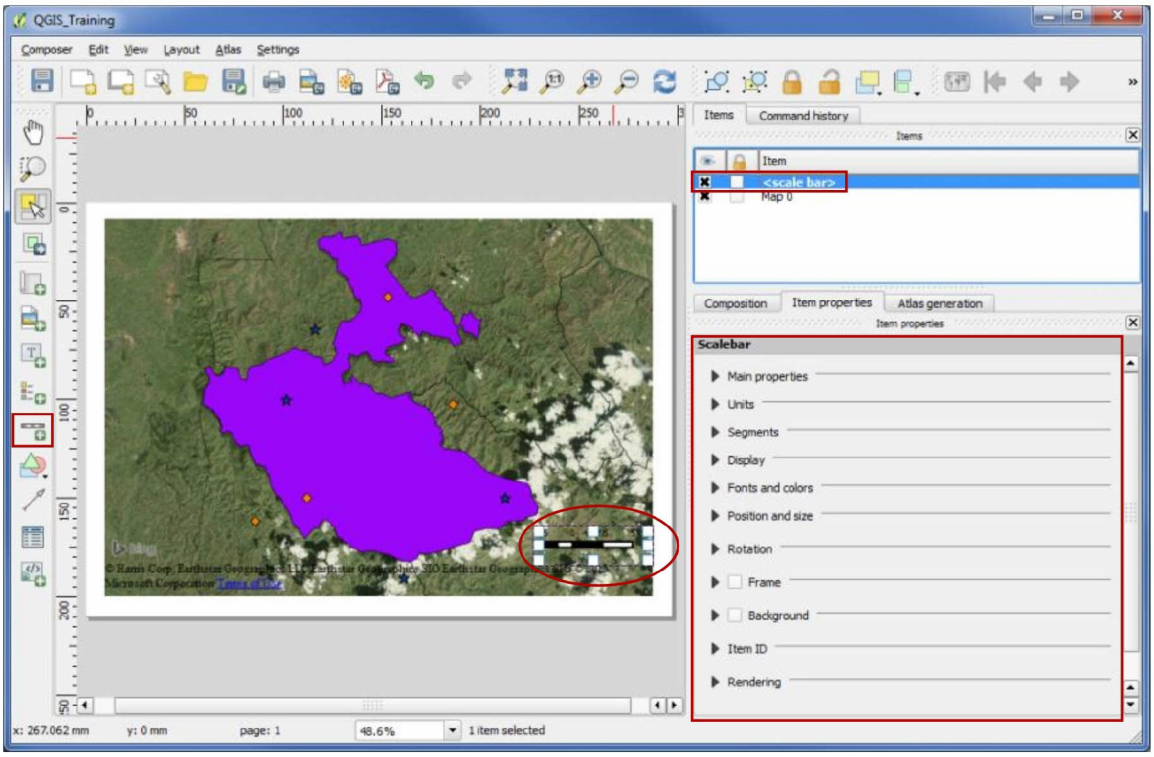


2. **Add New Map:** To add data to the Composer click the Add new map button, crosshairs will appear on the screen. Draw a box covering the area of the page. After you draw the box you will see the map image you just made in QGIS visualized in the composer window.



3) **Add a scale bar** by clicking the Add new scalebar button.
   a) With the crosshairs click on the image and a scale bar will appear.
   b) To change the properties of the scale bar you can click on **<scale bar>** in the **Items** window.
      i) Under **Main Properties** the **Style** pulldown menu will allow you to change the style of the scale bar.
      ii) Under **Units** you can change the units of the scale bar.
      iii) The **Segment** section allows you to change the number and size of the segments and height of the scale bar.
      iv) **Display** changes the style of the scale bar such as how far the text is away from the scale bar, size of the box etc.
      v) **Fonts and colors** allow you to change the color and font used for the scale bar.
      vi) **Position and Size** changes the location of the scale bar on the page (you can do the same thing by clicking the **Select/Move Item** icon and then select the scale bar and move it.
      vii) **Rotation** allows you to rotate the scale bar.
      viii) **Frame** allows you to put a frame around the scale bar.

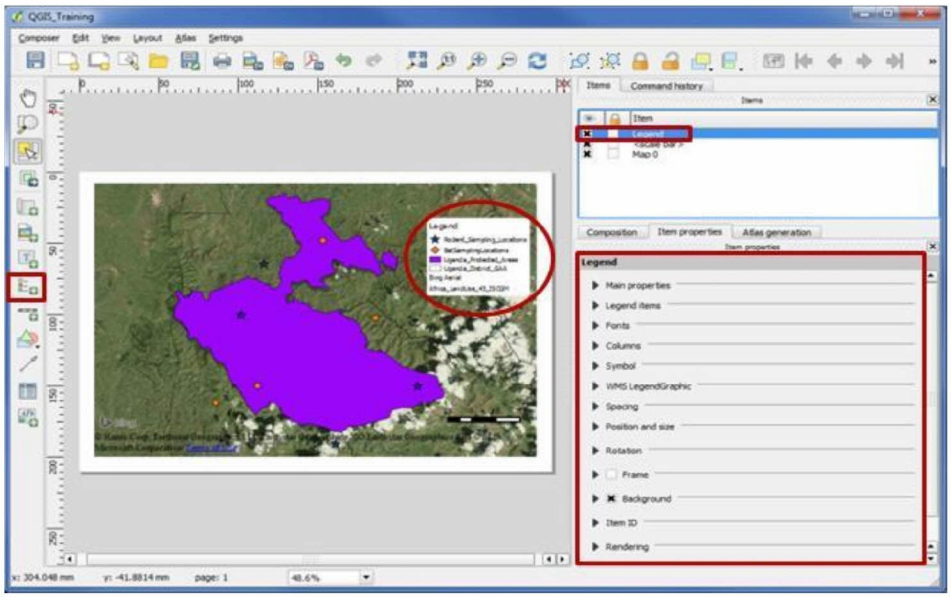
ix) **Background** allows you to put a background behind the scale bar.
x) **Item ID** allows you to add an ID (this will change the name from **<scale bar>** to whatever you type in the ID box in the **Items** window).
xi) **Rendering** has a function that will allow you to make the scale bar transparent or exclude from exports.



4) To add a legend, click the **Add new legend** button
   a) With the crosshairs click on the map and it will place the legend there (you can always change the location with the **Select/Move Item** tool). *Note: The legend tool will add all the files listed in your QGIS **Map Legend** window even if they are not activated.*
   b) To change the Legend properties, highlight **Legend** in the **Items** window and go to the **Item Properties** tab.
      i) **Main properties** allow you to change the legend **title,** the **alignment,** and **wrap text.**
      ii) **Legend Items** allows you to choose whether or not to auto update.
         (1) If you do not want to show some of the layer names in your QGIS window then uncheck the **Auto Update** and you will notice that you are now able to select the tools below.
         (2) The **+** tool will give you a list of layers you can add to the legend.
         (3) Highlight a layer you would like to delete from the legend and hit the **–** button. You will notice that the layer is removed from the legend.
         (4) You can also change the order of layers by highlighting a layer and using the up or down arrows.
         (5) By clicking on the editing tool  and highlighting a layer, you can change

the name of that layer.

iii) **Fonts** allow you to change the font style and color.
iv) **Columns** allow you to make multiple columns in your legend and then change the properties of those columns.
v) **Symbol** allows you to change the width and height of the legend box.
vi) **WMS LegendGraphic (Web map service)** allows you to make a Web Map Service (WMS) legend.
vii) **Spacing** allows you to change the space between and around text.
viii) **Position and Size** changes the location of the legend on the page (you can do the same thing by clicking the **Select/Move item** icon and then selecting the legend box to move it.
ix) **Rotation** allows you to rotate the legend.
x) **Frame** allows you to put a frame around the legend.
xi) **Background** allows you to put a background behind the legend.
xii) **Item ID** allows you to add an ID (this will change the name from **Legend** in the **Items** window to whatever you typed in the ID box).
xiii) **Rendering** has a function that will allow you to make the legend transparent or exclude from exports.

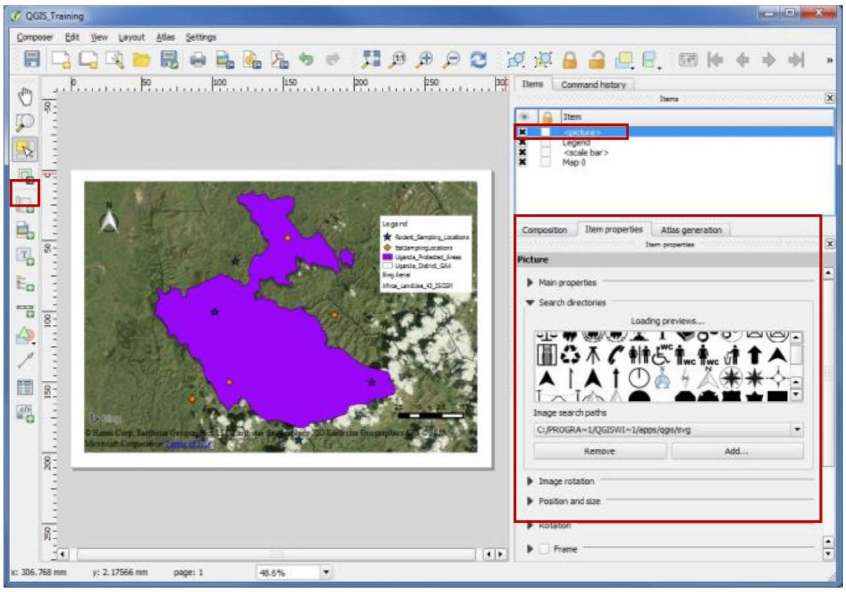


5) **Add a North Arrow:**

a) Click the **Add Image** button.

b) Click on the image and draw a box where you would like the north arrow to be.

c) Under **Items Properties** tab open **Search directories** by clicking on the arrow next to it. Images will appear in the box below, scroll through and choose the north arrow you would like to use**.** Click on the arrow. You should notice that the arrow now appears in the box you drew on the map.

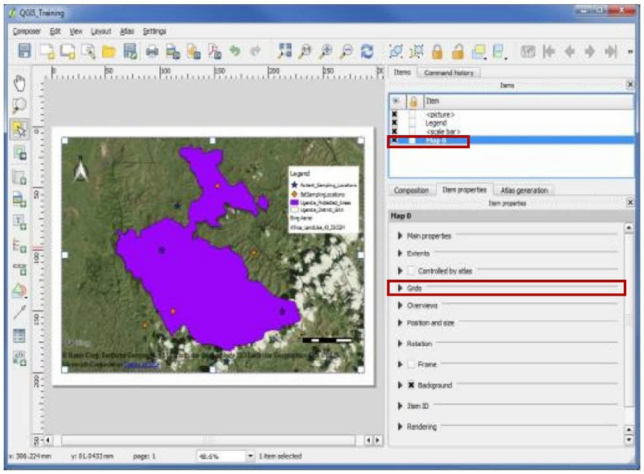


d) You can resize the arrow by changing the size of the box. This is done by dragging the box's corners to the desired size.

6) **Add a Graticule** (evenly spaced horizontal and vertical lines used to identify locations on a map often using latitude and longatitude):

a) Highlight **Map** under the **Items** window.

b) In the **Items Properties** window click on the arrow next to **Grids** to expand that section.



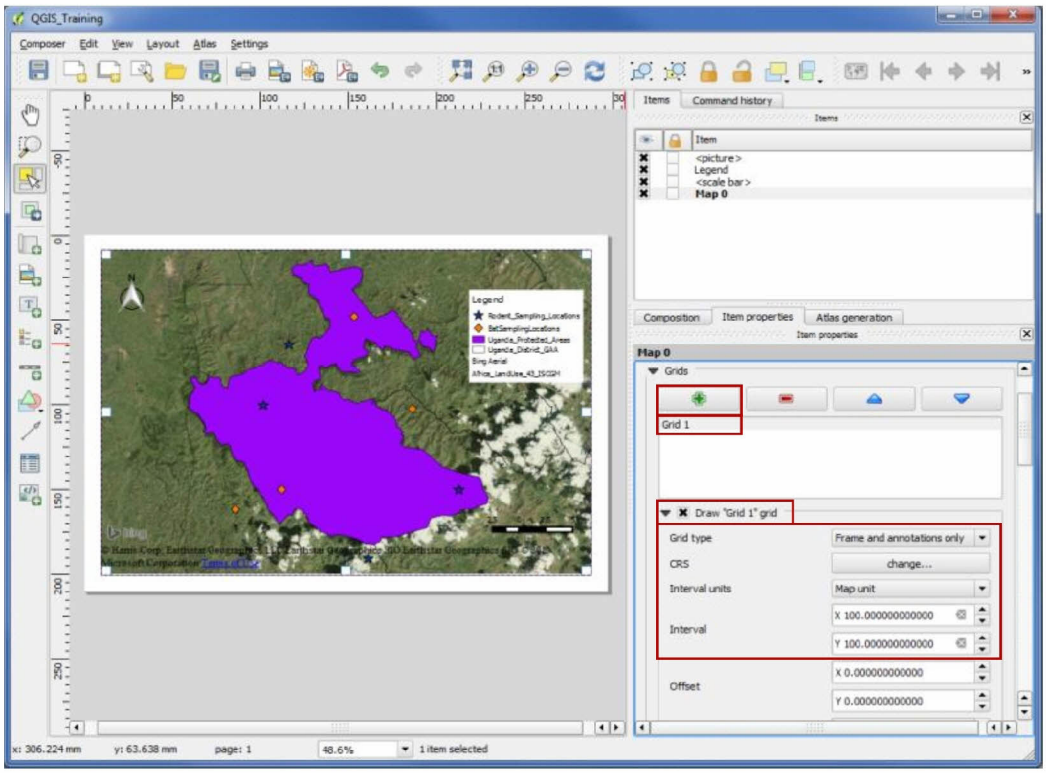
c) Click the + button and you should see **Grid 1** show up in the box below. Highlight **Grid 1** and activate the box next to **Draw "Grid 1" grid**, by clicking on it**.** This will open the grid properties which you can fill out.

i) Choose **Grid Type** as **Frame and annotations only.**

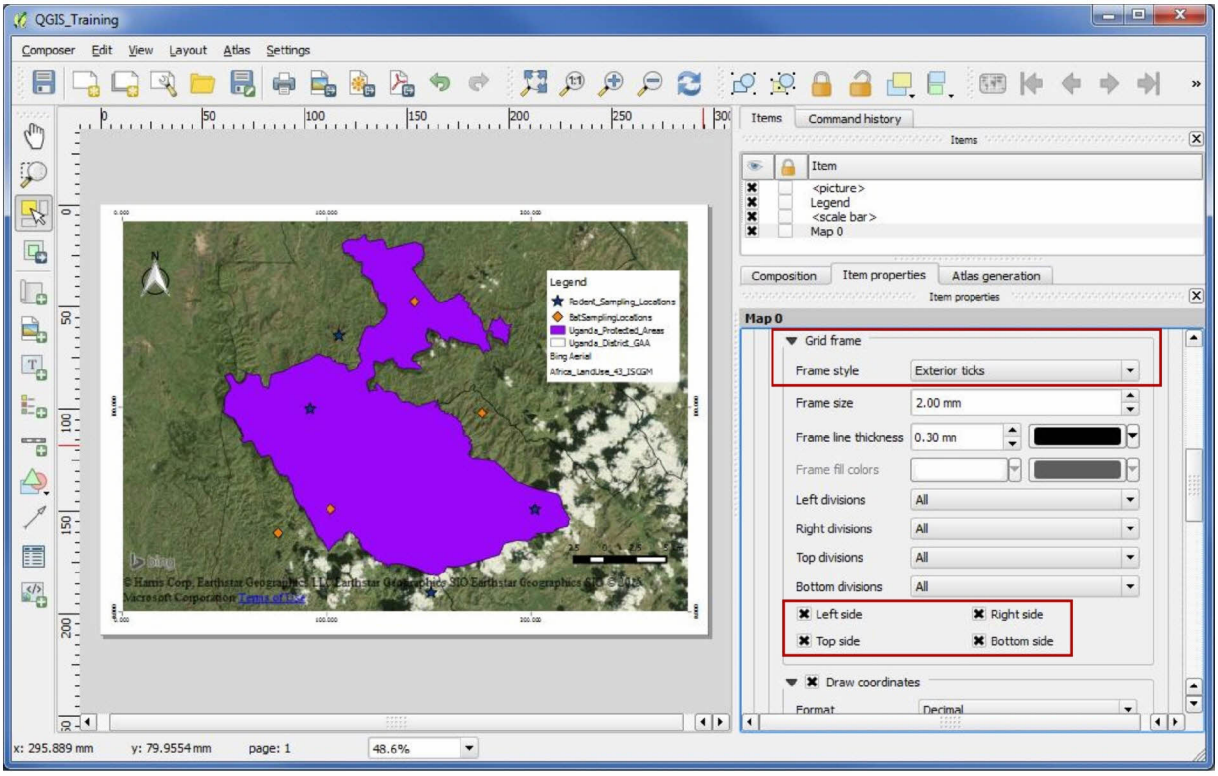
ii) For **CRS,** choose WGS 84 as the coordinate system so that the coordinates are displayed as latitude and longitude.

iii) **Interval Units** set to millimeter. *Note: you can keep this set to the default of Map Unit, however, if your coordinates don't show up change to millimeter or centimeter and they will show up.*

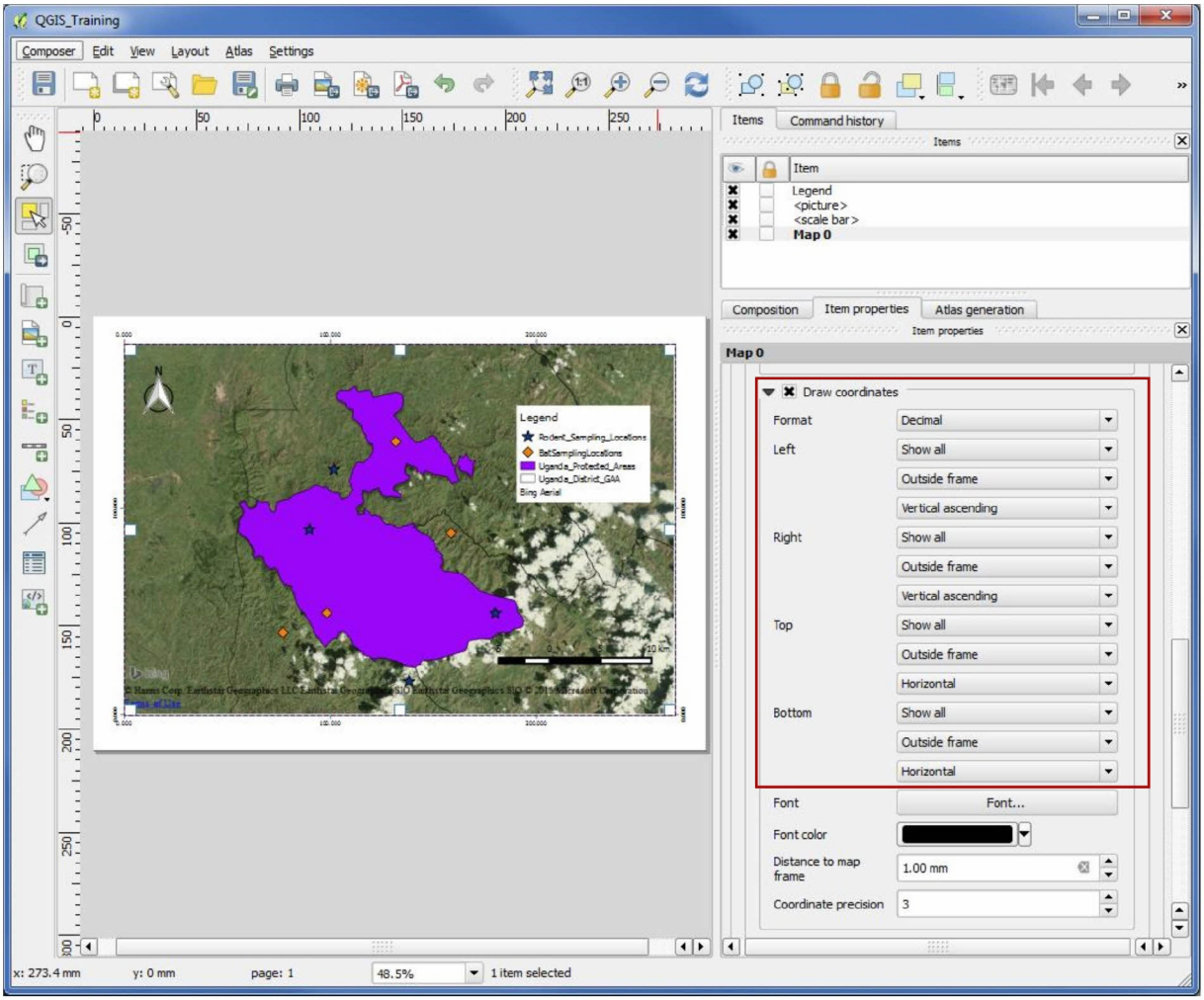
iv) **Interval** will set the intervals between the numbers displayed on the graticule. For this example set the interval to 100 for both X and Y.



v) Scroll down to **Grid Frame** and set the **Frame style** to **Exterior ticks** and make sure **Left side, Right side, Top side, and Bottom side** are all checked**.** This will display the coordinates on all four sides of your map.



vi) Activate the **Draw coordinates** button by clicking in the box next to it. Choose a **Format.** Here we choose for latitude and longitude to be displayed as **Decimal**. **Left, Right, Top, and Bottom** should all be set to **Outside frame;** and **Left** and **Right** should also be set to **Vertical**. You should now see your graticule around the map. *Note: There have been people using the Mac version where the graticule isn't showing up in QIGS but is there when they export the map. We have not been able to identify the problem yet, but are continuing to look into the problem.*

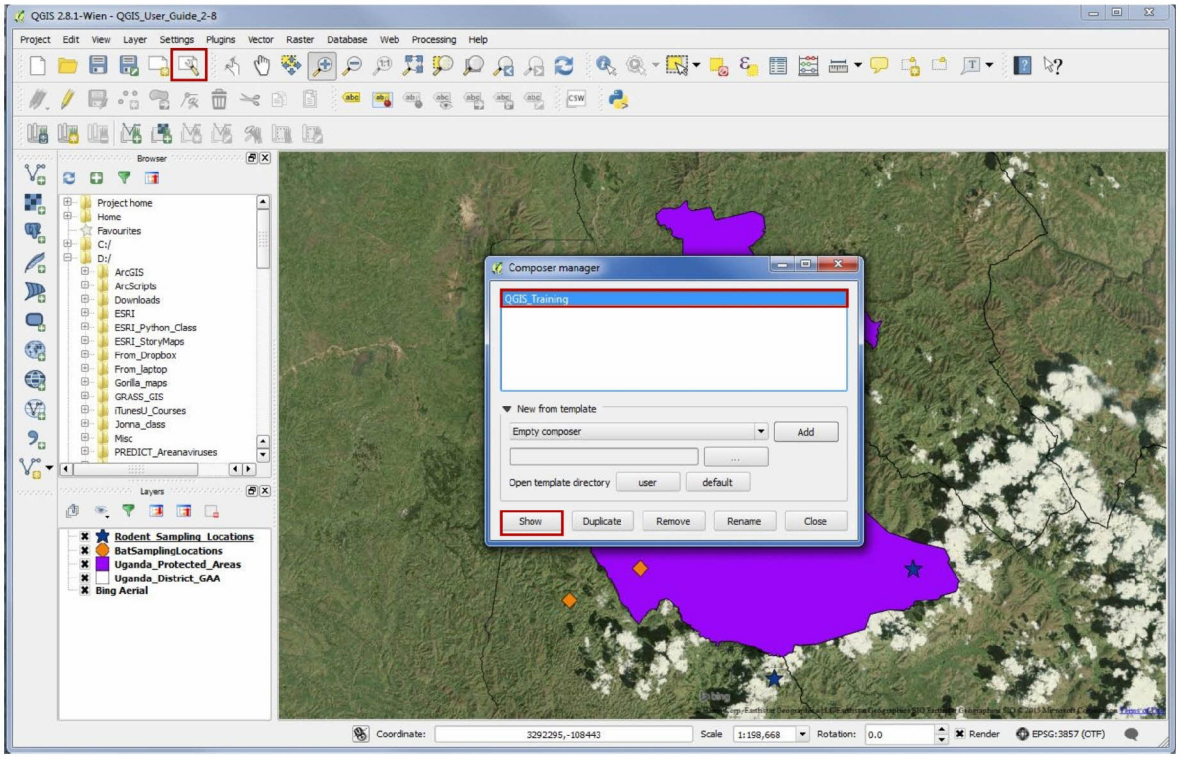


6) Once you are happy with the layout (feel free to move the items on the map around to make it more pleasing to the eye) you can **Export** the map as an image (.jpg) or .pdf file

   a) Export as **Image:** 
      i) **Browse:** browse to where you want to save the file.
      ii) **File name:** name the file you are saving.
      iii) **Save as type**: choose the type of file you would like to save i.e. jpg or .tif.

   b) Export as **pdf:** 
      i) Click **OK** if you get a warning about saving the file as a raster.
      ii) **Browse** to where you would like to save the file.
      iii) **File name:** give the file a name.
      iv) Click **Save.**

7) **Composer Manager:** If you close the New Print Composer window, you can reopen the Print Composer by clicking on the Composer Manager window.
   a) Highlight the template you would like to open and click the **Show** button.

