USAID | PREDICT

FROM THE AMERICAN PEOPLE

2018 SEMI-ANNUAL REPORT

TABLE OF CONTENTS

SECTION 1. PREFACE	1
SECTION 2. MONITORING AND EVALUATION	5
SECTION 3. GLOBAL REPORT	13
CAPACITY STRENGTHENING	14
ONE HEALTH SURVEILLANCE	18
CHARACTERIZING BEHAVIORAL RISK	24
IMPROVING GLOBAL SURVEILLANCE NETWORKS	29
VIRAL DETECTION & LAB IMPLEMENTATION	34
MODELING & ANALYTICS	41
ONE HEALTH PARTNERSHIPS	45
MANAGEMENT & OPERATIONS	50
SECTION 4. COUNTRY REPORTS	53
AFRICA & THE MIDDLE EAST	54
ASIA	78
SECTION 5. PUBLICATIONS AND PRODUCTS	94
PUBLICATIONS	95
IN THE MEDIA	98
APPENDIX	101
VIRUS TABLE	102
M&E MAPS & MODELS	105

ON THE COVER

Collecting bat guano samples in Cambodia

The PREDICT/Cambodia team collects guano (feces) samples from underneath a manufactured roost near a home in Cambodia. Guano farming has been identified as a high-risk interface for disease transmission, as people build roosts to attract bats to live near their homes and then frequently collect guano to use or sell as fertilizer for crops and gardens. PREDICT is working to better understand the viral transmission risk from bat guano to people and their domestic animals and to identify potential risk intervention strategies that may prevent viral spillover.

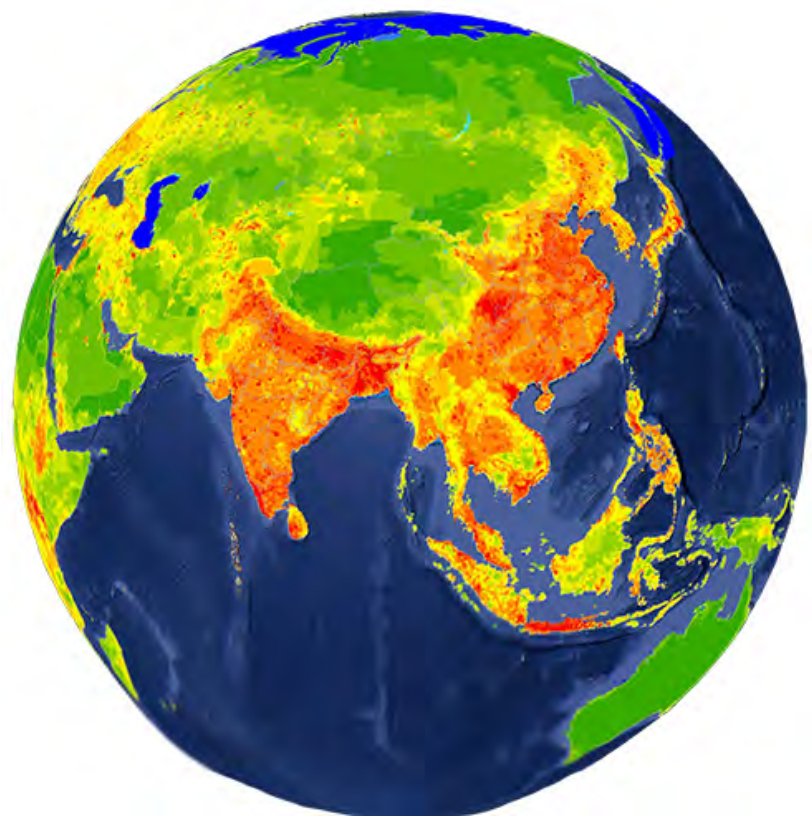
Photo: Lucy Keatts, PREDICT/Cambodia.


USAID
PREDICT
UCDAVIS
VETERINARY MED
INTRODUCTION
TECHNIQUES
LABORATOI
DE PREDIC
DU 15-16
FEVRIER 2018
LIEU : LABOR
DE FIEV
HEMORRA
EN GUI

I. PREFACE

USAID | PREDICT

FROM THE AMERICAN PEOPLE

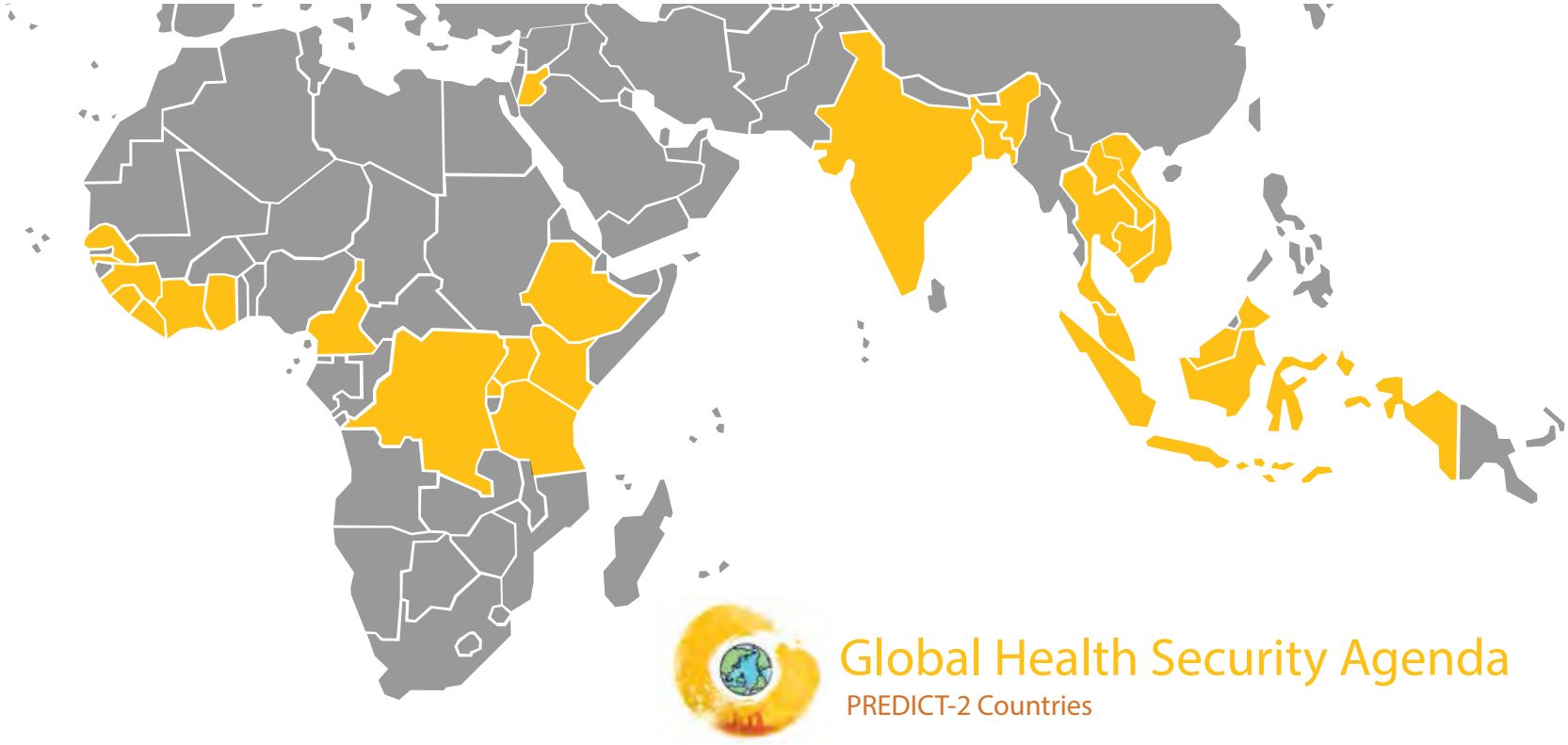


PREDICT, a project of USAID's Emerging Pandemic Threats (EPT) program, was initiated in 2009 to strengthen global capacity for detection and discovery of viruses with pandemic potential that can move between animals and people. Those include filoviruses, such as the ebolavirus and Marburg virus; influenza viruses; coronaviruses, the family to which SARS and MERS belong; and paramyxoviruses, like Nipah virus. PREDICT has made significant contributions to strengthening global health security by improving surveillance and laboratory diagnostic capabilities for new and known viruses.

Now working with partners in 30 countries, PREDICT is continuing to build platforms for priority viral surveillance and for identifying and monitoring zoonotic pathogens or those that can be shared between animals and people. Using the One Health approach, the project is investigating the behaviors, practices, and ecological and biological factors driving disease emergence, transmission, and spread. Through these efforts, PREDICT is improving global disease recognition and beginning to develop strategies and policy recommendations to minimize pandemic risk.

REDUCING PANDEMIC RISK, PROMOTING GLOBAL HEALTH

Supporting the Global Health Security Agenda in Africa and Asia



PREDICT is working to strengthen global capacity for detection and discovery of zoonotic viruses with epidemic and pandemic potential, including the Ebola, influenza, and Zika viruses that have been recent causes of devastating disease and necessary impetuses of dramatic and resource-intensive responses. The project is actively and diligently implementing GHSA activities in target countries aimed at developing and operationalizing strategies to improve disease management efficiencies in the short term and reduce zoonotic pathogen spillover, amplification, and spread in the long term, through improved public health policies and risk-reducing mitigation efforts. In every country of engagement, we work hand-in-hand with governmental and non-governmental stakeholders to develop and implement activities that are tailored to country and regional priorities and specifically designed to strengthen capabilities and ensure lasting positive effects from our engagements.

Using the One Health approach to improve capacity for **zoonotic disease** management and **surveillance** in a cross-sectoral manner and enable early detection of known and emerging disease threats, PREDICT is making significant contributions to strengthen **biosafety and biosecurity**, **national laboratory systems**, and **reporting** efficacy in all engagement-countries, while also improving the stability of these systems through One Health **workforce development**.

The PREDICT Consortium and Management

The USAID/PREDICT Consortium is a functionally collaborative working team that implements the project through in-country partners and benefits from the experience of world leaders in zoonotic disease detection and surveillance, epidemiology, disease ecology, and risk characterization. PREDICT's consortium includes partnerships with ministries of health, agriculture, and environment and implementing university and NGO partners in 30 countries.

USAID/PREDICT global-level consortium institutions

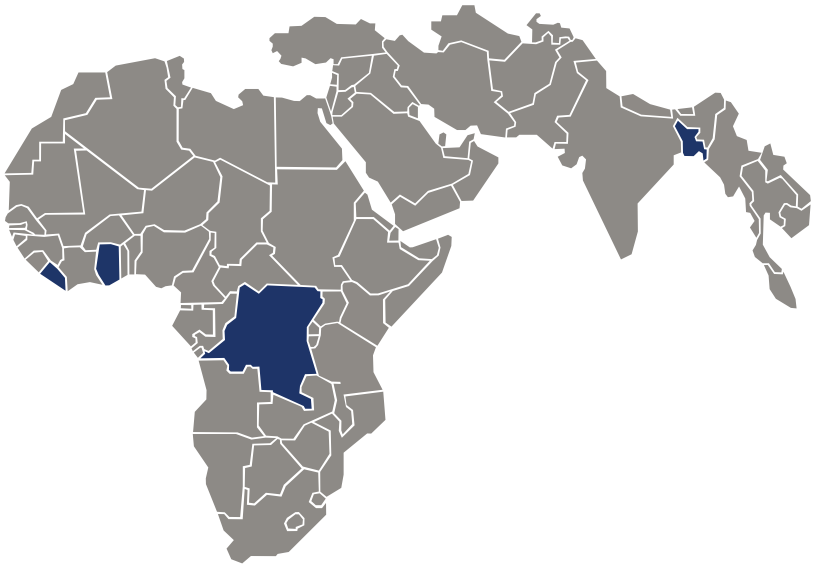
- **UC Davis' One Health Institute**, based in the most highly-rated veterinary school in the world, is active all over the globe, working at the interface of animals, people, and the environment to solve complex problems that impact health and conservation.
- **EcoHealth Alliance** is the first group to identify bats as the reservoir of SARS-like coronaviruses, to define hotspots of emerging diseases, and identify drivers of disease emergence.
- **Metabiota, Inc.** has made seminal discoveries regarding the role of hunting of nonhuman primates and food handling in moving animal pathogens to humans.
- **Smithsonian Institution and the National Zoo** are among the founders of the field of conservation biology.
- **Wildlife Conservation Society** was the first conservation organization with a dedicated team of wildlife veterinarians deployed around the world, with programs focused on environmental stewardship and health problem-solving.
- Other global partners include **Columbia University**; **Epidemico (HealthMap)**; and the **International Society for Infectious Disease**.

II. MONITORING & EVALUATION

PREDICT ACTIVITY	DEFINITION	MONITORING INDICATOR
Strengthening Systems for Prevention, Detection and Response		
Outbreak Response	Providing technical assistance with outbreak response if requested by the government and approved by USAID	Description of outbreaks supported; Percentage of countries with improved capacity to conduct outbreak investigations
One Health Surveillance and Risk Characterization	Conducting animal and human sampling; Conducting biological and/or behavioral data collection; Collecting data on ecological and epidemiological factors associated with virus evolution, spillover, amplification, and/or spread; Collecting data on animal-human contact for characterization of behavioral risk; Prioritization and description of identified intervention points to inform development of risk mitigation approaches	Risk mitigation strategies recommended for implementation and/or scaling up; Characterization of risk factors and/or interfaces associated with spillover, amplification and/or spread; Intervention points prioritized for development of risk mitigation approaches
Modeling and Analytics	Development of tools to better understand the emergence of disease pathogens	Viral, bacterial, or other disease risk pathway models or maps developed and/or refined
Lab Strengthening: PREDICT viral family screening	Laboratories have adequate infrastructure (facilities, lab equipment, staff, etc.) and sufficient training to conduct consensus PCR (cPCR) testing for the minimum four viral families (Corona, Paramyxo, Influenza, Filo) using PREDICT protocols and can perform, or have support to perform, cloning and sequencing to confirm PCR positives and to identify the virus present	Percentage of labs improving quality assurance and safety procedures; Percentage of labs able to perform EPT2/GHSA prioritized testing and # of tests performed;

PREDICT ACTIVITY	DEFINITION	MONITORING INDICATOR
Workforce Capacity		
Workforce Development: Training and Materials Developed	Personnel and/or students participating in the following types of trainings: Field Sampling, Information Management, Laboratory Techniques and Assay Development, and Risk Characterization	Number of faculty members that received OH training or professional development; Number of future professionals trained; Number of OH fellows placed; Number of current professionals trained
Workforce Development: Local Capacity	PREDICT training and employment of local or regional staff members in host countries	Total number of in-country staff who are from the host country or region
One Health Strengthening		
Advancement and improvement of One Health practices and policy	Development of One Health resources (including guidelines, technical protocols, standard operating procedures, standardized data collection instruments and protocols, and instructional tools and manuals for implementing risk mitigation recommendations) to provide evidence-based guidance on the operationalization and/or implementation of One Health principles and approaches; Inform policy change through evidence-based solutions	Description of application of OH approaches in the workforce; Description of national/regional coordination mechanisms showing improved capacity; Description of global, regional or country strategies under implementation; List of educational materials developed; Tools developed for implementation and operationalization; Evidence-based informational resources developed including policy briefs, research papers, situational analysis/risk assessment, and zoonotic prioritization resources

OUTBREAK RESPONSE ASSISTANCE 2017-2018



Bangladesh • Democratic Republic of Congo • Ghana • Liberia

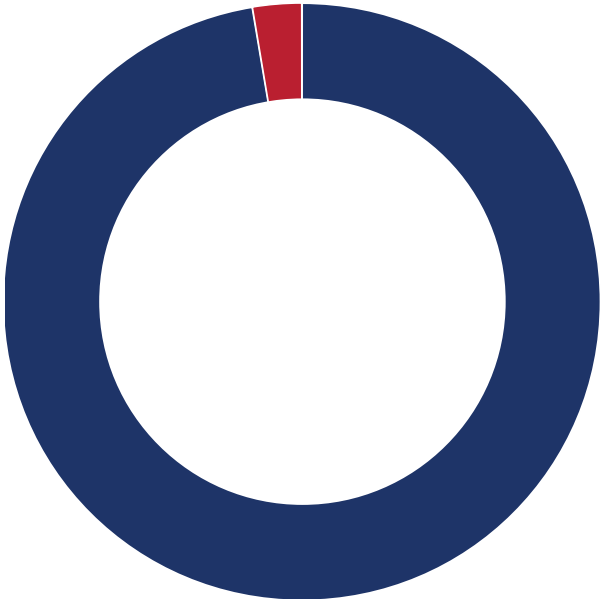
6

Outbreak events

4

Countries

STAFF IN COUNTRY 2017-2018



Staff from host country

Staff from outside of host country

241

Total Staff

97%

From host country

3

Staff from region

233

Staff from host country

5

Staff not from country or region

ONE HEALTH TOOLS & RESOURCES 2017-2018

3
Educational materials developed

30
Evidence-based informational resources

16
Publications

8
Tools developed for implementation

3
Policy briefs

ONE HEALTH STRENGTHENING 2017-2018

23
Countries with national or regional coordination mechanisms showing improved capacity

16
Countries with global, regional or country level strategies under implementation

6
Countries with high-level multisectoral and/or multilateral events coordinated

16
Countries coordinating community One Health events

RISK FACTORS & RISK INTERFACES 2017-2018

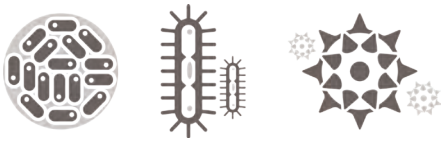
46

Risk factors and risk interfaces characterized since the beginning of PREDICT-2 in 2014

RISK MODELS & MAPS 2017-2018

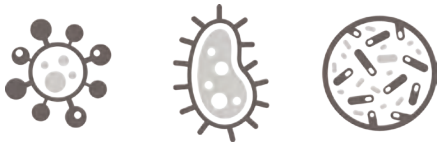
66

Models or maps developed, refined, analyzed, and described



32

Viral

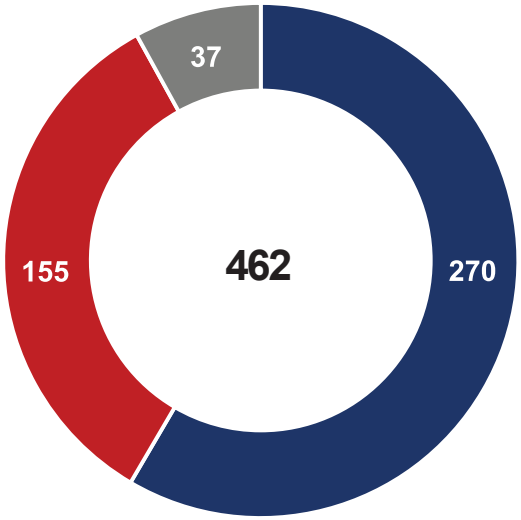


34

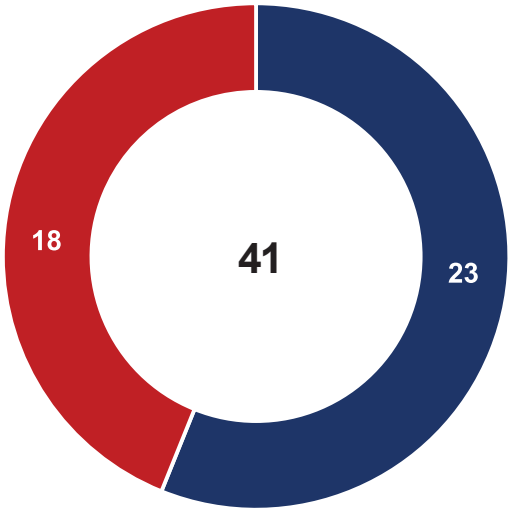
Disease risk

ONE HEALTH WORKFORCE CAPACITY 2017-2018

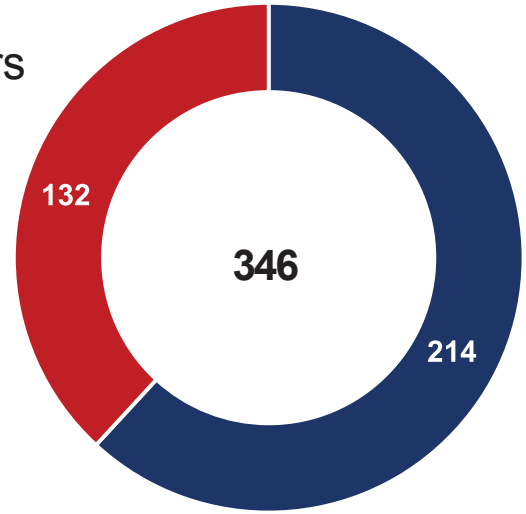
Current professionals trained



Future professionals



Faculty members who received training



One Health fellows placed

Males trained

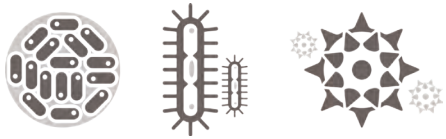
Females trained

Trainees who did not declare gender

LAB STRENGTHENING
2017-2018

115,265

Tests performed



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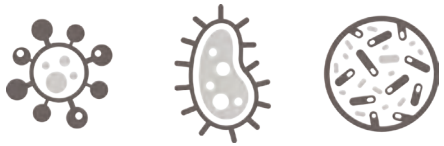
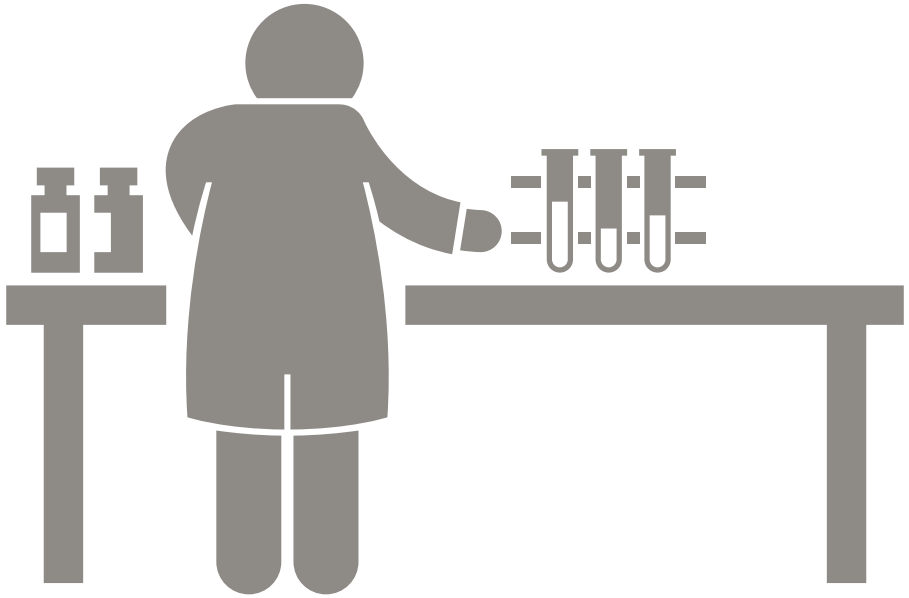
Labs able to perform
PREDICT prioritized testing

30

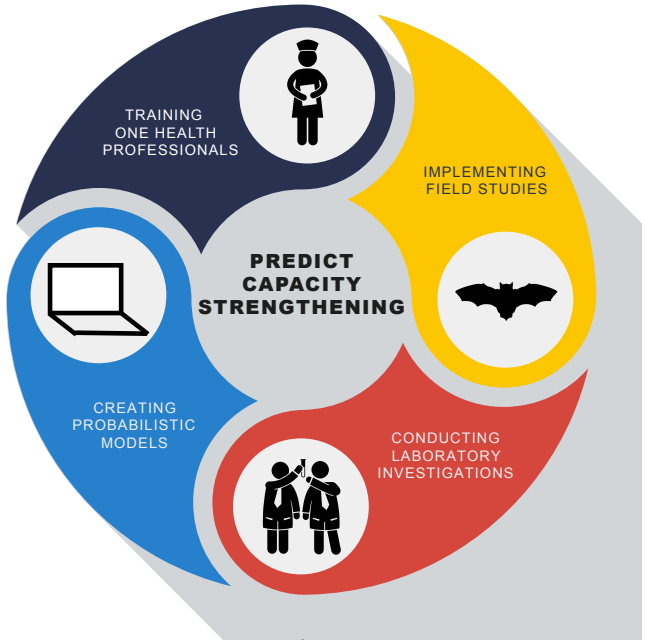
Labs improving quality assurance
and safety procedures





III. GLOBAL REPORT

Capacity Strengthening



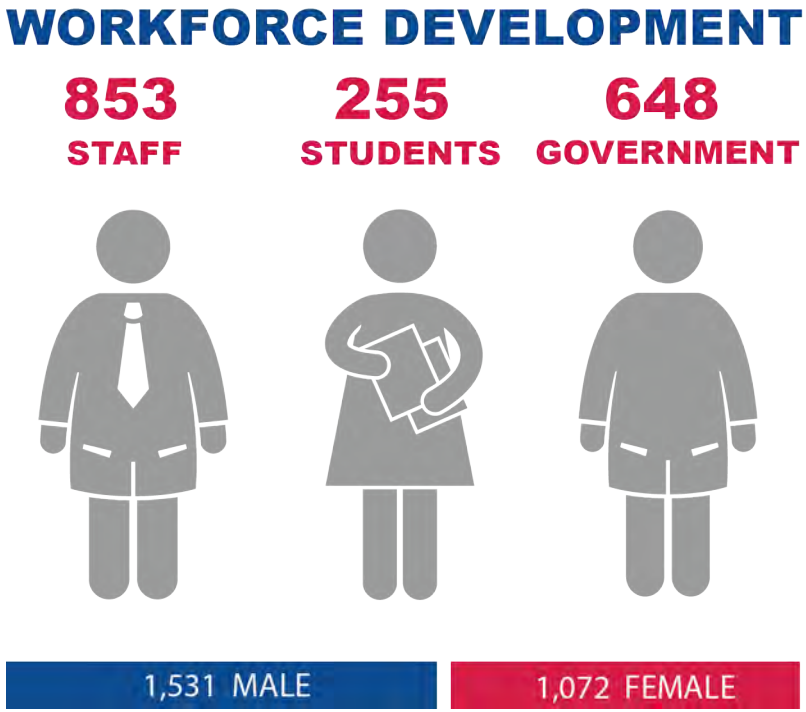
PREDICT uses an integrated approach to train in-country personnel on One Health competencies that enable field surveillance activities, laboratory testing for priority zoonotic diseases and other emerging threats, outbreak assistance, and data modeling to improve our understanding of zoonotic disease risks at key wildlife-livestock-human interfaces where spillover events may occur.

Improving surveillance capabilities in hot spot regions around the world

In this era of global connectivity, it is critical to strengthen the international system of health professionals that can detect and prevent spillover events of emerging viruses before they spread across borders. To this end, PREDICT has been working in many countries in Africa and Asia to conduct 'on the job', longitudinal training to mentor the next generation of One Health professionals and strengthen global health security. Since the start of the PREDICT-2 project in October 2014, 1,841 individuals (39% women) have been trained, including 1,740 individuals (95% of all individuals trained) in active-sampling countries where we are implementing One Health surveillance activities. Of these individuals, 648 (35% in total) are host country government staff, representing a major contribution to long-term improvements in national capabilities for zoonotic disease detection and response.

Strengthening regional capacity for disease surveillance in Africa

PREDICT teams across Africa and Asia have been regularly involved in capacity building exchanges in their respective regions. Recently, there have been several significant collaborations across animal and human sectors within these regions. For example, PREDICT/Ghana personnel from the Wildlife Division, Ministry of Land and Natural Resources; Veterinary Services Directorate of the Ministry of Food and Agriculture; and Noguchi Memorial Institute for Medical Research were actively involved in the One Health Zoonotic Disease workshop in Ghana organized by FAO under the guidance of CDC. Through the resulting ministry and university collaborations, there has been an improvement in coordination and efficiency in PREDICT surveillance activities and disease detection. Similarly, our teams in East Africa continue to contribute their expertise to national surveillance, prevention, and response systems. Over the past six months, the PREDICT/Uganda team participated in several workshops to advance the country's preparedness for an outbreak response and surveillance.



Since 2014, PREDICT has trained over 1,800 individuals in critical skills required by the One Health workforce.

Training exchanges between PREDICT countries exemplify our trainer-to-trainer approach and our commitment to building capacity across regions and among the current health workforce beyond the project. In addition to transferring critical disease surveillance skills, these trainings also provide a venue for One Health professionals to learn about techniques and best practices in other countries working towards implementing sustainable One Health teams and platforms. As a result of these regional trainings, PREDICT teams are more equipped to conduct animal and human field activities at surveillance sites and to transfer these skills and

PREDICT training is strengthening the animal health sector's workforce for zoonotic disease surveillance, a major contribution to the region's health security . Photo: PREDICT/ Nepal.

knowledge to local partners, students, and government staff. Overall, these trainings represent a key part of PREDICT's strategy for strengthening regional networks and mechanisms for One Health and zoonotic disease surveillance.

Forging One Health partnerships to investigate spillover and characterize risk in Asia

Working across universities, ministries, and international organizations, PREDICT strengthened key partnerships and collaborations to characterize risk. In Indonesia, PREDICT formed partnerships with Noongan Hospital to organize a well-attended training on Biosafety and Good Clinic Practices in Biomedical Research. In Myanmar, PREDICT joined the One Health International Conference in Bangkok and established networks with regional One Health partners. Meanwhile, in Nepal, PREDICT partners provided inputs into building a One Health Network for South Asia at the "The second One Health International Conference 2017" in Thailand. As a result of this

conference, a Nepal country partner joined the One Health Network for South Asia as a member and will be contributing to building collaborations and strengthening coordination for health security in the region.

Preparing for outbreaks and strengthening the animal health workforce in Ebola-affected countries

At host government invitation, PREDICT teams in many countries support outbreak response efforts for novel or high-consequence diseases with possible pandemic potential and time is of the essence. Rapid response is critical to contain an outbreak before it spreads to new populations and areas. Effective response involves understanding the process required for successful outbreak investigations, the appropriate government led chain of command, and perhaps most critically, having a trained and well-equipped workforce ready to mobilize at any given time on short notice. This year, PREDICT intensified capacity strengthening efforts for outbreak preparedness and response through formal group trainings, ongoing refresher briefings, and by learning through outbreak response investigations in six countries.

In the Ebola-affected countries in the West Africa region, PREDICT/Sierra Leone were observers and advisors in the Zoonotic Disease Prioritization workshop held by the USAID Preparedness and Response Project where they provided technical support to government partners. During the workshop, participants selected national-level target diseases for enhanced research and capacity development. Through this effort, priorities were set for viral hemorrhagic fevers, zoonotic Influenza, Rabies, Anthrax, Plague, and Salmonella. The Sierra Leone team also provided technical input for the World Bank sponsored REDISSE project to prioritize multi-sector collaboration within the country. Through these efforts,

PREDICT/Guinea is strengthening disease detection by working with national lab partners. Here participants in a recent laboratory training on biosafety and detection of Ebolaviruses pose for a group photo. Photo: PREDICT/Guinea

PREDICT in collaboration with government ministries, in Sierra Leone and other countries continue to expand knowledge of the power of One Health approaches to disease surveillance.

Working towards improved national capability for disease detection, the PREDICT/Guinea team successfully completed a training in biosafety and molecular detection of Ebola and other filoviruses. During this two-week hands-on training staff from three of Guinea's national laboratories were provided an overview of general laboratory safety, specimen storage handling procedures, and techniques for nucleic acid extraction and detection of filoviruses using PREDICT's viral family level approach.

PREDICT training resources are publicly available

PREDICT teams continued online learning activities involving PREDICT eBook resource and tabletop exercises for training in disease detection and outbreak response. Several of our project training materials, protocols, and eBook resources are available to the public to encourage sharing of the knowledge and skills essential for safe and effective One Health surveillance, detection, and characterization of zoonotic disease threats. The materials and resources below are accessible at this link.

Publicly available guides and protocols

Biosafety, Cold Chain and Emergency Preparedness Resources

- Basic Laboratory Safety (English-pdf, French)
- Biosafety and PPE Use (English-pdf, French)
- Emergency Preparedness (English-pdf, French)
- Implementing Cold Chain for Safe Sample Transport and Storage (English-pdf)
- Packing and Shipping Biological Samples (English-pdf)

One Health Surveillance & Field Sampling Guides

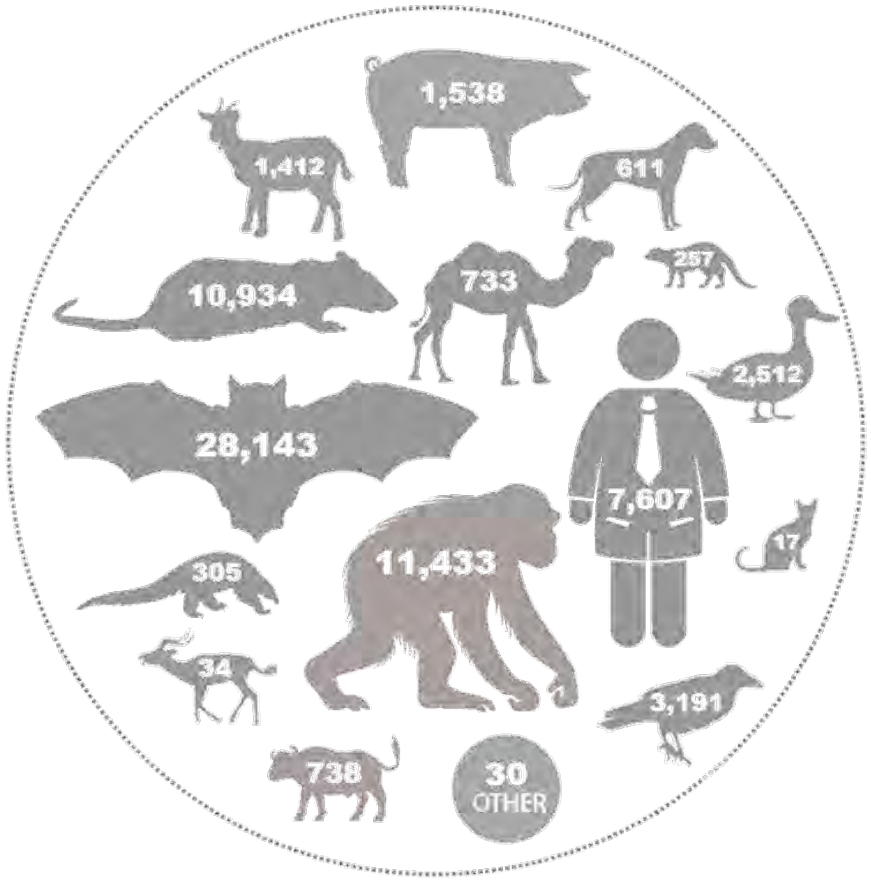
- Avian Sampling Methods (English-pdf)
- Bat Sampling Methods (English-pdf, French)
- Bushmeat Sampling Methods (English-pdf)
- Livestock Sampling Methods (English-pdf)
- Non-Human Primate Sampling Methods (English-pdf)
- Rodent Sampling Methods (English-pdf)
- Safe Animal Capture and Sampling (English-pdf)
- Small Carnivore Sampling Methods (English-pdf)

Behavioral Risk & Qualitative Research Guides

- Qualitative Research: Introduction & Observational Research Methods (English-pdf)
- Qualitative Research: Focus Groups, Ethnographic Interviews, & Data Analysis (English-pdf)

For more information or for information about other training resources, contact us at predict@ucdavis.edu.

One Health Surveillance – Characterizing Biological and Ecological Risk



Overview

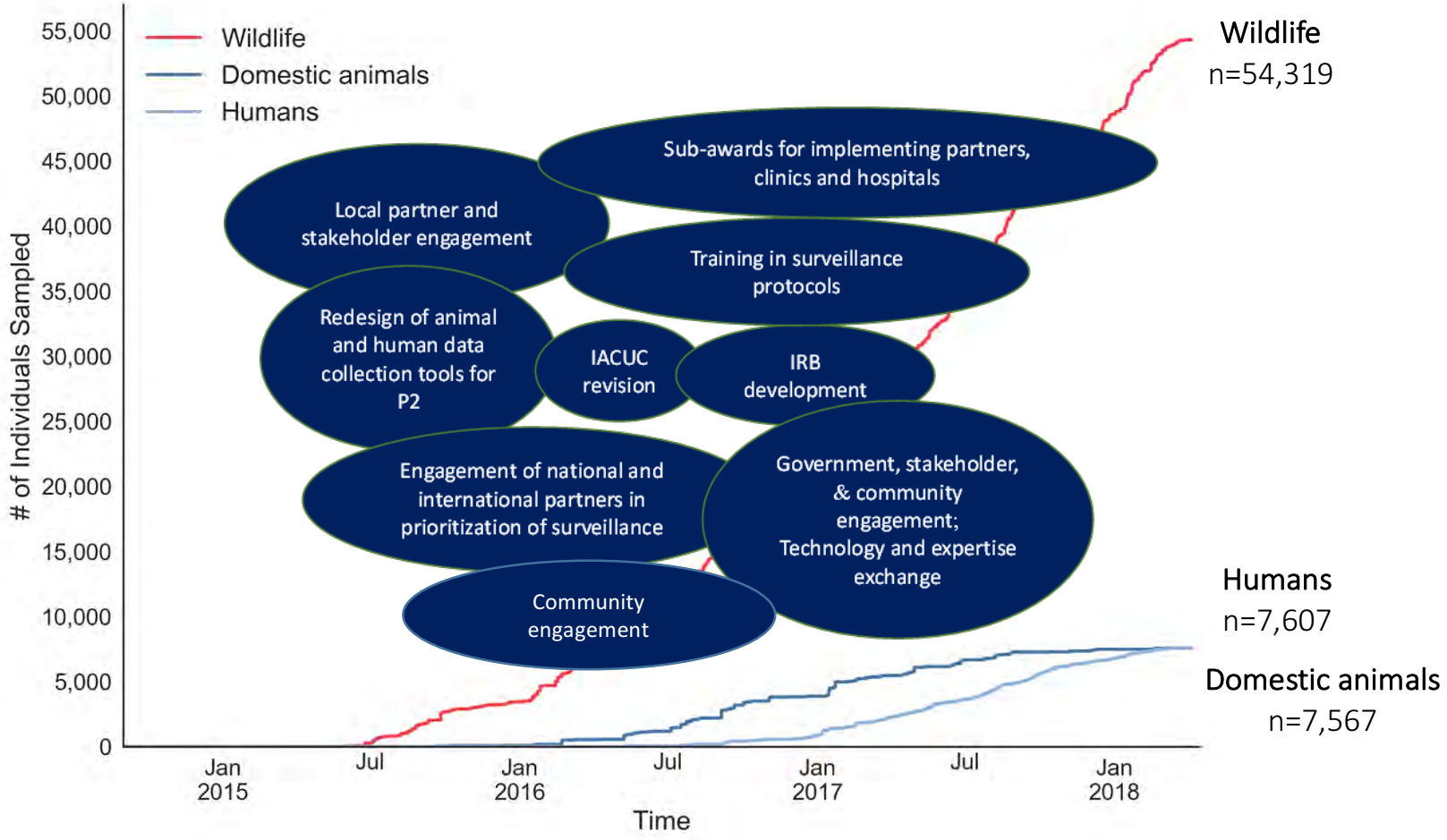
We continued implementation of our overall One Health surveillance strategy for animals and humans in coordination with USAID and Emerging Pandemic Threats-2 (EPT-2) partners to detect viral sharing across species, identify viral spillover to humans, and characterize biological and ecological risk. As surveillance activities involving humans were implemented, we reinforced the importance of the concurrent surveillance strategy for detection of viral sharing and spillover as a result of close proximity contact, or effective contact, between wildlife shedding viruses and susceptible people (and domestic species where relevant). Guidelines emphasize sampling people with high-risk occupations at concurrent sites concurrently with the sampling of animals and sampling ill human patients year-round at clinic and hospitals within the catchment area of concurrent sites.

At the PREDICT All-Country Meeting in January 2018, we delivered preliminary, country-level risk characterization reports via a workshop focused on reviewing biological and ecological risk factors using individual country surveillance data to date. The goal of generating these reports was to facilitate country and regional-level analyses of risk factors for zoonotic disease spillover and spread to assess progress toward improving surveillance and laboratory capacities in each country. We also reviewed surveillance progress and accomplishments to date to set the stage for the remainder of Year 4 as the final months for sampling and field activities in consensus with country coordinators, regional leads, and partners.

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

PREDICT has sampled over 61,000 animals and 7,000 people since the start of project activities in October 2014. Years 1-2 involved coordination of a multitude of required activities before sampling began in each country, including engagement of local partners and stakeholders, obtaining local and institutional permits for animal and human sampling, and staff training. Over the past year, field activities substantially ramped up with respect to sampling efficiency across wildlife, domestic animals, and humans (Figure 1).

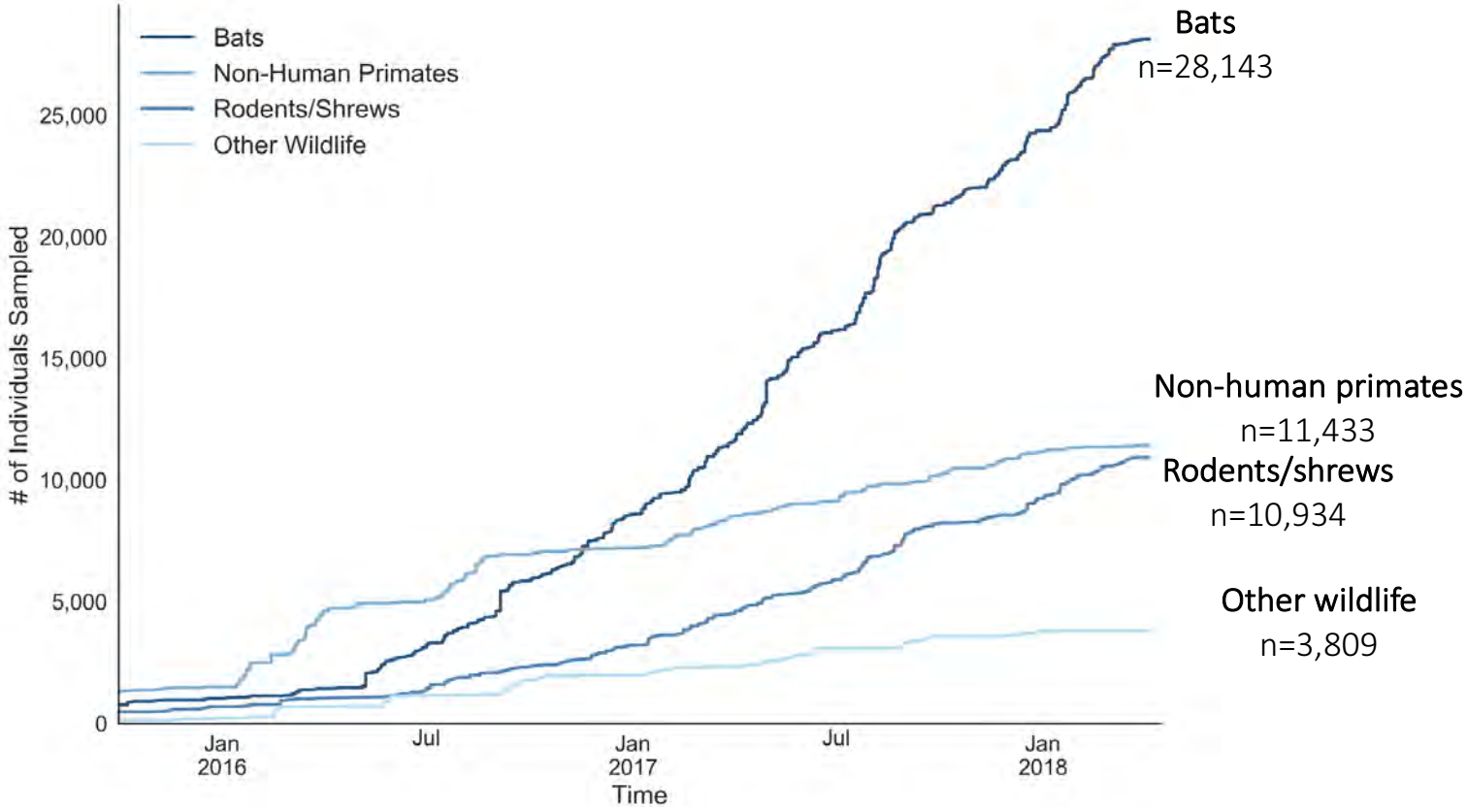
Figure 1: Number of Individual Wildlife, Domestic Animals, and Humans Sampled to Date



Wildlife

PREDICT made substantial progress sampling targeted wildlife species, primarily bats, rodents, and non-human primates, at high-risk interfaces for zoonotic spillover and spread. Wildlife sampling activities at high-risk interfaces were implemented in all 28 PREDICT countries including: Bangladesh, Cambodia, Cameroon, China, Cote d'Ivoire, Democratic Republic of Congo, Egypt, Ethiopia, Ghana, Guinea, India, Indonesia, Jordan, Kenya, Lao PDR, Liberia, Malaysia, Mongolia, Myanmar, Nepal, Republic of Congo, Rwanda, Senegal, Sierra Leone, Tanzania, Thailand, Uganda, and Viet Nam.

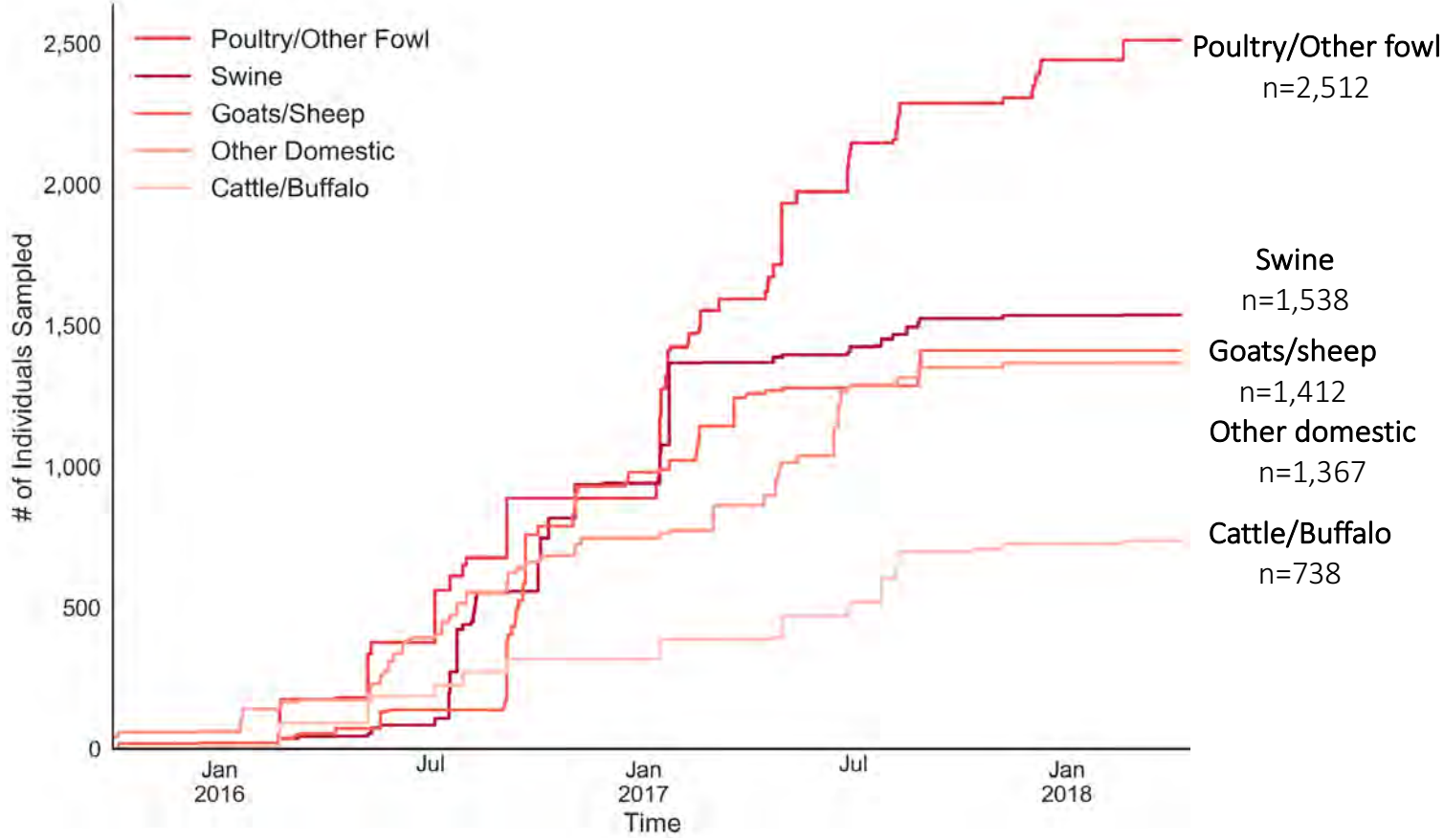
Figure 2. Number of individual wild animals sampled to date, by taxonomic group (with data entered into EIDITH).



Livestock

PREDICT coordinated closely with FAO on planning and sampling livestock at sites designated for concurrent and triangulated surveillance wherever possible. **Concurrent livestock sampling activities have been directly supported by FAO in** Viet Nam, Nepal, Cambodia, Lao PDR, and Myanmar. Together with PREDICT teams, FAO undertook sampling of livestock concurrently with wildlife sampling (and human sampling where possible) in Thailand, Indonesia, Egypt, and Jordan. To date, PREDICT has completed additional livestock sampling in Bangladesh, Democratic Republic of Congo, Guinea, Sierra Leone, and Uganda. Due to the recent change in FAO priorities, livestock sampling will not be prioritized further in Liberia, DR Congo, Rwanda, Republic of Congo, Cameroon, Ghana, Senegal, and Côte d'Ivoire.

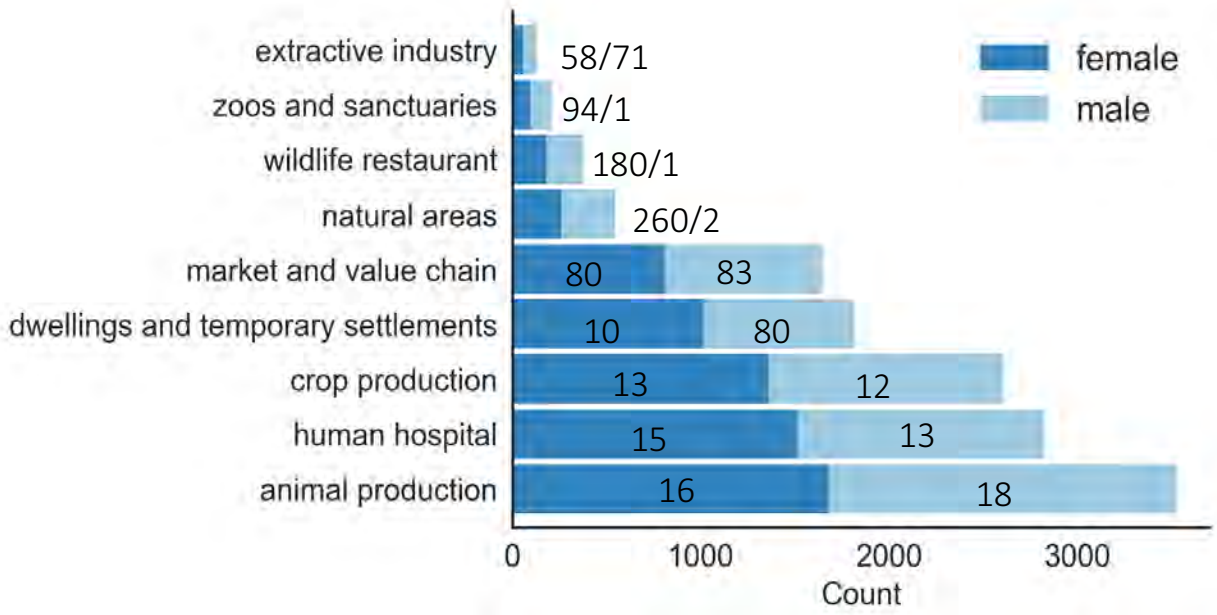
Figure 3. Number of individual domestic animals sampled to date, by taxonomic group (with data entered into EIDITH).



Humans

Human biological sampling and risk characterization surveys using PREDICT's human questionnaire were initiated in **high-risk communities** in **21** countries: China, Nepal, Bangladesh, India, Myanmar, Thailand, Cambodia, Lao PDR, Vietnam, Indonesia, Egypt, Jordan, Kenya, Tanzania, Uganda, Rwanda, Democratic Republic of Congo, Cameroon, Ghana, Côte d'Ivoire, and Senegal.

Figure 4. High risk interface modules completed by individuals sampled in the community or patient clinical setting, disaggregated by gender (note: many individuals sampled had exposure to more than one disease transmission interface).



PREDICT OUTBREAK SUPPORT

Oct 2017

Mar 2018

Democratic Republic of the Congo

Two people presented with symptoms consistent with viral hemorrhagic disease in Bas-Uele and Kinshasa. PREDICT provided assistance with testing of specimens for all five priority viral families. The PREDICT team initiated laboratory testing on the same day that they received the specimens.

Human encephalitis

Bangladesh

Two people in Bogra district presented with symptoms consistent with encephalitis, both had a history of drinking raw date palm sap. The PREDICT team was deployed to the outbreak site and collected 89 urine and 93 feces specimens from *Pteropus* bat roosts, half eaten palm fruit, as well as ecological information from the site. Specimens were tested for five priority viral families. The field team was deployed one day after receiving the request from the government.