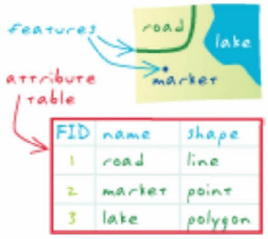


Section 8.1.9. Glossary

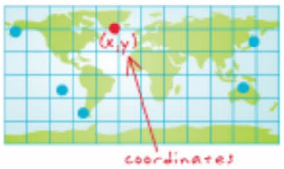
Definitions and pictures are sourced from ESRI unless otherwise stated.

Attribute – Non-spatial information about a geographic feature in GIS, usually stored in a table and linked to the feature by a unique identifier. For example, attributes of a river might include its name, length, and sediment load at a gauging station. In raster datasets, information associated with each unique value of a raster cell.

Attribute tables - A database or tabular file containing information about a set of geographic features, usually arranged so that each row represents a feature and each column represents one feature attribute. In raster datasets, each row of an attribute table corresponds to a certain zone of cells having the same value. In GIS, attribute tables are often joined or related to spatial data layers, and the attribute values they contain can be used to find, query, and symbolize features or raster cells.



Coordinates - A set of values represented by the letters *x*, *y*, and optionally *z* or *m* (measure), that define a position within a spatial reference. Coordinates are used to represent locations in space relative to other locations.



Coordinate System - Coordinate systems enable geographic datasets to use common locations for integration. A coordinate system is a reference system used to represent the locations of geographic features, imagery, and observations, such as Global Positioning System (GPS) locations, within a common geographic framework.

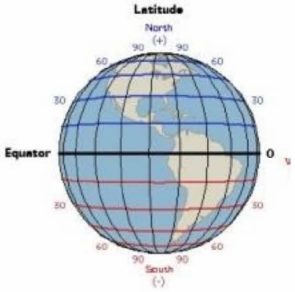
Datum - The reference specifications of a measurement system, usually a system of coordinate positions on a surface (a horizontal datum) or heights above or below a surface (a vertical datum).

Geographic Coordinate System - A geographic coordinate system uses a three-dimensional spherical surface to define locations on the earth. It includes an angular unit of measure, a prime meridian, and a datum (based on a spheroid). The spheroid defines the size and shape of the earth model, while the datum connects the spheroid to the earth's surface. A point is referenced by its longitude and latitude values. Longitude and latitude are angles measured from the earth's center to a point on the earth's surface. The angles often are measured in degrees. ***Note: Because latitude and longitude are based on angles they do not have a standard length throughout the globe. Because of this you cannot use a geographic coordinate system if you plan to do any analysis on your data. Instead you will want to use a projected coordinate system.***

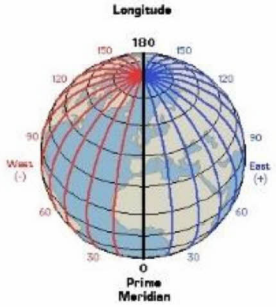
Graticule - A network of lines representing the Earth's parallels of latitude and meridians of longitude on a map.

Layer - The visual representation of a geographic dataset in any digital map environment. Conceptually, a layer is a slice or stratum of the geographic reality in a particular area, and is more or less equivalent to a legend item on a paper map. On a road map, for example, roads, national parks, political boundaries, and rivers might be considered different layers. A layer can also reference to a data source, such as a shapefile, coverage, geodatabase feature class, or raster that defines how the data should be symbolized on a map.

Latitude – Latitude values are measured relative to the equator and range from –90° at the South Pole to +90° at the North Pole. The equator is considered the 0° of latitude and the y value in a coordinate pair. Latitude is an angle measured from the earth's center to a point on the earth's surface. The angles often are measured in degrees.
Image: http://geographyworldonline.com/tutorial/instructions.html

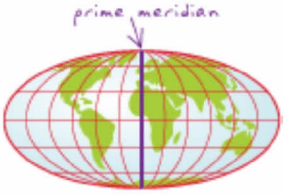


Longitude - Longitude values are measured relative to the prime meridian. They range from –180° when traveling west to 180° when traveling east. The prime meridian is considered the 0° of longitude and the x value in a coordinate pair. Longitude is an angle measured from the earth's center to a point on the earth's surface. The angles often are measured in degrees.
Image: http://geographyworldonline.com/tutorial/instructions.html



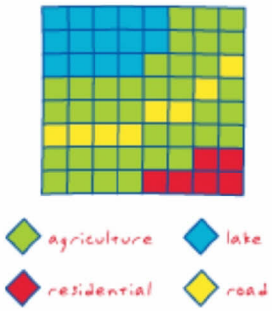
Metadata - Information that describes the content, quality, condition, origin, and other characteristics of data or other pieces of information. Metadata for spatial data may describe and document its subject matter; how, when, where, and by whom the data was collected; availability and distribution information; its projection, scale, resolution, and accuracy; and its reliability with regard to some standard. Metadata consists of properties and documentation. Properties are derived from the data source (for example, the coordinate system and projection of the data), while documentation is entered by a person (for example, keywords used to describe the data).

Prime Meridian - In a coordinate system, any line of longitude designated as 0 degrees east and west, to which all other meridians are referenced. The Greenwich meridian is internationally recognized as the prime meridian for most official purposes, such as civil timekeeping.



Projected Coordinate System - A projected coordinate system is defined on a flat, two-dimensional surface. A projected coordinate system has constant lengths, angles, and areas across the two dimensions. It includes a map projection, a set of projection parameters that customize the map projection for a particular location, and a linear unit of measure. Different projected coordinate systems are useful for different purposes, for example some projected coordinate systems might preserve distance, area, true directions, or shape. Wikipedia has a useful, detailed explanation of coordinate systems at http://en.wikipedia.org/wiki/Coordinate_system

Raster - A spatial data model that defines space as an array of equally sized cells arranged in rows and columns, and composed of single or multiple bands. Each cell contains an attribute value and location coordinates. Unlike a vector structure, which stores coordinates explicitly, raster coordinates are contained in the ordering of the matrix. Groups of cells that share the same value represent the same type of geographic feature.



Shapefile - A vector data storage format for storing the location, shape, and attributes of geographic features. A shapefile is stored in a set of related files and contains one feature class. There 3 mandatory files (first 3 listed below) that make up a shapefile, however, there may be files for the shapefile containing additional information:

.shp – shape format; the feature geometry itself
.shx – shape index format; a positional index of the feature geometry to allow seeking forwards and backwards quickly.
.dbf – attribute format; columnar attributes for each shape, in dBase IV format
.prj – projection format; the coordinate system and projection information, a plain text file describing the projection
.xml – geospatial metadata in XML format
.sbn and .sbx – a spatial index of features

Sphere vs. spheroid -

Sphere – a perfectly round geometrical and circular object in three-dimensional space
Spheroid – a spherelike but not perfectly spherical body

Symbology – The set of conventions, rules, or encoding that define how geographic features are represented with symbols on a map. A characteristic of a map feature may influence the size, color, and shape of the symbol used.

Vector – A coordinate-based data model that represents geographic features as points, lines, and polygons. Each point feature is represented as a single coordinate pair, while line and polygon features are represented as ordered lists of vertices. Attributes are associated with each vector feature, as opposed to a raster data model, which associated attributes with grid cells. Examples of a vector include points representing sampling locations, line representing roads, and polygons representing national parks.

Section 8.1.10. Data Download

Global Administrative Areas – Country administrative layers (country, state, county, etc)

http://www.gadm.org/country

Choose your **Country**

File format = Shapefile

Click **OK**

On the next page click **Download**

Protected Planet – National parks and protected areas

For this site you have to set up an account but it's free

http://www.protectedplanet.net/

International Steering Committee for Global Mapping – National data, Global elevation, Global land cover, and Global vegetation

For this site you will have to register to download data but it's free.

Home page - http://www.iscgm.org/

Data download page - https://www.iscgm.org/gmd/

IUCN (International Union for Conservation of Nature) Red List of Threatened Species – Download shapefiles on location information for threatened species.

http://www.iucnredlist.org/technical-documents/spatial-data

Natural Earth – Here you can download different data from administrative boundaries to shaded relief rasters.

http://www.naturalearthdata.com/

GrassWiki Geodata – This site as a list of data sites. Click on one of the layers you are interested in and it will take you that particular website.

http://grasswiki.osgeo.org/wiki/Geodata

United States Geological Survey (USGS) - This website has many links for data worldwide.

http://landcover.usgs.gov/landcoverdata.php#regional

Andreas Hamann's website – Climate data for North America, South America, and Europe

http://www.ualberta.ca/~ahamann/data.html

Section 8.1.11. Helpful Online Tools & QGIS Training Videos

Federal Communications Commission – Site that converts latitude and longitude between Degrees Minutes Seconds to Decimal Degrees

http://transition.fcc.gov/mb/audio/bickel/DDDMMSS-decimal.html

Geographic/UTM Coordinate Converter – Converts coordinates between latitude and longitude and UTM

http://home.hiwaay.net/~taylorc/toolbox/geography/geoutm.html

National Oceanic and Atmospheric Administration (NOAA) Understanding Datums, Coordinate Systems, and Map Projections

http://coast.noaa.gov/digitalcoast/_/elearning/datums/player.html

ESRI About Coordinate Systems and Map Projections

http://webhelp.esri.com/arcgisdesktop/9.3/index.cfm?TopicName=About_coordinate_systems_and_map_projections

There are many videos online which you might be interested in using as a reference. Below are just a few we thought were useful and easy to follow.

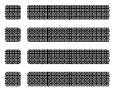
- The Interface: http://qgis-tutorials.mangomap.com/post/79334660226/qgis-video-tutorials-module-1-the-interface
- Creating a basic map: http://qgis-tutorials.mangomap.com/post/82295156067/qgis-video-tutorials-module-2-creating-a-basic
- Classifying vector data: http://qgis-tutorials.mangomap.com/post/83730031877/qgis-video-tutorials-module-3-classifying
- Creating a map for print: http://qgis-tutorials.mangomap.com/post/84321475284/qgis-video-tutorials-module-4-creating-a-map
- Creating vector data: http://qgis-tutorials.mangomap.com/#

Please visit: https://eidr.ecohealthalliance.org/about

EIDR is a centralized web platform dedicated to unraveling the origins of Emerging Infectious Diseases (EIDs). Through EIDR, multiple EID events can be compared, historical disease emergence can be visualized spatially, and individual emergence events can be explored in depth. This project builds upon previous work at EcoHealth Alliance, like the 'hotspots' map published by Jones et al., in 2008 in the journal Nature (Jones et al 2008).

How can you explore disease emergence using EIDR?

Emergence events can be sorted, compared, and investigated in a variety of ways.



Emergence Events

You can explore emergence events using an interactive table of EID events found in the 'Emergence Events' view. The information displayed in this table is customizable, allowing you to choose which EIDR variables you want to view. You can perform specific searches within the table using a filter feature. You may want to search for events with a common variable, like a specific host, or pathogen.

View Emergence Events (/events)

Event Pages

You can explore individual EID events in greater detail through event pages. These event pages can be accessed from the 'Emergence Events' list by clicking an event in the table. Each EID event page contains a detailed report on the event, including an abstract, a map showing the location of the event, and additional information on the event. References used for each event are available in each event page.

Event Map

The event map map provides a broad spatial depiction of all EID events within the EIDR database. Zoom into a specific region or event of interest and click on the map pin to be directed to the Event Page for that event.

View Event Map (/event-map)

Methods

EID Event Collection

For the purpose of EIDR, an EID event is defined as the original case or cluster of cases representing the emergence of an infectious disease in human populations. Emergence is defined as the development of any of the following with respect to a given microorganism:

1. Earliest instance of natural human infection
2. Reappearance after control or elimination
3. New drug resistance
4. New or expanded geographic region
5. Increased incidence
6. Increased virulence

Events are not counted amongst EID events unless some clinical significance and relevance is attributable to the pathogen in question. Potential EID events were evaluated based on these definitions by emerging infectious disease experts at EcoHealth Alliance and classified as EID events if they met any of the above criteria. See EIDR variable definitions for more information on these variables (/variable-definitions).

The events in EIDR date back to 1940, a cut-off chosen by Jones et al. (Jones et al. 2008), and informed by the Institute of Medicine's resources on EIDs (Smolinski, Hamburg, and Lederberg 2003). Potential EID events were collected from a review of meta-analyses on disease emergence, or through an internal literature review. All events between 1940 and 2004 derive from Jones et al. (Jones et al. 2008), which relied heavily on the review by Taylor and colleagues (Taylor, Latham, and Woolhouse 2001). Events between 2004 and 2013 derive from a recent effort to map emerging zoonoses (Grace et al. 2012), a review of trends in viral discovery (Rosenberg et al. 2013), or were compiled through a review of the literature.

Data Collection and Review

For each EID event data were collected on a set of variables identified as important by a team of EcoHealth Alliance experts. These variables are designed to capture critical spatial, temporal, clinical, epidemiologic, economic, pathogen, and host information. Data were also collected on potential drivers associated with each EID event, like war and famine, antimicrobial use, or proximity to wildlife. Driver categories are based on those found in Smolinski et al. (Smolinski, Hamburg, and Lederberg 2003) and Lederberg et al. (Lederberg, Shope, and Oaks 1992), but some categories are removed and others are broken down further. Emergence locations are resolved to the most specific spatial information available, frequently geographic coordinates representing the smallest administrative region associated with an event. Rarely, multiple potential emergence locations are provided for a single event due to insufficient temporal information within the available literature. Events were independently reviewed at least twice by EcoHealth Alliance veterinarians, disease ecologists, epidemiologists, and public health specialists. A list of all variables and their sub-categories can be found in EIDR variable definitions (/variable-definitions).

Short abstracts are included for all events. When possible, direct language from text was captured to justify values for subjective variables. If no information could be found on a particular variable this absence was captured. General contextual information for each event was acquired from various sources, many unrelated to EID events. For example, taxonomic information is from the National Center for Biotechnology Information (NCBI 2015), and economic information is from the World Bank (World Bank Group 2015).

EIDR was made possible by the generous support of the American people through the United States Agency for International Development (USAID) Emerging Pandemic Threats PREDICT, and through the support of the Defense Threat Reduction Agency (DTRA) through a contract (Contract No. HDTRA1-13-C-0029) awarded to EcoHealth Alliance. The contents are the responsibility of the authors and do not necessarily reflect the views of USAID, DTRA or the United States Government.

(//www.dtra.mil/)

USAID
FROM THE AMERICAN PEOPLE

(//www.usaid.gov/)

Funk, S., T. L. Bogich, K. E. Jones, A. M. Kilpatrick, and P. Daszak. 2013. 'Quantifying trends in disease impact to produce a consistent and reproducible definition of an emerging infectious disease', *PLoS One*, 8: e69951.

Grace D, Mutua F, Ochungo P, Kruska R, Jones K, Brierley L, Lapar ML, Said M, Herrero M, Phuc PM, Thao NB, Akuku I, Ogutu F. 2012. "Mapping of poverty and likely zoonoses hotspots." Nairobi Kenya: ILRI.

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: 990-3.

Lederberg, J., R. E. Shope, and S. C. Oaks. 1992. *Emerging Infections: Microbial Threats to Health in the United States* (Institute of Medicine, National Academy Press: Washington (DC)).

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The EIDITH R Package

The **eidith** R package provides programmatic access and analytical tools for data from the PREDICT program (http://www.vetmed.ucdavis.edu/ohi/predict/). housed at the Emerging Infectious Disease Information Technology Hub (https://www.eidith.org/).

The **eidith** package contains no data. To access data, you must be a registered (https://www.eidith.org/register.aspx) EIDITH user with data access privileges. If you have a question about your access level, contact technology@eidith.org (mailto:technology@eidith.org).

See the package tutorials under "Documentation" above for guides on how to install the package, download data (https://ecohealthalliance.github.io/eidith/articles/eidith.html), pull raw, processsed data (https://ecohealthalliance.github.io/eidith/articles/preprocessing.html) and work across multiple data sets (https://ecohealthalliance.github.io/eidith/articles/data_structure.html). The help files (https://ecohealthalliance.github.io/eidith/reference/index.html) document individual package functions.

Developed by Noam Ross, Nistara Randhawa, Cale Basaraba.

Site built with pkgdown (http://hadley.github.io/pkgdown/).

THE ROLE OF ENVIRONMENT IN ONE HEALTH AND NATIONAL HEALTH SECURITY

Across the world, ministries of environment and natural resources and/or environmental protection agencies have different mandates and missions, but many of them focus on the protection of the environment with the goal of protecting public health. Environmental health practitioners monitor food safety from farm to table; are responsible for vector and vermin monitoring and control; and monitor microbial and chemical pollution of the land, water, and air. Natural resource managers monitor ecosystems and landscapes and the creatures that occupy them. They often see trends in the natural world before they are seen in the urban world. For example, unusual wildlife morbidity and mortality can indicate presence of pathogenic or toxic agents that could potentially be detrimental to human health. The environment sector is a valuable contributor in the promotion of population health and well-being, particularly in "health security" efforts to prevent and prepare for endemic, epidemic, and pandemic threats.

LINKS BETWEEN ENVIRONMENT AND HEALTH

The links between biodiversity, ecosystems, and public health are well documented in recent publications (e.g., WHO-CBD *State of Knowledge Review on Biodiversity and Human Health* 2015; WHO *Millennium Ecosystem Assessment* 2005). These links range from ecosystem services that contribute to human health—provision of food, water, and medicines—to pollution remediation and pathogen regulation. Particularly relevant connections for health security include:

PHOTO BY CHRISTINE JOHNSON

- The majority of known pathogens infectious to humans have animal origins ("zoonotic diseases"). Of these, approximately three-quarters emerged from wildlife, such as HIV/AIDS, Ebola, and SARS;
- The drivers of biodiversity loss, ecosystem degradation, and disease emergence overlap (including changes in land use/habitat or hunting and trade). Changes associated with these drivers modify the dynamics of hosts and pathogens.

Under broad guidance from the World Health Organization, on the requirements of the International Health Regulations (IHR 2005), *countries are currently undertaking national action planning for health security, a process intended to promote multi-sectoral partnerships to prevent, prepare, and respond to disease threats.* The environmental community can play a crucial role in this process, and seek to inform and support animal and human health partners in identifying synergies. National Biodiversity Strategies and Action Plans and other land use planning tools provide important information for health security planning.

In 2014 parties to the United Nations Convention on Biological Diversity agreed to recognize "the value of the 'One Health' approach to address the cross-cutting issue of biodiversity and human health, as an integrated approach consistent with the ecosystem approach (decision V/6) that integrates the complex relationships between humans, microorganisms, animals, plants, agriculture, wildlife and the environment."

VALUE OF THE ENVIRONMENTAL AND NATURAL RESOURCE SECTOR TO THE PUBLIC HEALTH SECTOR

The environment sector plays an essential role in public health, yet, to date, it has been an under-utilized partner for health security in most countries. While authorities from the human health, animal health, and environment sectors may not be aware of the benefits of collaboration with one another, the "One Health" concept recognizes the connections between human, animal, and ecosystem health, which will hopefully allow the concept to reach its full potential in practice at local, national, and global levels. By utilizing data, expertise, and management approaches in the environment and natural resource sector, we can enhance our understanding of the root causes of diseases, better account for complexity of environmental factors, and ultimately encourage protection of natural resources to benefit health.

Involving environmental and natural resource professionals, and the data that they collect, will result in a more comprehensive picture of the factors that affect human health. Data include:

- Climate/weather forecasting to predict and inform vaccination campaigns, particularly for climate-sensitive vector-borne diseases.
- Water quality monitoring for bacterial, algal, and inorganic contaminants that can cause human and animal illness.
- The linkages between environmental contamination and animal and human health, including waste management practices and dissemination of anti-microbials, pesticides, and insecticides.
- Dynamics (ecological) and drivers (anthropogenic) leading to zoonotic and vector-borne disease emergence.
- Sentinel monitoring of wildlife to identify diseases before potential spillover to domestic animals and/or humans (e.g., for the predictive value of Ebola virus in great apes).

The environmental sector plays a key role in early warning, detection, and identifying disease risk, as well as in response. Examples include:

Egyptian Fruit Bats, *Rousettus aegpyticus*, during sampling by PREDICT staff in a cave at Belinga, Gabon PHOTO BY MATTHEW LEBRETON AND BRAD SCHNEIDER

- Identifying appropriate control strategies to balance immediate public health concerns and potential long-term damages to ecological systems and associated ecosystem services that may result from control measures (e.g. insecticide spraying, wildlife culling). For example, environmental health professionals in Liberia were responsible for dead body management during the Ebola crisis.
- Assessing outcomes from ecosystem modification (e.g. land use change for agriculture or extractive industries, invasive species introductions) and likely consequences (positive or negative) for human and animal health that may be associated with declining species habitat, changing presence of "generalist" species along fragmented landscapes, animal migration, suitable habitat for disease vectors, food chain, etc.
- Conducting risk assessments for known and novel disease presence and/or introduction/establishment, based on species range and ecological niche, behavior, and inter-species spillover potential.

Environmental authorities may also detect and monitor diseases in wildlife that do not pose a direct threat to humans. However, even non-zoonotic diseases may have implications for the health and functioning of ecosystems in ways that can indirectly affect humans (e.g. via pest control, pollination, etc.).

Expertise and infrastructure from environmental services are valuable components of health security, and should be included in national processes to maximize protection of the public's health.

For more information, please visit: www.preparednessandresponse.org and www.predict.global
Contact: predictonehealth@ecohealthalliance.org

USAID FROM THE AMERICAN PEOPLE | EMERGING PANDEMIC THREATS

One Health Lessons from PREDICT: Approaches to support sustained collaborations

M. Rostal, Indonesia, 2012


J. Goley, China, 2015


EcoHealth Alliance, Bangladesh


A. White, Malaysia, 2015

Building partnerships to prevent pandemics using a One Health approach.

USAID FROM THE AMERICAN PEOPLE | UCDAVIS VETERINARY MEDICINE One Health Institute | WCS | EcoHealth Alliance | METABIOTA | Smithsonian Institution


K. Olival, Thailand, 2014

One Health is an interdisciplinary collaborative effort to attain optimal health for people, animals, and our environment. The USAID Emerging Pandemic Threats program has supported the implementation of One Health efforts yielding sustained collaborations in partner countries. These approaches were adapted to each country's local context and unique stakeholders.

This represents a compiliation of examples to date, noting that best practices will be further established and refined in the work of Emerging Pandemic Threats projects and partners.

CAPACITY STRENGTHENING

The tendency to work within a single discipline can serve as a major impediment to collaboration across sectors and ministries, often inhibiting shared understanding and coordinated decision-making. Cross-sectoral training can help bring together disciplines by demonstrating intersections and engendering appreciation for the backgrounds and needs of others, as well as provide creative ideas and actions to generate new solutions. Under PREDICT, capacity building was emphasized through a One Health lens.

- In most countries veterinary services are typically oriented toward domestic (e.g. agricultural) animals, with limited experience in wildlife virus surveillance. Involving both veterinary services and environmental sector in wildlife virus surveillance training efforts helped strengthen capacity and also provided a forum for discussions by ministry personnel about coordination.

- Sharing of PREDICT protocols (including sampling, transport and storage, laboratory, and outbreak response guides) among ministries supported cross-disciplinary One Health capacity building.

- One Health conferences and workshops were held in several countries to support opportunities for bringing stakeholders together to explore shared priorities; for example, PREDICT co-hosted a conference with One Health Bangladesh that was attended by representatives of WHO, FAO, and the country's Public Health and Livestock Departments.

INTEGRATED APPROACHES

In addition to cross-disciplinary training, opportunities to engage or support ministries (typically those responsible for public health, agriculture, and environment) resulted in novel collaborations on activities such as:

Surveillance: in all PREDICT-engaged countries, multiple government ministries and local institutions participated in surveillance site selection. In some countries, this cross-sector collaboration continued into the field for sampling. For example, in Cambodia agreements were established with the National Veterinary Research Institute and the Forestry Administration for their staff to collect samples together in field surveillance for PREDICT.