Human encephalitis

Liberia

More than 60 people with diarrheal disease visited a clinic in Margibi County. PREDICT provided logistical support to the Liberian Ministry of Health to transport outbreak investigators and supplies to the affected area two days after they received the request.

Human diarrheal illness

Democratic Republic of the Congo

Following reports of an outbreak involving illness and death of more than 4,000 cattle, PREDICT tested ten specimens for six viral families. Response to this event was coordinated and carried out by a multidisciplinary team including PREDICT, Ministry of Fishery and Livestock, FAO, and LABOVET.

Cattle die-off

Bangladesh

The PREDICT field team observed neurological symptoms and unusual mortality in crows in Dhaka city. Following government request for assistance, PREDICT collected samples from crows, provided technical advice, and tested specimens for five viral families. Ongoing field work by the PREDICT team resulted in early detection of this unusual event, prompting quick and coordinated action. The field team was deployed one day after receiving request from the government.

Crow die-off

Ghana

One person in the Greater Accra region developed symptoms consistent with viral hemorrhagic fever, which was later confirmed as Lassa fever virus infection. PREDICT assisted with field investigations, and captured and sampled 52 reservoir host species (rodents and shrews). The PREDICT team also collected ecological information at the outbreak site and tested the specimens for five priority viral families.

Human Lassa fever

Characterizing Behavioral Risk

The goal of PREDICT's behavioral risk activities is to generate a data-driven approach to better understand behaviors that increase the risks of viral emergence, transmission, and spread. Results from our work are intended to inform the development of potential population or policy-level intervention strategies that could reduce the spillover, amplification, and spread of zoonotic viruses and other emerging threats.

Highlights

- To date, 632 professionals (43.7% women) in 28 countries around the world were trained on a variety of topics relevant to behavioral risk investigations.
- Standardized frameworks were developed and refined to enhance the rigor of mixed method behavioral risk characterization through data collection via quantitative questionnaires, qualitative interviews, focus groups, and participant observations.
- Key indicators and potential intervention points for behavioral risk reduction strategies were identified and refined by an inter-disciplinary team of scientists with expertise in human and animal ecological and biological surveillance, viral detection and discovery, modeling and analytics, and behavioral risk ethnography. This One Health approach to analysis increases the potential that recommended structural interventions are holistic and, as a result, more appropriate, feasible, effective, and sustainable.

Successes Stories

Behavioral Risk Mitigation Capacity Building in 28 Countries

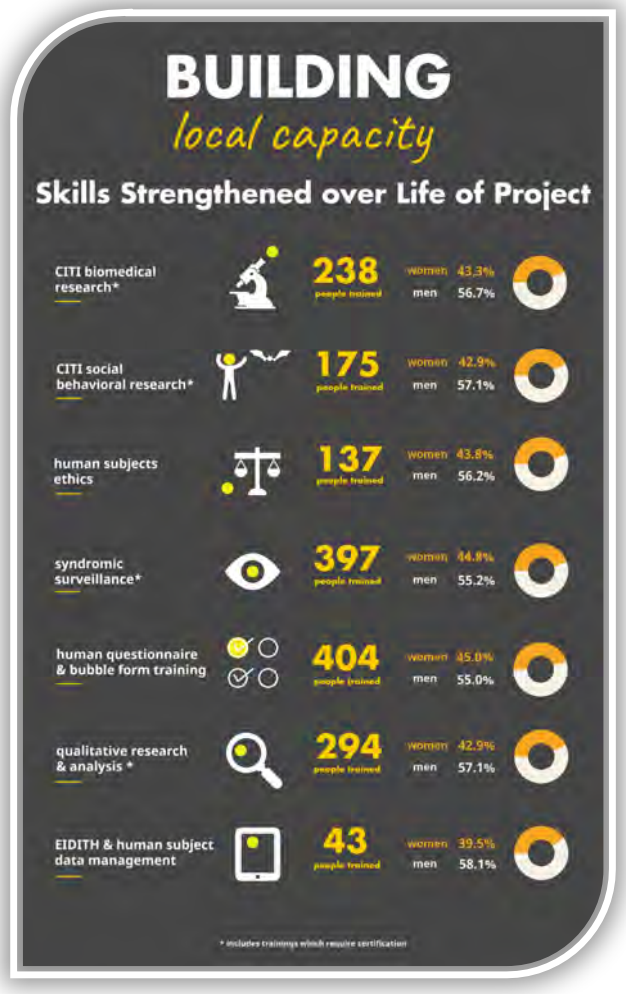


Figure 1. Global capacity building in behavioral characterization (through Y4 Q2)

Figure 1 provides a snapshot of global capacity building in behavioral risk characterization.

Standardizing Approaches to Studying Human Behavioral Risk

This period, PREDICT standardized and refined behavioral risk protocols, frameworks, and tools to improve scientific rigor across data collection and analysis, including:

- A **Questionnaire Analysis Matrix** which summarizes all data collection points associated with questionnaire administration, including the site and event form and modules, as well as the human questionnaire and supplementary modules. The matrix further identifies items that may be directly or indirectly associated with risk and protective factors as they relate to knowledge/beliefs, attitudes, skills, and behaviors.

- An **Interim Data Review Report (IDR)** that pulls the behavioral risk items described above into a user-friendly dashboard report format, depicting pie charts on prevalence.

- An **Intervention Development Tool** based on the risk and protective factors relevant to knowledge/beliefs, attitudes, skills, and behaviors described above, couched within a program evaluation 'logic model' framework to facilitate program development and evaluation of desired processes and outcomes. An example of the template in the Intervention Development Tool used to capture risk and protective factors as they relate to behavior can be seen in *Figure 2*. The template for the end-goal logic model which incorporates these findings can be seen in *Figure 3*.

Development of the logic model and associated preliminary intervention recommendations, includes:

- Qualitative analysis (as applicable)
- Quantitative analysis of questionnaire data
- Literature review
- Solicitation of subject matter expert (SME) input
- Collaboration across PREDICT technical teams to incorporate results
- Solicitation of international and local level feedback on draft recommendations
- Iterative and ongoing analysis and refinement of intervention recommendations

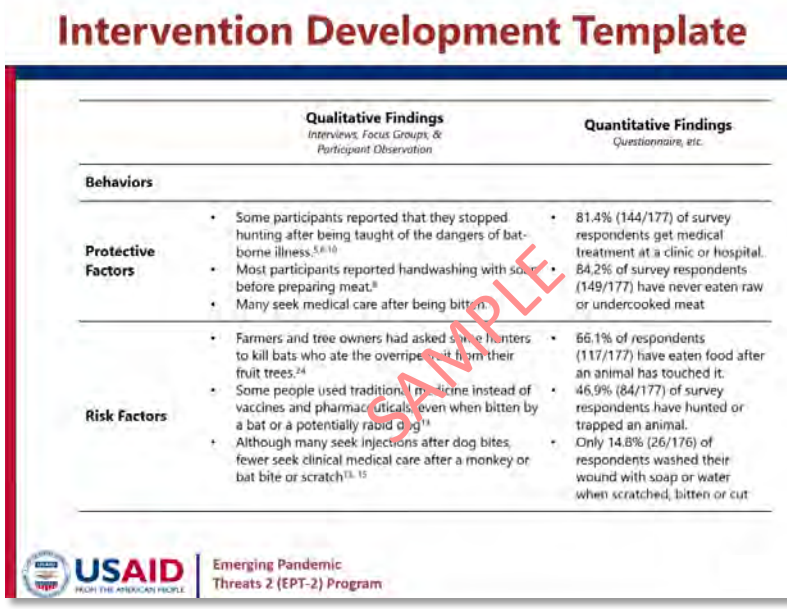


Figure 2. Example of Intervention Development Tool template for analyzing risk and protective factors as they relate to behaviors

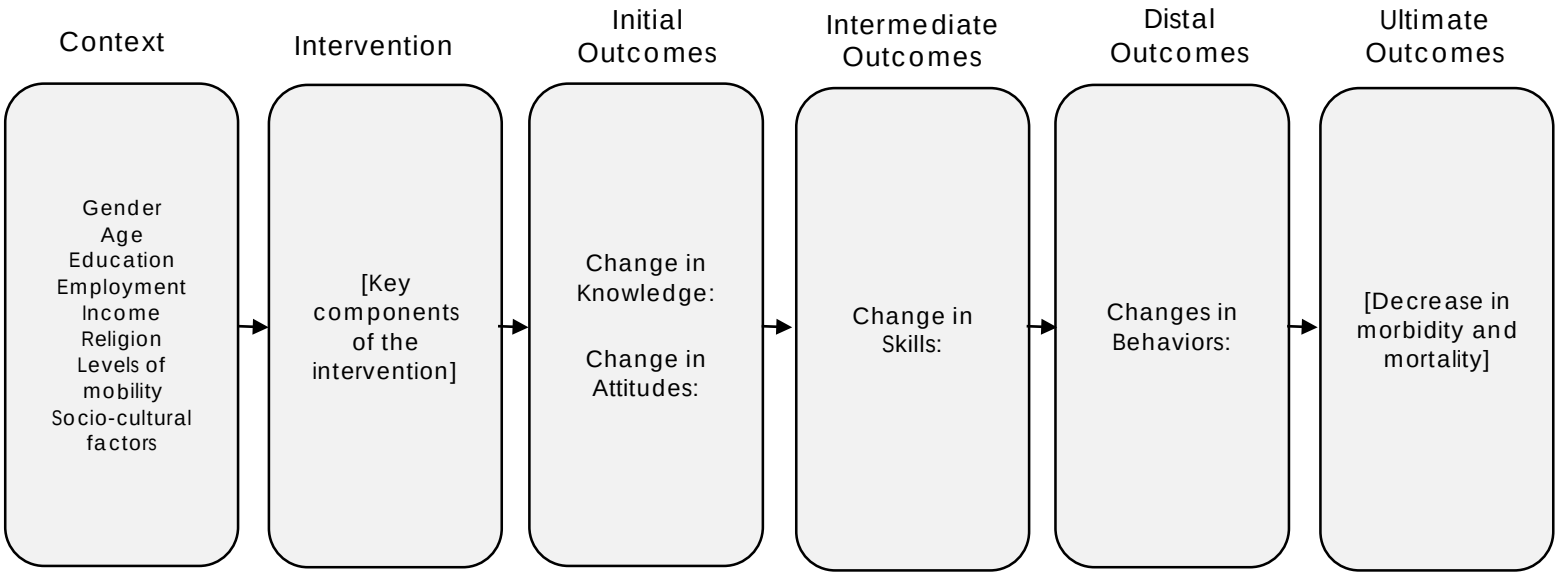


Figure 3. Example of Intervention Development Tool template for developing Logic Model that depicts intervention recommendations and associated desired outcomes

Identifying Potential Intervention Points

Preliminary analyses of PREDICT-2 data revealed that bat-related interfaces warrant particular attention, given the connection between bats and pandemics, such as SARS and Ebola. In addition, PREDICT detected numerous viruses in bats at high-risk interfaces, including coronaviruses, paramyxoviruses, and influenza viruses.

PREDICT also has the potential to make a significant contribution to the prevention of bat-related zoonotic pandemics, given the current lack of risk reduction tools and higher risk represented by this taxa. Market value chains also warrant unpacking, given the complexity of the multiple components. As such, PREDICT continued to conduct in-depth investigations into the deep dive topics shown in *Figure 4*. Planned data collection by deep dive topic can be seen in *Figure 5*. Data collected to date is shown in *Figure 6*.

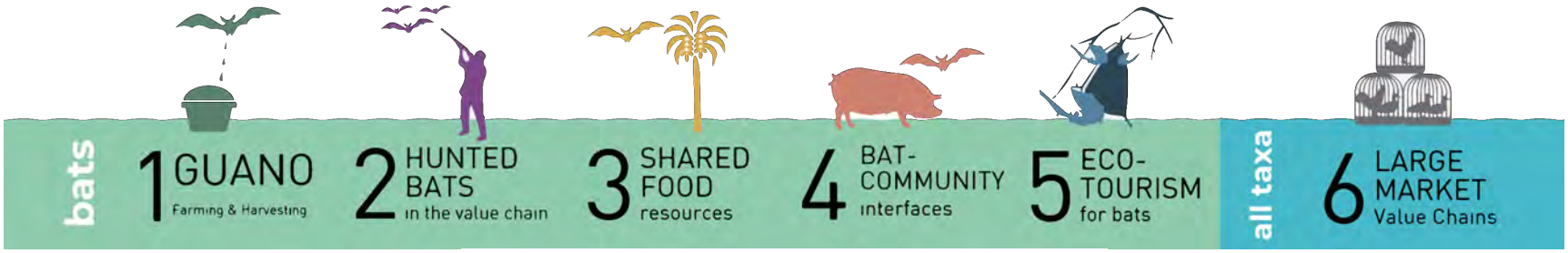


Figure 4. Behavioral Risk Deep-Dive Topics

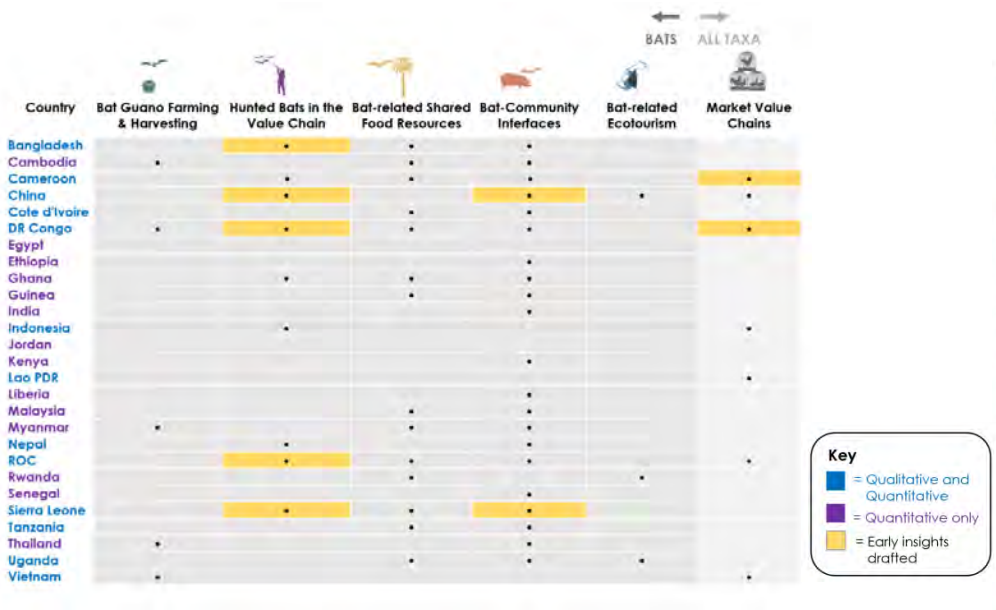


Figure 5. Planned Data Collection on Deep Dive Topics by Country

Country	Ethnographic Interviews	Focus Groups	Focus Group Participants	Questionnaires
	QUALITATIVE			QUANTITATIVE
Bangladesh	•	•	•	•
Cambodia				•
Cameroon	•	•	•	•
China	•	•	•	•
Cote d'Ivoire	•	•	•	•
DR Congo	•	•	•	•
Egypt				•
Ethiopia				
Ghana				•
Guinea				
India				•
Indonesia	•	•	•	•
Jordan				•
Kenya				•
Lao PDR	•	•	•	•
Liberia				•
Malaysia				•
Myanmar				•
Nepal	•	•	•	•
ROC	•	•	•	•
Rwanda				•
Senegal				•
Sierra Leone	•	•	•	
Tanzania	•	•	•	•
Thailand				•
Uganda	•	•	•	•
Vietnam	•	•	•	•
TOTALS	964	61	753	8,910

Figure 6. Behavioral Risk Data Collection through Y4Q2

Early insights into intervention recommendations have been drafted for nine deep dive topics across six countries. In terms of qualitative data collection to date, the team has conducted over 950 ethnographic interviews and over 60 focus groups (comprised of over 750 participants). In addition, quantitative questionnaires have been administered to close to 9,000 participants.

Early in-depth investigations in West Africa on the bat-community interface revealed community-level desires to better understand strategies for living safely with bats. Based on further discussion with local level staff and community members, we determined the most suitable channel of communication was a picture book that effectively addresses low literacy communities and that can be narrated by a trusted community leader. The book highlights ways that communities can live safely and humanely in concert with bats.

PREDICT's global-level subject matter experts developed technical content for the picture book, and a strategy was designed in conjunction with local and international stakeholders to implement the communication campaign. Roll-out in West Africa is planned for April 2018. Excerpts from the picture book can be found in *Figure 7*. Revisions to adapt the book to Asian contexts is currently underway.

Behavioral Risk Team Products

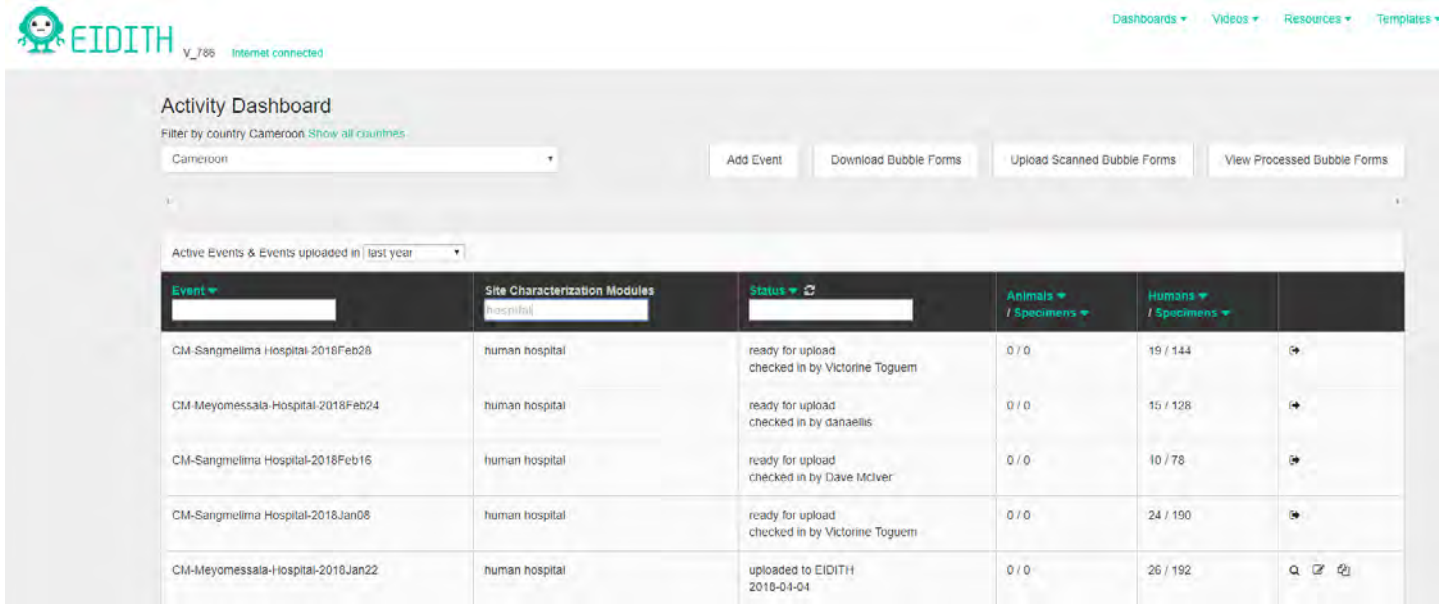
- Updated communication campaign picture book, "Living Safely with Bats"
- Intervention Development Tool
- Questionnaire Analysis Matrix
- Interim Data Review (IDR) report and prototype programmed into EIDITH
- GIS mockups depicting behavioral data
- Updated qualitative data collection and qualitative data analysis training decks

Figure 7. Excerpts from "Living Safely with Bats"

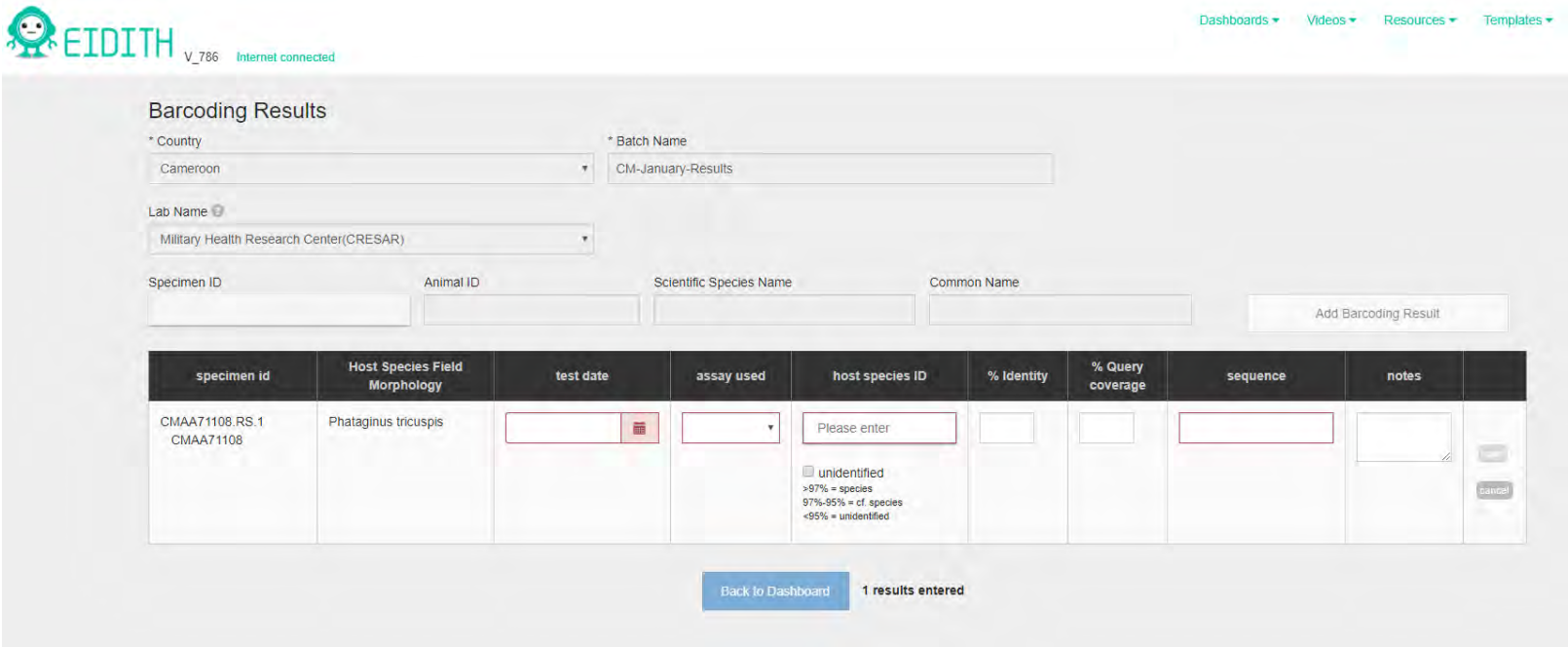
Improving Global Surveillance Networks

Strengthening One Health data platforms

The Emerging Infectious Disease Information and Technology Hub (EIDITH) *Surveillance Data Collection Application* was continually optimized to improve efficiency and scope and for integration with EPT-2 Monitoring and Evaluation indictors for improved data capture, quality assurance, and reporting functionality. These improvements included a new dashboard filter to allow users to sort their events by name, search modules for event status fields, and identify incomplete forms, thus improving workflow efficiency. Test result data entry functionality was also expanded to include serology test results. A new dashboard to allow laboratory teams to upload animal barcoding test results for samples from both PREDICT-1 and PREDICT-2 was also added to the application, thus improving species data accuracy throughout the EIDITH database. Finally, three new reports: *Animals/Humans Tested, Specimens Tested and Number of Tests by Month* were added to help improve lab team workflow.



EIDITH's event dashboard showing only PREDICT sampling events that include the human hospital module.

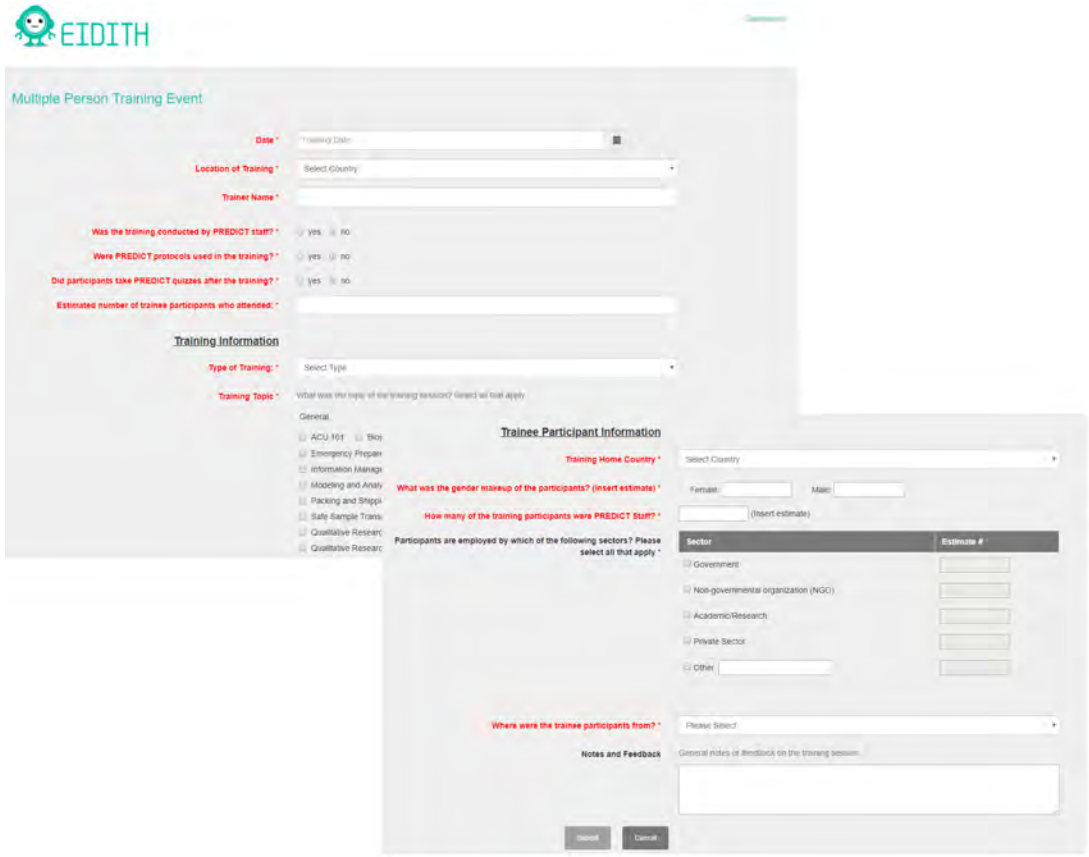


EIDITH's new host species identification DNA barcode results form.

To enable paper-based data collection and rapid digitization in situations for which digital data collection is not optimal, optical mark recognition (bubble) forms are used by our teams to collect data. Our challenge, however, was developing bubble forms for use in required project languages across all 28 participating countries. Translation of the human questionnaire into local languages continued throughout this reporting period (Thai, Amharic, and Malay languages to name a few recent language packages added to our forms), thereby enabling field teams the ability to conduct interviews in their local languages.

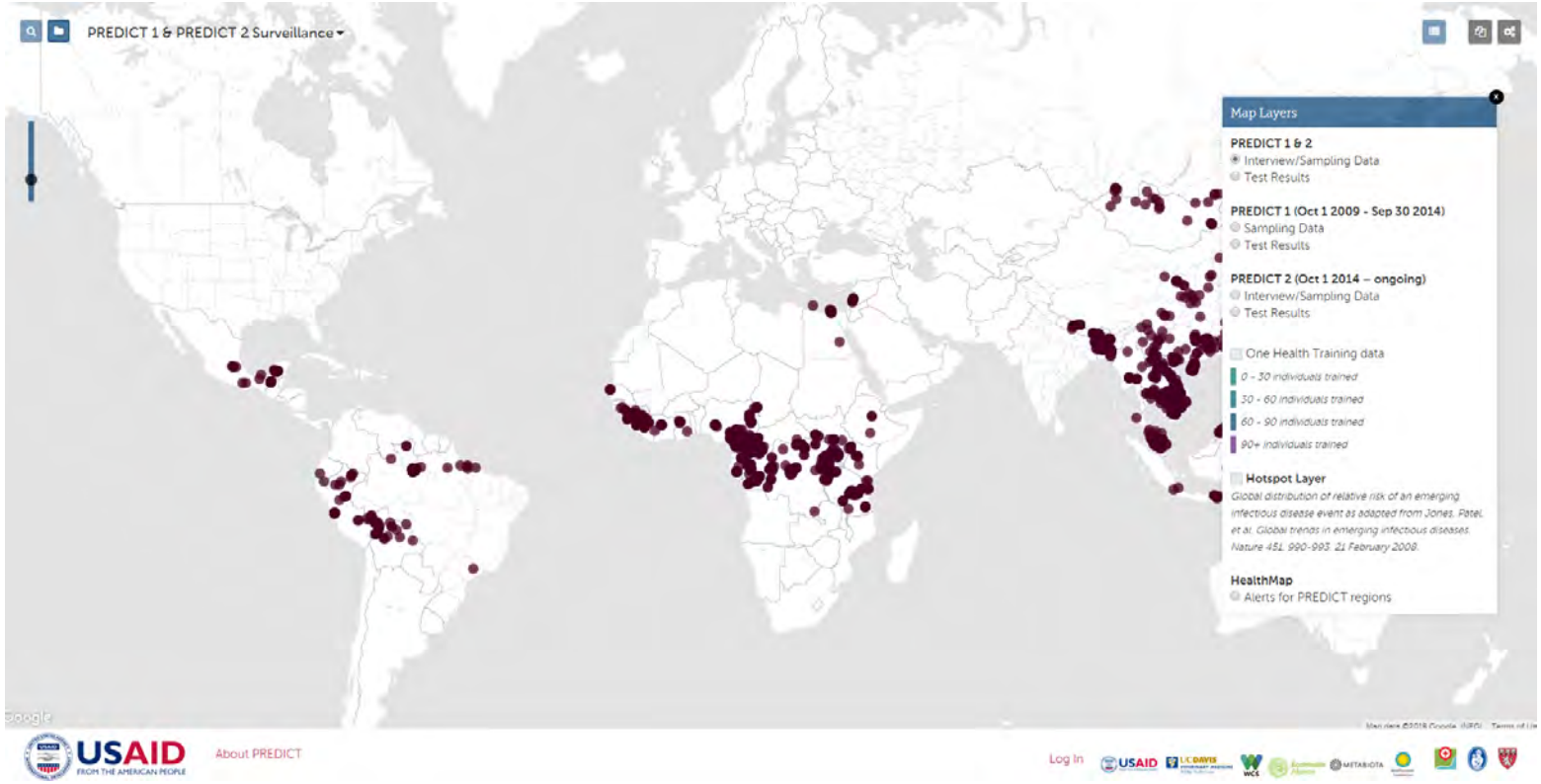
EIDITH's Human Questionnaire Bubble Form translated into Thai, one of the new language packs added this period.

We continued to support PREDICT's Capacity Strengthening team by improving systems for monitoring trainings. The EIDITH *Training Application* was optimized this period to include new data entry forms for tracking multiple-person trainings, such as lectures, large group workshops, and short courses; these forms capture one-time training events for persons involved in PREDICT activities from partners and ministries. Improvements were also made to enable alerts for project staff to complete refresher training when core trainings in PREDICT modules are nearing expiration, a feature that supports ongoing familiarity and mastery of our protocols for improved safety in field and lab settings.



A screenshot of the new multiple person training data entry form

Finally, PREDICT's HealthMap-hosted public site, available at http://data.predict.global, was revised to provide a new map layer combining PREDICT-1 and PREDICT-2 data into a single view, improving the ability to visualize and analyze data from the entire life of project. We also enabled extraction of information directly from the EIDITH database into the map (for all data approved for public release), providing real-time map views for training, surveillance, and viral findings data layers.



A screenshot of PREDICT's updated public site showing combined PREDICT-1 & PREDICT-2 data. The site is available at http://data.predict.global

Viral Detection and Lab Implementation

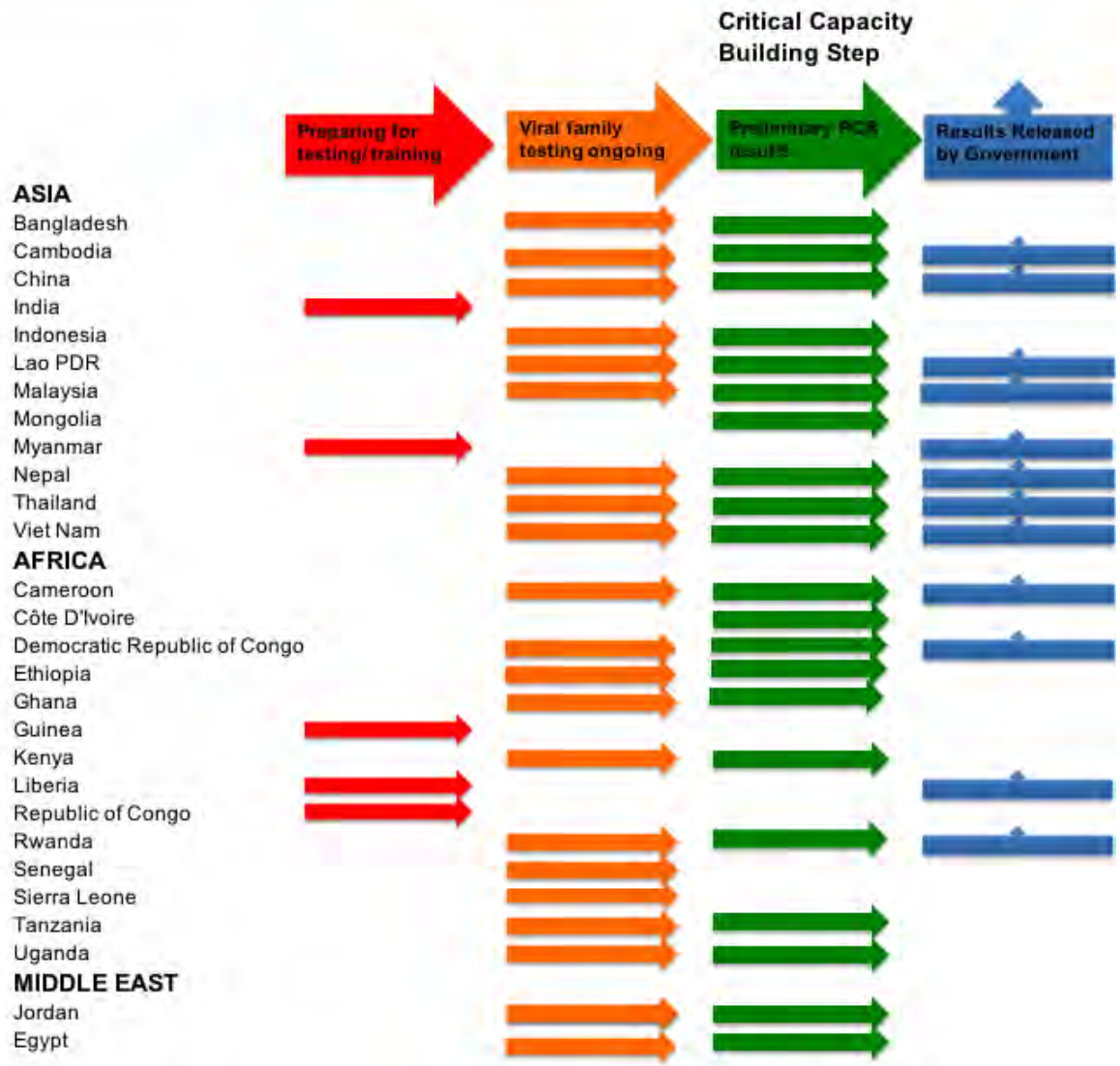
Laboratory capacity building

PREDICT continued to improve disease detection capabilities in 61 laboratories, which were targeted for training and testing across five priority viral families (corona, paramyxo, filo, influenza, and flaviviruses) known to cause zoonotic disease in humans and that are considered pandemic threats. This period, 28 labs gained a one, two or three step increase in detection capacity (Figure 1 next page): 19 gained a one-step increase, eight gained two steps, and one gained a three-step increase. As a result, five labs began training/preparing for testing, three labs began testing for the first time, seven labs produced preliminary results for the first time, and nine labs submitted sequence results for interpretation. There are now 34 labs testing for one or more priority viral families across Asia and Africa.

Result reporting also increased, and viral findings have now been approved for public released by host country governments in 12 countries (see summary of major milestones in laboratory testing). Results reports were also presented to an additional seven countries (now pending government approval for public release). Finally, results reports were prepared for nine additional countries and will be shared with government partners soon. All government approved results are available on our public site at www.data.predict.global.

Technicians receive training at PREDICT/Guinea's lab, the Viral Hemorrhagic Fever Laboratory (VHF) in Conakry. A group of technicians from the VHF Laboratory, Laboratoire Central de diagnostique Vétérinaire, and Laboratory of National Institute of Public Health received training from one of PREDICT's senior laboratory technicians from UC Davis over the course of 12 days. As a result, the VHF lab is now actively testing domestic animal samples collected as part of the Ebola Host Project. Photo: PREDICT/UC Davis

Figure 1. Summary of major milestones and laboratory capacity gains toward viral detection



PREDICT viral interpretation results*

Viral Family	Number of known viruses found in P1	Number of novel viruses found in P1	Number of additional known viruses found in P2	Number of additional novel viruses found in P2	Total
Coronavirus	31	69	14	19	133
Paramyxovirus	12	74	6	46	138
Filovirus	0	0	0	1	1
Influenza virus	8	0	1	0	9
Flavivirus	3	5	1	1	10
Hantavirus	4	3	1	0	8
Rhabdovirus	0	31	0	3	34

**Some findings not yet approved for release; data for other viral families detected during PREDICT-1 not shown*

** ***Definition of a new virus***: A virus is considered to be new if it has equal or greater genetic variation than the difference between the two closest known virus species within a family/genus and if it represents a distinct (monophyletic) lineage. Our data are strongly suggestive of a new virus but such classification can only be conferred by the International Committee on Taxonomy of Viruses (ICTV).

******Assessment of risk***: Results and their interpretation are provided on an individual test basis. Assessments of risk to public and animal health are based on what we know to be true for known viruses and relatedness of the viruses detected here to those known viruses. Further characterization is needed of novel viruses to understand if these viruses pose a threat to human health

Testing Progress

Side by side comparison shows that more individuals have been tested at this stage of the project compared with PREDICT-1 (Figure 2), indicating that we are on track for timely completion of testing by the end of March 2019. The majority of samples tested are from bats, rodents, and humans (Figure 3). Comparison of the number of positives detected in PREDICT-1 and PREDICT-2 shows a greater number of positive individuals at this stage of the project (Figure 4).

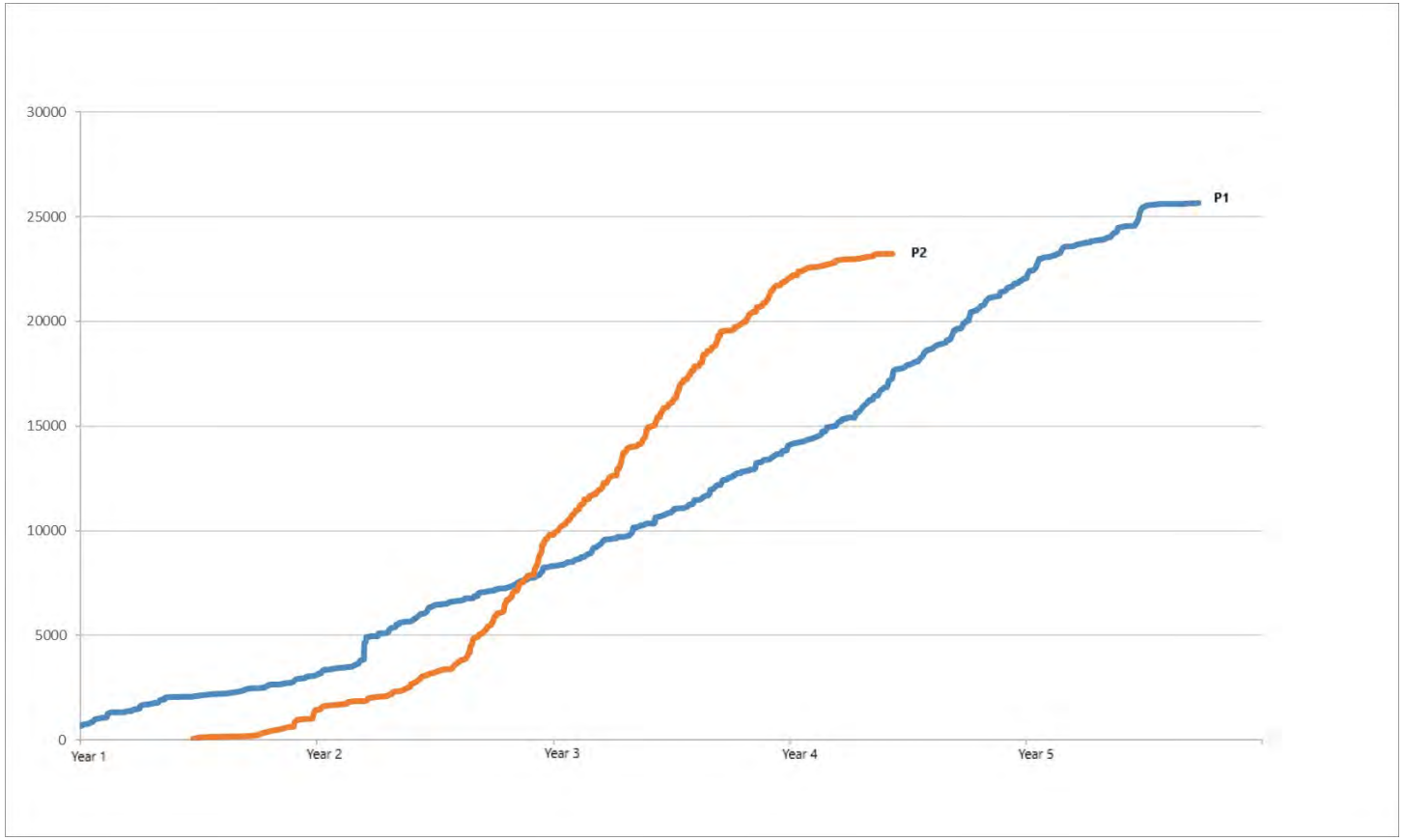


Figure 2: Total number of individual tested in PREDICT-1 (blue line) and PREDICT-2 (orange line).

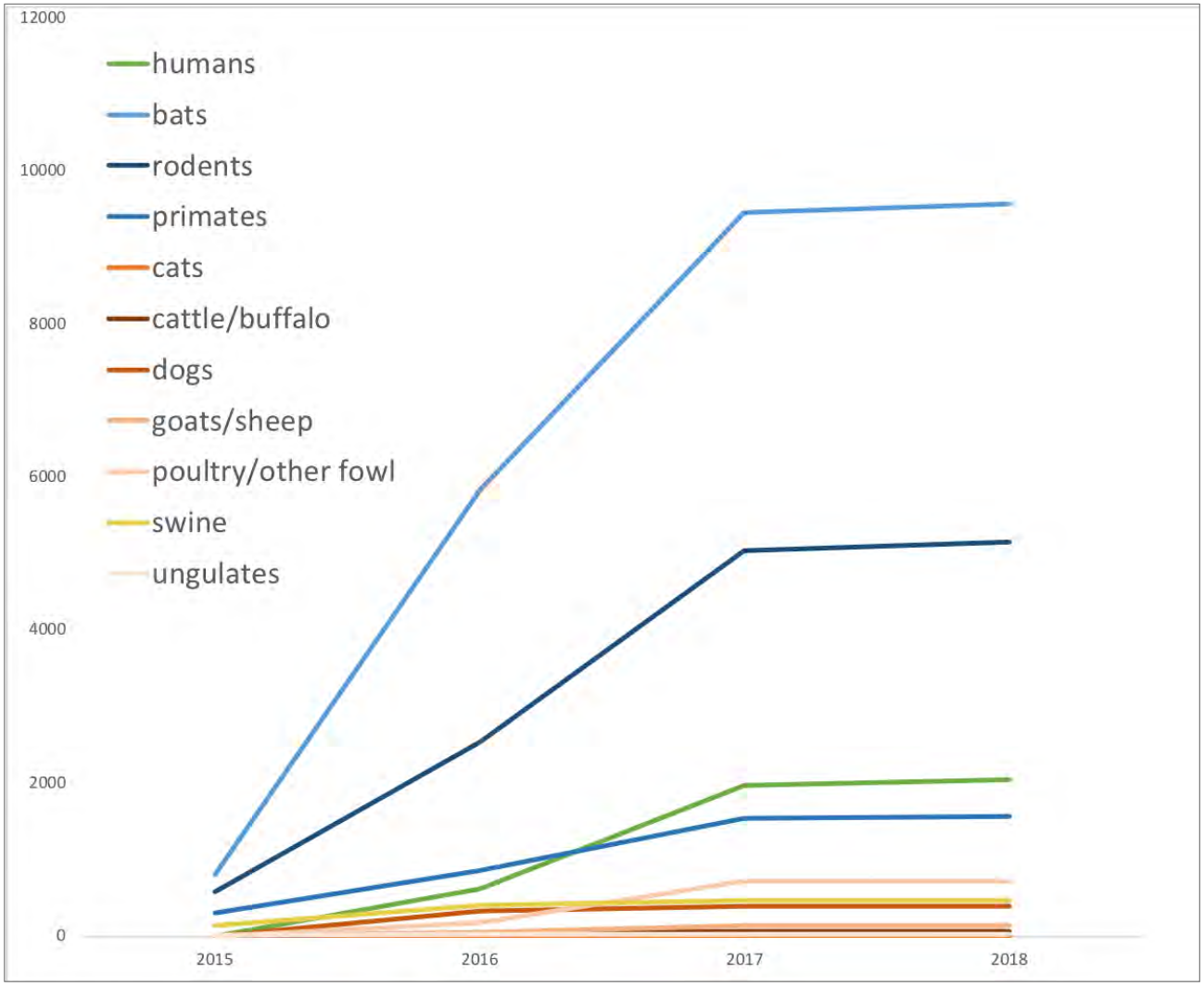


Figure 3. Total number of individuals tested to date broken out by taxa.

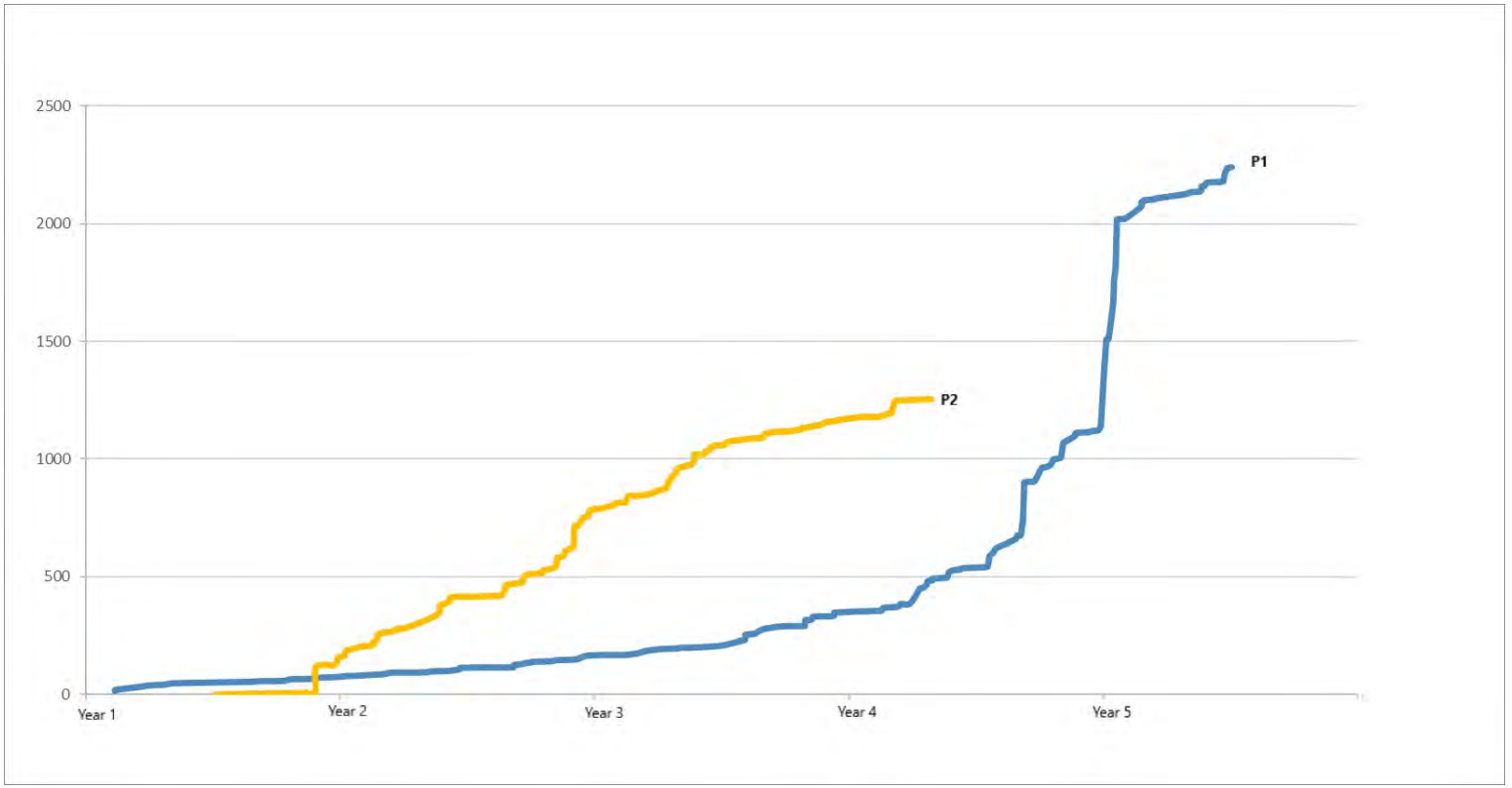


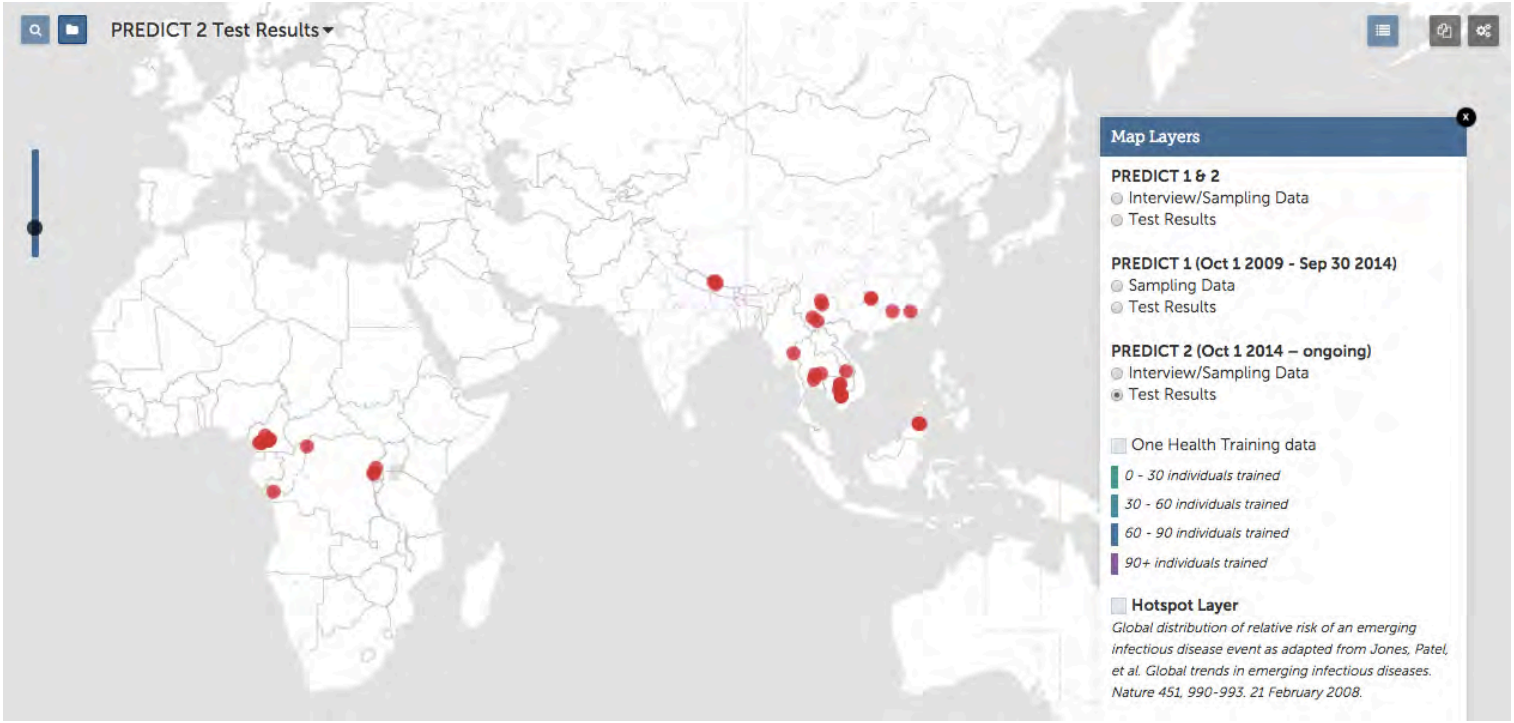
Figure 4. Total number of positives for PREDICT priority viral families in PREDICT-1 (blue line) and PREDICT-2 (yellow line).