Task Forces: cross-ministry task forces provided a useful platform for information sharing and coordinated interpretation and action, especially where budgets and mandates typically divide ministry activities. Task force activities were usually initiated to address specific diseases (e.g. Ebola virus), but also provided a foundation for discussion on expanded issues.

- In Malaysia, the Federal government formed a Zoonoses Technical Working Committee composed of representatives from the Ministry of Health, Ministry of Agriculture, the Ministry of Environment, and PREDICT, convening to discuss current issues regarding emerging diseases and national surveillance activities.

- One Health Bangladesh, an existing network involving public officials and university scientists that PREDICT collaborated with closely, developed a One Health National Strategy.

- PREDICT supported the Uganda National Task Force (NTF) for Epidemic Preparedness and Response in its investigations of several disease outbreaks, including outbreaks of Yellow Fever and Ebola virus, helping the NTF to prioritize and sample at sites where people were in close contact with animals and to collect epidemiologic data on potential human risk factors. As a result, the NTF now applies a One Health approach to disease outbreak investigation, control and prevention in Uganda by incorporating environmental investigations into disease outbreak response planning.

Technical Support: PREDICT provided technical expertise to reinforce One Health principles, including: serving on ministry task forces; acting as a reference center and providing diagnostic support; helping in the design of One Health training modules; reviewing ministry strategic plans; and assisting in investigating reports and detection of disease in human, domestic animal, and wildlife populations.

Information Sharing: a PREDICT-wide process was established for reporting of findings to relevant government ministries (typically those responsible for public health, agriculture, and environment) and gaining approval for public release (see Figure 1). The overall process was reviewed with ministry partners to designate points of contact and approval processes specific to each country (e.g. quarterly data reports, inter-ministerial meetings to discuss findings, timelines for approval, etc.). In Indonesia, PREDICT efforts initiated a government mandate for a national reporting framework for wildlife and human disease surveillance. Collaboration on joint presentations and/or publications demonstrated the wide range of partners involved in targeted One Health efforts (such as Wacharapluesadee et al. (2015) Diversity of coronavirus in bats from Eastern Thailand. Virology Journal 12:57).

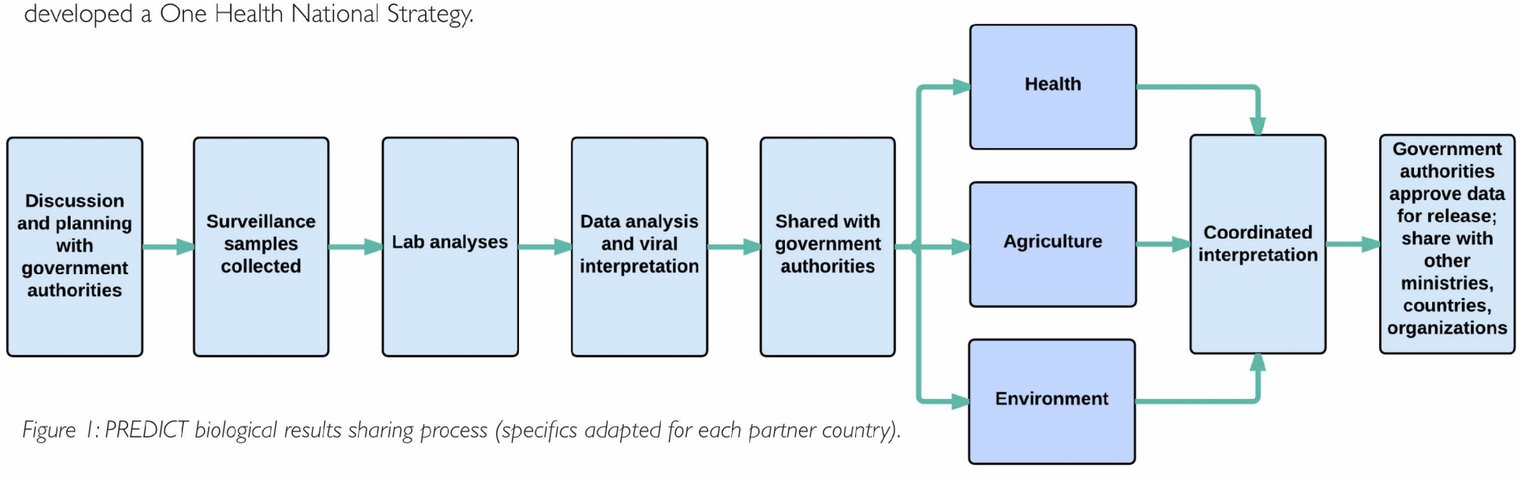

Figure 1: PREDICT biological results sharing process (specifics adapted for each partner country).

BROADENING STAKEHOLDER ENGAGEMENT

Expanding the scope of disease prevention and control efforts may also assist in One Health collaborations. Beyond core ministries typically responsible for health, agriculture, and environment, other stakeholders can provide key collaboration to support One Health, including in the reporting of suspected illness or animal mortality (e.g. hunters, park rangers, wildlife sanctuary staff, farmers), facilitating collection of specimens (e.g. access to wildlife at rehabilitation centers, syndromic surveillance at hospitals), training opportunities (e.g. universities) and use of information (e.g. risk mitigation measures, such as safeguards or alternatives for industry practices that present zoonotic disease risks). Specific country examples are numerous, such as:

- In Bolivia, wildlife sanctuary staff reported howler monkey carcasses near the sanctuary, leading to the detection of Yellow Fever virus for the first time in the animals and subsequent rapid cross-ministry action, including preventive human vaccination, public outreach, and mosquito control;
- In Rwanda, where ecotourism is a leading industry, the Development Board (RDB) was a key partner;
- In Cameroon, the Defense Ministry hosted the PREDICT laboratory and received surveillance findings;
- In Cambodia, rangers and hunters from Khmer and ethnic villages were engaged in collaboration on sampling and risk characterization;
- PREDICT coordinated with the Tanzania Wildlife Research Institute in field-based training exchange programs to strengthen veterinary capacity in the environment sector.

As demonstrated by the diversity of sectors relevant to PREDICT activities, opportunities to foster One Health collaborations were plentiful throughout project activities (Figure 2). In some cases, collaboration occurred informally; in others, MOUs were established to open collaboration pathways.

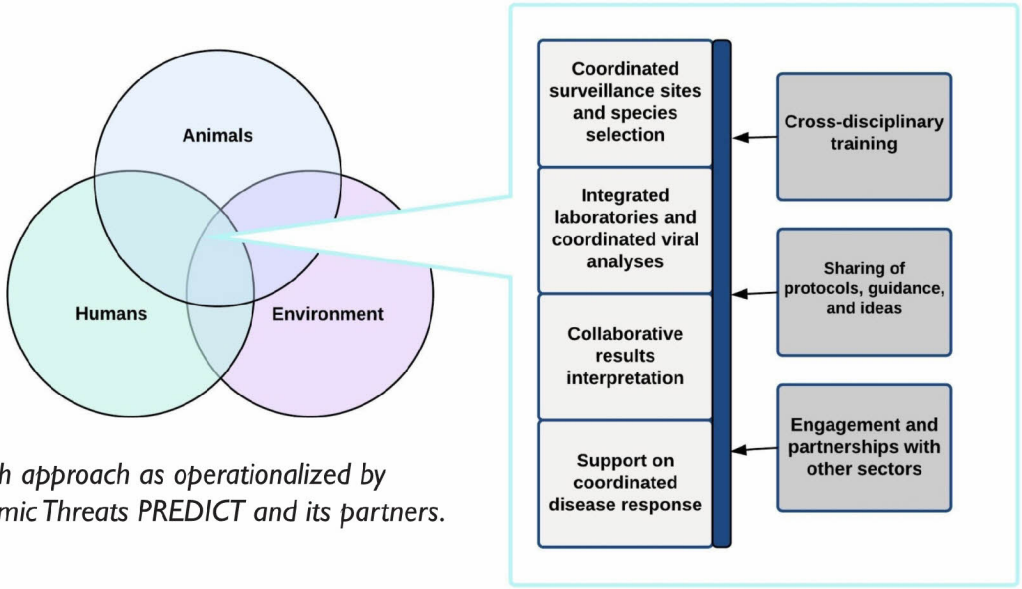

Figure 2: The One Health approach as operationalized by USAID Emerging Pandemic Threats PREDICT and its partners.

PREDICT is conducting global surveillance to detect and prevent spillover of pathogens of pandemic potential that can move between animals and people. The project is part of USAID's Emerging Pandemic Threats program.
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March 2016

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FROM THE AMERICAN PEOPLE

EMERGING PANDEMIC THREATS

ONE HEALTH IN ACTION

Reducing Pandemic Risk, Promoting Global Health

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

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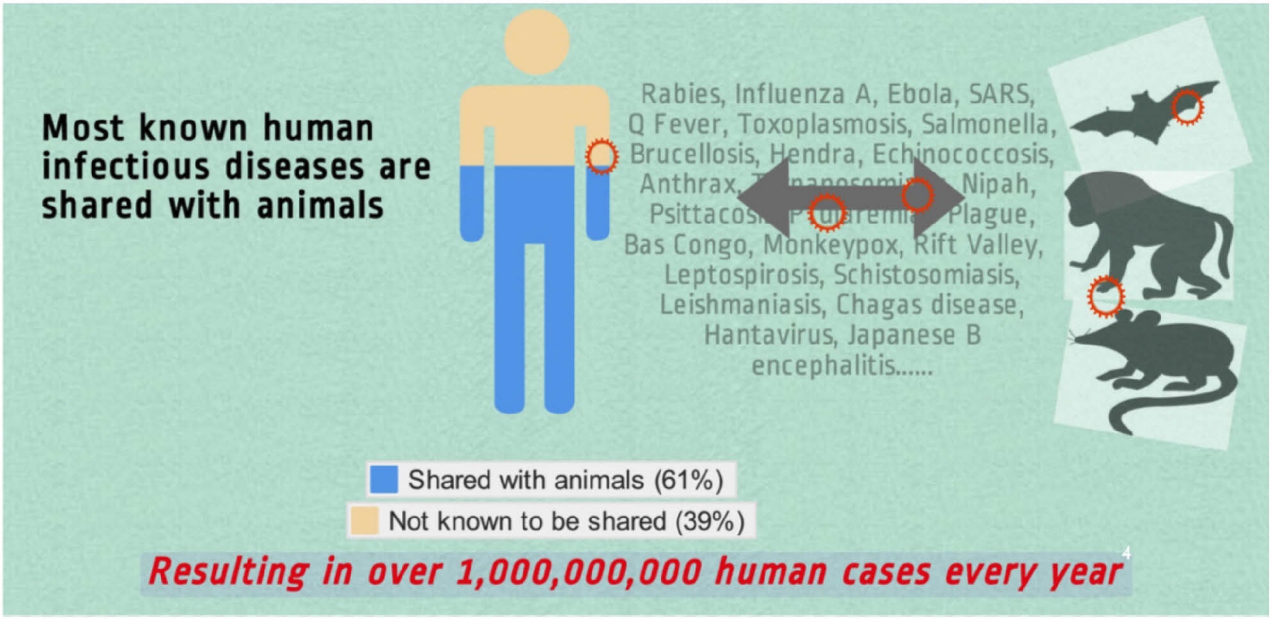
USAID FROM THE AMERICAN PEOPLE | PREDICT Preparedness&Response

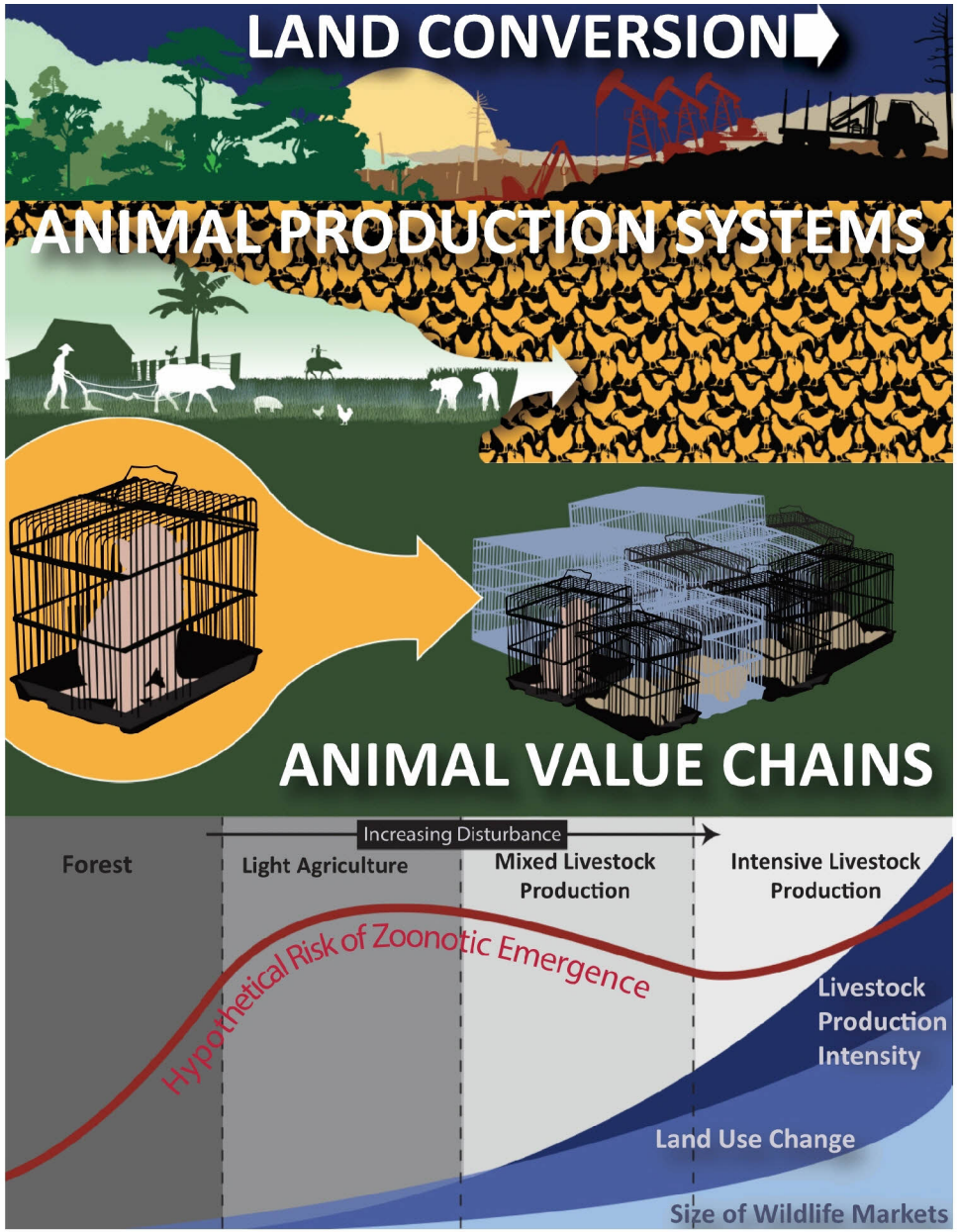
BRIDGING HUMAN, ANIMAL AND ENVIRONMENTAL HEALTH TO ADVANCE GLOBAL HEALTH AND DEVELOPMENT

Recent disease outbreaks have drastically threatened local and global health as well as country development. The Ebola outbreak in West Africa, beginning in late 2013 and continuing into 2016, resulted in over 28,600 cases, reducing gross domestic product growth in all three highly affected countries as well as disrupting progress in other key development priorities, including educational attainment, vaccination campaigns and management or treatment of disease such as HIV/AIDS, and malaria, food security, and poverty reduction.[1] Agricultural production has been heavily affected by past zoonotic disease outbreaks such as highly pathogenic avian influenza viruses, Nipah virus, and Rift Valley fever virus, resulting in economic impacts to the agricultural industry and livelihoods associated with it.

While focusing recovery efforts for affected countries is critical, the world still remains unprepared to tackle new disease outbreaks in the future. As such, in February 2014 the Global Health Security Agenda was launched to pursue a multilateral and multi-sectoral approach to strengthen both the global capacity and nations' capacity to prevent, detect and respond to human and animal infectious disease threats whether naturally-occurring or accidentally or deliberately spread.[2] With regard to Ebola virus, avian influenza virus, SARS-Coronavirus, HIV and many other recent outbreaks, all have been linked to infections from animals. But this trend is not new — in fact, the majority of known human infectious have originated at some point from animals ("zoonotic diseases").[3,4] The distinctions between so-called "emerging" diseases and established diseases are not static: as seen with HIV, a relatively new disease may quickly become established in human populations. The recent spread of Zika virus in the Americas represents the potential for new diseases to emerge and have rapid nation-level impacts.



WHAT IS CAUSING ZOONOTIC DISEASE OUTBREAKS?



Disease transmission events from animals or environmental sources to humans appear to be increasing. This has been prompted by major changes to ecosystems (brought on by human activities), and associated activities that increase human-animal contact. In turn, globalization's rapid trade and travel is enabling the spread of new diseases between countries and continents, resulting in pandemics.[5]

The underlying causes of diseases being transmitted from animals to humans include: conversion of landscapes, as often associated with deforestation for agriculture, timber logging, mining, oil extraction, changing agriculture and food production systems, and wildlife trade.[6] These pressures are providing more opportunities for pathogens to move between species and cause new outbreaks. They also are among main drivers of biodiversity loss.[7]

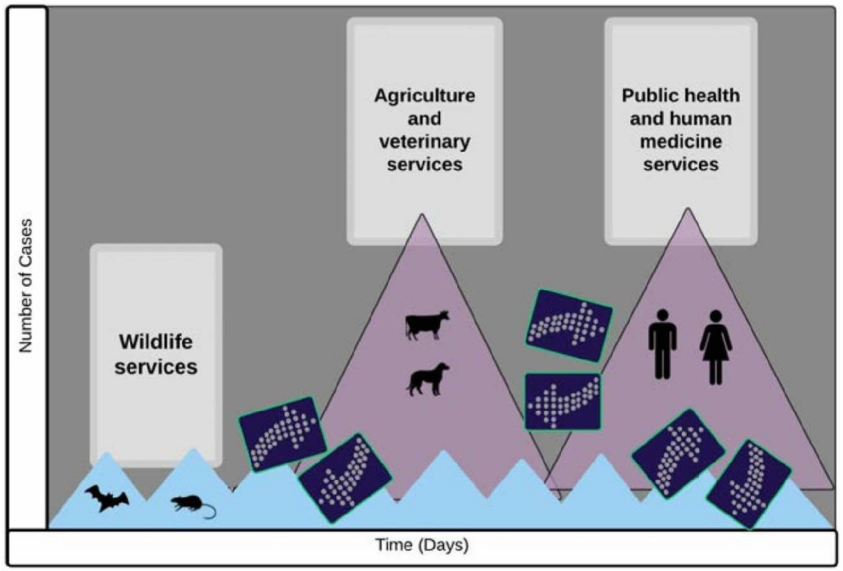
While wild and domestic animals may serve as sources for human disease, many also provide critical functions to ecosystems that support human health. Animals may also be affected by disease outbreaks (including, in some cases, diseases from humans). Past outbreaks of Ebola virus in Central Africa have taken their toll on humans as well as endangered great ape populations. Domestic animals, such as livestock, may also be affected by disease, threatening food production and food security.[7]

A HISTORICAL LOOK

Zoonotic disease outbreaks over recent decades have led to lasting public health and economic impacts. The 2003 outbreak of Severe Acute Respiratory Syndrome (SARS) cost the global economy an estimated US$30-40 billion.[8] HIV/AIDS, which was originally acquired from Great Apes (likely from hunting or butchering an infected animal), remains a public health crisis in several parts of the world, with 34 million infection-associated deaths to date.[9] Despite the ongoing impact of HIV/AIDS on public health and development, the systems in place to detect new diseases from other species have not changed significantly since the first detection of HIV/AIDS thirty-five years ago.

To date, only 1% of the estimated viruses in mammals have been detected.[10] While technological advancements have allowed us to discover pathogens more efficiently and affordably, to date there has been very limited screening of wildlife and livestock for pathogens they carry. Without knowing the pathogens circulating in our environments, we have limited information about diseases that may threaten our health in the future, thereby losing critical opportunities for prevention and risk reduction.

Health systems operate in a highly reactive fashion for emerging diseases, identifying and responding to a disease risk once an outbreak occurs. Human, veterinary/agriculture, and wildlife health sectors tend to work separately. This lack of coordination and information sharing limits our opportunities to prevent pathogens from 'spilling over' from one species to another.[11]



Gaps in authority and weak institutional capacity currently limit action in preventing the transmission of pathogens between humans, domestic animals, and wildlife. Each discipline typically responds once they see an outbreak in their own sector.

An alternate approach, with ongoing collaboration across sectors, could help identify critical transmission risks and potential solutions among these sectors.

ONE HEALTH GOES BEYOND ZOONOTIC DISEASE

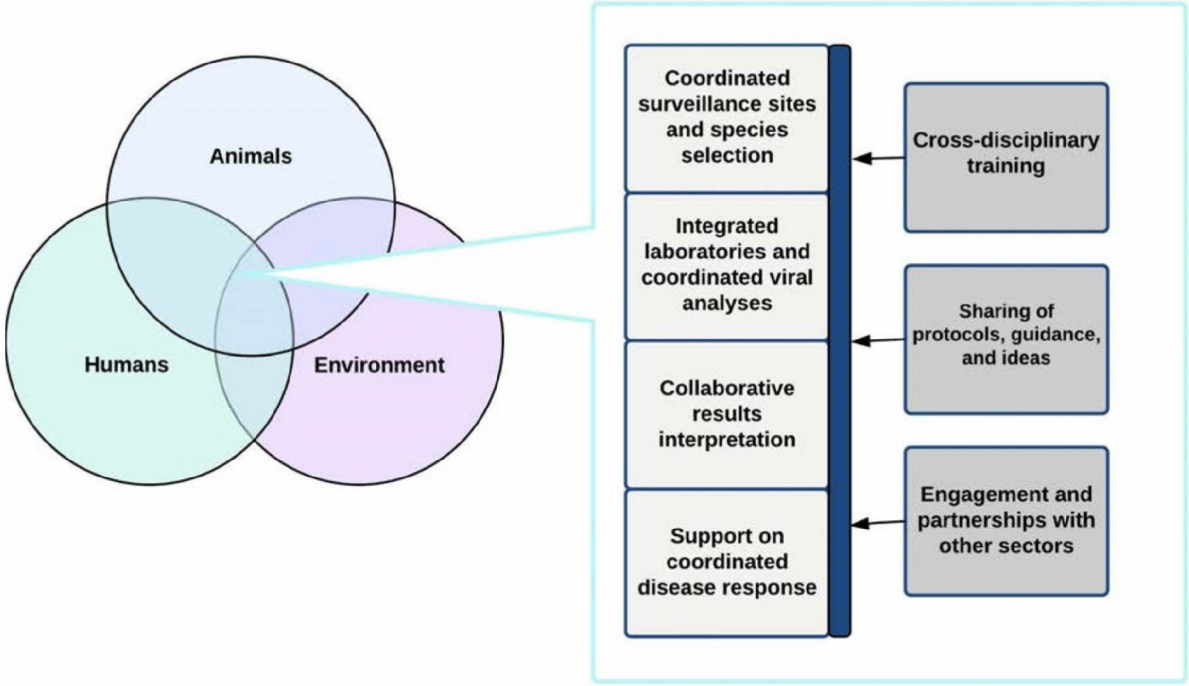
One Health is an interdisciplinary collaborative effort to attain optimal health for people, animals, and our environment.

One Health is founded on the need for a more integrated understanding of the connections among humans, animals and ecosystems within the political, economic and social systems in which they operate. By better understanding the full picture of disease transmission, the public health, veterinary, agriculture, and environmental communities can work together to identify more effective solutions. Their collaboration can result in more comprehensive, as well as cost-effective, outcomes than in single-discipline operations.

A One Health approach is especially needed in light of the rapid global environmental and agricultural changes that are presently occurring and expected to increase over the coming decades. These are creating pressures on natural systems and increasing contact between humans and other species, facilitating emergence of both infectious and noninfectious disease problems.

Support for One Health has been expressed at high levels, but its implementation on the ground remains limited due to a wide range of competing priorities. Over the course of the past six years, the USAID Emerging Pandemic Threats program has advanced One Health operations in 30+ developing countries.[12] This booklet provides case studies from partner countries to demonstrate the type of approaches, partnerships and benefits that One Health can yield.

The folloiwng case studies represent a compiliation of examples to date, noting that One Health examples will be further established and refined in the work of Emerging Pandemic Threats projects and partners.