Tools in development

- **Coronaviruses**: Received samples from Cambodia, Myanmar, Tanzania, and Nepal for full-genome sequencing (others ongoing) for coronaviruses. These sequences will be used to understand coronavirus evolution and to develop primer sets for in-country PCR characterization of spike proteins to assess risk for human infectivity.

- **Paramyxoviruses**: Continued development of a reverse genetics system for further characterization of paramyxoviruses to evaluate viral pathogenicity and host range; identified two PREDICT paramyxovirus genomes for evaluation using the reverse genetics system; sequencing of additional genomes is ongoing.
- **Ebola Serologic Assay**: Planned the first shipment of serum to be tested using PREDICT ebolavirus ELISA assays.
- **Refining our deep-sequencing approach**: Completed data collection and continued ongoing analysis to compare results of high throughput sequencing using unbiased sequencing and VircapSeq-VERT and factors that affect sequencing success.
- **Host cell receptors**: Completed sequencing of NPC1 from 100 bat species to assess the binding of Ebola virus to different bat NPC1 phenotypes.

Viral findings



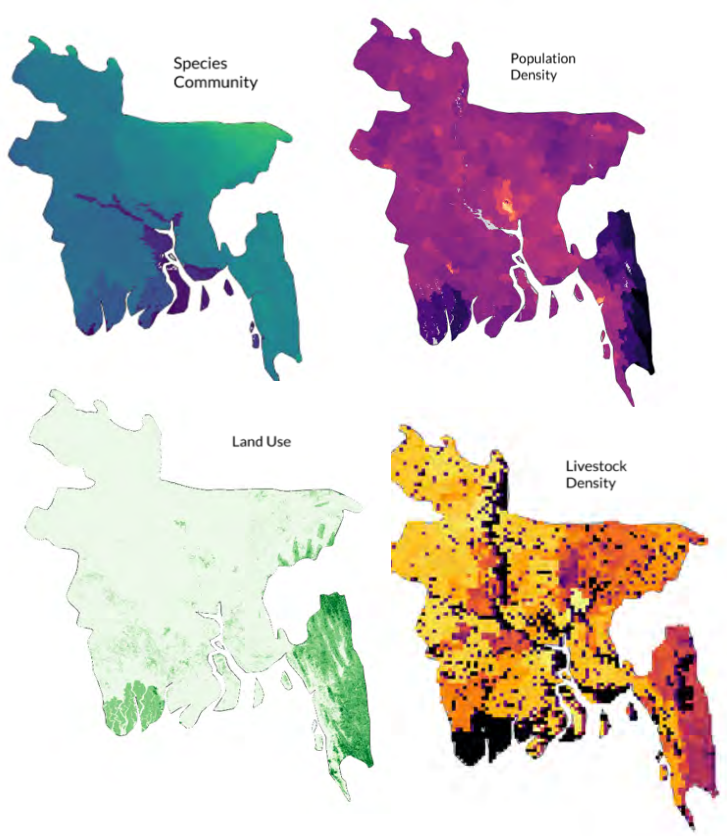
A table of comprehensive viral findings approved by host government partners for public release is provided in Appendix 1. All approved viral findings are also available on PREDICT's public site: www.data.predict.global.

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** (right)**.** Each report utilized 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 mapped out how key drivers vary across countries (e.g., land use, and 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.

PREDICT 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



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

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.

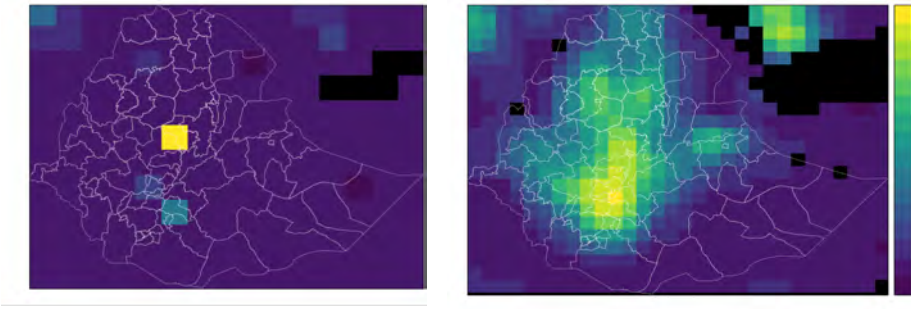
Our team visited the Indonesia One Health Network (INDOHUN) offices for three weeks in March 2018 (bottom right). In collaboration with INDOHUN and the University of Minnesota, they helped design an economic model of land conversion for the Riau province.

Progress and new model development

PREDICT completed three rounds of scientific screening to refine data for a spatial 'hotspots' model of antimicrobial resistance emergence in humans, which will be the first of its kind. A total of >49,000 articles have been screened to date. The project now moves on to full-text review of the selected articles. Additionally, we 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 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 also downscaled the Hotspots 2.0 model for each ASL2050 country to give higher resolution maps for in-country interpretations (top right).

We updated the EIDITH R package in collaboration with the Information Management team to allow individuals with EIDITH database access to download their country-level PREDICT-2 data into the statistical analysis program, R, for local analyses. Site characteristics, behavioral risk, animal, or testing data can then be manipulated in R to explore



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

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 data are also in development.

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

Analyzing PREDICT data to support surveillance

We 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 methods 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 health community.

We also refined estimates of viral richness using viral accumulation curves and project data (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 PREDICT sub-project GVP, for example.

Collaborations across teams to inform interventions

We are supporting PREDICT's six "deep dive" behavioral areas to assess potential feasibility and impact of interventions. Our team is working on analyses of available data to provide information on the boundaries under which interventions might prove successful. In addition, we are working with PREDICT technical teams and country staff to conduct analyses of literature, project data, and new data being collected over the next year 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 one IMPACT project, a regional map of *Rhinopholus* bat and pig overlap was 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 (see Publications and Products section for more details).

The six deep dive areas of the IMPACT projects.

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

For more information

A full list of PREDICT Modeling and Analytics team products and output is included in the *Monitoring and Evaluation Appendix 1*. Emerging Disease Insights are also available on our *Live Science* page: www.livescience.ecohealthalliance.org.

One Health Partnerships

One Health policy advocacy

PREDICT collaborated on the development of the World Bank's *Operational Framework for Strengthening Human, Animal and Environmental Public Health Systems at their Interface* ("One Health Operational Framework"). The Framework (see figure below) features extensive lessons learned through PREDICT and its partners, including One Health success stories and operational guidance across the prevent-detect-respond-recover spectrum, both at country level and in project design. Building on our work with the World Bank on One Health Economics, it details the value of investing in One Health and showcases how to identify relevant entry points and measure outcomes. It also suggests One Health-relevant Environment and Social Safeguards to help avoid unintended disease risks from development activities.

To reinforce the importance of coordination of national capacity assessments and planning across sectors for health security, **PREDICT coordinated a session on "Operationalizing One Health: from Assessment to Action"** in partnership with USAID, P&R and the World Bank at the Prince Mahidol Award Conference (PMAC) in Bangkok. The session launched the One Health Operational Framework and featured presentations on relevant tools, synergies and experiences from FAO, OIE, OHW, U.S. CDC, WHO, Toward a Safer World Network and country leaders in One Health.

In collaboration with USAID RDMA, we also convened a panel at PMAC on harnessing the economic dimensions of health security, including incentives to address the drivers of emerging infectious disease and AMR. An accompanying piece in the *WHO Bulletin* presents pillars for investments in EID prevention.

The One Health Operational Framework provides a 'map' of tools from different sectors to support One Health coordination.

To assist countries in determining where One Health approaches can be most beneficial for their operations, **we developed a "Quick Guide to One Health Evaluation**". The guide helps orient users to evaluation processes and identify relevant metrics to inform decisions, including budget allocation across sectors.

Quick Guide to One Health Evaluation

One Health is an interdisciplinary collaborative effort to attain optimal health for people, animals and the environment we depend on.

The One Health concept has received growing attention around the world as a way to help address challenges at the human-animal-environment interface—such as emerging and endemic zoonotic diseases (e.g. Ebola, Avian Influenza, Rabies), antimicrobial resistance, and food safety and security. With ecosystems and food production systems rapidly changing as a result of human resource demands, it is critical to understand the connections between humans, animals and the environment to find effective solutions that promote local and global health security and resilience.

To help move from broad interest to operational aspects of One Health on the ground, policy makers and donors have called for *an evidence base for One Health*, particularly in terms of its potential to assist public health systems in shifting from resource-intensive response to disease events to prevention, early warning, and enhanced detection of public health threats. As with evaluation for any program, evaluating One Health approaches can help refine implementation strategies for optimal outcomes and inform ways to adapt and upscale approaches in other settings, countries, and priority topics.

What should I evaluate?

Given the many topics that a One Health approach may assist with, a wide range of effectiveness and efficiency metrics (such as disease incidence, economic outcomes, years of life saved, number of people trained, etc.) could potentially be meaningful. Key factors to consider include:

- What is the scope of my particular topic and objective? Is it global, national or local?
- Who is my audience? What outcomes are relevant to them?
- What process(es) do I want to inform?
- What information is readily available?

This quick guide is intended to assist governments, research and service delivery projects, and donors to get started in thinking about opportunities to measure One Health's added value for decision-making. Models projecting outcomes under different scenarios can be useful and to date make up a large portion of One Health studies. However, results from implementation can help demonstrate feasibility and success in real-life and local contexts. The following pages provide insight on these and other criteria and introduce guidance for conducting evaluations. In general, the best approach is to choose an outcome that is relevant, understandable, and actionable for your audience.

? *What about other terms – Planetary Health, Eco-Health, or Veterinary Public Health? Like One Health, they all represent integrated approaches. Consider this a guide for all of them – regardless of the name, the goal is to improve outcomes for humans, animals and the environment.*

PREDICT served on the Scientific Committee for the 2nd OIE Global Conference on Biological Threat Reduction, which is organizing a session on the future of biological threat reduction.

In light of gaps in risk reduction efforts around environmental drivers of zoonotic disease, **PREDICT also provided key input into the development of the World Bank's Country Assessment for Environmental Health Services**, including capacities for wildlife disease monitoring and risk management. The draft capacity assessment tool, which is envisioned as a parallel to the WHO joint External Evaluation and OIE Performance of Veterinary Services evaluation, was introduced at the UN Convention on Biological Diversity (CBD) meeting in December 2017 in collaboration with the World Bank and the CBD Secretariat.

Other highlights and success stories

In recognition of strong country interest in PREDICT's approach to multisectoral economic evaluation of zoonotic disease, PREDICT presented on One Health Economics in a symposium at a conference organized by the Bangladesh Society for Veterinary Education and Research. The presentation was part of a symposium on the 'Economic Impact of Prioritized Zoonotic Diseases' and included representatives from the ministries of wildlife, livestock and disease control and FAO.

PREDICT **supported the development of the FAO/OIE/WHO Tripartite Zoonoses Guide** on *"Taking One Health Approaches to Address Zoonotic Diseases in Countries"*, co-authoring chapters on risk reduction and planning and preparedness and attending the expert meeting held in February 2018. In response to requests from country representatives on the need to make the case for One Health's utility, we also developed a section on financing and economic value-added from One Health approaches to zoonotic disease prevention and control.

Given the importance of efficient investigation of major emerging infectious disease events for health security, PREDICT has liaised with international animal trade organizations to address permitting delays that have hindered investigation of recent wildlife mass mortality events. We were appointed to serve on a working group on simplified procedures to promote timely movement of emergency diagnostic specimens convened by countries under the Convention on the International Trade of Endangered Species of Wild Fauna and Flora (CITES).

In continuation of our collaboration with WHO on the environmental dimensions of health security, we coordinated a presentation from a PREDICT partner from the Ghana Forestry Commission for WHO's Stakeholder Consultation on National Health Security and Pandemic Influenza Preparedness Planning held in Accra in December 2017. The presentation featured approaches for pathogen surveillance in wildlife.

The American Public Health Association adopted its first-ever policy statement on One Health at its Annual Meeting in November 2017. The policy was developed by PREDICT and provides concrete action steps for the public health community to advance health security and pandemic prevention and preparedness capacity in the U.S. and globally.

New publications, products, and policy briefs

Key outputs emphasized the economic benefits of reducing emerging disease risks, including:

- "A framework for stimulating economic investments to prevent emerging diseases" in the *Bulletin of the WHO*, calling attention to risk reduction to yield global public good through improved health security
- "Investing in One Health" policy brief, accompanying the World Bank One Health Operational Framework
- "One Health Economics to Confront Disease Threats" in *Transactions of the Royal Society for Hygiene and Tropical Medicine*, disseminating key messages from a 2017 workshop held at the World Bank

Selected presentations on PREDICT, One Health, zoonotic diseases, and global health security

- Presented on PREDICT One Health evaluation activities at the Chatham House meeting on "One Health: Developing Indicators to Monitor Progress Toward Implementation"
- Chaired the OIE Working Group on Wildlife Meeting, highlighting new and emerging wildlife disease events and reinforcing the importance of country reporting for wildlife diseases
- Presented on disease risks at the human-animal-environment interface in a PMAC panel on "Strategic Information and the Evolution of Emerging Infectious Diseases: Lessons from the Past and New Opportunities" organized by UNAIDS and U.S. CDC
- Presented at high-level GHSAC event held at the US State Department

- Presented on PREDICT approaches, including the role of wildlife health monitoring in global health security, at multiple side events at the Convention on Biological Biodiversity (CBD) 21st meeting of the Subsidiary Body on Scientific, Technical and Technological Advice, and PREDICT helped inform the Guidance on integrating biodiversity considerations into One Health approaches released by the CBD Secretariat
- Presented on risk reduction strategies on a Future Earth webinar with World Bank, CBD and UNISDR colleagues
- Presented on "One Health Economics: Assessing Impacts across Sectors to Inform Partnerships for Health Security" at the American Public Health Association meeting

For downloads, policy briefs, or more information on PREDICT's One Health policy and partnership activities please visit www.onehealth.predict.global

Management and Operations

Highlights and successes

The PREDICT Consortium held our second All-Country meeting January 9-11, 2018 in Brussels, Belgium. The meeting, which featured guests from the European Union and EPT-2 partners from the Food and Agriculture Organization of the United Nations, included over 100 participants, including representatives from all 30 PREDICT countries and provided a forum for evaluating our progress to date and for developing strategic plans for remaining activities. Through data-driven workshops on risk characterization, panel discussions exploring PREDICT's One Health approach in action, and discussions and consultations with USAID and the project's external advisory board, we built a strong foundation for tackling remaining tasks. Additionally, PREDICT hosted a poster competition, with participation from all 28 actively engaged One Health country teams, which encouraged dialogue and fostered a sense of community as peers worked together to review posters and award honors.

> *I think this type of meeting is essential for disseminating information broadly, guiding project deliverables and troubleshooting potential problems. Not to mention helping with collegiality for what is already a highly collaborative project.*
> - A participant at the PREDICT All-country meeting in Brussels, Belgium

On January 29, 2018, during the Prince Mahidol Award Conference (PMAC) in Bangkok, Thailand, PREDICT and the Global Virome Project (GVP) planned and successfully hosted a meeting titled "Introducing the Global Virome Project". This was the second global in-person meeting following the Beijing meeting in February 2017. In Bangkok, participants, including members of the GVP Steering Committee, Working Group members, country collaborators in China and Thailand, as well as PREDICT and EPT-2 partners worked together to discuss ways to implement evolving strategies and plans. Additionally, the project was introduced to the international public health community, various government officials, and key stakeholders. For more info on GVP visit: http://www.globalviromeproject.org/

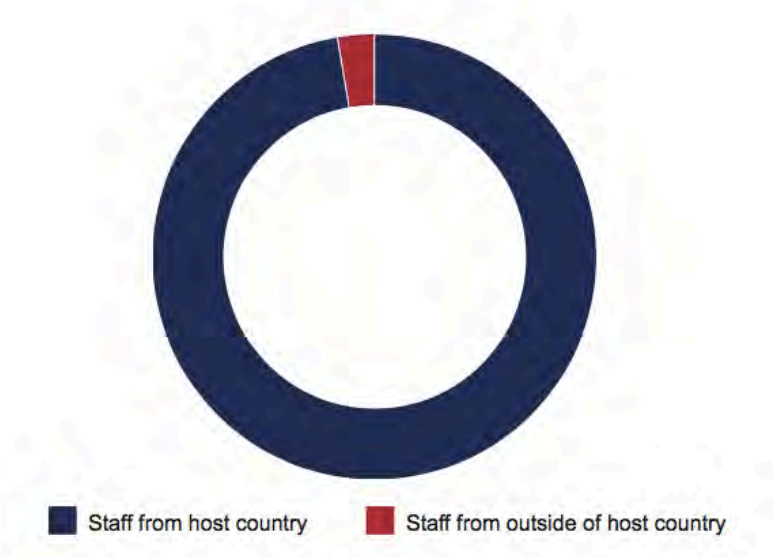
Partnerships

Continuing to build and formalize One Health partnerships, we obtained approval and executed 43 new subawards and subcontracts since the start of the project, 93% of which are with foreign government entities and laboratories in Asia and Africa enabling PREDICT to further advance capabilities for zoonotic disease surveillance, detection, and response.

The PREDICT team and partners from USAID and the Food and Agriculture Organization of the United Nations at the PREDICT 2018 All-country meeting in Brussels, Belgium. Photo: PREDICT.

Personnel

We continued to manage and coordinate an international consortium of partners consisting of over 241 staff, 97% from the host countries or regions where we work.



Permissions

PREDICT continued working with global and international partners to ensure compliance with all international and host country laws, regulations, and policies, including Memorandums of Understanding and Letters of Agreement, permissions for conducting research and collecting samples, import and export permissions, biosafety certificates, and ethical clearance for conduct of One Health surveillance (institutional review boards and animal care and use committees).

Communications

PREDICT continued outreach and communication efforts at the global and host country levels, producing briefings, reports, and online communications and establishing social media channels on Research Gate for scientific publications and presentations and Twitter (@PREDICTproject) for general outreach and information. In addition, PREDICT continued our commitment to open data, making host county government-approved findings available online through the PREDICT BioProject on GenBank and through our HealthMap hosted data portal at www.data.predict.global.

IV. COUNTRY REPORTS

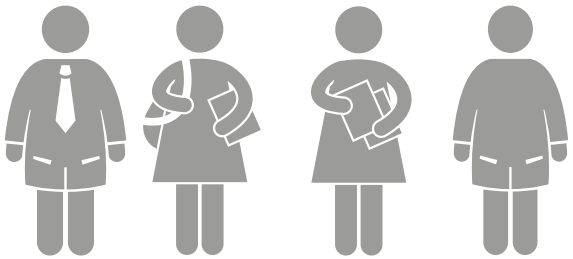
CAMEROON

USAID | PREDICT
FROM THE AMERICAN PEOPLE

Global Health Security Agenda

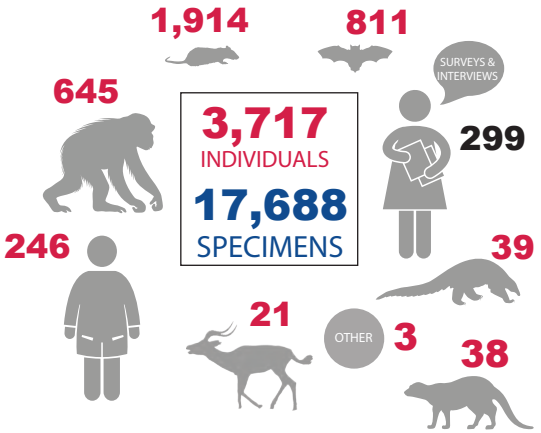
WORKFORCE DEVELOPMENT

37	31	40	74
STAFF	STUDENTS	GOVERNMENT	OTHER



107 MALE | 74 FEMALE

ONE HEALTH SURVEILLANCE



IMPACT

181 trained in One Health skills

3,717 individuals sampled
(246 humans and 3,471 animals)

299 individuals interviewed in behavioral risk investigations

30,756 tests for 5 viral families

128 viruses detected

www.predict.global

LAB STRENGTHENING

30,756
TESTS

CENTRE FOR ARMY HEALTH RESEARCH (CRESAR)

TRAINING → LIMITED TESTING → TESTING ALL TARGET VIRAL FAMILIES

VIRAL FINDINGS

PREDICT-1	PREDICT-2
91 NEW VIRUSES	**8** NEW VIRUSES
	12 PREDICT-1 VIRUSES
15 KNOWN VIRUSES	**2** KNOWN VIRUSES

Community-based risk communication in Cameroon

On 20-21 February 2018, in Sangmélima and Ebolowa, PREDICT/Cameroon conducted meetings with 10 officials from a Divisional Delegation of Wildlife and Livestock and community bushmeat sellers, a group in frequent contact with wild animals and therefore at higher risk for zoonotic disease. These two meetings allowed PREDICT to share government-approved surveillance results with communities, and resulted in the sensitization of 47 female bushmeat sellers on zoonotic disease infection risks, including valuable discussions about potential risk mitigation strategies. Many women in this region of Cameroon have been involved with selling bushmeat since childhood, and for some, this has been their livelihood for decades. Understandably, most would not be able to leave the trade and their only source of income. One of the bushmeat sellers at this meeting summarized this with her own words (translated):

> *"If we are told to stop, we will still always come back to this activity because this is how we feed our families."*

PREDICT encouraged those present to adopt simple mitigation techniques to reduce the risk of zoonotic disease transmission, advising the women to avoid handling or butchering fresh meat if their hands are cut or scratched, to always have soap and water nearby to wash immediately in case they are cut during butchering, to avoid contact with wildlife bodily fluids (using impermeable plastic to wrap meat during transport), to avoid contact with dead animals found in the forest, and to keep wildlife carcasses or bushmeat out of reach of children. PREDICT's surveillance test results and risk reduction strategies were well received by community members, and the government representatives present at the meetings took the opportunity to recognize the value of in-service training opportunities provided by PREDICT to local staff in wildlife disease surveillance.

PREDICT engages local communities in high-risk areas for disease transmission and emergence, such as bushmeat markets, and fosters improved recognition of zoonotic diseases and awareness of prevention and control options.
Photo: PREDICT/Cameroon

FACES OF
PREDICT

BAMAMBITA SIMON PIERRE, DVM

Dr. Bamambita Simon Pierre is a veterinary doctor with Cameroon's Directorate of Veterinary Services of the Ministry of Livestock, Fisheries, and Animal Husbandry (MINEPIA) in Yaoundé, Cameroon. He is also the Chief of Service in charge of wildlife diseases and an OIE national focal point for wildlife diseases. Dr. Bamambita has been receiving on-the-job training for zoonotic disease surveillance during PREDICT field activities since 2015. He has completed PREDICT protocol trainings and has been mentored by PREDICT staff in the use of personal protective equipment, capture and sampling of wildlife (bats, rodents, non-human primates), coding and labeling of samples, sample processing and transportation from field to laboratory, maintenance of cold chain, and waste management. Dr. Bamambita has been able to utilize these skills both with his appointment with the PREDICT project as well as his position with MINEPIA, providing a clear illustration of how PREDICT has contributed to Cameroon's increased capacity for zoonotic disease response.

Dr. Bamambita was part of the Cameroon government team who, in collaboration with PREDICT, managed the monkeypox reservoir surveillance during the 2016 monkeypox outbreak in Mefou National Park, and he also participated in a multisectoral investigation into the death of a wild gorilla in Lobeke National Park. During these events, he used techniques and knowledge gained from PREDICT surveillance trainings to efficiently carry out outbreak investigations. With improved understanding and experience with the One Health approach and refined skills in wildlife disease surveillance through participation in PREDICT field activities over the past 3 years, Dr. Bamambita is a leader in wildlife disease surveillance and strengthens the National Epidemiological Surveillance Networks for Animal Diseases in Cameroon (RESCAM).

"I value the hands-on aspect of my experience doing surveillance work with the PREDICT team, these practical skills have allowed me to expand animal disease control plans in Cameroon. PREDICT has demonstrated the importance of effective wildlife surveillance, and its integration with domestic animal surveillance as part of a One Health approach."
– Dr. Bamambita Simon Pierre

COTE D'IVOIRE

USAID | PREDICT
FROM THE AMERICAN PEOPLE

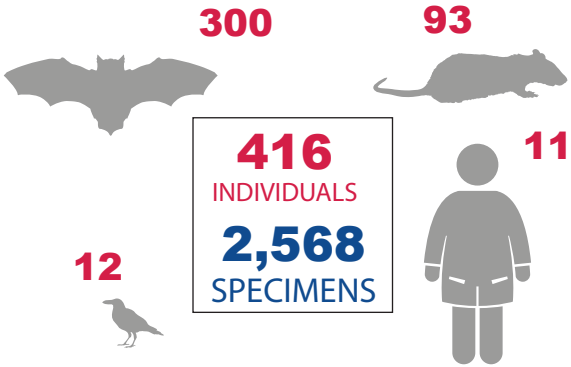
Global Health Security Agenda

WORKFORCE DEVELOPMENT

18	2	7	52
STAFF	STUDENTS	GOVERNMENT	OTHER

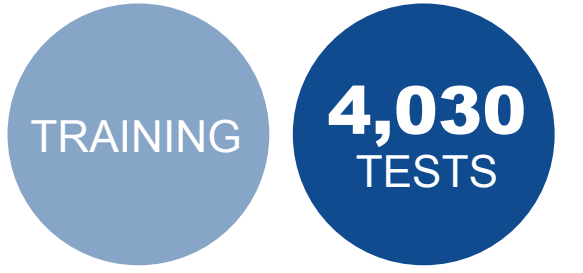
39 MALE | 32 FEMALE

ONE HEALTH SURVEILLANCE



IMPACT

LAB STRENGTHENING



71 trained in One Health skills

416 individuals sampled
(11 humans and 405 animals)

96 individuals interviewed in behavioral risk investigations

4,030 tests for 5 viral families

www.predict.global

A bat captured for sampling by PREDICT in Côte d'Ivoire.
Photo: PREDICT/Côte d'Ivoire

FACES OF
PREDICT

COULIBALY KALPY (JULIEN), PhD

Dr. Coulibaly Kalpy (Julien) is a Microbiologist at Institut Pasteur of Côte d'Ivoire (IPCI), and has served as PREDICT Country Coordinator since 2017. During his time with PREDICT and as a member of the Global Health Security Agenda (GHSA) Technical Secretariat in Côte d'Ivoire, Dr. Kalpy has learned how to implement GHSA guidelines in-country and has gained the expertise and diplomacy to work in a multidisciplinary environment.

When PREDICT is called upon by Ministries of Agriculture and Heath for expertise in identifying and detecting old and new zoonotic viruses, Dr. Kaply is the face of PREDICT in meetings. The government of Côte d'Ivoire, through the Ivorian Office of Parks and Reserves (OIPR), has been trying for years to reconcile conservation and human populations along Marahoué National Park borders. By understanding the benefit of shared experiences and knowledge, Dr. Kalpy involves OIPR agents in PREDICT field activities and his intervention has reassured the civil population in Côte d'Ivoire. Dr. Kalpy's integrated approach to zoonotic disease surveillance has triggered discussions about the trade-off between bushmeat consumption, zoonotic spillover risk, and wildlife conservation and his role is fundamental in implementing the PREDICT Project in Côte d'Ivoire, broadcasting the advantages of the "One Health" approach, and fostering relationships between different partner institutions involved with PREDICT.

As a result of Dr Kalpy's presence in Côte d'Ivoire, PREDICT is currently working with local authorities to set up a surveillance system for animal health, and Dr. Kalpy has helped bring together and improve communication between institutions involved in One Health actions.

"PREDICT, c'est le vrai visage du One Health."

["For me PREDICT is the true face of One Health."]
-Dr. Coulibaly Kalpy (Julien)

DEMOCRATIC REPUBLIC OF CONGO

USAID | PREDICT
FROM THE AMERICAN PEOPLE

Global Health Security Agenda

WORKFORCE DEVELOPMENT

23	5	67	11
STAFF	STUDENTS	GOVERNMENT	OTHER

62 MALE | 42 FEMALE

ONE HEALTH SURVEILLANCE

570 | 638 | 16

391

1,328 INDIVIDUALS
7,222 SPECIMENS

SURVEYS & INTERVIEWS
276

7 | 546 | 9 OTHER

LAB STRENGTHENING

14,841 TESTS

INSTITUT NATIONAL RECHERCHE BIOMEDICALE

TRAINING → LIMITED TESTING → TESTING ALL TARGET VIRAL FAMILIES

IMPACT

- **104 trained** in One Health skills
- **2,179 individuals sampled** (570 humans and 1,609 animals)
- **276 individuals interviewed** in behavioral risk investigations
- **14,841 tests** for 5 viral families
- **83 viruses** detected

www.predict.global

VIRAL FINDINGS

49 NEW VIRUSES

29 KNOWN VIRUSES

PREDICT-1

1 KNOWN VIRUS

4 PREDICT-1 VIRUSES

PREDICT-2

EGYPT

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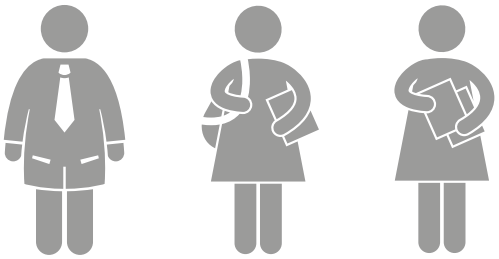
WORKFORCE DEVELOPMENT

13 STAFF
9 STUDENTS
18* GOVERNMENT

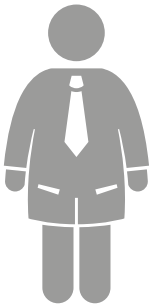


9 MALE | 9 FEMALE

* Trained staff are government employees

ONE HEALTH SURVEILLANCE

899



802

1,701 INDIVIDUALS
5,157 SPECIMENS

LAB STRENGTHENING

3,906 TESTS

CENTER OF SCIENTIFIC EXCELLENCE FOR INFLUENZA VIRUSES

TRAINING → LIMITED TESTING → TESTING ALL TARGET VIRAL FAMILIES

IMPACT

18 trained in One Health skills

1,701 individuals sampled
(899 humans and 802 animals)

3,906 tests for 5 viral families

9 viruses detected

VIRAL FINDINGS

6
NEW VIRUSES

1
PREDICT-1 VIRUS

2
KNOWN VIRUSES

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ETHIOPIA

USAID | PREDICT
FROM THE AMERICAN PEOPLE

Global Health Security Agenda

WORKFORCE DEVELOPMENT

7	2	3
STAFF	STUDENTS	OTHER

9 MALE | 3 FEMALE

ONE HEALTH SURVEILLANCE

270

254

524 INDIVIDUALS
1,523 SPECIMENS

LAB STRENGTHENING

484 TESTS

ADDIS ABABA UNIVERSITY AKLILU LEMMA INSTITUTE OF PATHOBIOLOGY

TRAINING → LIMITED TESTING → TESTING ALL TARGET VIRAL FAMILIES

IMPACT

12 trained in One Health skills

524 individuals sampled (wildlife)

484 tests for 5 viral families

www.predict.global

Baboons explore a home and interact with a family at a residence located near to Awash National Park. PREDICT is working in Awash to explore zoonotic disease transmission risks between wildlife (such as these baboons) and people and to identify potential risk mitigation options to prevent zoonotic disease transmissions and spread.
Photo: PREDICT/Ethiopia

GHANA

USAID | PREDICT
FROM THE AMERICAN PEOPLE

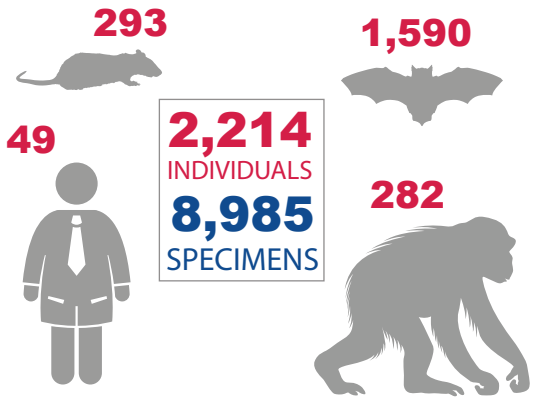
Global Health Security Agenda

WORKFORCE DEVELOPMENT

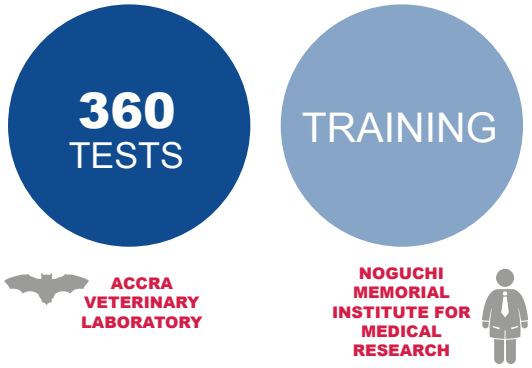
9	8	123
STAFF	GOVERNMENT	OTHER

71 MALE | 65 FEMALE

ONE HEALTH SURVEILLANCE



LAB STRENGTHENING



IMPACT

136 trained in One Health skills

2,214 individuals sampled
(49 humans and 2,165 animals)

44 individuals interviewed in behavioral risk investigations

360 tests for 5 viral families

www.predict.global

Mona monkeys (*Cercopithecus mona*) and sheep feed on discarded corn cobs/husks immediately adjacent to a home in a village near the Boabeng-Fiema Monkey Sanctuary.
Photo: Terra Kelly

GUINEA

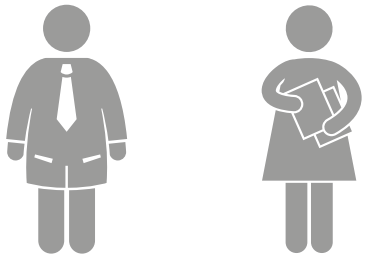
USAID | PREDICT
FROM THE AMERICAN PEOPLE

Global Health Security Agenda

WORKFORCE DEVELOPMENT

38 STAFF

33 OTHER



61 MALE | 10 FEMALE

ONE HEALTH SURVEILLANCE

321

1,628

2,460 INDIVIDUALS
14,190 SPECIMENS

8

497

6

LAB STRENGTHENING

TRAINING

891 TESTS

LABORATOIRE DE FIEVRES HEMORRAGIQUES

UC DAVIS ONE HEALTH INSTITUTE

TRAINING → LIMITED TESTING → TESTING ALL TARGET VIRAL FAMILIES

*As part of the Ebola Host Project, samples are being tested at UC Davis to accelerate release of viral findings for use for decision-making and risk mitigation efforts.

IMPACT

71 trained in One Health skills

2,460 animals sampled

891 tests for Ebola and other filoviruses

Members of the PREDICT/Guinea team process samples collected from bats as part of the Ebola Host Project.
Photo: Jaber Belkhiria, UC Davis

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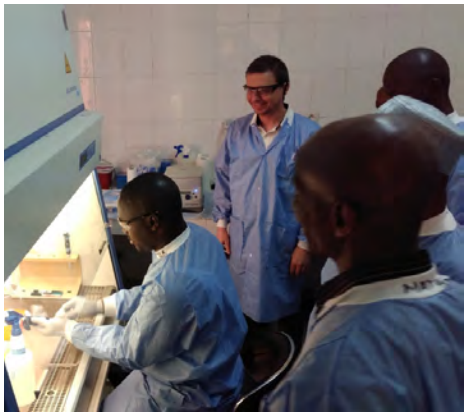
PREDICT SUCCESS STORIES

Preparing for the next pandemic: Strengthening capacity in Guinea to detect current and future disease threats



Members of the VHF lab in Guinea engage in a practical training session on conventional PCR for detection of zoonotic diseases and emerging threats in February 2018. Photo: PREDICT/Guinea

In February 2018, PREDICT/Guinea worked with partners at the Viral Hemorrhagic Fever Lab-Guinea and organized a 12-day training on zoonotic disease detection protocols to help strengthen the animal health sector's capacity to detect priority zoonotic diseases such as Ebola, a key area of emphasis for the country's JEE. The training, led by Dr. Alexandre Tremeau-Bravard from PREDICT's global laboratory implementation team at the University of California, Davis, covered the full range of activities required for safely detecting Ebola and other filoviruses, including biosafety and biosecurity, cold chain, safe sample storage, data management, safe sample transport and shipping, and molecular viral detection techniques. For the first two days, 15 individuals were trained: two from the Laboratoire Central de Diagnostique Veterinaire, two from the Laboratoire de l'Institut de Sante Publique, and 11 from the Laboratoire de Fievres Hemorragiques de Guinee (VHF). Over the next two weeks, in-depth training continued with four staff members from the VHF lab.

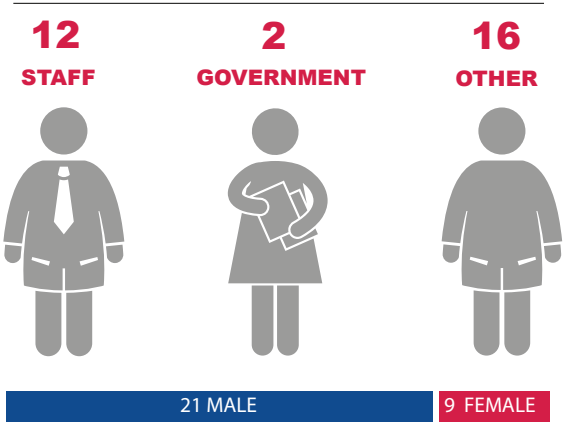
Along with the technical instruction, the training provided an opportunity to strengthen ties in the national laboratory system through multi-sectoral collaboration, another focus of the JEE. Following the training, the PREDICT/ Guinea lab team, in collaboration with the personnel from the VHF laboratory, performed 200 conventional PCR tests for filoviruses on samples collected from domestic animals, putting new skills and techniques in action and demonstrating newly acquired competency. With the training complete and the lab actively testing samples and confidently strengthening their skills, the VHF Lab-Guinea is essentially prepared for Ebolavirus testing and with continued PREDICT mentorship and support, is also ready to begin serving as a training center for students and professionals, including government staff from other nodes in the national lab system.

JORDAN

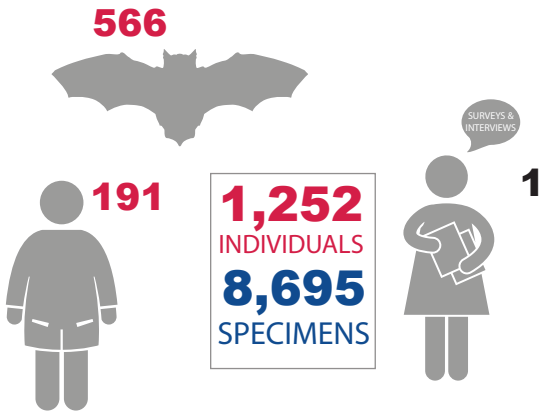
USAID | PREDICT
FROM THE AMERICAN PEOPLE

Global Health Security Agenda

WORKFORCE DEVELOPMENT



ONE HEALTH SURVEILLANCE



LAB STRENGTHENING

JORDAN UNIVERSITY OF SCIENCE AND TECHNOLOGY (JUST)

TRAINING → LIMITED TESTING → TESTING ALL TARGET VIRAL FAMILIES

IMPACT

30 trained in One Health skills

1,252 individuals sampled
(439 humans and 813 animals)

5,540 tests for 5 viral families

3 viruses detected

VIRAL FINDINGS

1
NEW VIRUSES

2
KNOWN VIRUSES

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PREDICT-2

FACES OF
PREDICT

EHAB ABU-BASHA, DVM

Professor Ehab Abu-Basha joined the PREDICT team in 2016 as the Jordan Country Coordinator while serving as Dean of the Faculty of Veterinary Medicine at Jordan University of Science and Technology. As the Country Coordinator, he is responsible for training, mentoring, and supervising the PREDICT Jordan team. The project in Jordan is centered around the camel value chain because Jordan is part of the epidemiological zone for Middle East Respiratory Syndrome Coronavirus (MERS-CoV), which is believed to be transmitted from camels to humans.

Since joining the project, Ehab has elevated the role and importance of PREDICT at local, national, and international levels. He coordinates sampling trips with local leadership and communities, liaises closely with the USAID/Jordan Mission office, and represents PREDICT Jordan at international meetings. His leadership in PREDICT helped bring in additional funding from the USAID/Jordan Mission for the project, which helps fund sampling and testing activities as well as One Health capacity-building initiatives in Southern Jordan. He also worked with USAID/Jordan to implement a national One Health platform in Jordan that brings together focal points from Ministry of Health, Ministry of Agriculture, Ministry of Environment, World Health Organization (WHO), and other key partners on a regular basis to discuss PREDICT activities and One Health concerns. In September 2017, Ehab briefed colleagues from around the world on PREDICT Jordan activities at the Food and Agriculture Organization of the United Nations (FAO) – World Organisation for Animal Health (OIE) – WHO Global Technical Meeting for MERS-CoV at WHO headquarters in Geneva, Switzerland.

"PREDICT has provided me with an opportunity to become deeply involved in zoonotic disease research and health capacity building in Jordan. Our contributions to the PREDICT project will have a lasting impact on One Health implementation in Jordan."
– Dr. Ehab Abu-Basha

KENYA

USAID | PREDICT
FROM THE AMERICAN PEOPLE

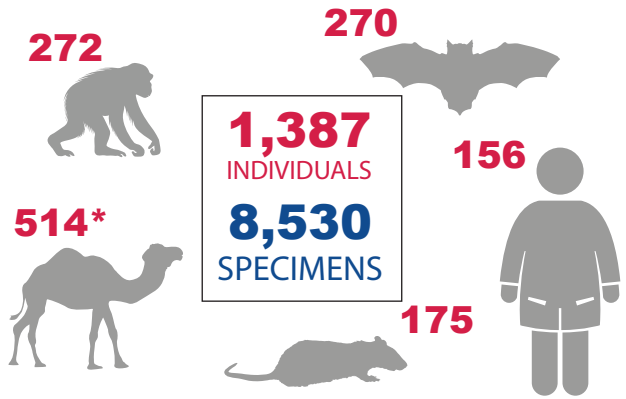
Global Health Security Agenda

WORKFORCE DEVELOPMENT

3	10	22	602
STAFF	STUDENTS	GOVERNMENT	OTHER

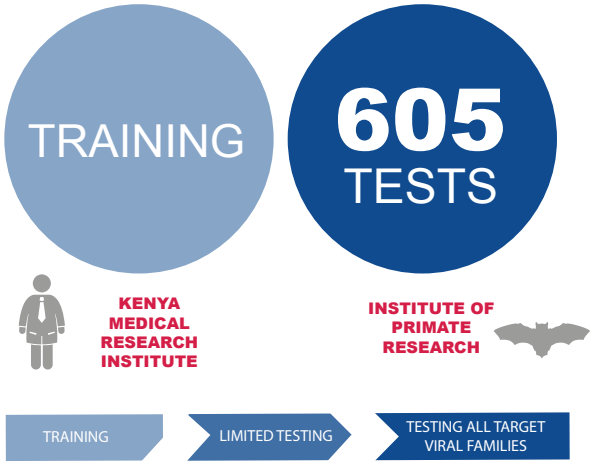
366 MALE | 270 FEMALE

ONE HEALTH SURVEILLANCE



*Samples collected in collaboration with FAO

LAB STRENGTHENING



IMPACT

636 trained in One Health skills

1,387 individuals sampled
(156 humans and 1,231 animals)

605 tests for 5 viral families

PREDICT partnered with OHCEA to hold a One Health outreach event that included handing out bookmarks to the Laikipia community that informs on disease transmission from animals to humans. *Photo: PREDICT/Kenya*

www.predict.global

Strengthening national laboratory capacity in Kenya

PREDICT, in partnership with FAO, jointly conducted disease surveillance training for over 30 individuals in biosafety, biosecurity, safe animal handling, biological sampling, and laboratory molecular diagnostics. The trainees represented multiple sectors of the governmental of Kenya: public health (Zoonotic Disease Unit), Department of Veterinary Services (DVS), Kenya Wildlife Service (KWS), regional laboratories, and universities. The training focused on equipping the regional veterinary laboratories that serve major parts of the country with the capacity to rapidly conduct disease surveillance, and to detect and identify causative agents in case of an outbreak.

In addition, PREDICT continued to build capacity at the national laboratories responsible for the testing of outbreak samples: Central Veterinary Laboratory (CVL) for a disease outbreak in animals and Kenya Medical Research Institute (KEMRI) for a disease outbreak in humans. Advanced training in viral detection was also provided to these labs, focusing on priority zoonotic diseases and other emerging threats. Further, in-service training on PREDICT detection protocols was provided to 11 Kenyan government officers from the CVL and Foot and Mouth Disease (FMD) Laboratory – the two laboratories that handle the majority of veterinary diagnostics throughout the country. In addition, two university staff (Kenyatta, Nairobi), two KWS staff, two Nairobi County public health personnel, two Kenya Agricultural and Livestock Organization (KALRO) staff, and 18 staff members from Regional Veterinary Referral Laboratories across the country (from eight regions previously known as provinces) were trained in both field and laboratory surveillance techniques for zoonotic disease detection. As a result, these labs have improved capacity to rapidly detect known priority diseases, and have systems in place to identify new viruses as they emerge.

Government regional lab staff from RVL, CVL, universities, KWS and FMD labs receiving training in biosafety and PPE during a biosecurity training at PREDICT's IPR labs in February 2018
Photo: PREDICT/Kenya

LIBERIA

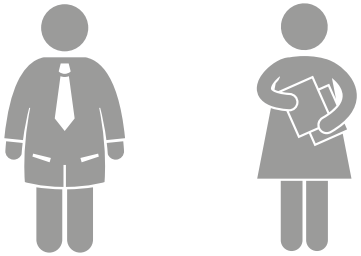
USAID FROM THE AMERICAN PEOPLE | PREDICT

Global Health Security Agenda

WORKFORCE DEVELOPMENT

26 STAFF

45 OTHER



52 MALE | 19 FEMALE

ONE HEALTH SURVEILLANCE

2,939

19

2,958 INDIVIDUALS

16,802 SPECIMENS

LAB STRENGTHENING

TRAINING — NATIONAL REFERENCE LABORATORY

TRAINING — LIBERIA INSTITUTE FOR BIOMEDICAL RESEARCH

2,504* TESTS — COLUMBIA UNIVERSITY CENTER FOR INFECTION AND IMMUNITY

TRAINING → LIMITED TESTING → TESTING ALL TARGET VIRAL FAMILIES

*As part of the Ebola Host Project, samples are being tested at Columbia University to accelerate release of viral findings for use for decision-making and risk mitigation efforts.

IMPACT

71 trained in One Health skills

2,958 animals sampled

2,504 tests for Ebola and other filoviruses

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The PREDICT/Liberia team processes bat samples in a field tent as part of Ebola Host Project sampling activities. *Photo: PREDICT/Liberia.*

PREDICT SUCCESS STORIES

Building the animal health workforce in Liberia

A PREDICT/Liberia team takes biometric measurements of a bat during wildlife sampling efforts as part of the Ebola Host Project. PREDICT is working to build animal health capacity in Liberia, a critical need for improving the country's health security. Photo: PREDICT/Liberia

In the wake of the Ebola outbreak, Liberia identified a lack of well-trained and equipped animal health workforce as a key deficit in the country's health security. PREDICT has been instrumental in addressing this need, as our project in Liberia has successfully trained 20 Liberians in wildlife and domestic animal disease surveillance, as well as two social scientists that accompany the field surveillance team that are actively addressing human behavioral risk for zoonotic transmission due to wildlife interaction in some of the country's most at-risk communities. This animal disease surveillance team is the first of its kind in Liberia and is very proficient and professional, having sampled over 3,000 animals, primarily bats, over the past year and a half. Liberia now has a team that can contribute to disease outbreak detection and response, as well as detect new and known threats before they emerge, providing a critical but previously absent epidemiological component to Liberia's public health surveillance activities.

Through these surveillance activities, the PREDICT team is working to identify the wildlife reservoir for Ebola virus and understand the transmission pathways of Ebola and other viruses. As part of their training, team members learned proper biosafety and PPE use; safe animal capture, handling and biological sampling; basic laboratory safety; assisting in outbreak response; emergency preparedness; maintaining proper cold chain; and packaging and shipping biological samples. Furthermore, among those trained were two Forestry Development Authority (FDA) personnel to facilitate knowledge transfer and capacity building within the primary government partner institution. In addition, PREDICT continues to promote the One Health approach within the public health sector by continuing to strengthen collaborations with the Ministry of Agriculture, FAO, National Public Health Institute of Liberia (NPHIL) and the Ministry of Health. As a result, PREDICT is now viewed as an important contributor to health security in Liberia, actively bolstering systems and strengthening expertise in One Health and zoonotic disease surveillance.

REPUBLIC OF CONGO

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WORKFORCE DEVELOPMENT

7 STAFF

6 GOVERNMENT

8 MALE | 2 FEMALE

ONE HEALTH SURVEILLANCE

200

145

1

346 INDIVIDUALS

1,611 SPECIMENS

SURVEYS & INTERVIEWS

179

LAB STRENGTHENING

4,461 TESTS

INSTITUT NATIONAL RECHERCHE BIOMEDICALE (INRB)

TRAINING | LIMITED TESTING | TESTING ALL TARGET VIRAL FAMILIES

*To date, animal specimen testing has been conducted by partners at the Institut National Recherche Biomédicale (INRB) lab in DR Congo.

IMPACT

10 trained in One Health skills

346 individuals sampled (wildlife)

4,461 tests for 5 viral families

71 viruses detected

www.predict.global

VIRAL FINDINGS

55 NEW VIRUSES

14 KNOWN VIRUSES

2 PREDICT-1 VIRUSES

PREDICT-1 PREDICT-2

RWANDA

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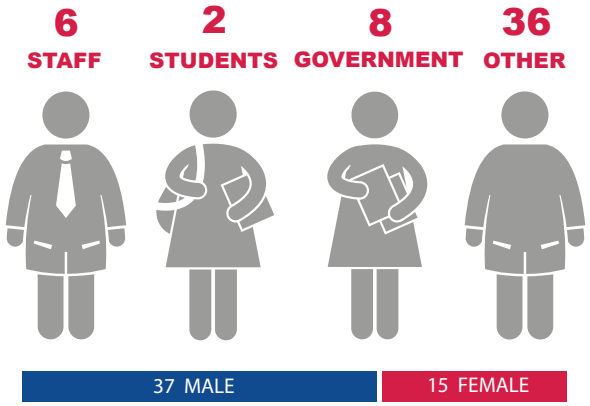
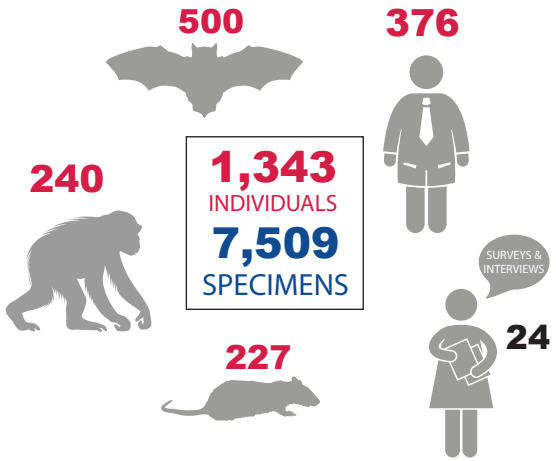
FROM THE AMERICAN PEOPLE

Global Health Security Agenda

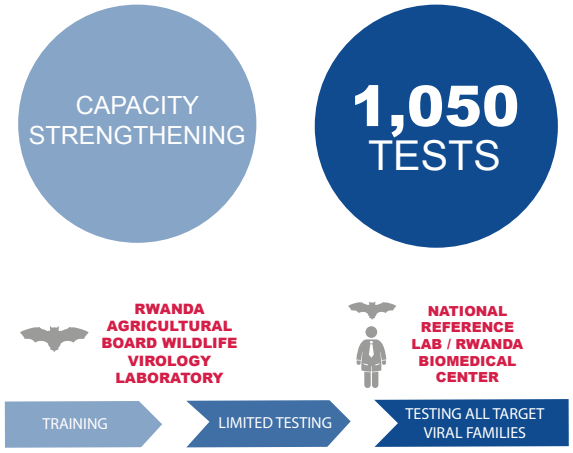
WORKFORCE DEVELOPMENT



ONE HEALTH SURVEILLANCE



LAB STRENGTHENING



IMPACT

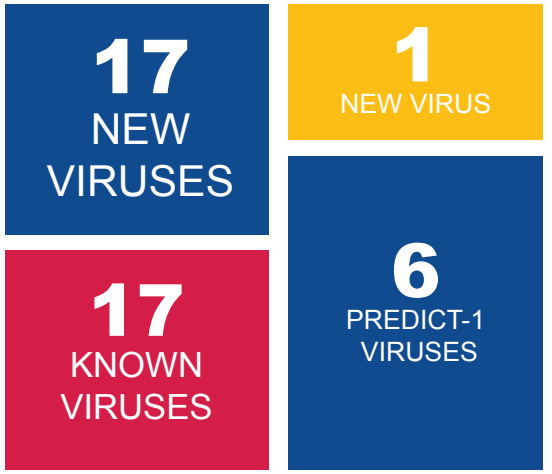
52 trained in One Health skills

1,343 individuals sampled
(376 humans and 967 animals)

1,050 tests for 5 viral families

41 viruses detected

VIRAL FINDINGS



www.predict.global

SENEGAL

USAID | PREDICT
FROM THE AMERICAN PEOPLE

Global Health Security Agenda

WORKFORCE DEVELOPMENT

13 STAFF
4 GOVERNMENT
54 OTHER

44 MALE | 27 FEMALE

ONE HEALTH SURVEILLANCE

67
283
542 INDIVIDUALS
3,473 SPECIMENS
141
51
SURVEYS & INTERVIEWS
1

LAB STRENGTHENING

TRAINING

119 TESTS

L'INSTITUT SENEGALAIS DE RECHERCHES AGRICOLES (ISRA)

CHEIKH ANTA DIOP UNIVERSITY (UCAD)

TRAINING → LIMITED TESTING → TESTING ALL TARGET VIRAL FAMILIES

IMPACT

71 trained in One Health skills

542 individuals sampled
(283 humans and 259 animals)

119 tests for 5 viral families

www.predict.global

PREDICT/Senegal team samples an Eidolon species fruit bat during a training session.
Photo: Chris Kilonzo

SIERRA LEONE

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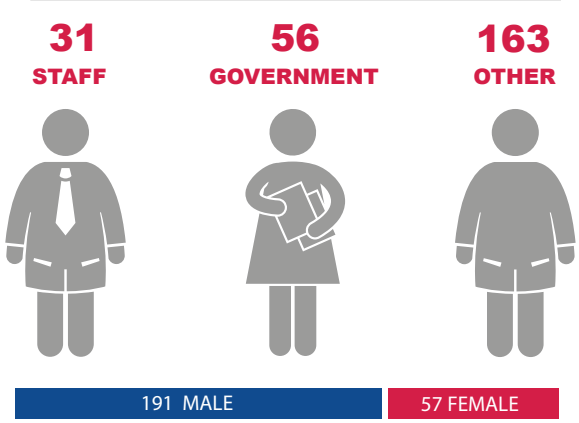
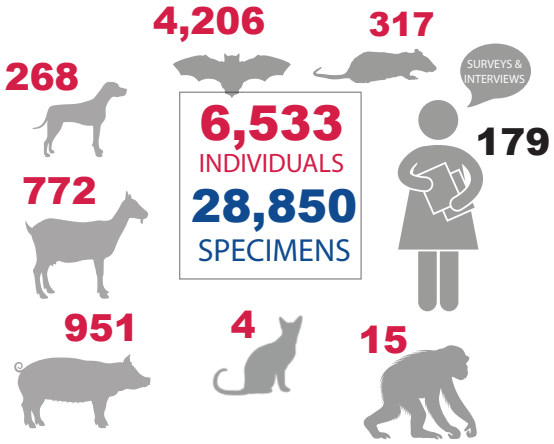
Global Health Security Agenda

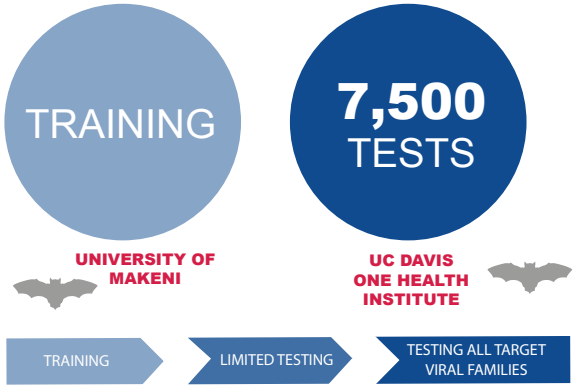
WORKFORCE DEVELOPMENT



ONE HEALTH SURVEILLANCE



LAB STRENGTHENING



*As part of the Ebola Host Project, samples are being tested at Columbia University to accelerate release of viral findings for use for decision-making and risk mitigation efforts.