National One Health Networks

Bangladesh has a strong legacy of interest and leadership in One Health efforts, with participation from a wide range of collaborating institutions. A Pandemic Influenza Preparedness and Response plan was initiated in 2005 and involved veterinary, public health, and wildlife health sectors working together. One of the pillars of the plan was coordination. Experts at Chittagong Veterinary & Animal Sciences University (CVASU) began informal discussions with stakeholders from public health, animal health, wildlife, and environmental communities. The need for a One Health approach was identified based on Bangladesh's high population density, vulnerable food and water security, threatened ecosystems, close contact between humans and animals, and its identification as a "hotspot" for disease emergence.[4] A "One Health Bangladesh" organization was soon established, with representatives from 12 national and international organizations. One Health Bangladesh has co-hosted eight conferences since its establishment, including an event hosted by USAID Emerging Pandemic Threats program partners with participation by representatives of the Food and Agriculture Organization, the World Health Organization, the country's Public Health and Livestock Departments, and the International Centre for Diarrhoeal Disease Research, Bangladesh (icddr,b).

In 2012 One Health Bangladesh — jointly with Ministry of Health and Family Welfare, Ministry of Fisheries and Livestock, Ministry of Environment and Forestry, and UN Agencies — developed a National One Health Strategic Framework and Action Plan for Infectious Diseases in Bangladesh. The Framework identified nine components

for undertaking various activities involving relevant stakeholders and has been officially approved by the aforementioned three Ministries, which have given instruction to the relevant agencies for its implementation. One component is One Health Governance under which a One Health Secretariat would be established to coordinate implementation of activities. One Health Bangladesh now has nearly 400 members — including physicians, veterinarians, agriculturists, environmentalists, wildlife experts, ecologists, anthropologists, economists, allied scientists and practitioners, and activists. One Health Bangladesh is also a member of the One Health Alliance of South Asia, a regional network of governmental and non-governmental scientists and policy makers working on human, animal and environmental issues. Partners report a "new professional culture is emerging" in the country that acknowledges the value of cross-sectoral collaboration.

ONE HEALTH PARTNERS: Institute of Epidemiology, Disease Control and Research, Bangladesh Ministry of Health and Family Welfare; Department of Livestock Services, Ministry of Fisheries and Livestock; Forest Department, Ministry of Environment and Forests; Chittagong Veterinary & Animal Sciences University; International Centre for Diarrhoeal Disease Research, Bangladesh (icddr,b); EcoHealth Alliance; FAO; WHO; U.S. CDC; Massey University; UNICEF; USAID Emerging Pandemic Threats PREDICT, PREVENT, Preparedness and Response.

One Health Partners: Ministry of Public Health; Ministry of Environment; Wildlife Conservation Society; EcoHealth Alliance; Pan-American Health Organization; Ambue Ari wildlife sanctuary; University of San Andres' Institute of Molecular Biology; the Vesty Pakos Zoo; USAID Emerging Pandemic Threats PREDICT.

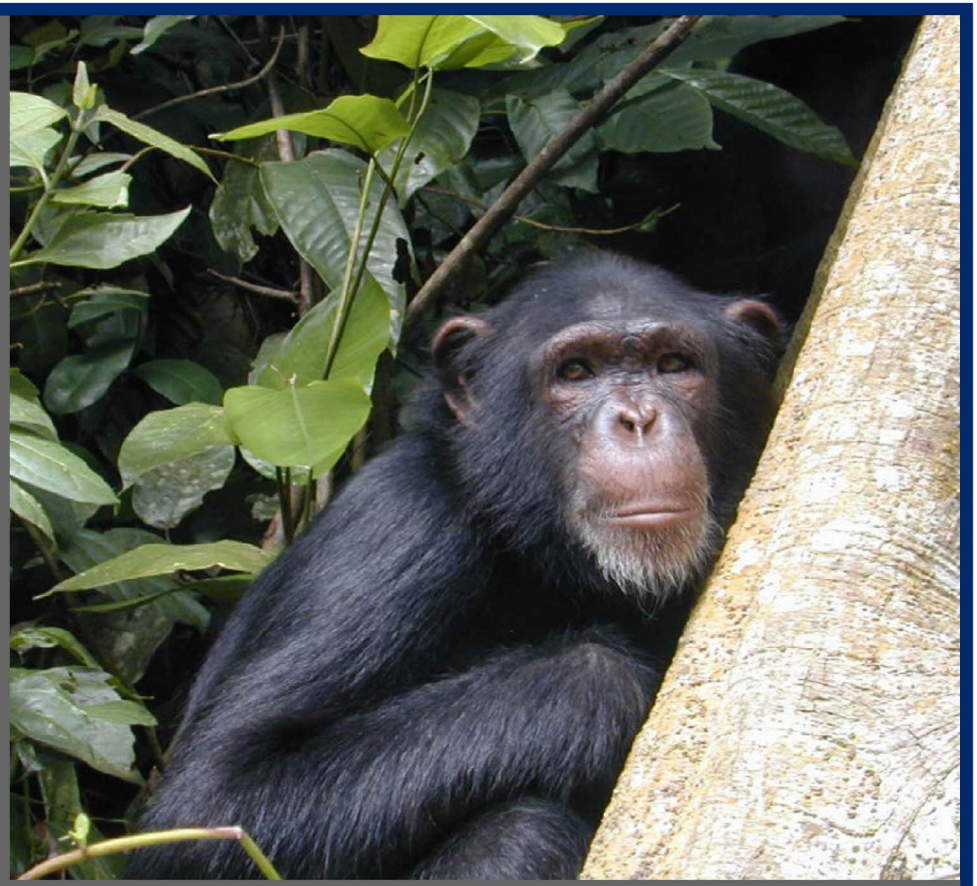
Early Warnings from Wildlife and Effective Collaboration to Prevent Human Outbreaks

Yellow Fever is a mosquito-borne virus that infects humans as well as non-human primates, potentially resulting in hemorrhagic fever leading to death. Yellow Fever transmission can occur if infected monkeys and any of the mosquito vector species are present. In 2012, after One Health training by partners from the PREDICT program, staff at a wildlife sanctuary in Santa Cruz, Bolivia, reported six dead Howler Monkeys near the park. Early investigation during specimen collection and analysis at University of San Andres' Institute of Molecular Biology suggested that the infection was associated with a Flavivirus (a family of viruses transmitted from mosquitos or ticks). PREDICT partners alerted the Bolivian Ministry of Health while conducting further analysis for the specific pathogen — ultimately identified as Yellow Fever virus. A transdisciplinary, collaborative and coordinated response was undertaken in the region, including preventive human vaccination campaigns, mosquito control, and public outreach. Although infected monkeys had never been previously reported in Bolivia, the response to this outbreak was rapidly mobilized — within eight days from the detection to resolution of the outbreak. No human cases were reported, suggesting the benefit of awareness of risks, early warning systems in animals (including local laboratory capacity to screen for pathogens), and effective collaboration channels with a wide range of partners.

Collaboration for a Successful Outbreak Response

The monkeypox virus causes an infectious disease with clinical symptoms similar to smallpox. In parts of West and Central Africa, monkeypox virus has been found in small mammals including certain types of rats, mice, and squirrels, but can occasionally spill over into monkeys, chimpanzees, and human populations. Death occurs in about 10% of human cases, and there is no known treatment, and very little is known about transmission from animal reservoirs to human populations. Monkeypox is endemic to some countries in the region and there had been a single human case recorded in Cameroon in the past decades, but no recent cases had been observed in the country until March 2014. At this time, several chimpanzees fell ill at the Sanaga Yong Chimpanzee Rescue Center. Cameroon's newly adopted One Health Strategy and Zoonotic Program, with One Health focal persons appointed to four ministries, was put into action shortly after the suspected cases were reported to the Ministry of Health.

The cross-sectoral planning and response, which included literature reviews, on-site risk investigation, observations, sampling and laboratory diagnostics, as well as reporting to international agencies such as the World Animal Health Organisation (OIE) and the International Health Regulation of WHO, allowed for better knowledge sharing, faster response time, and decreased cost. Of the 72 chimpanzees in the sanctuary, the outbreak was limited to 6 cases of infection, with only one fatality and no spillover to human contacts. The PREDICT project and Cameroon Epidemiological and Veterinary Public Health Association provided support to the ministries during the investigation planning and response phases, helping to reinforce a One Health approach and practice.



After the outbreak ended and the investigation was complete, agencies compared this response to previous outbreak responses. The use of a One Health approach in this case was estimated to provide a two-third reduction in the total cost of the investigation and a response time that was a full 10 days faster. This was achieved through sending a single investigation team with representatives from multiple ministry sectors and requiring only a single government travel authorization.

One Health Partners: Sanaga Yong Chimpanzee Rescue Center; Ministry of Public Health; Ministry of Livestock, Fisheries and Animal Industries; Ministry of Forestry & Wildlife; U.S. CDC; U.S. National Institutes of Health; Centre de Recherche pour la Santé des Armées; Metabiota; Mosaic; Global Viral; Cameroon Epidemiological and Veterinary Public Health Association; USAID Emerging Pandemic Threats PREDICT and Preparedness and Response.

One Health Partners: Ministry of Enrivonment and Forestry; Ministry of Agriculture; Ministry of Health; Ministry of Research and Technology; Coordinating Ministry of People's Welfare; Indonesian Institute of Science (LIPI); KomNas Zoonosis Control; Primate Research Center at Bogor Agricultural University; Eijkman Institute for Molecular Biology; Universitas Sam Ratulangi (Manado Sulawesi Utara); Universitas Negeri Gorontalo, Padjadjaran University (Bandung, Javaz) EcoHealth Alliance; Metabiota; Smithsonian Institution; USAID Emerging Pandemic Threats PREDICT project.

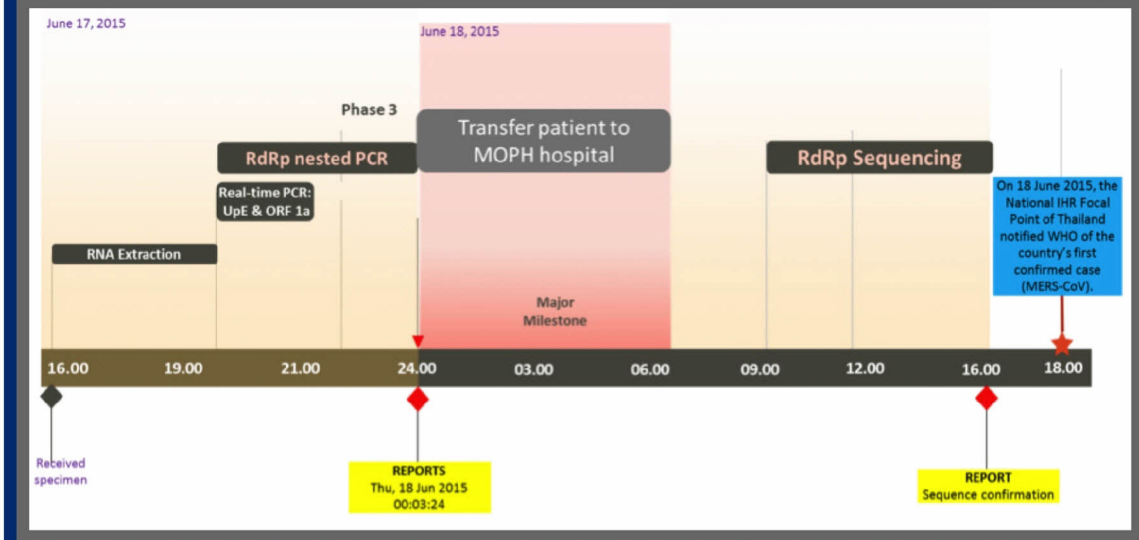
Coordinated Information Sharing and Interpretation

PREDICT developed a systematic One Health approach to surveillance results sharing, review, and approval for public release. The information flow process involved designated points of contact in each country at the ministries representing human health, livestock, and wildlife who received each results report. In many cases, sampling and/or laboratory screening occurred in partnership with Ministries, so surveillance results were directly relevant, but the routine results dissemination to all three ministries was emphasized as a way to showcase One Health intersections and opportunities for identifying coordinated solutions. Integrated discussions of results were encouraged in inter-ministerial forums (e.g. at task force meetings). In Indonesia, PREDICT's reporting efforts helped initiate a government mandate for a national reporting framework for wildlife and human disease surveillance. These streamlined and more comprehensive reporting systems assist the country in disease monitoring, as well as in meeting its reporting obligations to the World Health Organization (WHO) under the International Health Regulations as well as to the World Organisation for Animal Health (OIE).

Identifying Animal Reservoirs to Mitigate Risk

One Health efforts in Cameroon also helped identify gorillas as the animal reservoir for human T-lymphotropic virus type 4 (HTLV-4) in 2014.[13] The source of the first known human infection, discovered in a hunter in 2005, was unknown. In a strong collaboration with the Cameroonian ministry responsible for wildlife, the Limbe Wildlife Centre and Ape Action Africa who is responsible for managing primates in Mfou National Park sanctuary, and with rural communities throughout the country, PREDICT program partners tested specimens for HTLV-4, finding the virus in a number of captive and wild gorillas. Given that other HTLV strains are known to cause severe illness in humans, this finding was important for informing risk mitigation practices. Hunters were educated about risks of contact with wildlife and informed on protection measures. Given their critically endangered conservation status, as well as previous findings of other zoonotic viruses in gorillas, this finding provides further support for protection of gorillas from illegal hunting to promote both public health and conservation.

One Health Partners: Ministry of Forestry and Wildlife; Centre de Recherche pour la Santé des Armées; Limbe Wildlife Centre; Ape Action Africa; Mosaic; Global Viral; Metabiota; U.S. CDC; Ape Action Africa; USAID Emerging Pandemic Threats PREDICT.



One Health Partners: Ministry of Public Health; WHO Collaborating Center for Research and Training on Viral Zoonoses at Chulalongkorn University; World Health Organization; EcoHealth Alliance; Department of National Parks, Wildlife and Plant Conservation; USAID Emerging Pandemic Threats PREDICT.

Surveillance Preparedness

The Middle East Respiratory Syndrome Coronavirus (MERS-CoV), caused by a Coronavirus, is an emerging infectious disease that was first detected in 2012. MERS-CoV is thought to have an animal source, but infections may also be transmitted between humans through airborne spread or direct contact. In June 2015, Thailand saw its first case of MERS-CoV, brought into the country by an international traveler. As a result of prior preparedness efforts, including viral discovery for human infections as part of the PREDICT program, training on sampling for potential MERS-CoV infections, and MERS-CoV laboratory screening protocols, the country had strong capacities in place. Paired with infection control practices, intensive surveillance was rapidly implemented in high-risk settings including points of entry into the country and in healthcare settings. Specimens were rapidly tested (only 7 hours for first results and 24 hours for confirmation) at the WHO Collaborating Center for Research and Training on Viral Zoonoses at Thailand's Chulalongkorn University (which reports to the Ministry of Health). No secondary infections were detected in Thailand suggesting no human to human transmission occurred. Given the limited knowledge on coronaviruses, surveillance efforts have also been undertaken by the One Health partners involved in the human MERS outbreak to screen for coronaviruses in wildlife and domestic animals in the country to help improve understanding about this group of viruses.

Rapid Identification and Containment of Disease Outbreaks

In July 2014, in the midst of the Ebola virus crisis in Guinea, Liberia, and Sierra Leone, a separate outbreak of Ebola virus occurred in the Democratic Republic of Congo (DRC). When it occurred, several virology experts from DRC's Institut National de Recherche Biomédicale (INRB), the national infectious disease laboratory responsible for haemorrhagic fever diagnostics, were out of the country responding to the West African outbreak. However, the country had experienced prior Ebola virus outbreaks and had preparedness capacity in place. Through a long-standing INRB-PREDICT partnership, the PREDICT laboratory (which is hosted at INRB), was requested to assist with conducting the diagnostic testing. Samples were collected from suspected cases and screened, with preliminary confirmation of Ebola virus within a day of receiving the samples. Based on the early results of the laboratory tests, the DRC government was able to enact rapid disease control measures such as control of travel, dispatch of a mobile laboratory, and infected patient contact tracing, among other measures, leading to containment of the outbreak. Sequencing of the positive cases indicated that the DRC outbreak was an independent outbreak from the outbreak in West Africa, and the source of the outbreak (the butchering of an infected animal that had been found dead and collected for food) was identified through trace-back efforts, helping to elucidate the transmission chain and target high-risk practices to prevent future infections. The outbreak response demonstrated the value of strong partnerships between institutions as well as efficient and effective communication systems, diagnosis capabilities, and disease control measures. The PREDICT team was also requested to conduct wildlife sampling in the affected area to determine the presence of *Ebolaviruses* circulating in wildlife, and to participate in the training of health care providers and epidemiologists to be deployed in the Ebola affected countries of West Africa.

One Health Partners: Institut National de Recherche Biomédicale (INRB); Ministry of Health; Metabiota; Ministry of Environment; Institut Congolais pour la Conservation de la Nature (ICCN); Direction of animal production and health at the Ministry of Agriculture; USAID Emerging Pandemic Threats PREDICT.

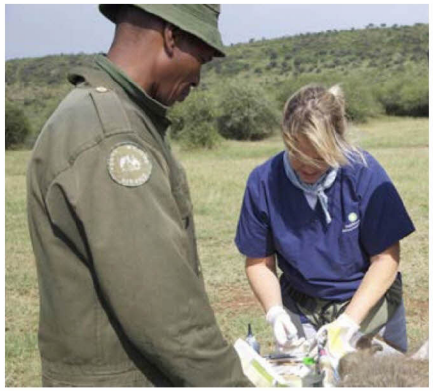
WAYS FORWARD

One Health approaches have been employed in a range of situations over the past six years in partner countries. These have helped enhance understanding of and solutions to emerging infectious disease threats. The case studies demonstrate the relevance and benefits of One Health to economic, public health, agricultural, and environmental issues, as well tourism and development, food and nutrition, climate and weather, and more.

Successful approaches include interdisciplinary surveillance, reporting and laboratory collaboration, coordinated data sharing and interpretation, and strong communication channels for disease reporting and rapid action. While One Health is adaptable to country-specific contexts, in addition to the direct contribution to the Global Health Security Agenda, best practices established abroad can provide valuable lessons for domestic health systems on efficiencies across sectors, outbreak preparedness, and overall greater focus on preventing disease.

Given the high economic and societal cost of recent outbreaks, policy decisions and global and local health capacity investments can be oriented to create incentives for advancing a One Health approach aimed at preventing, not just responding to, disease outbreaks.

Future case studies and evaluation can offer further insight into other potential applications. In addition to predicting, preventing and preparing for pandemic threats, One Health may be beneficial for addressing many complex problems involving humans, animals, and their shared environments such as addressing pollution, food security, and sustainable development goals.




ADDITIONAL RESOURCES

To learn more about the Global Health Security Agenda and One Health, please visit:

Global Health Security Agenda

- Program background: http://ghsagenda.org/

USAID Emerging Pandemic Threats program

- Program background: https://www.usaid.gov/what-we-do/global-health/pandemic-influenza-and-other-emerging-threats
- PREDICT: http://www.predict.global
- PREDICT project report: http://www.report.predict.global
- Preparedness & Response: www.preparednessandresponse.org

Additional One Health Case studies

- ISID competition: http://www.syndromic.org/cop/one-health-surveillance/957-ohs-resources
- Network for Evaluation of One Health: http://neoh.onehealthglobal.net/

Disease Monitoring Resources

- Subscribe to ProMED (Program for Monitoring Emerging Diseases) Mail: http://ww4.isid.org/promedmail/subscribe.php
- HealthMap: http://www.healthmap.org/en/
- HealthMap PREDICT: http://www.vetmed.ucdavis.edu/ohi/predict/predict_surveillance.cfm

PHOTO CREDITS

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Section 6.2. Packing and Shipping Biological Samples

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Objective: To provide guidance to ensure safe, proper, and efficient packaging and shipping of biological samples.

THIS DOCUMENT IS NOT TO SERVE AS A REPLACEMENT FOR CERTIFIED TRAINING TO SHIP INFECTIOUS SUBSTANCES.

This document was made possible by the generous support of the American people through the United States Agency for International Development (USAID) Emerging Pandemic Threats PREDICT program. It was drafted to support activities conducted under PREDICT and is intended for an audience of qualified professionals trained in standard, associated best practices. This guide is not intended for use by untrained individuals.

For more information about the contents of this guide, please contact predict@ucdavis.edu.

Suggested Citation Form: PREDICT One Health Consortium 2016. PREDICT Operating Procedures: Packing and Shipping Biological Samples.

Table of Contents: Packing and Shipping Biological Samples

Section 6.2.1. Learning Objectives and Confirmation

If you understand the material in this Guide, you should be able to:

- Classify biological substances based on the specifications of US Code of Federal Regulations Title 49 (49 CFR) Parts 171-175.
- Select the proper shipping name and United Nations (UN) identification number for biological substances.
- Complete a shipper's declaration to accompany biological substance shipments.
- Package biological substances safely and in accordance with regulations.
- Mark and label shipments containing biological substances in accordance with regulations.
- Properly notify the receiver of a shipment containing biological substances.

Confirm you understand the material of this Guide:

When you are familiar with the information in this Guide, take the PREDICT quiz on ***Packing and Shipping Samples (Section 8.4.15.)***.

Section 6.2.2. Introduction

Correct packing and shipping of biological substances is necessary to prevent potential exposure to infectious diseases that affect people, animals or both. Samples collected from wildlife, domestic animals and people for the purpose of disease surveillance often fall into Categories A and B:

Infectious Substances, Category A -- Samples collected from sources that are known to be infected with a Category A pathogen (See Section 3 for definition of Category A).

Biological Substances, Category B -- Samples that *may be infected with a pathogen,* but are collected for diagnostic purposes,[1] or samples that are likely infected with a non-Category A pathogen. Most samples, such as blood serum and swabs collected from apparently healthy animals, fall into this category.

Non-regulated Biological Materials -- Samples that do NOT contain pathogens and/or samples that have been treated such that the pathogens have been inactivated (heat treated, formalin, etc.). This category also includes environmental samples such as food and water that are not considered to pose significant risk of infection. (However, it is important to note that certain sample preservatives, namely formalin, are considered "dangerous goods"; samples in formalin cannot be shipped without adhering to the appropriate restrictions, as discussed later in this guide.)

[6] Note that prior to 2006, *Category B* samples (whose status of infectiousness was unknown) were referred to as "Diagnostic Specimens".

Exempt Patient Specimens – Patient specimens not likely to contain a pathogen that are undergoing testing for non-infectious disease. In order to classify a patient specimen as Exempt, professional judgment is required. Factors such as the known medical history, symptoms and individual circumstances of the source, human or animal, and endemic local conditions must be considered. This label is inappropriate for specimens being tested for infectious disease.

Samples of Category A and Category B are legally considered to be *"Dangerous Goods"* and are regulated by the United States International Air Transport Association (IATA) and the United States Department of Transportation (DOT). Keep in mind that these organizations use the word "dangerous" as a technical term for substances that you may not normally consider being dangerous (including dry ice).

United States regulations state that anyone involved in preparing "dangerous goods" such as biological samples for shipment must be trained to perform these tasks. A record of current training must be maintained by the employer, and training must be provided for anyone involved in any aspect of packing and shipping samples, from the investigator and/or technician who handles the samples, to the administrative staff who may complete the DHL or Federal Express labels for the shipping containers.

If you are shipping anything into or out of the US, failure to comply with the correct packing and shipping regulations is punishable by significant fines, and can jeopardize your and/or your home institution's current and future ability to obtain permits to import and export samples.

Keeping good records and knowing the regulations will be helpful if you encounter problems when the carrier, the laboratory receiving the samples, or authorities, inspects a shipment.

Problems can and do arise even if you follow these instructions. Complications that may occur include differences in national and local laws that you must follow in each country regarding importing, exporting and shipping samples, in addition to the US and international regulations discussed here. In the event that the country's local or national regulations are less stringent, use the regulations described here as your guide.[2] Sometimes problems arise because there are many authorities and individuals involved in the process, each of whom may interpret the regulations differently.

Be prepared by familiarizing yourself with the regulations and double check that you have completed each step using the checklist provided at the end of this section.

[2] These protocols follow rules for air transport of samples, which are somewhat stricter than those for ground transport; one cannot always control how samples are shipped once they are given to the carrier, and therefore it is safer to follow the stricter rules, in keeping with the precautionary principle.

The protocols discussed below will enable you and your staff to comply with the highest standard of safety for packing and shipping biological samples. The underlying principles are:

1) Minimize the risk of inadvertent exposure to an infectious agent through shipping, importing or exporting biological samples (including samples from domestic and wild animals and humans).