IMPACT

248 trained in One Health skills

6,533 animals sampled

179 individuals interviewed in behavioral risk investigations

7,500 tests for Ebola and other filoviruses

VIRAL FINDINGS

1
NEW VIRUS

www.predict.global

PREDICT-2

PREDICT SUCCESS STORIES

Training One Health professionals to confront pandemic threats in West Africa

Multinational trainees pause for a moment of good cheer before beginning a long day of animal sampling near Makeni, Sierra Leone. Photo: Dr. Aiah Gbakima, PREDICT/Sierra Leone.

Nowhere are the overarching goals of PREDICT and GHSA more relevant than in Sierra Leone, Guinea, and Liberia. The devastation left by an unprecedented Ebola virus outbreak between 2013 and 2016 revealed the urgent need for increased animal and public health sector capacity strengthening at all levels. In efforts to foster even greater international collaboration and success towards GHSA milestones and aims, the PREDICT/Sierra Leone team successfully conducted a 10-day multi-national continuing education and refresher training on biosafety and biosecurity, field data collection and quality control, and animal sampling for 14 PREDICT staff from the University of Makeni in Sierra Leone, eight staff from the Viral Hemorrhagic Fever laboratory in Guinea, and three staff from the Interregional School of Veterinary Medicine (EISMV) in Senegal.

This training, held at the University of Makeni in Sierra Leone (October 1st–10th, 2017), brought together a diverse group of participants with backgrounds in ecology, animal health, laboratory skills, veterinarians, epidemiologists, and experts in high-hazard virus and animal sampling technique for a rigorous, exciting, and scenario based training to enhance three countries capacity to safely capture, sample, and transport under proper cold-chain conditions biological specimens from remote locations in the field to diagnostic laboratory centers. Especially relevant to West Africa, meticulous detail and training was devoted to personal protective equipment (PPE) usage and proper donning/doffing procedures to ensure worker safety and reduce the risk of occupational exposures to zoonotic pathogens. As a result of this workshop, local animal health capacity was strengthened in biosafety, field surveillance, basic laboratory safety, the social sciences, and behavioral risk investigations. In Sierra Leone, PREDICT training and field experience has empowered staff at the University of Makeni and established a professional cadre of zoonotic disease surveillance professionals ready to confront pandemic threats.

TANZANIA

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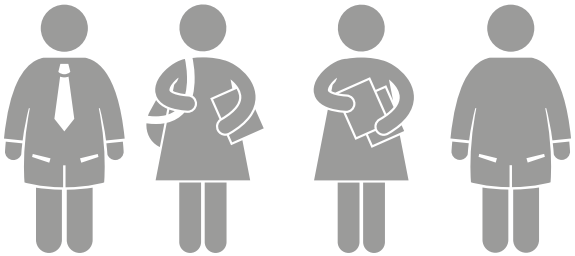
Global Health Security Agenda

WORKFORCE DEVELOPMENT

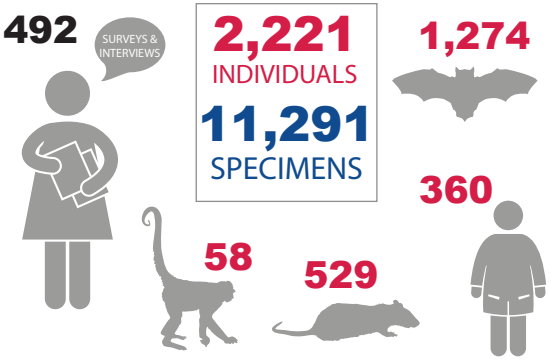
34	27	21	9
STAFF	STUDENTS	GOVERNMENT	OTHER



35 MALE | 45 FEMALE

*9 individuals gender not recorded

ONE HEALTH SURVEILLANCE



LAB STRENGTHENING

672 TESTS — IFAKARA HEALTH INSTITUTE

5,831 TESTS — SOKOINE UNIVERSITY

TRAINING → LIMITED TESTING → TESTING ALL TARGET VIRAL FAMILIES

IMPACT

- **81 trained** in One Health skills
- **2,221 individuals sampled** (360 humans and 1,861 animals)
- **492 individuals interviewed** in behavioral risk investigations
- **6,503 tests** for 5 viral families
- **64 viruses** detected

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VIRAL FINDINGS

51 NEW VIRUSES

13 KNOWN VIRUSES

UGANDA

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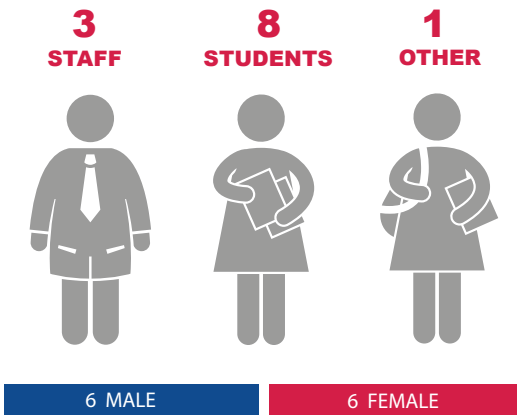
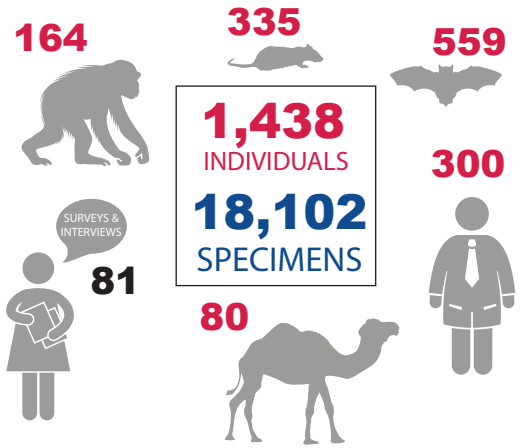
Global Health Security Agenda

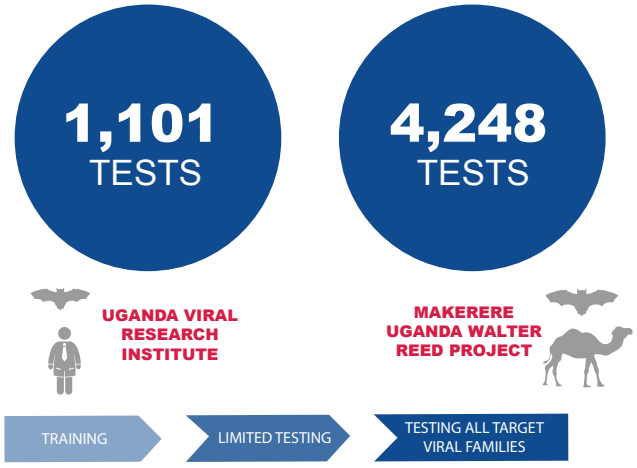
WORKFORCE DEVELOPMENT



ONE HEALTH SURVEILLANCE



LAB STRENGTHENING



IMPACT

- **12 trained** in One Health skills
- **1,438 individuals sampled** (humans and animals)
- **81 individuals interviewed** in behavioral risk investigations
- **5,349 tests** for 5 viral families
- **60 viruses** detected

VIRAL FINDINGS

41
NEW VIRUSES

19
KNOWN VIRUSES

www.predict.global

BANGLADESH

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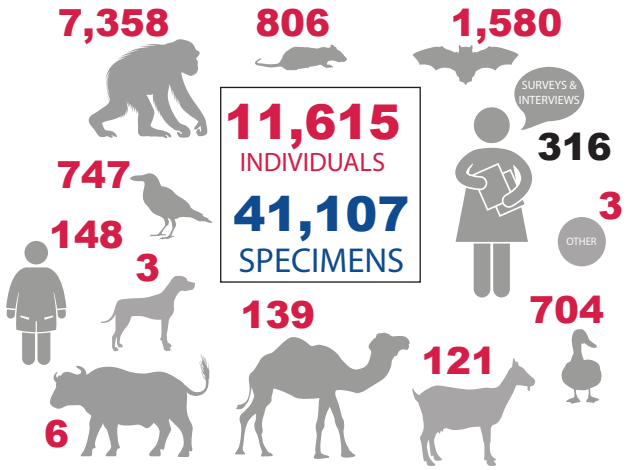
Global Health Security Agenda

WORKFORCE DEVELOPMENT

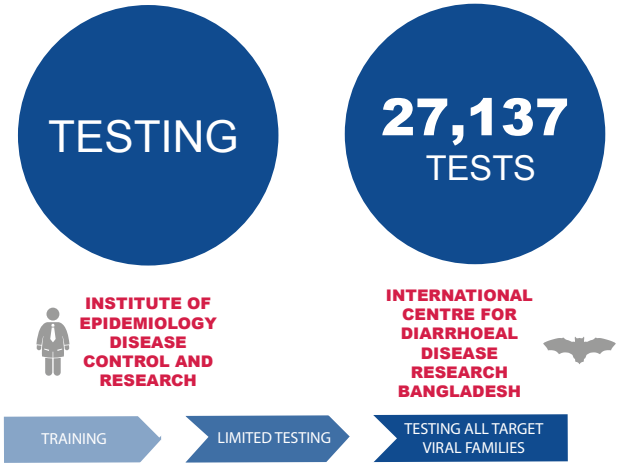
25	74	10	11
STAFF	STUDENTS	GOVERNMENT	OTHER

89 MALE | 25 FEMALE

ONE HEALTH SURVEILLANCE



LAB STRENGTHENING



IMPACT

114 trained in One Health skills

11,615 individuals sampled (148 humans and 11,467 animals)

316 individuals interviewed in behavioral risk investigations

27,981 tests for 5 viral families

267 viruses detected

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VIRAL FINDINGS

220 NEW VIRUSES

22 KNOWN VIRUSES

PREDICT-1

8 NEW VIRUSES

16 PREDICT-1 VIRUSES

1 KNOWN VIRUS

PREDICT-2

PREDICT SUCCESS STORIES

PREDICT outbreak investigation team members collect biological samples from a dead crow in Bangladesh
Photo: PREDICT/ Bangladesh

One Health outbreak response support in Bangladesh

In November through early December 2017, PREDICT assisted Government of Bangladesh partners with sample collection during a crow mortality event. Samples were collected from crows and poultry offal and environmental samples from neighboring live bird markets to investigate and identify the cause of mortality, source of infection, extent of the outbreak, and whether there were any associated human illnesses. The event took place at Mohakhali wireless and Ramna Park, Dhaka Bangladesh. Samples were confirmed to be positive H5N1 avian influenza. PREDICT encouraged notification of OIE and the Department of Livestock Services officially notified OIE on December 26, 2017.

This was the third time since 2015 that PREDICT was requested by the Government of Bangladesh to assist in an outbreak of crow mortality that was later diagnosed as avian influenza. Through the One Health Secretariat, PREDICT collaborated with a team from the Department of Livestock Services (DLS) during sample collection for this recent outbreak to increase the capacity of DLS to respond to crow mortality events. PREDICT and DLS were both involved in Government of Bangladesh meetings to discuss the One Health response to the mortality event and regularly updated the One Health Secretariat. This is the first joint outbreak response for DLS and the PREDICT team through the One Health Secretariat, which reflects the institutionalization of One Health and workforce capacity development in Government of Bangladesh partners.

FACES OF
PREDICT

JINNAT FERDOUS, DVM

Dr. Jinnat Ferdous serves as the inaugural One Health Economics Fellow with the PREDICT-2 project. Dr. Ferdous trained as a Doctor of Veterinary Medicine and also received Masters in Veterinary Epidemiology at Chittagong Veterinary and Animal Sciences University, where she learned economic analysis methods. Prior to joining the PREDICT project she conducted an internship with FAO on food safety. Her unique expertise allows her a strong technical understanding of zoonotic disease systems, epidemiological study design, and economic analysis and interpretation for policy making.

Based at the Institute of Epidemiology, Disease Control and Research in Dhaka City, Bangladesh, her work will assess the economic impact of zoonotic diseases to the public and private sectors as well as individual households, and also inform understanding of the economic implications of disease avoidance behaviors. Given Bangladesh's strong interest and leadership in advancing One Health collaboration, this information can assist country partners in developing disease prevention and control strategies that optimize resource allocation to promote 'whole-of-society' benefits.

"People will listen more to us when we will tell them that you or your sector could lose important economic solvency or revenue per case of Nipah or other zoonotic diseases.
We are trying to make a difference in preventing zoonotic disease by showing these figures to policy makers."
– Dr. Jinnat Ferdous

BANGLADESH

CAMBODIA

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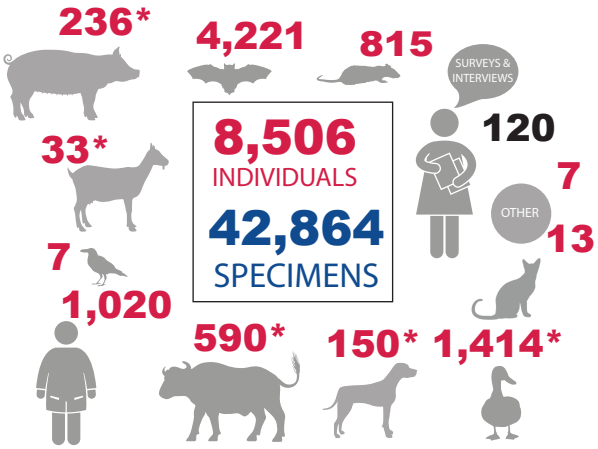
Global Health Security Agenda

WORKFORCE DEVELOPMENT

12	22	7	17
STAFF	STUDENTS	GOVERNMENT	OTHER

34 MALE | 24 FEMALE

ONE HEALTH SURVEILLANCE



*Samples collected in collaboration with FAO

LAB STRENGTHENING

TRAINING → LIMITED TESTING → TESTING ALL TARGET VIRAL FAMILIES

IMPACT

58 trained in One Health skills

8,506 individuals sampled
(1,020 humans and 7,486 animals)

120 individuals interviewed in behavioral risk investigations

15,192 tests for 5 viral families

62 viruses detected

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VIRAL FINDINGS

29 NEW VIRUSES

19 KNOWN VIRUSES

14 PREDICT-1 VIRUSES

PREDICT-1 PREDICT-2

CHINA

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WORKFORCE DEVELOPMENT

29	7	18
STAFF	STUDENTS	GOVERNMENT

26 MALE | 21 FEMALE

ONE HEALTH SURVEILLANCE

1,460

318

2,055 INDIVIDUALS
5,808 SPECIMENS

172 SURVEYS & INTERVIEWS

277

LAB STRENGTHENING

10,481 TESTS — WUHAN INSTITUTE OF VIROLOGY

1,526 TESTS — GUANGDONG CDC

TRAINING → LIMITED TESTING → TESTING ALL TARGET VIRAL FAMILIES

IMPACT

- **47 trained** in One Health skills
- **2,055 individuals sampled** (318 humans and 1,737 animals)
- **172 individuals interviewed** in behavioral risk investigations
- **4,424 tests** for 5 viral families
- **80 viruses** detected

www.predict.global

VIRAL FINDINGS

PREDICT-1

- **46** NEW VIRUSES
- **22** KNOWN VIRUSES

PREDICT-2

- **4** NEW VIRUSES
- **10** PREDICT-1 VIRUSES

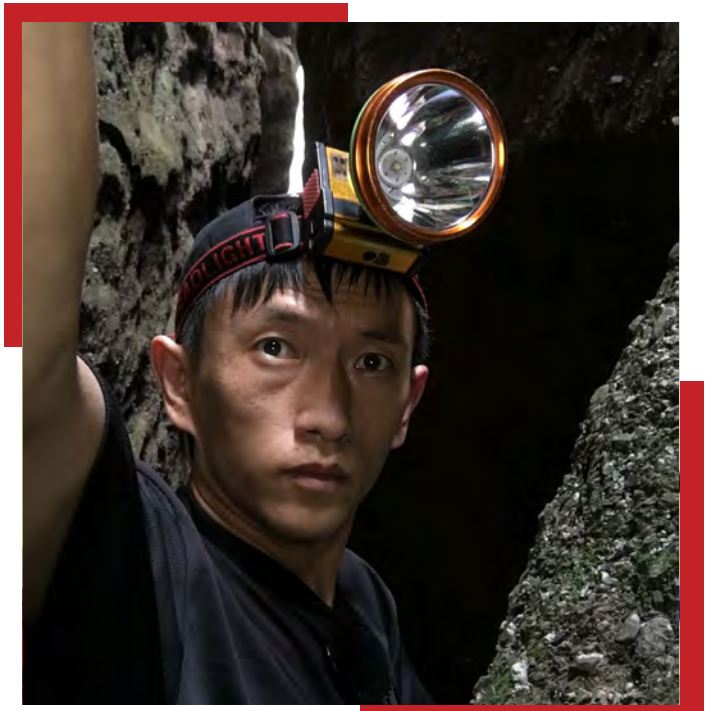
FACES OF
PREDICT

GUANGJIAN ZHU, PhD

Dr. Guangjian Zhu, PREDICT Field Coordinator in China, is one of the most well-known field scientists in the country. Dr. Zhu holds a Master's degree and PhD in ecology and zoonosis, and has extensive field experience in more than 20 provinces across China.

Guangjian's field work with bats began in 2004 during a study to understand disease ecology among bat populations that carry SARS-CoVs. He quickly became an indispensable member of the team, identifying bats as the natural reservoir of SARS-related CoVs. Guangjian also has many subsequent viral discoveries in China.

Dr. Zhu joined EcoHealth Alliance in 2008. During his tenure, he has been coordinating and implementing field surveillance work in China for PREDICT 1 and PREDICT 2, and his field research has contributed to many discoveries. Most importantly, benefiting from PREDICT's knowledge and capacity building, Guangjian has been providing training sessions for field research teams in China at various universities and institutions, raising awareness and improving the standard of biosafety and animal welfare for field wildlife sampling work in China. In 2010, Guangjian won the Ig Nobel Prize in Biology for a study on bats that produced a paper entitled "Fellatio by Fruit Bats Prolongs Copulation Time."



"I believe every individual who works with PREDICT is the key of its success. The greater success of PREDICT in China lies in the sharing and collaborating with the world."
-Dr. Guangjian Zhu

INDIA

USAID FROM THE AMERICAN PEOPLE | PREDICT

Global Health Security Agenda

WORKFORCE DEVELOPMENT

11 STAFF

26 OTHER

18 MALE | 14 FEMALE | 5 UNREPORTED

ONE HEALTH SURVEILLANCE

7

3

4

79 INDIVIDUALS

1,243 SPECIMENS

65

LAB STRENGTHENING

TRAINING

SANJAY GHANDI POSTGRADUATE INSTITUTE OF MEDICAL SCIENCES

TRAINING → LIMITED TESTING → TESTING ALL TARGET VIRAL FAMILIES

IMPACT

37 trained in One Health skills

79 humans sampled

PREDICT/India and Bangladesh teams pose for a picture with an anesthetized macaque during a training on safe live-capture and sampling techniques held in Bangladesh. *Photo credit: PREDICT/Bangladesh*

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INDONESIA

USAID | PREDICT
FROM THE AMERICAN PEOPLE

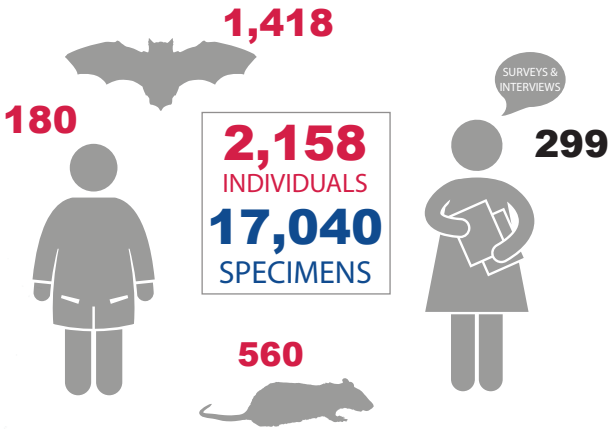
Global Health Security Agenda

WORKFORCE DEVELOPMENT

21	1	19	8
STAFF	STUDENT	GOVERNMENT	OTHER

27 MALE | 22 FEMALE

ONE HEALTH SURVEILLANCE



LAB STRENGTHENING

540 TESTS

EIJKMAN INSTITUTE FOR MOLECULAR BIOLOGY (EIMB)

14,372 TESTS

PRIMATE RESEARCH CENTER BOGOR AGRICULTURAL UNIVERSITY

TRAINING → LIMITED TESTING → TESTING ALL TARGET VIRAL FAMILIES

IMPACT

49 trained in One Health skills

2,158 individuals sampled
(180 humans and 1,978 animals)

299 individuals interviewed in behavioral risk investigations

14,912 tests for 5 viral families

42 viruses detected

www.predict.global

VIRAL FINDINGS

PREDICT-1	PREDICT-2
14 NEW VIRUSES	**9** NEW VIRUSES
6 KNOWN VIRUSES	**13** PREDICT-1 VIRUSES

LAO PDR

USAID FROM THE AMERICAN PEOPLE | PREDICT

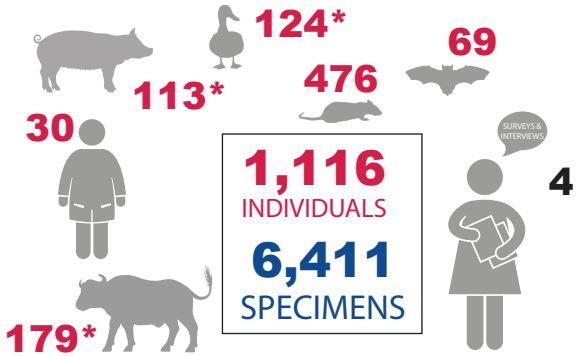
Global Health Security Agenda

WORKFORCE DEVELOPMENT

29	19	8
STAFF	GOVERNMENT	OTHER

22 MALE | 18 FEMALE

ONE HEALTH SURVEILLANCE



*Samples collected in collaboration with FAO

LAB STRENGTHENING

TRAINING

9,640 TESTS

NATIONAL CENTER FOR LABORATORY AND EPIDEMIOLOGY

NATIONAL ANIMAL HEALTH LABORATORY

TRAINING → LIMITED TESTING → TESTING ALL TARGET VIRAL FAMILIES

IMPACT

40 trained in One Health skills

990 individuals sampled (humans and animals)

5,435 tests for 5 viral families

21 viruses detected

www.predict.global

VIRAL FINDINGS

PREDICT-1	PREDICT-2
16 NEW VIRUSES	1 PREDICT-1 VIRUS
5 KNOWN VIRUSES	

MALAYSIA

USAID | PREDICT
FROM THE AMERICAN PEOPLE

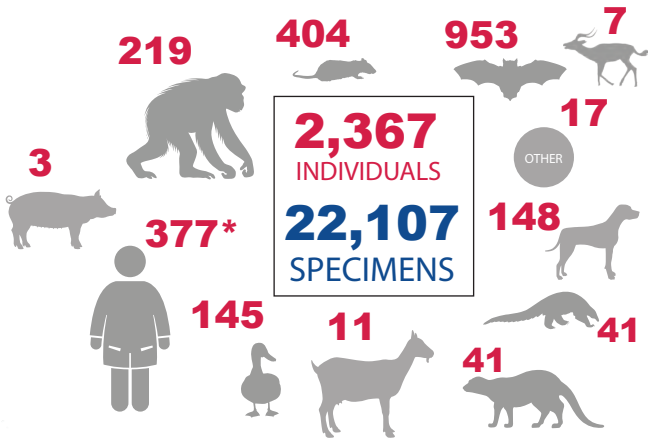
Global Health Security Agenda

WORKFORCE DEVELOPMENT

126	19	200	60
STAFF	STUDENTS	GOVERNMENT	OTHER

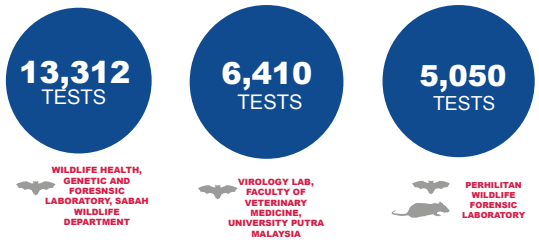
190 MALE | 118 FEMALE

ONE HEALTH SURVEILLANCE



*Samples collected in collaboration with the Malaysian government

LAB STRENGTHENING



TRAINING | LIMITED TESTING | TESTING ALL TARGET VIRAL FAMILIES

IMPACT

308 trained in One Health skills

2,367 individuals sampled
(377 humans and 1,989 animals)

24,772 tests for 5 viral families

103 viruses detected

www.predict.global

VIRAL FINDINGS

PREDICT-1		PREDICT-2	
59 NEW VIRUSES		15 NEW VIRUSES	
23 KNOWN VIRUSES		6 PREDICT-1 VIRUSES	

MONGOLIA

USAID | PREDICT
FROM THE AMERICAN PEOPLE

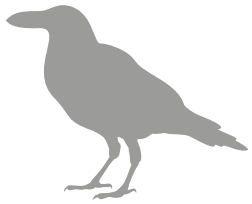
WORKFORCE DEVELOPMENT

8	60	9
STAFF	GOVERNMENT	OTHER

51 MALE | 25 FEMALE

ONE HEALTH SURVEILLANCE

2,268



2,268 INDIVIDUALS

4,660 SPECIMENS

LAB STRENGTHENING

3,400 TESTS

STATE CENTRAL VETERINARY LABORATORY

TRAINING → LIMITED TESTING → TESTING ALL TARGET VIRAL FAMILIES

IMPACT

76 trained in One Health skills

2,268 wild birds sampled

3,400 tests for influenza viruses

1 virus detected

VIRAL FINDINGS

1
KNOWN VIRUS

www.predict.global

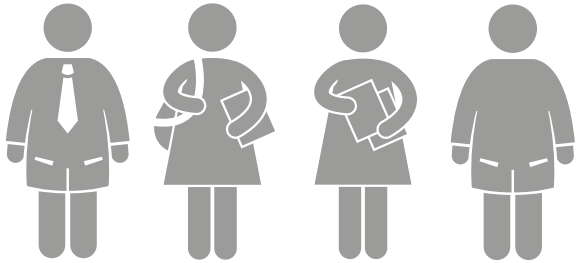
PREDICT-2

MYANMAR

USAID | PREDICT
FROM THE AMERICAN PEOPLE

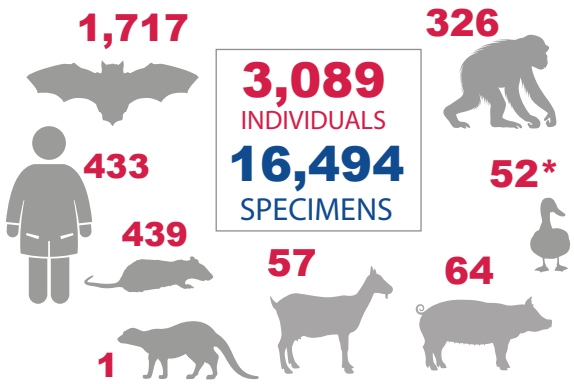
WORKFORCE DEVELOPMENT

4	28	52	393
STAFF	STUDENTS	GOVERNMENT	OTHER



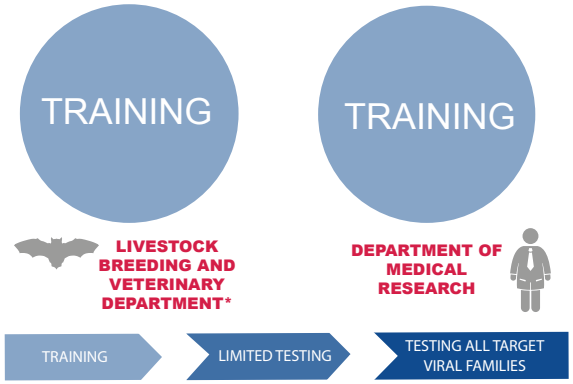
162 MALE | 315 FEMALE

ONE HEALTH SURVEILLANCE



*Samples collected in collaboration with FAO

LAB STRENGTHENING



*Samples were tested at UC Davis during training of DMR lab technicians. 4,284 tests were conducted at UC Davis across 5 viral families as part of the training.