2) Prevent human injury, as well as damage to the samples, the environment and property, that can be caused by improper handling and packing of storage and shipping materials that are flammable and/or toxic (e.g., alcohol, formaldehyde) and/or volatile (e.g., dry ice).

Investigators and project supervisors must be trained to ensure that hazards to human and animal health are clearly identified and communicated to project personnel; that all personnel fully understand the techniques to be used for handling known biohazards specific to the species under study; and that written procedures and any necessary protective packing materials and equipment are made available.

Investigators or project supervisors are responsible for:

- Keeping a record of personnel who have been trained and the content and date of that training.
- Staying informed about changes in regulations at the regional or national level, so that appropriate updates in training can be provided to personnel.
- Providing a "Useful Contacts" list for staff, with numbers of local offices that handle import and export permits for domestic animals, wildlife, migratory birds, and CITES samples.
- Creating and posting first response guidelines in the event of exposure to a known or suspected infectious or toxic agent while handling, packing and/or shipping samples.

COORDINATE WITH US OFFICIALS WHEN IMPORTING SAMPLES:

When importing samples to the USA by air you must be met at the airport by an agent from 1, 2 or 3 US agencies (USFWS, USDA, CDC), depending on your samples. Work with them by phone and fax in advance to encourage efficient and positive interactions with agents (who have the power to help or hinder your imports and exports, and even to destroy samples.)

Example of samples being imported:	Agents to meet you at the airport:
Common duck serum and/or feathers	USFWS, USDA
Endangered duck serum and/or feathers	USFWS, USDA
Wild orangutan serum	USFWS, CDC
Serum from wild rats trapped in an urban market	USFWS
Ticks from rats at an urban market	USFWS, USDA
Serum from domestic cows	USDA

CHECKLIST FOR PLANNING TO SHIP SAMPLES

DO YOU HAVE…?

- Valid **export** permit from the country you are exporting from
- Valid **import** permit from the USA (or other country of import) to bring field samples into the USA (or other country) for analysis and/or storage
- Valid CITES I, II, III, and/or Migratory Bird permits, if applicable. (For CITES species search www.cites.org/eng/resources/species.html; for Migratory Birds: http://www.fws.gov/birds/policies-and-regulations.php)
- Permits that explicitly allow for the **fixative and containers** you will use. (Permits specify how biological samples are expected to be fixed and stored for shipping.)
- Arrangements with all the relevant authorities about your planned shipment, e.g.
    - United States Fish and Wildlife Service (USFWS), management authority for importation of ALL wildlife samples, whether from threatened, vulnerable, endangered, OR common species not listed by IUCN or CITES.
    - United States Department of Agriculture (USDA), regulator of importation of biological materials from wild and domestic birds, ungulates, and plants. Permits are required to import parasites and materials potentially containing bacteria, viruses, or fungi, which may pose a threat to U.S. livestock or agriculture.
    - United States Centers for Disease Control (CDC), regulator of importation of ALL non-human primate samples. (See www.fws.gov/le/ImpExp/Info_Importers_Exporters.htm)
- Flight arrangements that facilitate the safe arrival of your samples; specifically, if bringing the samples to the USA in person by air:
    - Fly into a *designated* U.S. port of entry (see list at: http://www.fws.gov/le/designated-ports.html).
    - Arrive during USFWS business hours (9:00 am-5:00 pm M-F) so that inspectors will be able to meet you with the least inconvenience to all of you. (It is your responsibility to know which inspectors must meet you and to alert the proper agencies; see text box 2 below.) Make arrangements with the agent IN ADVANCE if you cannot arrive at these times.
    - Have all your forms in order for imports:
        - USFWS Import Declaration Form 3-177
        - Sample Inventory
        - **Copies** of relevant **import** permits (CITES, USDA, CDC, Migratory Bird)
        - **Originals** of all relevant **export** permits (from country of origin) or letters of permission from the regional ministry, with required signatures and stamp.
        - Letter on official letterhead from your institution giving you permission to use EACH permit, if any of the permits are not in your name.
    - Make sure your inventory of all your samples contains NO errors and that it EXACTLY matches your physical samples.

Section 6.2.3. Summary of Key Terms

Biological Sample – A biological specimen including, for example, blood, tissue, hair, feathers, skin, urine, nail clippings etc. collected from a human, domestic or wild animal. Samples collected from any part of a plant are also biological samples.

Dangerous Goods *(also known as Hazardous Materials)* – The United Nations (UN) Economic and Social Council's Recommendations on the Transport of Dangerous Goods defines these as: "substances which are capable of posing a risk to health, safety, property or the environment." IATA and the DOT regulate the movement of dangerous goods within and between countries and global regions.

Infectious Substances – Substances which are known to contain, or can reasonably be expected to contain, pathogens including bacteria, viruses, parasites, fungi and other agents such as prions that can cause disease in humans or animals. Infectious substances include BOTH "Infectious Substances, Category A" and "Biological Substances, Category B."

Infectious Substances, Category A – Infectious substances in a form(s) capable of causing permanent disability or life-threatening or fatal disease in otherwise healthy humans or animals when exposure to it occurs. An exposure occurs when an infectious substance is released outside of its protective packaging, resulting in physical contact with humans or animals (49CFR 173.134).

Biological Substances, Category B – Potentially infectious substances not in a form generally capable of causing permanent disability of life-threatening or fatal disease in otherwise healthy humans or animals when exposure to it occurs. This includes Category B infectious substances transported for diagnostic or investigational purposes (49CFR 173.134). Most biological samples collected during disease surveillance among human and animal populations will fall into Category B.)

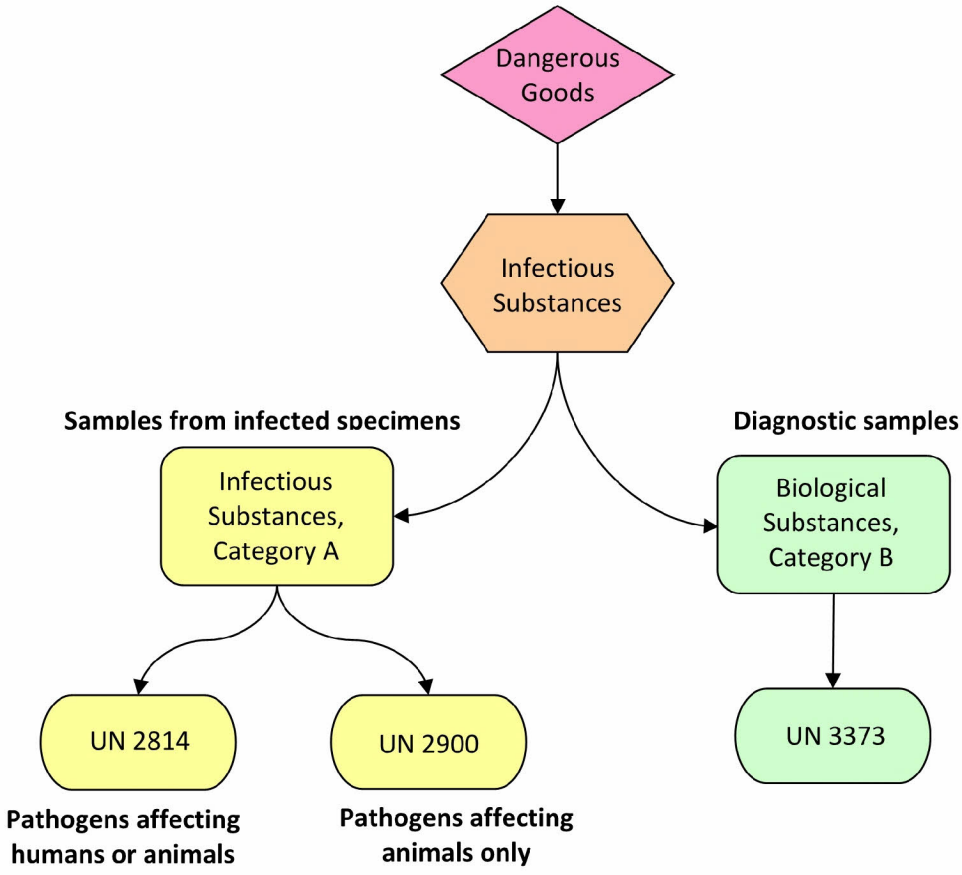
Exempt Patient Specimens – Patient specimens not likely to contain a pathogen that are undergoing testing for non-infectious disease. Examples include, but are not limited to, samples taken for routine testing not related to the diagnosis of an infectious disease (such as for drug/alcohol testing, cholesterol testing, blood glucose level testing). Factors such as the known medical history, symptoms and individual circumstances of the source, human or animal, and endemic local conditions must be considered in making this determination. If testing for infectious diseases is being performed, or if a medical history is not known, the sample must not be shipped as an exempt patient specimen. Samples are packaged the same as Category B substances, but do not require a UN number or PSN, and instead must have the term "Exempt Human Specimen" or "Exempt Animal Specimen" on the box.

Non-regulated Biological Substances – Substances that are not subject to the regulations unless they meet the criteria for inclusion in another Class or Division of dangerous goods. Examples include, but are not limited to, microorganisms that do not cause disease in humans or animals, DNA, RNA or other non-infectious genetic elements, environmental samples such as food and water, dried blood spots, or blood taken for the purpose of transfusion. For a full list of exemptions, please refer to 49 CFR 173.134, searchable at **http://www.ecfr.gov.**

Section 6.2.4. Classifying and Identifying Biological Samples

In order to determine the correct way to package and label your biological samples for shipment, you need to know how to classify and identify the sample.

STEP 1*: Assign the sample to one of nine "hazard classes" as defined by the United Nations. The following diagram gives an overview of the process you will use to identify your biological samples, which will be explained in more detail in this section. If the sample is known to be infected with a non-category A pathogen, it can be placed in Category B.*



Hazard Classes

There are nine categories of "dangerous goods" specified by the UN Globally Harmonized System of Classification and Labeling for Chemicals (GHS). Some of the nine classes have further sub-categories. In the case of samples collected for disease surveillance in humans and animals, we will primarily be working with two hazard classes:[3]

Class 6.2 – Infectious Substances
Class 9 – Miscellaneous Dangerous Goods (dry ice and formalin)

Each hazard class is identified by a diamond symbol containing the class number, class name and a unique icon.

STEP 2: *Assign a UN Number based on the hazard classification and the composition of the sample.*

UN Identification Numbers

The United Nations Committee of Experts on the Transportation of Dangerous Goods has developed a system of 4-digit numbers to identify substances that fall into one of the nine hazard classes. This number is accompanied by a "proper shipping name" as well as a "technical name" for each substance. Proper shipping names are used in shipping documents, notifications and on package labels.

You should be familiar with the following four UN numbers:

UN 2814: assigned to Infectious Substances, Category A, which cause disease in humans or both in humans and animals. The proper shipping name for UN2814 is "*Infectious substances, affecting humans.*"

UN 2900: assigned to Infectious Substances, Category A that causes disease only in animals. The proper shipping name for UN 2900 is "*Infectious substances, affecting animals only.*"

UN 3373: assigned to *all* Category B (see above) infectious substances. The proper shipping name for UN 3373 is "*Biological Substance, Category B.*"

UN 1845: assigned to shipments that contain dry ice. The proper shipping name for UN 1845 is "*Carbon Dioxide, solid*" or "*Dry Ice.*"

[3] The other classes include: Class 1-Explosives; Class 2-Gases; Class 3-Flammable Liquids; Class 4-Flammable Solids; Class 5-Oxidizing Substances and Organic Peroxides; Class 7-Radioactive Material; Class 8–Corrosives.

Class 6.2 – Infectious Substances and Class 9 – Miscellaneous Dangerous Goods:

Hazard class and UN numbers should be assigned to biological samples based on the known medical history and symptoms/signs of the source human or animal, endemic local conditions, and professional judgment concerning the individual circumstances of the source human or animal. Likely hazard classes for human and animal disease surveillance work includes the following:

Class 6.2 – Infectious Substances:

All samples collected from humans or animals which are known to contain, or are reasonably expected to contain, pathogens including bacteria, viruses, parasites, fungi and other agents such as prions which can cause disease in humans or animals should be assigned to hazard class 6.2 - Infectious Substances. Samples collected for the purpose of diagnosing an infectious disease fall within Class 6.2 – Infectious Substances.

Infectious Substances, Category A (UN 2814 and UN 2900):

If you think your sample contains a pathogen in a form that, when exposure to it occurs, is capable of causing permanent disability, life-threatening or fatal disease in otherwise healthy humans or animals, it should be assigned to Category A. These are assigned the following UN numbers and proper shipping names:

UN 2814 – Infectious Substance, affecting humans; or
UN 2900 – Infectious Substance, affecting animals only

Biological Substances, Category B (UN 3373):

Biological samples that do not meet the criteria for inclusion in Category A are assigned to Biological Substances, Category B. This includes samples collected for the purpose of diagnosing infectious diseases. They are assigned the following UN number and proper shipping name:
UN 3373 – Biological Substance, Category B

Most biological samples collected as part of human and animal disease surveillance activities will fall into Biological Substances, Category B.

Class 9 – Miscellaneous Dangerous Goods:

According to IATA and the DOT, dry ice is considered a "dangerous good". Dry ice falls into Class 9 - Miscellaneous Dangerous Goods, which are hazardous substances that do not fall into the other categories (this class also includes asbestos, air-bag inflators, and self-inflating life rafts). The amount of dry ice that you are allowed to ship with your samples will vary with each carrier or airline, and you must determine this BEFORE shipping your samples. Dry ice is assigned the following UN number and proper shipping name:

UN 1845 – Carbon dioxide, solid, or
UN 1845 - Dry ice

Section 6.2.5. Packing Instructions

The classification and identification of your biological sample determine how you will pack and ship it. The following guidelines apply to shipments classified as 6.2 – Infectious Substances (both Category A and Category B).

Class 6.2 – Infectious Substances must be packed in triple packaging consisting of:

1) A primary receptacle that contains the infectious substance and must be watertight to prevent leakage. Primary receptacles include those made of glass, metal, or plastic and include screw-cap tubes or rubber-stopped glass vials fitted with metal seals. The primary receptacle should have a specimen ID label. The primary container must be capable of withstanding without leakage an internal pressure producing a pressure differential of not less than 95 kPa and temperatures in the range of -40°C to 55°C.
2) One or more primary receptacle placed in a water tight secondary packaging. The secondary packaging should also bear a label with the name, address, and telephone number of the shipper. If multiple fragile receptacles are in a single secondary package they must be individually wrapped to prevent contact. Absorbent material must be placed between the primary receptacle and secondary packaging. The absorbent material must be sufficient to absorb the entire contents of the primary containers. An itemized list of contents must be placed between the secondary packaging and outer packaging. Filling out the submission form of the laboratory receiving the samples can meet this requirement.
3) The secondary packaging should be placed within a styrofoam container inside of a shipping box. The outer shipping box must be of adequate strength for its capacity, mass, and intended use. You must be able to drop the complete package from a height of 1.2 meters without it suffering any damage. Outer package dimensions must be at least 4"L x 4"W x 4"D (10 cm x 10 cm x 10 cm).

It is best to obtain appropriate outer packing materials used by your carrier (both DHL and FedEx sell them). Packaging should be used exactly as written in the directions supplied with the packaging.

If dry ice is used as a refrigerant, tape only some of the seams between the dry ice and outer packaging. Seal the outside package such that the carbon dioxide gas that forms is able to escape, preventing the build-up of pressure that could rupture the package or put transporters at risk.

Examples of the CORRECT packaging of biological samples:

Example 1:

These three screw-cap tubes contain specimens being sent to a laboratory for diagnostic testing. The tubes have been sealed with parafilm, to prevent leakage around the cap. Parafilm should always be on hand when you package your samples for shipping.

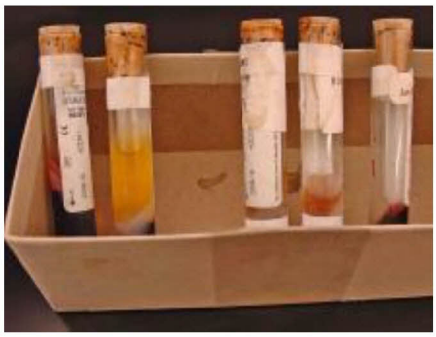
Tubes should be packed with absorbent material into a leak-proof secondary container. Multiple primary receptacles are individually wrapped to prevent contact between them. The absorbent material must be sufficient to absorb the entire contents of the primary containers.

The container with the tubes is placed in the center of an insulated styrofoam carton inside a shipping box. Dry ice is added above the samples (and below if possible). The lid of the styrofoam carton is added. The plastic liner is folded around the styrofoam carton.

REMEMBER: The lid of the styrofoam carton is NEVER taped shut when you are shipping with dry ice, to allow gas to escape cartons.

Example 2:

Examples of POORLY packaged biological samples:



Tubes with cork stoppers are NOT acceptable; evidence of leakage is visible on the labels and in the box.

Ensure that your packaging can withstand wear and tear.

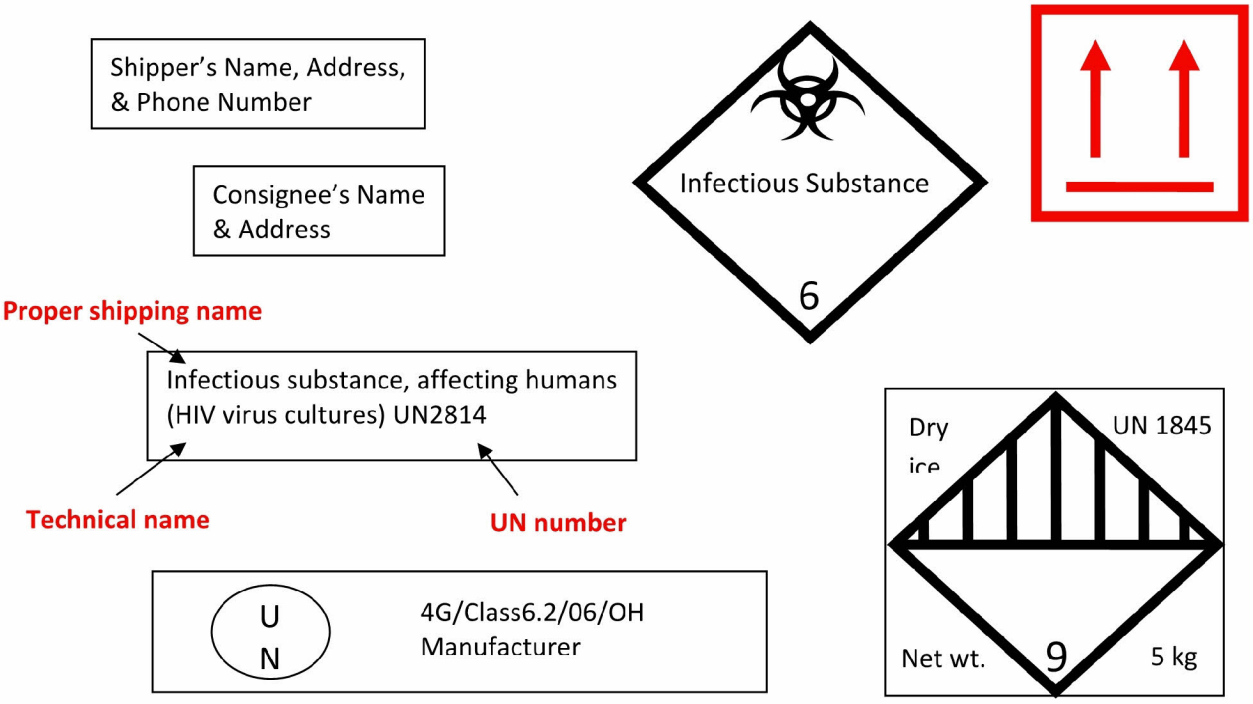
Packaging must be constructed and closed so as to prevent loss of contents that might occur under normal conditions of transport, by vibration, or by changes in temperature, humidity or pressure.

Section 6.2.6. Marking and Labeling

The labeling requirements differ depending on whether your biological samples are classified as Infectious Substances, Category A or Biological Substances, Category B. Make sure to follow the guidelines that are appropriate for the type of samples you have.

INFECTIOUS SUBSTANCES, CATEGORY A (UN 2814 & UN 2900), Marking and Labeling:
Packages containing Category A, Infectious Substances, must be marked on the outside of the shipping container with the following:

- Diamond shaped label for Class 6.2 – Infectious Substances.
- Diamond shaped label should be 50mm on all sides.
- Diamond shaped label should have a line width of 2mm.
- The proper shipping name of the dangerous goods and corresponding UN number in type that is at least 6mm. The technical name of the suspected infectious agent must be listed on the shipper's declaration per "Special Provision A140". It should NOT be marked on the box.
- Package orientation (This Way Up) labels affixed on opposite sides of the outer package.
- The full name and address of the shipper and the consignee.
- 24-Hour emergency response number and name of the person responsible for the contents (this information can be on the waybill for Category B).
- Successful drop and pressure test certification labels.
- For dry ice, Class 9 diamond label and the net weight of the dry ice contained.



Example of PROPER Infectious Substances, Category A marking and labeling:

Side 1 of outer packaging:

Package orientation

Label alerting receiver to keep package frozen

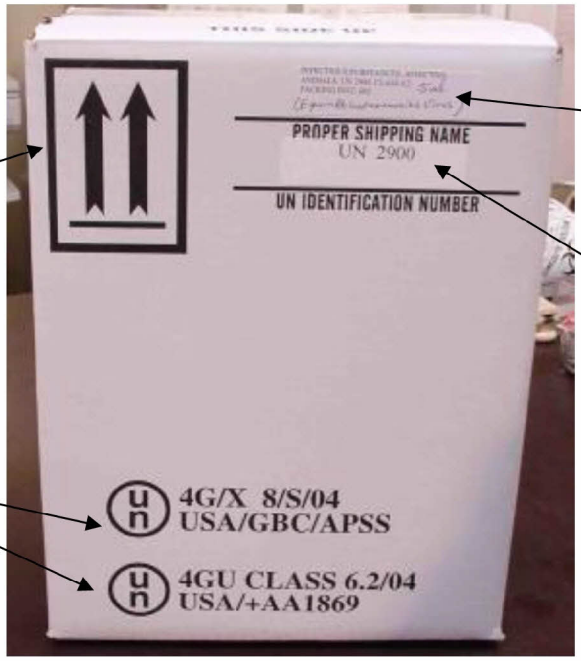
Class 9 Miscellaneous Dangerous Goods diamond label, specifying net weight of dry ice within the package

Class 6.2 Infectious Substances diamond label

Shipper and the name, address, phone of the person responsible for the contents

Consignee's Name and Address

Side 2 of outer packaging:



Package orientation label

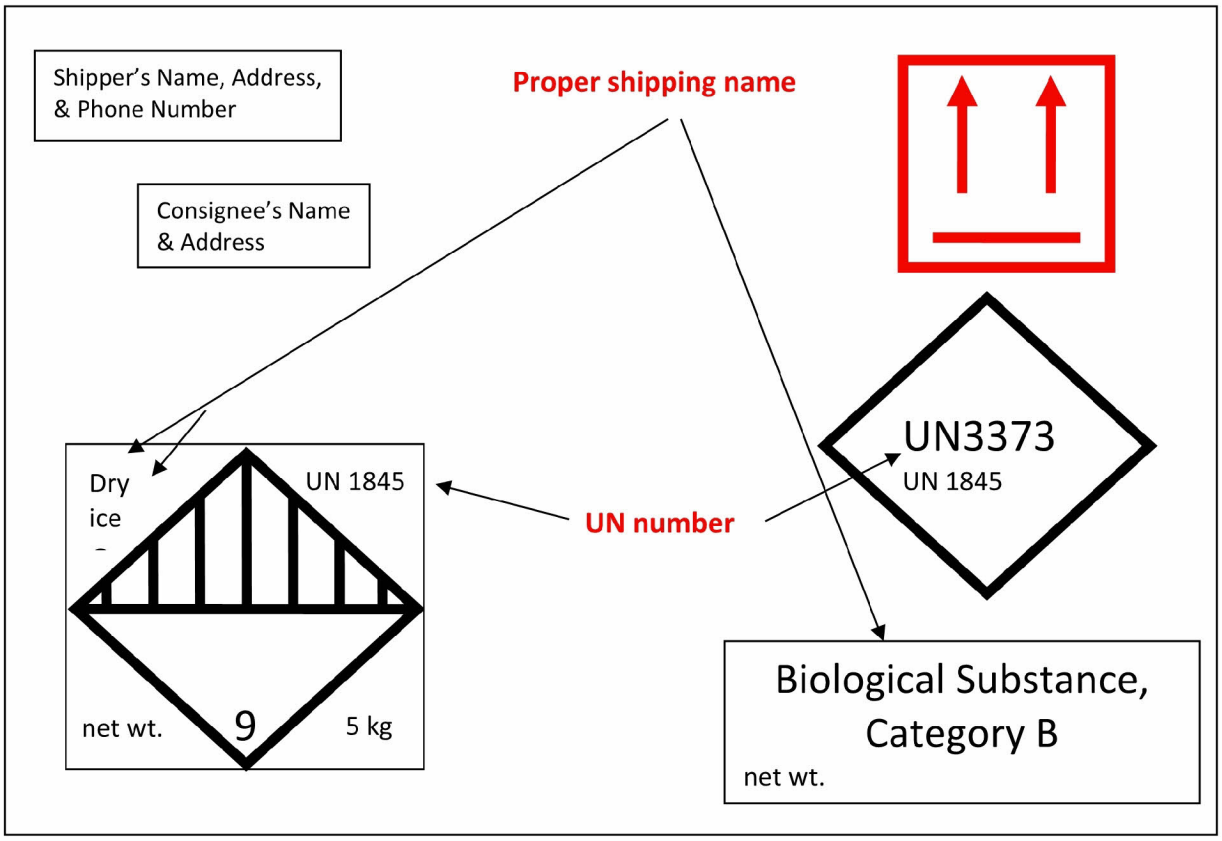
Manufacturer's certification of successful drops and pressure tests

Proper UN shipping name (Infectious substances, affecting animals only)

Proper UN number (UN 2900)

Biological Substances, Category B (UN 3373) marking and labeling:
Packages containing Category B, Biological Substances must be marked on the outside of the shipping container with the following:

- The proper shipping name of "Biological Substances, Category B" and corresponding UN number 3373 in font at least 6mm tall.
- Package orientation (This Way Up) labels affixed on opposite sides of the outer package.
- The full name and address of the shipper and the consignee.
- For dry ice, Class 9 diamond label and the net weight of the dry ice contained.



Example of PROPER Biological Substances, Category B marking and labeling:

Side 1 of outer packaging:

Package orientation label

Proper UN number (UN 3373)

Proper UN shipping name (Biological Substance, Category B)

Label alerting receiver to keep package frozen

Class 9 Miscellaneous Dangerous Goods (dry ice) diamond label

Side 2 of outer packaging:

Package orientation label

Net weight of dry ice contained within package and UN 1845

Shipper's Name, Address, and Phone Number

Consignee's Name & Address

Section 6.2.7. Documentation

Shipper's Declaration of Dangerous Goods:
Packages containing Infectious **Substances, Category A** that are transported by air must contain a "Shipper's Declaration for Dangerous Goods" form. This is a legal document and must be fully and accurately completed by you, the shipper. Carriers will refuse incomplete, illegible or inaccurate documents.

Shipments of Infectious Substances, Category A require the shipper to make advance arrangements with the consignee and the operator to ensure that the shipment can be transported and delivered without unnecessary delay.

A Shipper's Declaration is NOT required for Biological Substances, Category B and it is not required for dry ice without other dangerous goods.

Enter the following information on the Shipper's Declaration:

Shipper – enter the full name and address of person responsible for sending the shipment
Consignee – enter the full name and address of person who will receive the shipment
Air Waybill Number – if known, enter the air waybill number provided by the courier, this information may also be entered or amended by the shipper, a brokering agent or by the airline or its handling agent
Page of pages – enter the page number and the total number of pages (for a single page Shipper's Declaration, enter "page 1 of 1 pages")
Transport Details – Indicate whether the shipment is packaged to comply with the limitations for passenger and cargo aircraft OR cargo aircraft only, mark X in the box that *does NOT apply*
Airport of Departure – enter the full name of the airport or city of departure, if known; this information may also be entered or amended by the shipper, a brokering agent, or by the airline or its handling agent
Airport of Destination – enter the full name of the airport or city of arrival, if known; this information may also be entered or amended by the shipper, a brokering agent or by the airline or its handling agent
Shipment Type – enter X's to block out "RADIOACTIVE" (for shipments which do not contain radioactive material) or to block out "NON-RADIOACTIVE" (for shipments which contain radioactive material)
Nature and Quantity of Dangerous Goods – Enter the required information strictly in accordance with IATA 8.1.6.9. Per IATA, the following information fields ***must*** *b*e entered in sequence within the columns provided. If your information will not fit without going over the lines separating the columns, enter text on another line below the first line.
Emergency Contact Number – you must include a telephone number for a 24-hour emergency response agency (in the US this would be the Center for Disease Control, CDC, 1-800-232-0124).

Name and Title of Signatory – Enter the name and title of the person actually signing the Shipper's Declaration. Only a *certified* shipper may fill out a declaration (this training guide does NOT count as a certification).
Place and Date – Enter the place and date to indicate where and when the form was actually signed.
Proper shipping name – Enter the appropriate UN proper shipping name either "Infectious substances, affecting humans" or "Infectious substances, affecting animals only" or "Carbon dioxide, solid"
Class or Division – Enter hazard class "6.2" for Infectious Substances or hazard class "*9*" for dry ice.
UN or ID Number – Enter the appropriate UN number to match the shipping name either *UN 2814* or *UN 2900* or *UN 1845.*
Packing Group – Leave blank (Class 6.2 does not have a packing group).
Subsidiary Risks – Leave blank.
Quantity and Type of Packing – List the amount of dangerous good included in shipment and type of packing used to contain it.
Packing Instruction – Enter *602* for Category A Infectious Substances; enter *904* for dry ice.
Dry ice -- If using dry ice in your shipment, be sure to include it in the declaration list.

Example of Shipper's Declaration for Dangerous Goods:

SHIPPER'S DECLARATION FOR DANGEROUS GOODS (Provide at least three copies to the airline.)

Shipper
Dr. Jane Smith
Ebola Research Program
123 Research Street
New York, NY, 10000, United States

Air Waybill No. 12345678

Page 1 of 1 Pages

Shipper's Reference Number

Consignee
Generic Laboratory
4567 Laboratory Avenue
Chicago, IL, 60000, United States
Telephone: 1-800-123-4567

FedEx Express

Two completed and signed copies of this Declaration must be handed to the operator

WARNING

Failure to comply with all respects with the applicable Dangerous Goods Regulations may be in breach of the applicable law, subject to legal penalties.

TRANSPORT DETAILS

This shipment is within the limitations prescribed for: *(delete non applicable)*

PASSENGER AND CARGO AIRCRAFT | ~~CARGO AIRCRAFT ONLY~~

Airport of Departure: LaGuardia, NY

Airport of Destination: O'Hare, IL

Shipment type: *(delete non-applicable)*

NON-RADIOACTIVE | ~~RADIOACTIVE~~

NATURE AND QUANTITY OF DANGEROUS GOODS

Dangerous Goods Identification				Quantity and type of packaging	Packing Inst.	Authorization
UN or ID No.	Proper Shipping Name	Class or Division (Subsidiary Risk)	Packing Group			
UN 2814	Infectious substance, affecting humans (Ebola virus)	6.2		5 ml in plastic screw-top vial	602	
UN 1845	Carbon dioxide, solid (Dry ice)	9		5 kg in unsealed sytrofoam cooler	904	

Additional Handling Information

Prior arrangements as required by the IATA Dangerous Goods Regulations 1.3.3.1 have been made

I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labelled/placarded, and are in all respects in proper condition for transport according to applicable International and National Governmental Regulations. I declare that all of the applicable air transport requirements have been met.

Name/Title of Signatory
John Doe

Place and Date
Ebola Research Program, New York, NY 1/1/2010

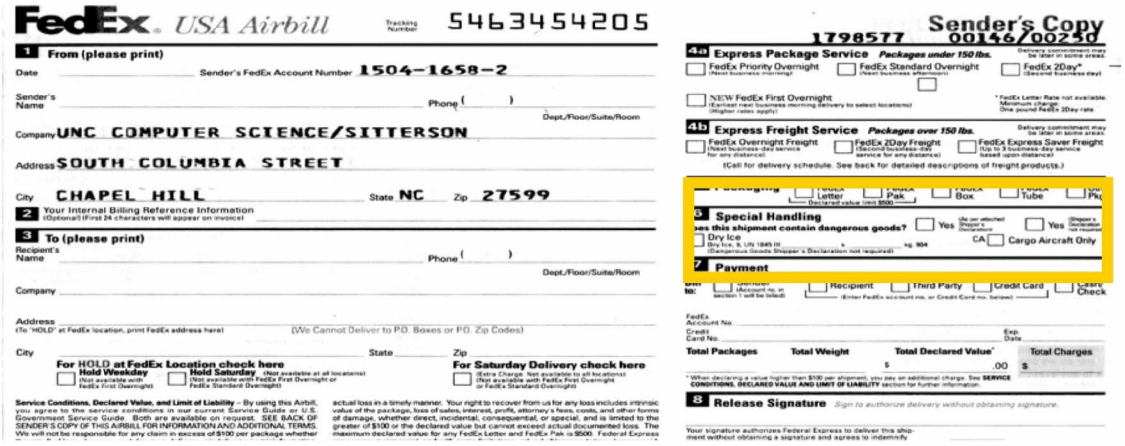
Signature *(see warning above)* [A typed signature may be used if the origin and destination are in the United States or its territories.]
John Doe

CDC, 1-800-232-0124 Emergency Telephone Number

FOR RADIOACTIVE MATERIAL SHIPMENT ACCEPTABLE FOR PASSENGER AIRCRAFT, THE SHIPMENT CONTAINS RADIOACTIVE MATERIAL INTENDED FOR USE IN OR INCIDENT TO RESEARCH, MEDICAL DIAGNOSIS, OR TREATMENT. ADR EUROPEAN TRANSPORT STATEMENT: CARRIAGE IN ACCORDANCE WITH 1.1.4.2.1

Air Waybill:

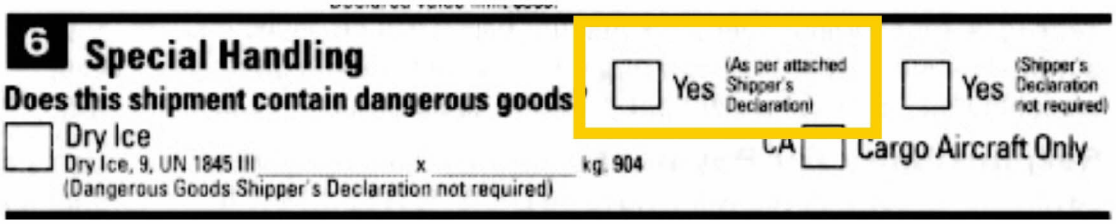
A waybill is different from a Shipper's Declaration. All shipments require a waybill regardless of contents. Forms may vary depending on the shipping company (FedEx, DHL, Compass Forwarding, etc.). In the following example from FedEx you will need to specify in Box 6 that the package contains dangerous goods.


FedEx USA Airbill Tracking Number 5463454205

1 From (please print)
Date
Sender's FedEx Account Number 1504-1658-2
Sender's Name
Phone ( )
Dept./Floor/Suite/Room
Company UNC COMPUTER SCIENCE/SITTERSON
Address SOUTH COLUMBIA STREET
City CHAPEL HILL State NC Zip 27599
2 Your Internal Billing Reference Information
3 To (please print)
Recipient's Name
Phone ( )
Dept./Floor/Suite/Room
Company
Address
(We Cannot Deliver to P.O. Boxes or P.O. Zip Codes)
City State Zip
For HOLD at FedEx Location check here
Hold Weekday Hold Saturday
For Saturday Delivery check here

Sender's Copy
1798577 00146/00250

4a Express Package Service Packages under 150 lbs.
FedEx Priority Overnight FedEx Standard Overnight FedEx 2Day*
NEW FedEx First Overnight
4b Express Freight Service Packages over 150 lbs.
FedEx Overnight Freight FedEx 2Day Freight FedEx Express Saver Freight
5 Special Handling
Does this shipment contain dangerous goods? Yes Yes
Dry Ice
Dry Ice, 9, UN 1845 III x kg 904
(Dangerous Goods Shipper's Declaration not required)
CA Cargo Aircraft Only
7 Payment
Recipient Third Party Credit Card
Total Packages Total Weight Total Declared Value Total Charges
8 Release Signature


6 Special Handling
Does this shipment contain dangerous goods?
Yes (As per attached Shipper's Declaration)
Yes (Shipper's Declaration not required)
Dry Ice
Dry Ice, 9, UN 1845 III x kg 904
(Dangerous Goods Shipper's Declaration not required)
CA Cargo Aircraft Only

If you are shipping Biological Substances Category A mark "Yes (As per attached Shipper's Declaration)".


6 Special Handling
Does this shipment contain dangerous goods?
Yes (As per attached Shipper's Declaration)
Yes (Shipper's Declaration not required)
Dry Ice
Dry Ice, 9, UN 1845 III x kg 904
(Dangerous Goods Shipper's Declaration not required)
CA Cargo Aircraft Only

If you are shipping Biological Substance Category B, mark "Yes (Shipper's Declaration not required)."

The proper shipping name and UN number need to be on the waybill. For FedEx, there is no designated area for this information and it should be written in by the shipper.
If your shipment includes dry ice, mark "Dry Ice (Dangerous Goods Shipper's Declaration not required)" and include the number of blocks and their weight in kg.

When shipping infectious substances, your waybill is a legal document. It must be legible (typed), CANNOT contain spelling errors and must be in triplicate – one copy each for the shipper, the carrier and the recipient. Shippers must keep their copies for 375 days.

Section 6.2.8. Summary of Protocol for Packing Biological Samples for Shipment

Review the basic procedures:
Before you begin packing samples, refer to the checklist on page 7 regarding all relevant permits and regulating authorities that must be advised, and all travel-related details that can facilitate or hinder the success of your shipment.

Keep an updated log of all the sample shipments you send, and include relevant details including the contents, recipient, contact names and phone numbers of agencies, etc.
Assemble required materials: The following materials can be ordered from commercial suppliers:

1. *Outer packaging* (box) in good condition. If you re-use packing containers be mindful of when the container needs to be replaced. Outer package (box) must be:
    a. At least 4 in. length x 4 in. width x 4 in. depth (10 cm x 10 cm x 10 cm)*
    b. Sturdy
    c. Able to be dropped from 1.2 meters without suffering damage*
2. *An insulating styrofoam container* that fits snugly into the cardboard outer box
3. *Primary containers* (containers in direct contact with the biological material) that are watertight (e.g. vacutainer tube, screw-top cryo-tube, etc.). Primary or secondary containers must withstand 95kPa internal pressure differential[4]. Parafilm works well to ensure that tubes do not leak in transit and is mandatory for Category A shipments.
4. *Absorbent material* (e.g. cotton or paper towels) to wrap each primary container individually, in an amount sufficient to absorb the entire contents of the primary container(s) in the event that they should leak or break.
5. *Watertight secondary container* (e.g. zip-lock bag) in which to place the individually wrapped primary containers
6. *Itemized list of contents* between the secondary and outer packaging.
7. *Diamond-shaped shipping labels* for Class 6.2 – Infectious Substances (UN 2814 or UN2900) and Class 9 – Miscellaneous Dangerous Goods (UN 1845, Dry ice).
8. *Shipping labels* for UN3373 – Biological Substances, Category B

[4] When you purchase packing materials for shipping dangerous goods, they will have been tested to meet these specifications. However, you are only in compliance when using these packages if you follow the manufacturer's instructions on how to use them.

Shipping instructions for samples WITHOUT dry ice:

1. Prepare an itemized list of samples that you will ship and type the list in Excel or other easily read format. Keep a backup for your records.
2. Locate all the materials you will need from the above list.
3. Make sure all the samples are contained in watertight primary containers (e.g., vacutainer tube, screw-top cryo-tube, etc.)
4. Wrap each sample individually with absorbent material such as cotton or paper towels.
5. Place the individually wrapped samples in a watertight secondary container (such as a ziploc bag)
6. Place the secondary container in styrofoam container and secure it.
7. Place the Styrofoam container in the box.
8. Place the itemized list of contents between the styrofoam container and the box (outside the top of styrofoam container, but within cardboard box).
9. Seal the box with strong tape for shipping.
10. Label the box appropriately depending on the contents of the package:
    a. Infectious Substances, Category A
        - Label with UN number and proper shipping name: **UN2814** - *Infectious substances, affecting humans* OR **UN2900** - *Infectious substances, affecting animals only.* The technical name for the pathogen of concern should be placed on the shipper's declaration.
        - Successful drop and pressure test certification labels
        - 24 hour emergency response contact and the name and telephone number of the person responsible for the shipment
    b. Biological Substances, Category B
        - Label with UN number and proper shipping name: **UN3373** *Biological Substances, Category B*
11. Label the box with shipper's name & address and the receiver's (consignee) name & address. Include contact telephone information if applicable.
12. If shipping Category A, fill out a Shipper's Declaration and attach to the outside of the package (see instructions above).
13. Fill out the Air Waybill as per the courier's instructions.
14. Log your shipment for the record in a format agreed upon with the investigator or project supervisor.

Shipping instructions for samples WITH dry ice:

1. Prepare the itemized list of samples that you will ship and type the list in Excel or other easily read format.
2. Locate all the materials you will need from the above list.
3. Make sure all the samples are contained in watertight primary containers (e.g., vacutainer tube, screw-top cryo-tube, etc.)
4. Wrap each sample individually with absorbent material such as cotton or paper towels.
5. Place the individually wrapped samples in a watertight secondary container (such as a zip-lock bag)

6. Place the secondary container in styrofoam container and surround with dry ice. DO NOT SEAL the secondary container. You must allow for the carbon dioxide to escape as the dry ice sublimates.
7. Place the Styrofoam container in the box.
8. Place the itemized list of contents between the styrofoam container and the box (outside the top of styrofoam container, but within cardboard box).
9. Seal the outer box only for shipping, allowing gases to escape if necessary.
10. Label the box appropriately depending on the contents of the package:
    a. Infectious Substances, Category A
        - Diamond-shaped label for Class 6.2 – Infectious Substances
        - Label with UN number, proper shipping name, and technical name for pathogen contained: **UN2814** - *Infectious substances, affecting humans* OR **UN2900** - *Infectious substances, affecting animals only* (Successful drop and pressure test certification labels
        - 24 hour emergency response contact and the name and telephone number of the person responsible for the contents of the shipment
    b. *Biological substances, Category B*
        - Label with UN number and proper *shipping name: **UN3373** Biological Substances, Category B*
11. Label with appropriate dry ice labels:
    Diamond-shaped label for Class 9 – Miscellaneous Dry Goods
        - Label with UN number, proper shipping name, and technical name for dry ice: UN1845 *Carbon dioxide, solid* (dry ice).
        - Include Net weight of dry ice contained within package.
12. Label the box with the shipper's name & address and the receiver's (consignee) name & address. Include contact telephone information if applicable.
13. If shipping Category A, fill out a Shipper's Declaration and attach to the outside of the package (see instructions above).
14. Fill out the Air Waybill as per the courier's instructions. Be sure to mark inside the box "contains dangerous goods" and specify the net weight of the dry ice contained within the package.
15. Log your shipment in your records in the format agreed upon with the investigator or project supervisor.

Section 6.2.9. References and Acknowledgments

Birr, A. (2006) *Shipping & Receiving Diagnostic Specimens*. PowerPoint presentation. AZVT.

CFR. (2010) Transportation, Hazardous Materials Regulations, 49 CFR, pt. 171-177.

United Nations. (2009) Committee of Experts on the Transport of Dangerous Goods. Globally Harmonized System of Classification and Labeling of Chemicals. New York and Geneva.

Walsh, L. and C. Henry (2005) *Shipping Specimens to the National Veterinary Services Laboratories*. PowerPoint presentation. NVSL, USDA.

Walsh, P. and K. Ingerman (2008) *Shipping Training 2008 Transportation of Dangerous Goods.* PowerPoint presentation. Global Health Program, WCS.

A technical review incorporating recent modifications to USG regulations was conducted in June, 2013, by Kenneth Conley, Wildlife Pathologist, Wildlife Conservation Society. The material was originally compiled and edited with the assistance of Sarah Pilzer.

Section 6.1. Implementing Cold Chain for Safe Sample Transport and Storage

Prepared by
David Wolking, University of California, Davis,
and the PREDICT One Health Consortium

Objective: To provide principles and general considerations for cold chain maintenance, the safe transport and storage of samples collected during PREDICT surveillance activities, and the safety of personnel.

This document was made possible by the generous support of the American people through the United States Agency for International Development (USAID) Emerging Pandemic Threats PREDICT program. It was drafted to support activities conducted under PREDICT and is intended for an audience of qualified professionals trained in standard, associated best practices. This guide is not intended for use by untrained individuals.

For more information about the contents of this guide, please contact predict@ucdavis.edu.

Suggested Citation Form: PREDICT One Health Consortium 2016. PREDICT Operating Procedures: Implementing Cold Chain for Safe Sample Transport and Storage.

Table of Contents: Implementing Cold Chain for Safe Sample Transport and Storage

Section 6.1.1. Introduction to Cold Chain

This guide focuses on implementing an efficient cold chain and sample transport/storage plan appropriate for PREDICT disease surveillance activities. The guidance provided is to ensure that all PREDICT materials arrive at their end laboratories in suitable condition for PREDICT diagnostics and pathogen testing. When you are familiar with the information in this Guide, take the PREDICT quiz on ***Implementing a Cold Chain for Safe Sample Transport (Section 8.4.14.)***.

A cold chain is a monitored temperature-controlled supply chain. The goal of the cold chain is to keep a sample or material within a certain temperature range during all stages of delivery, processing and storage (Figure 1). Cold chains are widely used to ensure the viability of products in the pharmaceutical and agricultural sectors, and are critical components of vaccination programs and bio-medical surveillance activities.

Many biological samples deteriorate when exposed to heat, sunlight, or fluorescent light. When transporting and storing such biological substances, it is imperative that field and laboratory teams control environmental conditions, ensuring that exposure to potentially damaging environmental factors is minimized.

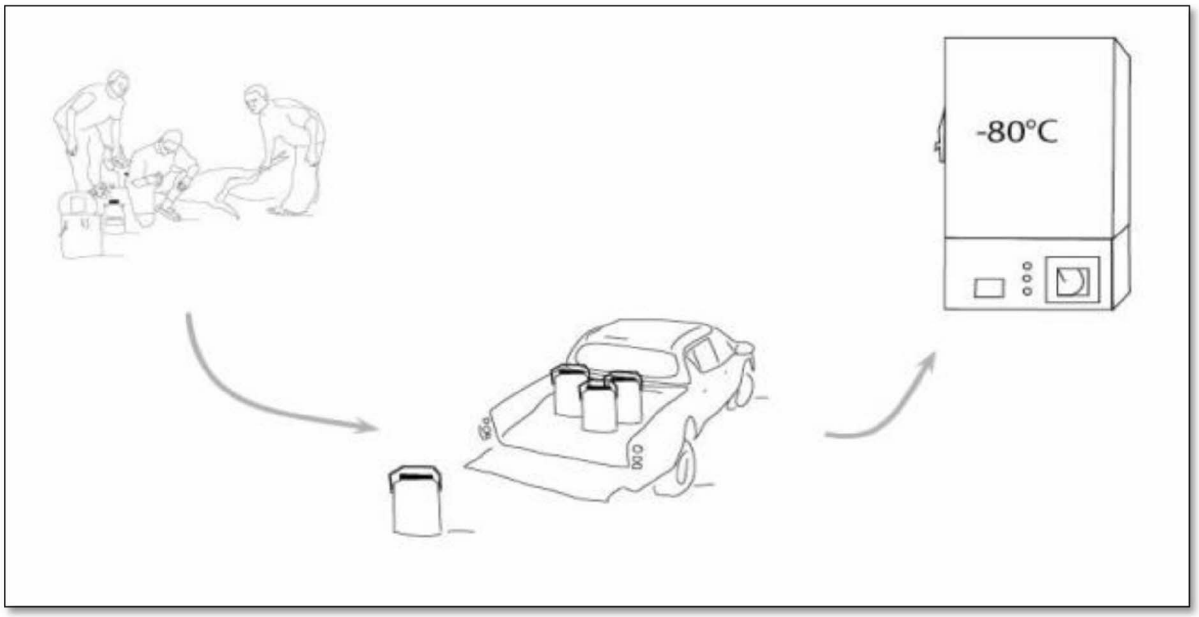


Figure 1: Illustration of a typical cold chain from field to lab storage for PREDICT biological samples. Field teams sample an animal and place specimens in liquid nitrogen dewar for storage. The dewar with specimens is transported in the back of a project vehicle to long-term storage at a PREDICT laboratory or field station, inventoried, and archived until testing in an ultra-low temperature freezer (<-80°C).

Freezing is the simplest way to ensure that the biological samples remain viable for laboratory analysis. The cold chain for PREDICT samples can be maintained through the use of ice packs, coolers and dry ice (for a very brief period immediately following collection), liquid nitrogen (LN2) containers and freezers, and the use of ultra-low temperature (-80°C and colder) freezers. It is recommended that PREDICT samples be placed in LN2 or ultra-low temperature freezers as soon as possible to optimize sample viability for diagnostics and pathogen testing.

Repeated exposure to heat leads to a cumulative and irreversible loss of sample viability and may render a sample useless for laboratory analysis.

PREDICT Sample Cold Chain Requirements: All biological samples from PREDICT surveillance activities should be stored and transported at temperatures colder than -80ºC suitable for the preservation of targeted PREDICT pathogens and viral detection.

Section 6.1.2. Implementing the Cold Chain

This section introduces recommended steps for cold chain planning and implementation.

Section 6.1.2a. Planning

The first step in implementing the cold chain is planning. Your team must identify the cold storage needs for your sampling activities, then identify and procure all necessary materials and resources. In addition, it is critical to train your team to understand the logistics of the cold chain, how to monitor cold chain temperature, and how to maintain system records.

Considerations for Cold Chain Planning:

1. What is your surveillance plan and what type of cold chain is appropriate for that plan? What types of samples are you collecting? What are the temperature requirements for safely storing these samples?
2. Assess local context and conditions. Do you have access to long-term sample storage facilities? Are your sampling activities located in remote rural locations several days or weeks from the project infrastructure or laboratory?
3. Determine where the cold chain ends. If your field team delivers samples to a laboratory with an ultra low temperature freezer, then initiating your cold chain may require simply extending it from laboratory to sampling site through the use of LN2 dry-shippers or dewars. If you are developing a cold chain without any pre-existing infrastructure, mapping out an appropriate cold chain from sample collection to endpoint is essential (Figure 2).
4. Determine the maximum amount of time samples will be located outside of long-term cold storage. If your field activities are 5 days away from long-term storage, then you will need a minimum of 5 days mobile cold storage in LN2. If you plan to export samples, how long will it take to ship from origin to destination?
5. Determine the minimum amount of time samples will stay in long-term storage. Planning for long-term storage requires assessing the space necessities of your cold chain. Are you

maintaining a sample bank or archive? If so, you will need to plan for sufficient storage space for the life of the project to preserve sample viability.

6. Establish procedures for monitoring the cold chain and tracking the samples moving through the cold chain. Confirm all team members have been trained in cold chain maintenance and record keeping. Prepare forms for data logging and recording. Prepare a schedule for re-filling LN2 containers and contingency plans for equipment failure.

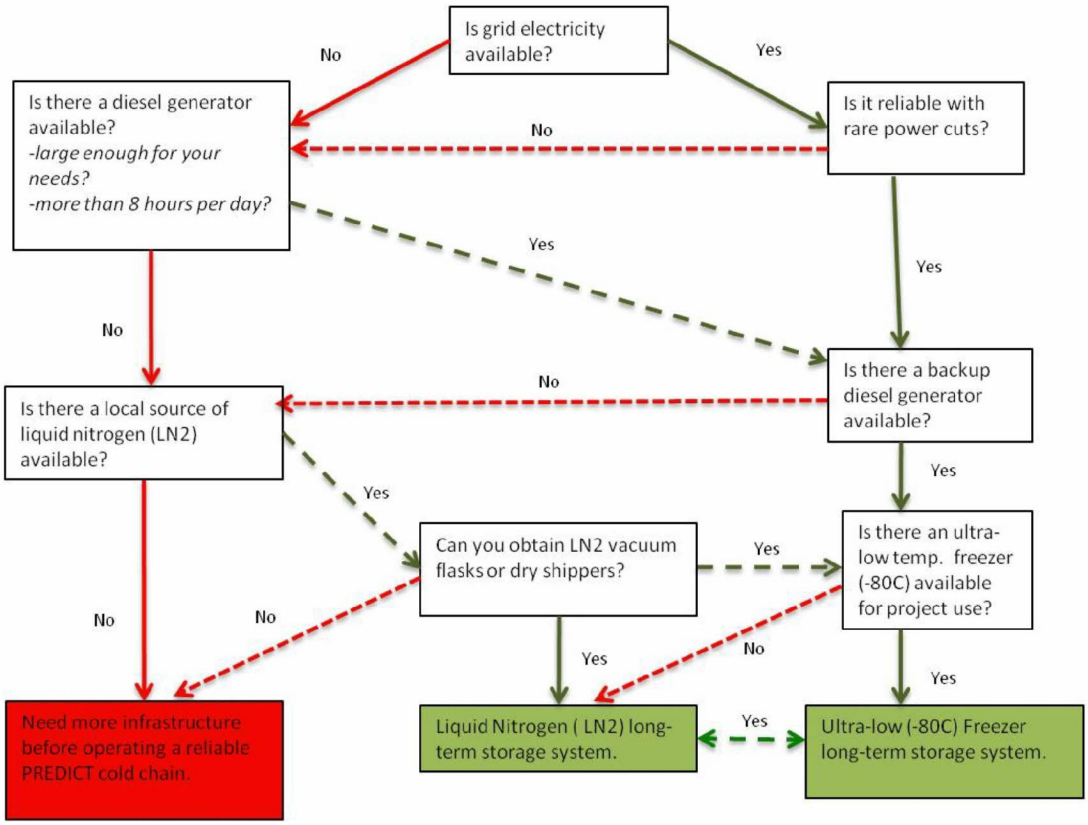


Figure 2: A decision tree for cold chain planning. Based on United Nations World Food Program Logistics Cluster "Logistics Operational Guide".

Developing a Cold Chain System

To develop and maintain a cold chain, a series of simple and routine processes must be established. These processes should be designed to function efficiently in each team's environmental and local conditions, and should be easy to maintain with available materials and resources.

1. Assess the opportunities and constraints to developing a cold chain in your area. These may include:
    a. Access to a pre-existing cold chain
    b. Access to LN2, and LN2 transport and storage supplies
    c. Access to an ultra-low temperature (sub -80°C) freezer available for use
        i. If freezer available, does it have a backup generator and alarm system?

2. Identify the appropriate materials and resources needed to implement and maintain the cold chain. Required materials and resources may include:
    a. Personal Protective Equipment (PPE) for working with LN2 and -80ºC freezers
    b. Coolers
    c. Ice/gel freezer packs
    d. Liquid Nitrogen (LN2) dewars and/or LN2 vapor-phase dry shippers (see distinctions below in Table 2)
    e. Source of LN2
    f. Large capacity LN2 storage dewars or ultra-low temperature (<-80°C) freezers for longer-term sample storage
    g. Temperature gauges, thermometers, data loggers (as needed), alarm systems, and an alert network for staff when facilities are unoccupied
    h. Appropriate sample storage containers and racks for sample organization
3. Identify local suppliers or other sources for procurement of materials and resources. (Note: Carefully assess the reliability/sustainability, and costs of any suppliers to assure procurement of reliable supplies and ability to service equipment.)
4. Establish a written protocol for monitoring the cold chain and stored samples. The protocol should cover:
    a. Temperature regulation and record
    b. Sample storage and tracking system
    c. Equipment maintenance schedules
    d. Response procedures in event of container/freezer failure or power outage
    e. Training programs to ensure continued and safe operation of cold chain system
    f. Annual review of cold chain operation and sample storage procedures

Cold Chain Materials and Resources

A cold chain can consist of any combination of materials and resources that serve to maintain samples at a desired temperature. **For all PREDICT samples, that temperature is -80°C or lower.** This temperature range requires the use of specialized cooling technologies and specially designed freezers. Gas-based coolants (LN2) do not require electricity, and can be deployed to remote and rural areas. In contrast, ultra low temperature (< -80°C) commercial freezers are dependent upon an electrical grid and emergency generators in the event of blackouts or grid failure.

Safety Considerations for Coolants

Working with cold chain coolants can be dangerous if appropriate precautions are not taken. The recommended PREDICT cold chain requires samples to be stored in temperatures well below freezing. Exposure to these temperatures can cause severe burns and damage to living tissue. There are three coolants commonly used in implementing a cold chain: 1) ice/gel packs, 2) dry ice, and 3) liquid nitrogen (LN2). Dry ice and LN2 give off gases that can cause asphyxiation and should only be handled by trained personnel in ventilated areas. In addition, dry ice and LN2 containers must be able to vent evaporated gas to avoid the risk of explosion. Characteristics and safety considerations for working with cold chain coolants are listed in Table

1. For more information on human safety when working with PREDICT field and laboratory activities, please review the *PREDICT guide to* ***Biosafety and PPE Use (Section 4.)***.

Table 1: Characteristics and safety considerations for PREDICT cold chain coolants.

Coolant	Characteristics	Use and Maintenance	Safety Considerations
Ice Packs	Ice packs are water filled packs that obtain the temperature of a standard freezer (approx.-18°C). **Ice packs DO NOT achieve temperatures sufficient for the preservation of PREDICT biological samples.**	Ice packs must be kept in a freezer for 12-24 hours to achieve maximum coldness. Keep at a temperature colder than the freezing point of the ice pack, to ensure longer cold life.	None (water-based product). Do not chill ice packs used for samples in refrigerators or freezers used for food and beverages.
Gel Packs	Gel packs consist of a liquid blend of chemicals that depress the melting point of a cold pack allowing the gel pack to remain colder than 0°C for longer time intervals than an ice pack. **Gel packs DO NOT achieve temperatures sufficient for the preservation of PREDICT biological samples.**	Before purchase, request documentation from the manufacturer to validate manufacturer claims on the product's cold life, and to obtain instructions on appropriate use of the product, including packaging a cooler with biological samples and the gel packs. Gel packs take at least 24 hours to reach their lowest temperature and can take even longer if chilled in a domestic refrigerator.	Though most gel packs are non-toxic, be careful to not ingest gel from ruptured gel packs. Consult manufacturer guidelines for product use on safety.
Dry Ice	Dry ice is the solid form of carbon dioxide (CO_2), and is approximately -78.5ºC. In ambient conditions, dry ice is unstable and evaporates quickly. Therefore, samples packed in dry ice should be transferred to a <-80º container within 24 hours. **Dry ice is recommended as a SHORT-TERM COOLANT ONLY**, to be used for transporting samples from the field to more reliable temperature controlled storage containers.	Dry ice is easily manufactured, often as a byproduct of other processes, and is widely used in the food industry for preservation. Dry ice can frequently be sourced from breweries, importers of frozen products like ice cream, and meat processing facilities. Any specimens transported on dry ice must be placed in specially insulated containers capable of venting gaseous CO_2. Note: sealing seams of containers like Styrofoam cold boxes prevents ventilation of the gas and can lead to unsafe pressure build-up.	Wear insulated gloves. Always work in well-ventilated areas. Always transport dry ice in containers approved for transport, ensuring that the CO_2 can diffuse minimizing pressure build-up.

Liquid Nitrogen (LN2)	LN2 is a readily transportable and highly effective compound used for the cryopreservation of blood, reproductive cells, and other biological samples and materials. LN2 is produced through the distillation of liquid air, and is stored and transported in vacuum flasks insulated from ambient heat.	LN2 can often be locally obtained through international airports (urban areas), and services that work with artificial insemination (beef/dairy industry located primarily in rural areas). LN2 boils at -196°C, and can cause rapid freezing on contact with living tissue, and severe damage to materials if spilt.	Wear insulated gloves, a thermal apron and a face shield. Always work in well-ventilated areas. LN2 tanks feature pressure relief devices, which if not routinely checked and properly maintained can fail resulting in tank explosion and considerable damage. Consult the manufacturer's recommendations for tank maintenance to ensure compliance. Transporting LN2 tanks or dewars inside project vehicles can be dangerous: there is a risk of rupture or tank failure, and the tanks can potentially explode. When possible, transport LN2 in dry shippers or vacuum flasks approved for transport. If using LN2 tanks or dewars, be sure to secure these containers on the exterior of the vehicle to maximize safety in transport. LN2 tanks should only be placed in an upright position.

Containers for Cold Chain Transport and Shipping

There are two main types of LN2 containers: dry shippers (vapor shippers) and vacuum flasks (dewar flasks). The insulating capacity of LN2 containers varies considerably from a few hours to weeks, requiring constant vigilance for signs of leakage, and routine assessment of container temperature.

Dry shippers (vapor shippers)

Dry shippers are large vacuum containers that contain an absorbent material to hold LN2. A properly prepared dry shipper does not contain any free LN2, and can safely store samples at the optimal temperature range for a period of 24 hours to several weeks depending on the type. Dry shippers are highly recommended for sample storage when samples need to be transported or shipped (bicycle, car, airplane, etc.). Because of their transport utility, dry shippers are often smaller and more compact, and well suited to more short-term storage applications.

Vacuum (dewar) flasks

Vacuum flasks are non-pressurized LN2 containers lacking absorbent material, in which biological samples or specimens are suspended in LN2 within the container. Vacuum flasks should not be used to transport or ship biological specimens. Rather, vacuum flasks are suited

for longer-term storage application (storage time dependent on size of the flask – consult the manufacturers guidelines) in laboratories, field offices, or other locations where samples are expected to reside for longer period of time. Vacuum flasks come in a range of sizes from small to very large capacity containers.

Recommended steps for using dry shippers/vacuum flasks:

- Always consult and follow the manufacturer's instructions for filling, as procedures for each type of container can vary.
- Always wear a face shield and insulated gloves made for handling liquid nitrogen.
- Always work in well-ventilated areas, as a significant amount of nitrogen gas will be generated as the cold liquid contacts the warm surfaces inside the shipper.

Refrigerators and Freezers

Domestic (e.g., household/home) refrigerators and freezers are designed and built for food and drink storage; they do not meet the requirements for sample storage, and do not reach the temperature levels needed for preservation of PREDICT biological material (e.g., specimens for viral screening). **DO NOT STORE SAMPLES IN REFRIGERATORS OR FREEZERS THAT CONTAIN FOOD OR BEVERAGES FOR CONSUMPTION.** In addition, temperature in domestic refrigerators varies significantly with door opening, defrosting, and variable ambient temperatures; they should not be used in a cold-chain for storage of PREDICT samples. Additionally, freezers designated as "frost free" should not be used for sample storage; because the temperature cycling mechanisms they utilize to avoid ice accumulation can damage samples.

Only specially designed ultra-low temperature (< -80°C) commercial freezers are recommended for use with samples when viral isolation is an objective.

Ultra-low temperature (< -80°C) commercial freezers

Commercial freezers come in a variety of temperature settings (-20, -40, -50, -85, and cryogenic freezers at -150°C), and in a variety of configurations (upright, chest, and bench top freezers). It is important to be sure any commercial freezers utilized for biological sample and specimen storage are able to consistently maintain a sub 80°C environment.

Operating a commercial freezer requires a constant source of electricity to maintain temperatures colder than -80°C temperatures and ensure the viability of the cold chain. In many places where PREDICT projects are being conducted, electricity is intermittent and blackouts are common. **It is imperative that the electrical source for a commercial freezer be supported by a back-up generator to ensure continued power for the freezer and viability of the samples.** It is equally imperative that each team has a contingency plan for power outages, to ensure that the back-up generator is functioning and that the freezer remains operational. Teams should clearly mark the power source to the freezer to prevent accidental disconnection, which can cause heat damage if unnoticed over long periods of time. The power source can also be protected by placing a sticker above the power plug or switch, or by installing a lockable

switch. Additional steps on maintaining the cold chain during blackouts are included in Section 3 below.

The location of the freezer in the laboratory or field office impacts performance. Avoid placing a freezer in direct sunlight or near heat sources (hot water or a warm external wall), because that makes the freezer work harder to maintain cool temperatures. In addition, -80°C freezers often require a certain amount of airspace in their immediate surroundings for ventilation and to function efficiently; -80°C freezers should not be located in close proximity to other freezers, equipment, counters, etc. When possible, leave at least 1 meter of space between the -80°C freezer and other freezers or equipment.

Temperature Gauging Equipment

Continual temperature monitoring of the cold chain assures that all samples remain in an optimal environment for preservation. There are a number of methods to monitor cold chain temperatures, from simple thermometers to more complex temperature gauges, cold chain monitors, and data loggers. When combined with an appropriate record keeping system, temperature monitoring provides an ideal method to evaluate the viability of the cold chain and to respond accordingly to any interruptions.

Table 2: Temperature gauging equipment used in the cold chain.

Type	Description	Guidelines for use
Thermometers	Minimum/maximum thermometers are essential equipment for temperature monitoring, and come in two main types: dial and digital.	All thermometers used for temperature monitoring should be set to Celsius, must be reset on a daily basis, and require annual checks to ensure accuracy, as battery failure or damages temperature probes can impact readings. In addition, a temperature-monitoring chart should be maintained to provide a record of variation in temperature that may indicate problems with the freezer or thermometer.
Temperature Chart Recording Systems	Temperature Chart Recording Systems are automated systems that record temperature and provide visual or audio alarms at signs of malfunction.	These systems are fully automated and provide digital output of temperature variations over time. These are typically after-market modifications to freezers, and if installed, should be verified to function with the freezer manufacturer as they may void product warranty.
Data loggers	Data loggers are used to record temperature patterns over time by recording temperature data electronically, and providing an electronic and downloadable record.	Data loggers are not a replacement for manual monitoring, and daily minimum and maximum temperatures should still be recorded to ensure the maintenance of the cold chain. When used for routine temperature monitoring, a data logger must be equipped with a visual min/max temperature display to allow for daily real-time recordings.

Cold chain monitors	Cold chain monitors generally consist of dual-time temperature indicators (WarmMark™ and MonitorMark™) and function by displaying changes in temperature through color change on an indicator strip. Other types of cold chain monitors include freeze indicators (Freeze Watch™, ColdMark™) consisting of color bulbs that release a dye at a threshold temperature. There are also combined indicators featuring dual time-temperature indicators and freeze indicators.	Cold chain monitor color change allows for an estimation of the amount of time a temperature exceeds a pre-determined threshold. No color change means the cold chain was not interrupted and temperature remained safe for sample transport. Note: these monitors are often for temperatures warmer than -80°C (e.g. cold boxes/coolers, refrigerators, -20°C freezers) and are often not designed for samples kept at or colder than -80°C.

Management of Cold Chain Equipment.

Procuring the needed equipment is only one aspect of keeping a functional cold chain. Equipment management and maintenance is equally important, and requires:

- Maintaining an equipment inventory
- Planning and budgeting for equipment operation (e.g., electricity), maintenance, and repair
- Planning and budgeting for equipment replacement
- Emergency response or contingency planning in the event of cold chain breach or equipment failure

Equipment Inventory

An inventory should be developed to track all equipment, tools, and parts that are used as part of the cold chain. A good inventory will allow team members to track the location of all materials used in the cold chain, schedule maintenance and repair, arrange for replacement and evaluate the project supplies. Table 3 includes some information recommended for a sample storage equipment inventory.

Table 3: Sample storage equipment inventory database example.

Item	**Specifications (brand, model, SN, date of acquisition)**	**Current Location**	**Current Condition (Working, Under repair, Out of commission)**	**Date of purchase – warranty number**	**Estimated Replacement Date**	**Notes**
Ultra-low freezer	TS Revco ElitePlus, S/N 007054568, Oct. 2010	Morogoro	Working	September 2010	October 2013 (MFR warranty expiration)	Recently purchased and installed
Dryshipper	MVE Cryomoover, S/N 9989900745, Oct. 2010	Serengeti, PREDICT Mobile team	Working	September 2010	October 2013 (MFR warranty expiration)	Field sampling with TAWIRI team
LN2 Generator	StirLITE, S/N 356777456, Oct. 2010	Iringa, PREDICT office	Out of Commission	September 2010	October 2013 (MFR warranty expiration)	Installation issues: working with support services to resolve; sourcing LN2 from supplier in Dar es Salaam currently.

Equipment Operation, Maintenance, and Repair

All equipment requires maintenance to protect against failure and degradation. Maintenance planning involves identifying procedures and plans to keep equipment functioning properly, as well as planning for emergency repair in the event of equipment failure. Some equipment requires routine maintenance (daily, weekly, or monthly), while others may require maintenance following use (dry shippers, vacuum flasks, cold boxes, etc.). Maintenance instructions are usually included with the equipment, and can often be obtained from the manufacturer. It is important that team members receive training in routine maintenance and repair within reason, while skilled technicians should be identified for complex maintenance and repair procedures.

In addition, it is important to estimate the costs of installing, operating, and maintaining the equipment. Ultra-low temperature freezers utilize significant quantities of electricity, though newer models are designed to minimize power consumption. It is possible that the installation of new equipment will drastically increase power consumption requiring a re-budget of operational costs.

You may use the following equation to estimate the cost of your electrical equipment using the manufactures specifications to obtain the value for kilowatt hours (kWh). [kWh / 24 h] x [kWh costs in your location] x [365 days] = Operational Cost / Year

Maintenance of equipment over time will also require a budget, and should be included in operational cost planning.

Equipment Replacement

Equipment will eventually wear out, and if plans are not in place to address equipment failure, a significant cold chain breach may occur (See Section 6.1.3.). It is important that teams understand the lifecycle of all cold chain materials and equipment, and that plans are in place to address equipment failure when it occurs. Most manufacturers provide estimates of equipment life expectancy. When developing the equipment inventory, estimated replacement dates should be included in documentation to assist in replacement planning. As equipment can often take months for order and delivery, temporary cold chain storage plans should be considered to ensure no breach or interruption.

Emergency Planning

Cold chains are fragile, material dependent, and subject to interruption through breakdowns of background infrastructure (electricity failure) and equipment failure (leakages of cold storage containers or freezer malfunction). Team members must set up emergency planning for identifying equipment failure early, along with arrangements for maintaining the cold chain during repairs or replacement. Equipment outages caused by shortages of spare parts or materials should not occur.

Power surges and "brown-outs" are often frequent occurrences in areas where PREDICT teams are active. A brown-out is a drop in voltage in an electrical power supply, most commonly observed by the dimming of lights. Black outs are covered below in the Section 6.1.3.. To prevent adverse impacts to cold chain equipment during power surges, it is imperative to have stand-by generators, back-up power sources, and other mechanisms in place (surge protectors, CO2 backup systems, etc.). Often electrical equipment is sensitive to undercurrent (for example a 220V system running at 205V temporarily), and equipment failure and destruction is possible.

Section 6.1.2b. Recommended Temperature Requirements for Sample Transport and Storage

An essential component of cold chain planning is knowing the optimal temperature requirements for different diagnostic methods, sample types and storage media.

For PREDICT purposes all samples (stored in VTM and Trizol) must be frozen in liquid nitrogen immediately in the field and transferred to a -80°C freezer once back in the lab. If the location of the field site allows, you may use short term (maximum 48 hrs.) refrigeration (i.e., ice/gel packs) prior to transfer to -80°C freezer or LN2 dewar.

ONLY if there is no **short term** access (i.e., within 24 hours) to cold chain such as in an emergency situation samples can be collected in 200 µL of RNAlater instead of Trizol and VTM. Storage times and temperatures for samples in RNAlater are as follows: 1 day at 37°C (i.e., room temperature), 1 week in the refrigerator, and transfer to -80°C for long term storage as soon as possible and within 1 week until analysis.

Do not collect samples onto dried blot spot cards.

Section 6.1.2c. Cold Chain Initiation at the Sampling Sites

Following collection in the field, samples must be immediately introduced to the optimum temperature range. When possible, collected samples should be initially stored in cryotubes allowing for immediate introduction to the cold chain and minimizing any freeze/thaw issues involved in sample transfer at a later time.

Table 4 provides an overview of temperature ranges used in PREDICT activities, along with procedures for optimizing these ranges for short-term storage. This table is followed by recommendations on the use of referenced equipment.

Table 4: Maintenance of transit temperature by optimum temperature range.

4°C *Commercial Refrigerator or "on-ice"*	**-70°C** *Dry ice*	**-80°C or colder** *LN2*
Time interval: 1-2 days (chilled). Limit to a minimum	Time interval: 1-2 days (frozen).	Time Interval: Indefinite (as long as LN2 quantities are maintained)
*Procedure: The sample transport container (cold box or cooler) should be fitted with as many ice/gel packs as possible. Temperature should not exceed 4°C. If available, a cold chain monitor should also be inserted.	*Procedure: Place a minimum 1 kg of dry ice per 1 kg of samples (but double or triple dry ice amount if possible) for every 24 hours in transit. Place in a sturdy Styrofoam container, allowing for release of carbon dioxide gas to prevent explosion. Use solid dry ice cubes when possible as their duration greatly exceeds that of chips or snow.	*Procedure: Place samples into special cryotubes with screw-down lids (no snap-tops). Cryotubes are then inserted into a LN2 "charged" dry shipper or vacuum flask.

**Maintain at least 4 frozen gel packs and an additional transport container as a contingency plan in case of package or container failure with dry ice or LN2.*

Using temporary cold boxes or coolers

Insulated cold boxes or coolers may be used for sample transport of less than 48 hours duration for all samples requiring storage at -80° C or if no LN2/dry ice supplies are available, or during equipment failure or emergency maintenance periods.

Figure 3: The PREDICT Tanzania team packs blood specimens on ice in a cooler after sampling rodents. Other specimens from field collection were stored in LN2 consistent with sample storage guidelines (Table 6). Photo by Liz Vanwormer.

Recommended steps when using cold boxes or coolers:

- Samples must be protected from heat, sunlight and fluorescent light at all times.
- Check the temperature in the cold box using a mercury or digital thermometer every 3 hours. Note: repeated opening and closing of the cold box will cause temperatures inside the box to elevate more rapidly. Teams must use good judgment when deciding to monitor the cold box temperatures.
- Rotate ice/gel packs to maintain maximum coldness within the container. If possible have extra ice gels to replace thawing or thawed ones.
- Do not transport samples in the trunks of vehicles (or the floors of some vehicles) due to the risk of exposure to temperature extremes. Be familiar with the coolest part of the vehicles.
- Do not remove samples from cold box or cooler until ready to transfer to recommended vacuum flask, dry shipper, or commercial freezer.
- When transferring samples, do not leave them out on the counter or the floor subjected to room temperature and light.
- Keep records of amount of time samples were stored at temperatures warmer than -80°C, and record the date and time when samples were introduced to the -80°C cold chain.

Using containers with dry ice

Dry ice (-78.5°C) is colder than ice and gel packs and allows for maintenance of samples frozen in transit. Any specimens transported in dry ice must be placed in specially insulated containers capable of venting gaseous CO2.

Recommended steps when using dry ice:

- Pack samples in a good insulated container. Thick polystyrene/styrofoam boxes work well with dry ice as they allow for the necessary off gassing of CO_2 (release of CO_2 gas) and are durable enough to last through transport.
- Sufficient dry ice is needed for maintaining samples consistently frozen. If dry ice quantities are insufficient samples will thaw and rendered useless.
- Use a minimum 1 kg of dry ice for each 1 kg of samples for every 24-hour transit period. Keep in mind however that depending on the quality of your shipping container and environmental conditions you will need to adjust these quantities to ensure constant temperatures. In hot conditions and whenever possible use double or triple the recommended dry ice quantity (i.e., 2 or 3 kg dry ice per kg of samples). For longer than 24 storage/transit times, double the amount of dry ice.
- When packaging items, place dry ice and sample containers as close together as possible and cover with additional dry ice. Fill any empty space with newspaper (ideal) or cloth, bubble packs, or Styrofoam peanuts. Empty space allows the dry ice to sublimate (change from liquid to gas) more quickly.
- Dry ice blocks take longer to evaporate and are better at maintaining samples frozen for longer storage/transit periods. However, samples must be close to dry ice (or surrounded by it) for adequate preservation. Solid blocks of 2-3 kg are ideal, yet not always available. Avoid using “snow” or chip dry ice whenever possible as they evaporate very quickly.

Using dry shipper or vacuum flask storage (LN2)

Dry shippers and vacuum flasks when properly charged provide ideal low temperatures for preservation of PREDICT samples both in the short-term following sample collection, in transport, and in the long-term as samples await analysis and/or shipping for diagnostics.

Recommended steps for filling dry shippers/vacuum flasks for sample transport:

1. Use appropriate PPE!
2. Add the LN2 slowly into the container.
3. Stop filling the container when the liquid reaches the neck of the dry shipper. (**DO NOT OVERFILL**)
4. Then, attach the cap and set the container aside to saturate the absorbent for the period specified by the manufacturer. This is called "charging" the container.
5. Repeat the steps above until the liquid level no longer drops on standing (e.g. the container is "charged"). Some manufacturers provide empty and full weights for their containers. If the dry shipper will not reach the expected full weight specified by the manufacturer, there may be a problem with the absorbent's ability to hold the LN2, and could indicate the container is compromised, and that samples transported or stored in the container may be at risk of degradation. In this case, contact the manufacturer or supplier of the equipment to assess whether the container is fit for use with biological samples.
6. Remove all free liquid nitrogen from the container prior to transport.
7. Empty the container by pouring the excess liquid nitrogen back into a large LN2 vacuum flask.
8. If the LN2 cannot be poured back into the flask, pour the LN2 into an appropriate area.
9. Do not pour LN2 onto the floor or onto hard surfaces. LN2 can crack and destroy concrete and other hard surfaces, and the liquid could splash onto your shoes or legs and cause severe burns.
10. Ensure that any area where LN2 is poured away is well ventilated. Remember that handling or spilling LN2 in a small, confined space has been known to cause fatalities via asphyxiation /displacement of oxygen. Appropriate safety precautions outlined in the Protocol above must be considered.
11. After pouring out excess LN2, hold the dry shipper or vacuum flask upside down to be sure that all liquid has stopped flowing.
12. Stand the dry shipper upright for the period specified by the manufacturer.
13. Repeat the LN2 removal steps as many times as necessary to make sure there is no excess LN2 in the container.
14. Put the samples into the dry shipper/container and replace the cap.
15. Record the date, time, and ID of the samples for when they were placed into the container to initiate the cold chain data log.
16. Ready the dry shipper/container for transport by securing the container in the vehicle. If using a protective bin for the container, then secure the container in the bin first, before securing the bin in the vehicle.

Recommended steps for using dry shippers or vacuum flasks for sample storage:

- Make sure containers are fully charged prior to deployment in the field or removal from dry ice/LN2 source (See steps on filling shippers/flasks above).
- Make sure containers are not leaking.
- Make sure to have sufficient quantities of LN2 on hand for sample storage and emergencies.
- Develop a plan for obtaining additional dry ice/LN2 supplies in the event of emergency or container failure.
- When in the field, always keep additional cold boxes with conditioned (e.g., properly prepared) ice/gel packs as back up in event of container failure.
- Following sample collection, organize samples in the containers according to animal or sample ID consistent with PREDICT sample tracking recommendations for rapid retrieval.
- Remove samples from containers only when ready to prepare for analysis or shipping.
- Record the length-of-time samples were kept in containers and document the number of times and duration containers were opened.

Figure 1: The PREDICT Tanzania team packs up equipment after collecting specimens from rodents. The mushroom shaped container in the background is a specially designed transport container for LN2 dryshippers, ensuring the dryshipper container is well protected during overland or air travel, and that all stored specimens are well within the temperature range required for viral isolation. Photo by Liz Vanwormer.

Section 6.1.2d. Sample Transport

Following sample collection, it is imperative that the field teams coordinate with the receiving laboratories or PREDICT Country Coordinators on all details involving sample transport and storage planning. In many cases, samples will be delivered from the field/collection site to a temporary storage facility prior to shipment to end-use processing laboratories, and may involve multiple phases of the cold chain. In the event of international transport of samples to a processing laboratory, all PREDICT personnel must follow the guidelines specified in ***Section 6.2 Packing and Shipping Biological Samples***.

All sample transport containers must be secured (e.g., tied down) in the transport vehicle. If possible, LN2 dryshippers should be secured in a separate compartment space from the passengers (e.g., rooftop bin or a covered canopy of a flatbed truck), and equipped with a spill kit containing absorbent materials to protect personnel from any accidents involving spillage. Non-LN2 containers with unprocessed samples may be secured in the project vehicle with proper secondary containment to minimize sample jostling during transport. There is a risk that containers may leak during transport, so it is imperative that teams understand the risk of asphyxiation in a closed vehicle and be prepared to address any spills and leakages with appropriate equipment. **PREDICT vehicles should be equipped with cold chain PPE (e.g., disinfectant, heavy reusable gloves, disposable gloves, mask, apron, goggles, and a sealable and leak proof disposal container) to respond to any incidents involving sample spillage**. To ensure maintenance of the cold chain, additional ice/gel packs, dry ice and appropriate containers, or an additional LN2 dry shipper should be available to prepare for travel delays or primary container failure.

Section 6.1.2e. Safe Storage of Samples

Upon delivery of samples from the field, it is the responsibility of the receiving party to ensure that cold chain is continued and samples are appropriately stored, documentation transferred (See Section 6.1.3.. Records below), and Country Coordinator or other supervisor notified. **For PREDICT purposes ALL SAMPLES must be stored frozen at -80°C or lower temperatures.**

Additional Sample Storage Guidelines

- Samples should be divided or aliquoted into the smallest useful units during initial processing in order to avoid excessive freeze-thaw cycles, and to avoid damage leading to a loss of infectivity.
- When samples are removed from cold storage and shipped to a laboratory facility for analysis, teams should follow the PREDICT training guidelines on ***Packing and Shipping Biological Samples (Section 6.2)***.

Long-term Sample Storage

It is strongly recommended that all samples kept for long-term storage be maintained at temperatures at or below -80°C. This can be achieved either through the use of large capacity LN2 dewars or through ultra-low temperature freezers.

Using Liquid Nitrogen

There are generally two types of sample storage systems available for LN2 dewars: box/rack (or canister systems) and cane/straw systems. While cane/straw systems are acceptable for short-term storage, it is highly recommended that samples for long-term storage be kept in box/rack systems, which allow for quick retrieval and identification with minimal temperature reduction upon retrieval. Cane/straw systems have less storage capacity and often increase the amount of time required to locate samples for pathogen testing.

Recommended steps for using LN2 in long-term sample storage:

- Make sure containers are filled to capacity, functioning properly, and are not leaking.
- Develop a plan for obtaining additional LN2 supplies in the event of emergency or container failure.
- Maintain a supply of ice/gel packs to maintain temperature in the container in the event of container failure, or for use in emergency storage or transport.
- Organize samples in box/rack systems according to animal or specimen ID consistent with PREDICT sample tracking recommendations for rapid retrieval.
- Remove samples from containers only when ready for testing or shipping.
- Record the length-of-time samples were kept in containers and document the number of times and duration containers were opened.

Using Ultra-low Temperature Freezers

Like samples in LN2, samples stored in ultra-low temperature freezers (-70/80°C and colder) must also be easily identifiable and organized in a way to minimize the time required for sample location and access. Freezers must be well managed, and staff must be prepared for disruption of electricity, blackout, or other event where the freezer malfunctions.

Recommended steps for using ultra-low temperature freezers:

- Store material in the freezer leaving space between boxes/containers to allow for air to circulate.
- Organize samples according to animal or sample ID consistent with PREDICT sample tracking recommendations for rapid retrieval.
- Remove samples from freezer only when ready to prepare for testing or shipping.
- Minimize the number of times the freezer is opened, and make sure the freezer door is closed tightly.
- Secure the electrical outlet and freezer plug to prevent accidental disconnection and freezer failure.
- Post a highly visible sign or sticker by the electrical outlet to ensure the freezer is not unplugged, or cover the electrical outlet with a cage to prevent disconnection.
- Maintain a supply of ice/gel packs in the freezer to maintain temperature in the event of freezer failure, and for use in emergency storage or transport.
- Employ a temperature monitoring system.
- Train all staff members in monitoring and documenting temperatures.

Section 6.1.2f. Cold Chain Maintenance

Checking, Recording and Monitoring Cold Chain Temperature

Implementing a temperature-monitoring plan through consistent and regular thermometer readings is essential to maintaining a secure and reliable cold chain.

Recommended Steps for Cold Chain Temperature Monitoring:

- Check LN2 levels and container temperature (if using gauge), and ensure that the container is not leaking twice per day in the mornings and evenings.
- Check and record freezer temperature twice per day in the mornings and evenings (Figure X) as follows: (Note: these readings must be done more frequently if samples are temporarily stored in cold boxes or coolers).
    - Check and record the current freezer temperature.
    - Check and record the maximum freezer temperature.
    - Clear the maximum reading after it is documented.
    - Check and record the minimum freezer temperature.
    - Clear the minimum reading after it is documented.
    - Reset the thermometer.
- Do not open the freezer door to take the temperature readings; an external temperature gauge should be used for commercial freezers.
- Change the thermometer or temperature gauge battery every 6 months (i.e., seasonally with the time change) or as recommended by the manufacturer, as a low functioning battery may give false temperature readings.
- Keep a supply of spare batteries in case of device failure.

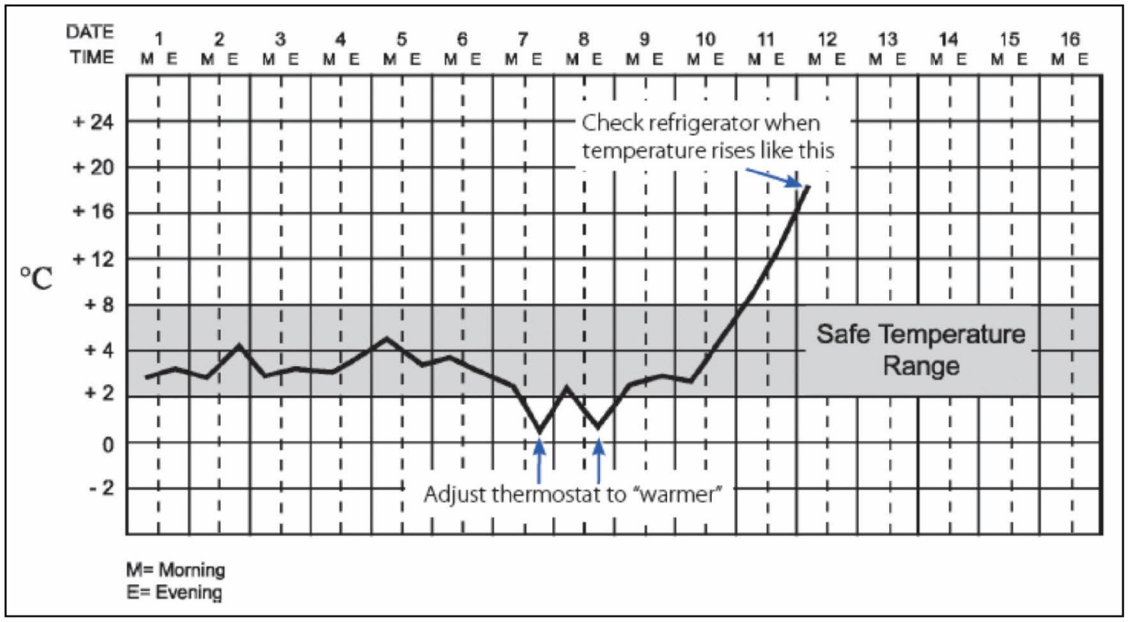


Figure 5. An example of a cold chain temperature monitoring chart. Source: WHO, 2004.
Note: this chart is for a cold chain optimized for vaccines at 2-8ºC. Use the chart included in the Appendix for the PREDICT cold chain at lower storage temperatures optimal for viral isolation.

Section 6.1.3. Contingency Planning and Responding to a Cold Chain Breach

Preserving and maintaining below freezing temperatures in tropical conditions requires attention to detail and intensive logistical planning, linking equipment, people, policies, and procedures into an integrated system. Country coordinators, laboratory technicians, and field personnel all have a role to play in ensuring that PREDICT samples are collected, transported, stored, and shipped (if necessary) without breaks in the cold chain. In addition, team members must be trained and prepared to address incidents in which there is a cold chain breach, to enact response measures for rapid cold chain rehabilitation.

Contingency Planning

It is imperative that all PREDICT teams have a pre-determined contingency plan for maintaining the cold chain in the event of freezer or container malfunction or electricity disruption. It is highly recommended that all facilities using commercial -80°C freezers be linked with a back-up generator for continued electrical operation (see box below). However, it is the team's responsibility to make sure that the back-up generator is of sufficient capacity to operate the freezer, is functioning and has sufficient fuel to maintain electricity, or that alternative measures for maintaining the cold chain are necessary. Arrangements with other facilities for temporary sample storage (if necessary) should be made in advance, along with plans for rapid sample transfer with minimal cold chain disruption.

Essential Steps in Setting-up your Back-up Generator System

Generators should be connected to freezers before a power failure to determine:

a) If the generator can effectively operate the freezer
b) The temperature at which the freezer operates when connected to the generator, and whether an appropriate temperature is maintained for samples over an extended period of time
c) How long the generator can be used in the event of a power outage

If these three conditions are met, then the generator is sufficient to act as a back-up system in the event of a breach. If these conditions are not met, please see "Recommended Steps for Contingency Planning" below.

Recommended Steps for Contingency Planning:

- Identify possible sources of cold chain interruption or breach (e.g., equipment failure, supply shortages, power outages, etc.).
- Identify preparations and solutions for possible chain interruptions
- Prepare back-up infrastructure for sample storage.
- Identify alternate storage facilities for samples and initiate communication to facilitate emergency use.
- Monitor and evaluate equipment regularly and maintain records to assist in understanding potential weaknesses in the cold chain.
- Ensure staff are trained on cold chain maintenance and monitoring for prevention of a breach.

Recommendations for a Power Failure Contingency Plan

Power Failure Contingency Plan (Example)

Start-up the Generator! If Generator is not working, or is insufficient to provide adequate backup (See Box above), then proceed with these steps below:

Samples stored in refrigerator

Monitor the temperature of refrigerator (temperature gauges should be battery powered).

During a power failure of 4 hours or less, the refrigerator door should be kept closed at all times.

If samples are at risk of warming, implement alternative storage arrangements. All samples must be transferred to cold boxes/coolers with prepared ice/gel packs. Monitor sample temperature through the use of a thermometer probe placed near the samples inside the cold box or cooler.

Samples stored in commercial freezer

Monitor the temperature of freezer (temperature gauges should be battery powered).

If samples are at risk of thawing, implement alternative storage arrangements (either in dry ice or LN2, or in cold boxes and coolers with prepared ice/gel packs).

Responding to a Cold Chain Breach

A cold chain breach is an interruption in the cold chain exposing samples to temperatures above the required range for viral preservation (for prolonged periods – opening and closing a freezer door will often cause temperature fluctuation, but does not qualify as a "breach"). If not quickly rehabilitated, such an interruption can destroy sample viability and render samples useless for PREDICT pathogen testing activities. It is imperative that all teams have documented plans for addressing a breach in the cold chain, and that all team members have received training on appropriate response and cold chain rehabilitation.

Recommended steps in responding to a cold chain breach:

1. Contact your PREDICT Country Coordinator (or supervisor) as soon as possible for advice on emergency response measures, and consult your contingency plans.
2. Define the incident: check all temperature monitoring records, equipment, and discuss with staff possible explanations for the breach.
3. Confirm accuracy of equipment by referencing manufacturer specifications to ensure that the breach is not simply equipment malfunction (data loggers, cold chain monitors and temperature gauges may have operational failure. It is important that emergency measures are not implemented until staff is certain the failure is with the freezer or storage container).
4. Assess the condition of the freezer/storage container. Can the cause be identified (e.g., leaky dewar, freezer door no longer closing completely)?
5. Record:
    a. When the cold chain was last guaranteed?
    b. What monitoring has been recorded prior to breach?
    c. What is the time interval of breach?
    d. What is the temperature range of the breach period?
    e. What samples were involved in incident? Enter record in sample database.

6. Continuously monitor temperatures of the containers/freezers and record the duration of time samples are exposed to temperatures warmer than -80°C.
7. If temperatures approach -30°C, begin planning for sample transfer to temporary cold boxes or coolers, or other laboratory facilities.
8. If temperatures climb to warmer than -20°C, transfer samples to temporary storage containers and continue monitoring temperature. If there is no -20°C capacity, actively pursue an alternative storage facility and prepare insulated boxes for sample transport.
9. DO NOT discard any samples until advice has been sought from PREDICT Country Coordinators and laboratory personnel.
10. Label all samples exposed to elevated temperatures in the PREDICT sample tracking information database.

Take active steps to correct and prevent the problem from recurring.
In the event of a cold chain breach, it is important to keep records to guide in response implementation, to help prevent future breaches, and to inform PREDICT team members of any potentially affected samples. The following table includes an example data sheet for a cold chain breach. A blank data sheet is included in the Appendix.

Example data sheet for cold chain breach

Date and suspected time of the breach	Date: Aug. 13, 2010	Time: 5:14 PM
Do you store your samples in a commercial freezer or vacuum flask container?	Commercial Freezer	LN2 vacuum flask
Minimum and maximum temperature readings	Minimum: -88°C	Maximum: -57°C
When was the thermometer last reset	Dave of reset: July 12, 2010	Time of reset: 11:12 AM

Section 6.1.4. References

Commonwealth of Australia, Department of Health. 2003. *Cold Chain and Immunization Operations Manual: Guidelines for handling heat sensitive vaccines and pharmaceuticals*.

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United Nations World Food Program Logistics Cluster. "Logistics Operational Guide: Response: Cold Chain." Available online: http://log.logcluster.org/response/cold-chain/index.html

Vaccine Preventable Disease Program, Niagara Region Department of Public Health. 2007. *Cold Chain and Influenza Information for Private Sector Clinics*.

World Health Organization Epidemic and Pandemic Alert and Response. 2006. *Collecting, preserving and shipping specimens for the diagnosis of avian influenza A(H5N1) virus infection: Guide for field operations*. WHO/CDS/EPR/ARO/2006.1

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World Health Organization Department of Immunization, Vaccines, and Biologicals. 2004. "Ch. 3. The Cold Chain Module." In *Immunization in Practice: A practical resource guide for health workers (CD)*. World Health Organization.

Section 6.1.5. Appendix I. Datasheets and Checklists for Cold Chain Planning and Implementation

Equipment Inventory Template

Item	Specifications (brand, model, SN, date of acquisition)	Current Location	Current Condition (working, in repair, out of commission)	Date of Purchase	Estimated Replacement Date	Notes

Equipment Maintenance Record Template

Model No.	Serial No.	Purchase Date	Last Service Date	Work (Maintenance) Performed

**Note: It is also recommended that teams catalog recommended maintenance forms, registries, and schedules that accompany equipment to help plan for equipment maintenance and minimize interruptions in the cold chain. It may also be helpful to keep a record of responsible team members so staff are aware of equipment maintenance duties.*

Data Sheet Template for Cold Chain Breach

Date and suspected time of the breach	Date:	Time:
Do you store your samples in a commercial freezer of vacuum flask container?	Yes	No
Minimum and maximum temperature readings?	Minimum	Maximum
Are Cold Chain Monitors (CCMs) stored with the samples? If 'yes', be ready to report the reading when breach was noticed.	Yes	No
When was the thermometer last reset?	Date of reset:	Time of reset:
When was the thermometer battery last changed?	Date of battery change:	Time of batter change:
When was the last check on the accuracy of the thermometer done?	Date:	Time:
How long do you think the temperature was above -80°C?	Minimum Estimate	Maximum Estimate:
How long do you think these problems have been occurring?	First breach	Recurring (state number):
Where is the temperature probe situated?	Location:	Notes:
What type and number of samples were exposed to the breach?	Type of samples:	Number of samples:
Are all samples labeled and accessible?	Yes	No
Are there ice/gel packs in the freezer to use if transfer is necessary?	Yes	No
What do you think was the cause of the cold chain breach?	Suspected cause:	Notes:
Has the cause of the cold chain breach been rectified?	Yes	No
Free fields for customization		

Temperature Monitoring Chart (-80ºC and ultra-low temperature freezers).

Date	1		2		3		4		5		6		7		8		9		10	
Time	M	E	M	E	M	E	M	E	M	E	M	E	M	E	M	E	M	E	M	E
10																				
0																				
-10																				
-20																				
-30																				
-40																				
-42																				
-44																				
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-82																				
-84																				
-86																				
-88																				
-90																				
-92																				
-94																				
-96																				
-98																				
-100																				
-102																				
<																				

M=Mornings; E=Evening

Red: *Critical zone above freezing temperatures;* ***Green:*** *Safe zone for PREDICT samples;*

Yellow: *Temperature zone indicating thawing of samples and potential breach.*

Note: This Chart will produce a visible trend from dot plots of temperature like in Figure 6, showing your equipment's temperature variation over time. You may customize the temperature column to use with other temperature ranges as needed. This form will need to be replaced every 10 days (with dates adjusted in the "Date Column"). If using grey-scale, feel free to remove the color shading and print a simple table format.

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TEMPERATURE LOG

Site: _____
Refrigerator ID#:_____ Required Temp: _____
Freezer ID#: _____ Acceptable Range: _____

ENTER TEMPERATURE AND INITIALS DAILY!

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
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28						
29						
30						
31						

NOTE: CROSS OUT WEEKENDS AND HOLIDAYS – UPDATE FOR REMAINING MONTHS.
**This is a sample template for use with refrigerators and other equipment; it can be used together with the "Temperature Monitoring Chart" above.*