IMPACT

477 trained in One Health skills

3,089 individuals sampled
(433 wildlife and 2,656 domestic animals)

96 individuals interviewed in behavioral risk investigations

4,284 tests for 5 viral families

2 viruses detected

www.predict.global

VIRAL FINDINGS

1
NEW VIRUS

1
PREDICT-1 VIRUS

PREDICT-2

NEPAL

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WORKFORCE DEVELOPMENT

36 STAFF
4 GOVERNMENT
3 OTHER

28 MALE | 15 FEMALE

ONE HEALTH SURVEILLANCE

956
335
154
2,908 INDIVIDUALS
15,049 SPECIMENS
SURVEYS & INTERVIEWS
136
905
558

LAB STRENGTHENING

18,026 TESTS

CENTER FOR MOLECULAR DYNAMICS NEPAL / INTREPID NEPAL

TRAINING → LIMITED TESTING → TESTING ALL TARGET VIRAL FAMILIES

IMPACT

43 trained in One Health skills

2,908 individuals sampled (956 humans and 1,952 animals)

131 individuals interviewed in behavioral risk investigations

10,788 tests for 5 viral families

17 viruses detected

www.predict.global

VIRAL FINDINGS

6 NEW VIRUSES

5 KNOWN VIRUSES

1 NEW VIRUS

7 PREDICT-1 VIRUSES

PREDICT-1 PREDICT-2

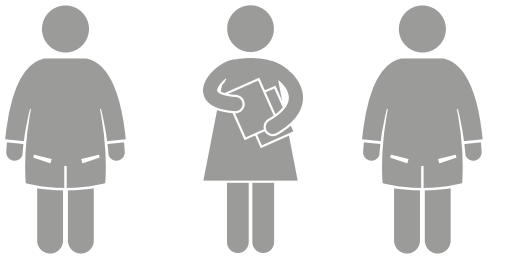
THAILAND

USAID FROM THE AMERICAN PEOPLE | PREDICT

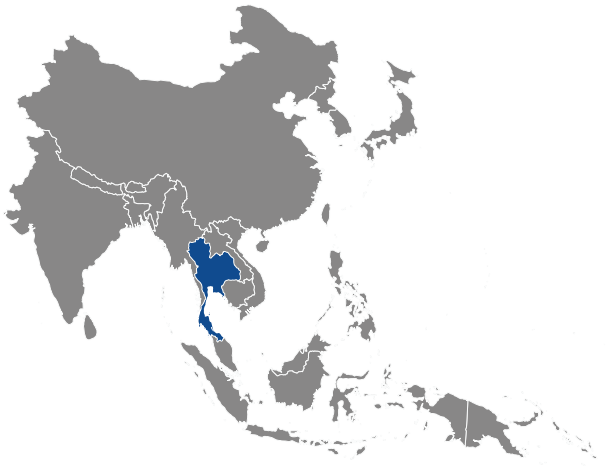
Global Health Security Agenda

WORKFORCE DEVELOPMENT

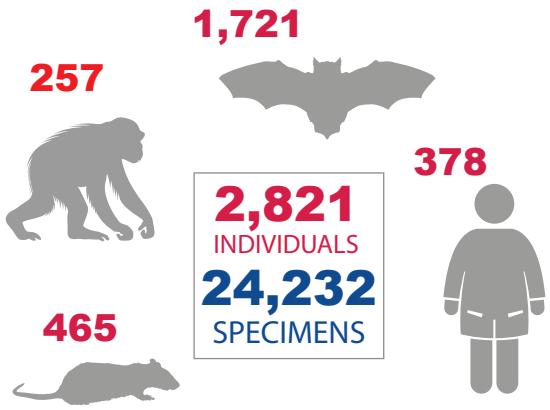
57	24	2
STAFF	GOVERNMENT	OTHER



32 MALE | 27 FEMALE



ONE HEALTH SURVEILLANCE



LAB STRENGTHENING

22,141 TESTS

WHO-CC VIRAL ZOONOSES CHULALONGKORN UNIVERSITY

TRAINING → LIMITED TESTING → TESTING ALL TARGET VIRAL FAMILIES

IMPACT

59 trained in One Health skills

2,821 individuals sampled
(378 humans and 2,443 animals)

22,141 tests for 5 viral families

150 viruses detected

www.predict.global

VIRAL FINDINGS

PREDICT-1	PREDICT-2
83 NEW VIRUSES	**2** NEW VIRUSES
	28 PREDICT-1 VIRUSES
34 KNOWN VIRUSES	**3** KNOWN VIRUSES

VIET NAM

USAID | PREDICT
FROM THE AMERICAN PEOPLE

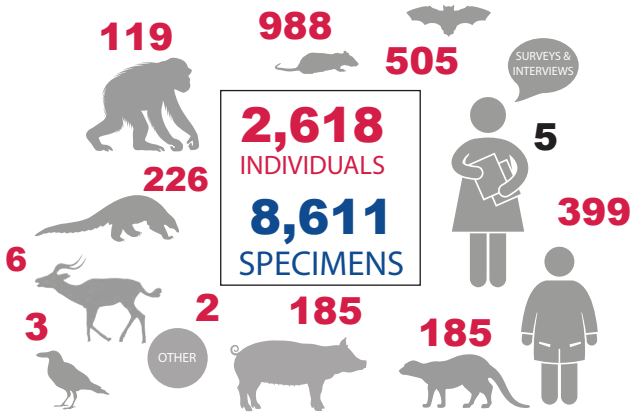
Global Health Security Agenda

WORKFORCE DEVELOPMENT

6	7	35	102
STAFF	STUDENTS	GOVERNMENT	OTHER

97 MALE | 53 FEMALE

ONE HEALTH SURVEILLANCE



*Samples collected in collaboration with FAO

LAB STRENGTHENING

1,399 TESTS	4,158 TESTS	1,218 TESTS
VIET NAM NATIONAL UNIVERSITY OF AGRICULTURE	REGIONAL ANIMAL HEALTH OFFICE NO. 6	NATIONAL INSTITUTE OF HYGIENE AND EPIDEMIOLOGY (NIHE)

TRAINING → LIMITED TESTING → TESTING ALL TARGET VIRAL FAMILIES

IMPACT

- **150 trained** in One Health skills
- **2,618 individuals sampled** (399 humans and 2,219 animals)
- **51 individuals interviewed** in behavioral risk investigations
- **6,775 tests** for 5 viral families
- **39 viruses** detected

www.predict.global

VIRAL FINDINGS

PREDICT-1	PREDICT-2
25 NEW VIRUSES	2 PREDICT-1 VIRUSES
12 KNOWN VIRUSES	

PREDICT SUCCESS STORIES

One Health surveillance at wildlife farms in Viet Nam

A dog stands next to a cage at a porcupine farm in Dong Nai Province where PREDICT is conducting zoonotic disease surveillance and behavioral risk investigations. Photo: PREDICT/Viet Nam.

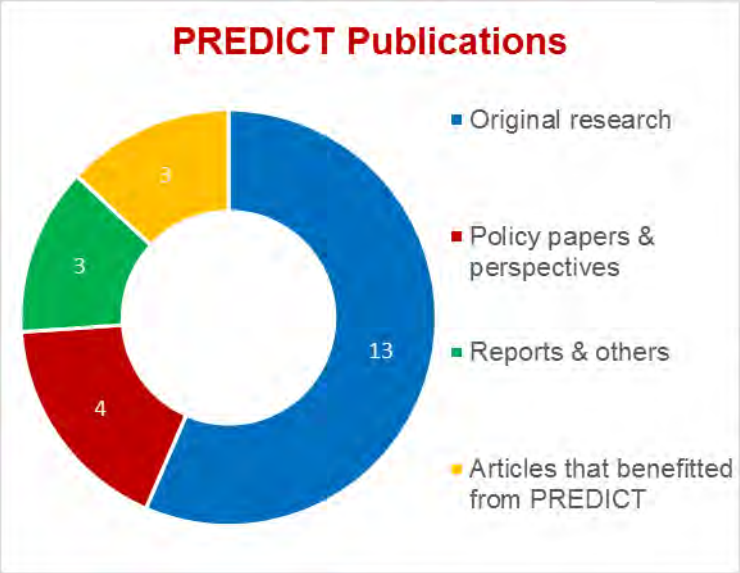
Responding to JEE calls to bolster Viet Nam's capability for zoonotic disease surveillance in wildlife, PREDICT in Viet Nam focused on the wildlife farm interface as part of the One Health approach to facilitate understanding of the dynamics of zoonotic virus evolution and spillover from animals to people and to inform prevention and control guidelines. The expansion of wildlife farming, alongside poor farming practices, such as shared captive breeding of different species, poor hygiene condition and veterinary care, increased wildlife-human close contact, and potential of viral presence and spillover in the process of wildlife transport and trade, makes wildlife farms "hot spots" of high-risk disease transmission interfaces. The Viet Nam Ministry of Health and Ministry of Agriculture and Rural Development expressed interest in examining this complex interface and collaborated with PREDICT/Viet Nam to conduct concurrent surveillance in Dong Nai, a province with many wildlife farms.

Through the end of March 2018, the collaborating wildlife team collected over 1,800 samples from 850 individuals across rodent, carnivore, and non-human primate taxa. PREDICT concurrently (at the same location and within the same quarter) studied human health by collecting samples and questionnaires from 122 people directly engaged in the wildlife farm activities. In addition to the questionnaire, to further characterize and understand behaviors that facilitate pathogen transmission and identify risk mitigation measures, additional behavioral risk investigations were launched and 19 ethnographic interviews conducted. All collected biological samples were safely transported to project partner laboratories for zoonotic disease testing and viral discovery using PREDICT protocols. Lastly, through close partnership with the human health partners, including the National Institute of Hygiene and Epidemiology, Dong Nai Preventive Medicine and provincial hospitals, PREDICT launched syndromic surveillance in hospitals serving the wildlife farming community.

V. PUBLICATIONS & PRODUCTS

Publications and Products

From October 2017 to March 2018, PREDICT research led to 23 publications, including 13 original research articles. Articles appeared in many top-tier journals including *Nature, Science, The Bulletin of the World Health Organization, The Philosophical Transactions of the Royal Society B,* and *Emerging Infectious Diseases.* A bibliography of all publications over the reporting period is provided below, sorted by type of publication. For a comprehensive bibliography containing all PREDICT publications to date, please visit: www.publications.predict.global



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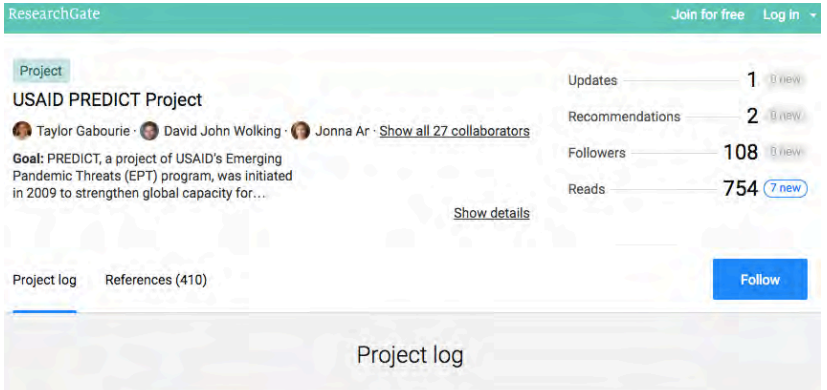

Follow PREDICT on ResearchGate to explore our current work, receive notifications of new publications, and interact with our authors.

In the Media

PREDICT was featured in a number of films/videos, radio programs, news articles, and press releases, further extending the project's global reach. Links to news and other media are found on the PREDICT website and Twitter.

USAID | PREDICT NEWS
FROM THE AMERICAN PEOPLE

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Featured stories

Smithsonian Magazine: Can Virus Hunters Stop the Next Pandemic Before It Happens?

PREDICT's Dr. Kevin Olival joins Indonesian hunters to find the next undiscovered zoonotic virus.

Dr. Kevin Olival and the USAID PREDICT wildlife team surveying areas for bat trapping at the entrance to a cave in Thailand. (Copyright 2018 EcoHealth Alliance)

In Thailand, Dr. Supaporn Wacharapluesadee is testing fruit bats and pigs with help from local experts & volunteers.

On TV

Check your local television provider for the 3-part series #InvisibleKillers on the Discovery & Science Channels featuring PREDICT in Parts #1 Influenza & #2 Ebola.

International Buzz

The Guardian Nigeria recognizes the work of the Global Virome Project (GVP), including PREDICT's Dr. Jonna Mazet.

ISTOÉ: Projeto quer identificar vírus que possam causar a próxima pandemia

Brazilian Magazine ISTOÉ Recognizes PREDICT efforts and its international partners.

Tec Review Monterrey: Esta iniciativa busca 'cazar' virus para prevenir pandemia

Monterrey, Mexico based magazine also shines light on the hunt to prevent the next virus epidemic.

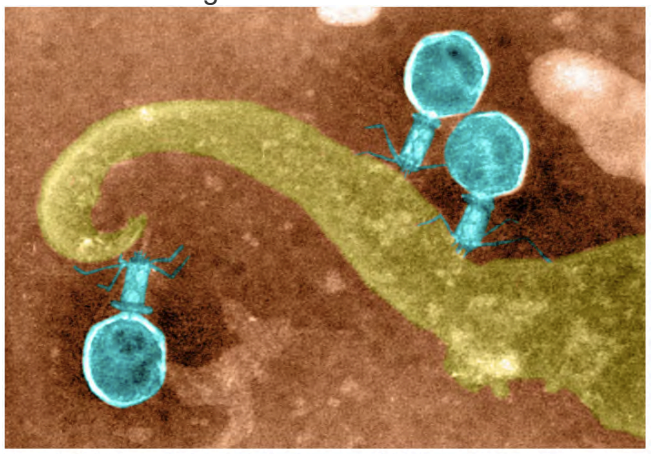
News & Radio

Scientists Trying To Understand Viruses Before They Become Pandemics

Dr. Mazet sits down with KJZZ in Phoenix to discuss identifying & preparing for viruses that could jump to humans.

New York Times: Trillions Upon Trillions of Viruses Fall From the Sky Each Day

PREDICT's Dr. Peter Daszak speaks with the New York Times about the ecological effects of viral infections.



Viruses attached to a fragment of a bacterial cell wall. "Viruses modulate the function and evolution of all living things," scientists wrote last year. "But to what extent remains a mystery."
Biophoto Associates/Science Source

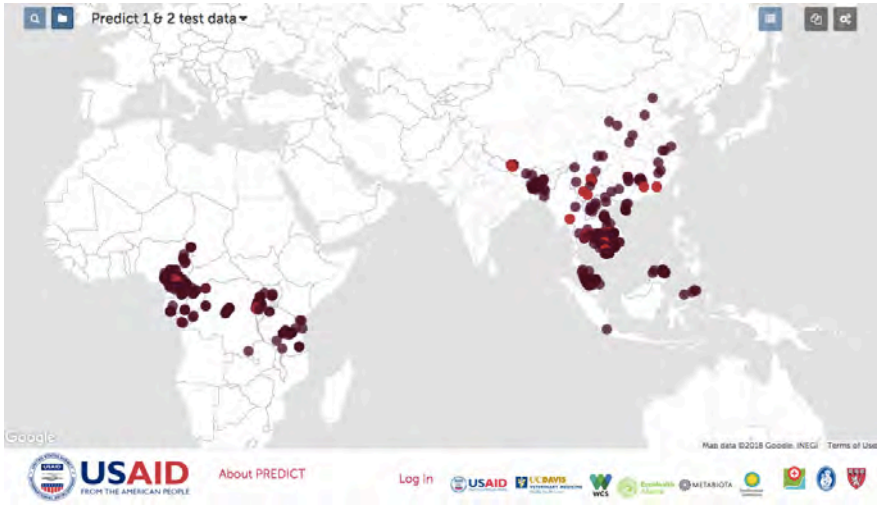
Wired: The Race to Find the Next Pandemic – Before it Finds Us

In Southern China, PREDICT & EcoHealth Alliance helped identify the mysterious cause of piglet deaths.

The Atlantic: Is It Possible to Predict the Next Pandemic?

The Atlantic spotlights the Global Virome Project (GVP).

Stay up to date with PREDICT on Healthmap



Coming Soon

EPIDEMICS GOING VIRAL: Innovation vs. Nature

Register for the free Live Web Event on Friday April 27, featuring PREDICT's Global Director Dr. Jonna Mazet.

APPENDIX

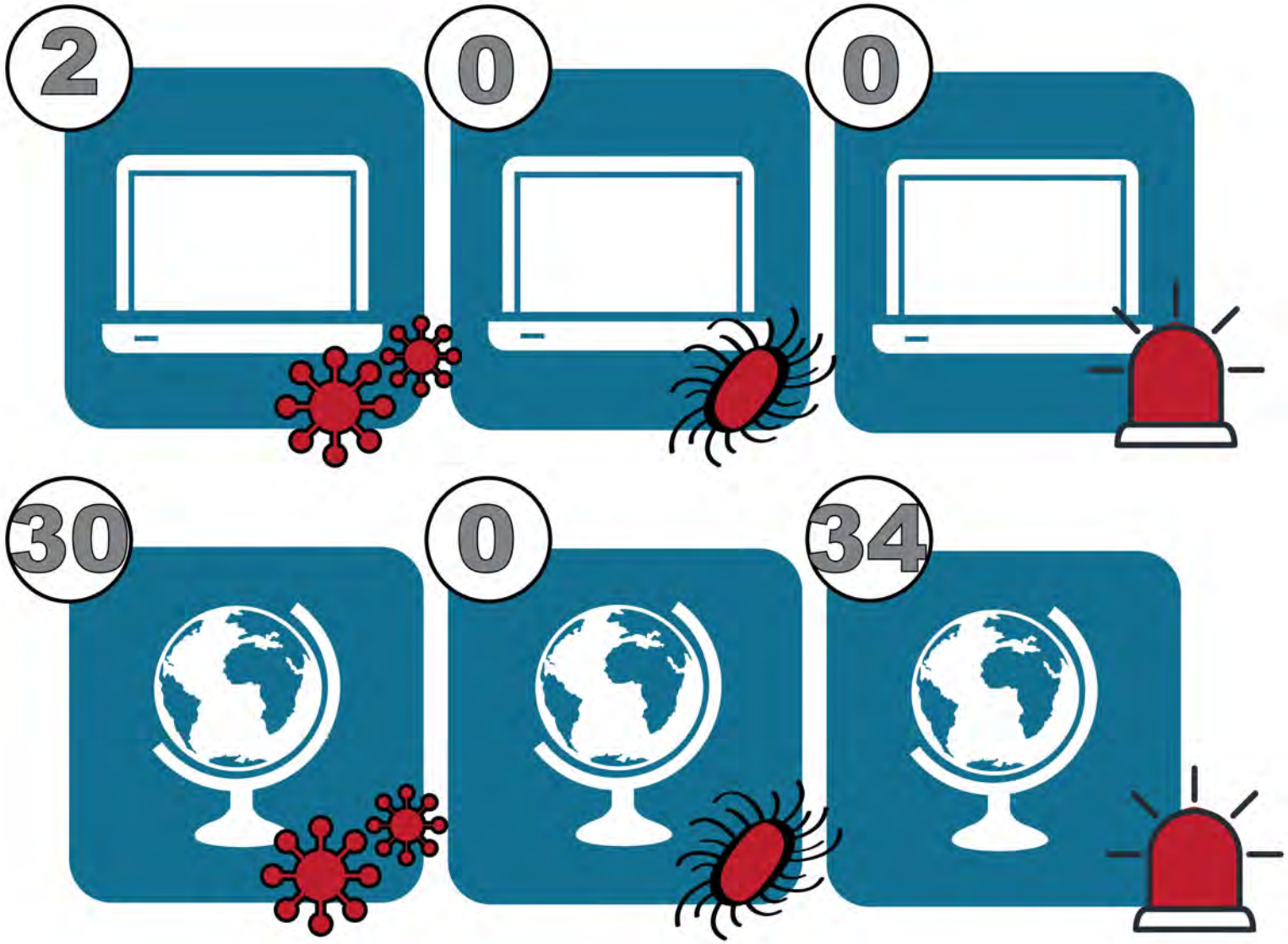
Appendix 1. Viral findings approved for release broken out by country, taxa and season in which each virus was detected

Country	Virus	Taxa	Season 1 (Jan-June 2015)	Season 2 (July-Dec 2015)	Season 1 (Jan-June 2016)	Season 2 (July-Dec 2016)
Cambodia	PREDICT_CoV-25	Bats		1		
	PREDICT_PMV-13	Bats		6		
	PREDICT_PMV-63	Bats		1		
	PREDICT_PMV-66	Bats		3		
	PREDICT_PMV-67	Bats		9		
	PREDICT_RbdV-21	Bats		1		
	PREDICT_RbdV-28	Bats		1		
	PREDICT_RbdV-31	Bats		2		
	PREDICT_RbdV-32	Bats		1		
	PREDICT_RbdV-33	Bats		1		
	Strain of Bat coronavirus 512/2005	Bats		2		
	Strain of Lonquan Aa mouse coronavirus	Rodents/shrews		24		
	Strain of Murine coronavirus	Rodents/shrews		53		
	Thottapalayam virus	Rodents/shrews		2		
Cameroon	Monkey pox	Environmental sample				1
		Non-human primates				3
	PREDICT_CoV-30	Bats		1		
	PREDICT_CoV-35	Bats		1		
	PREDICT_CoV-66	Bats		1		
	PREDICT_CoV-75	Carnivores			1	
	PREDICT_CoV-81	Bats				2
	PREDICT_PMV-79	Bats			1	
	PREDICT_PMV-80	Bats			1	
	PREDICT_PMV-82	Bats			1	

	PREDICT_PMV-91	Rodents/shrews				1
	strain of Human Coronavirus 229E	Bats			2	5
China	Influenza A	Humans				1
	PREDICT_CoV-22	Bats			9	
	PREDICT_CoV-79	Bats			8	
	PREDICT_PMV-49	Bats			1	
	PREDICT_PMV-88	Bats			1	
	PREDICT_PMV-89	Bats			1	
	PREDICT_PMV-90	Bats			1	
	Strain of Bat Coronavirus 1	Bats				22
	Strain of Bat Coronavirus HKU10	Bats			4	
	Strain of Bat coronavirus HKU2	Bats			1	
	Strain of Rhinolophus/Hipposideros Alphacoronavirus	Bats			1	
	Strain of SARS-related betacoronavirus	Bats			1	
DR Congo	Strain of Bat coronavirus Hipposideros	Bats				1
	Strain of Eidolon bat coronavirus/Kenya/KY24/2006	Bats				8
	Strain of Kenya bat coronavirus/BtKY56/BtKY55	Bats		1	1	
	Strain of Pan paniscus lymphocryptovirus 1	Non-human primates			3	
Lao PDR	Strain of Lonquan Aa mouse coronavirus	Rodents/shrews				2
Malaysia	PREDICT_CoV-76	Bats		2		
	PREDICT_CoV-78	Bats		2		
	PREDICT_CoV-80	Bats		2		
	PREDICT_PMV-72	Bats		1		
	PREDICT_PMV-81	Bats		3		

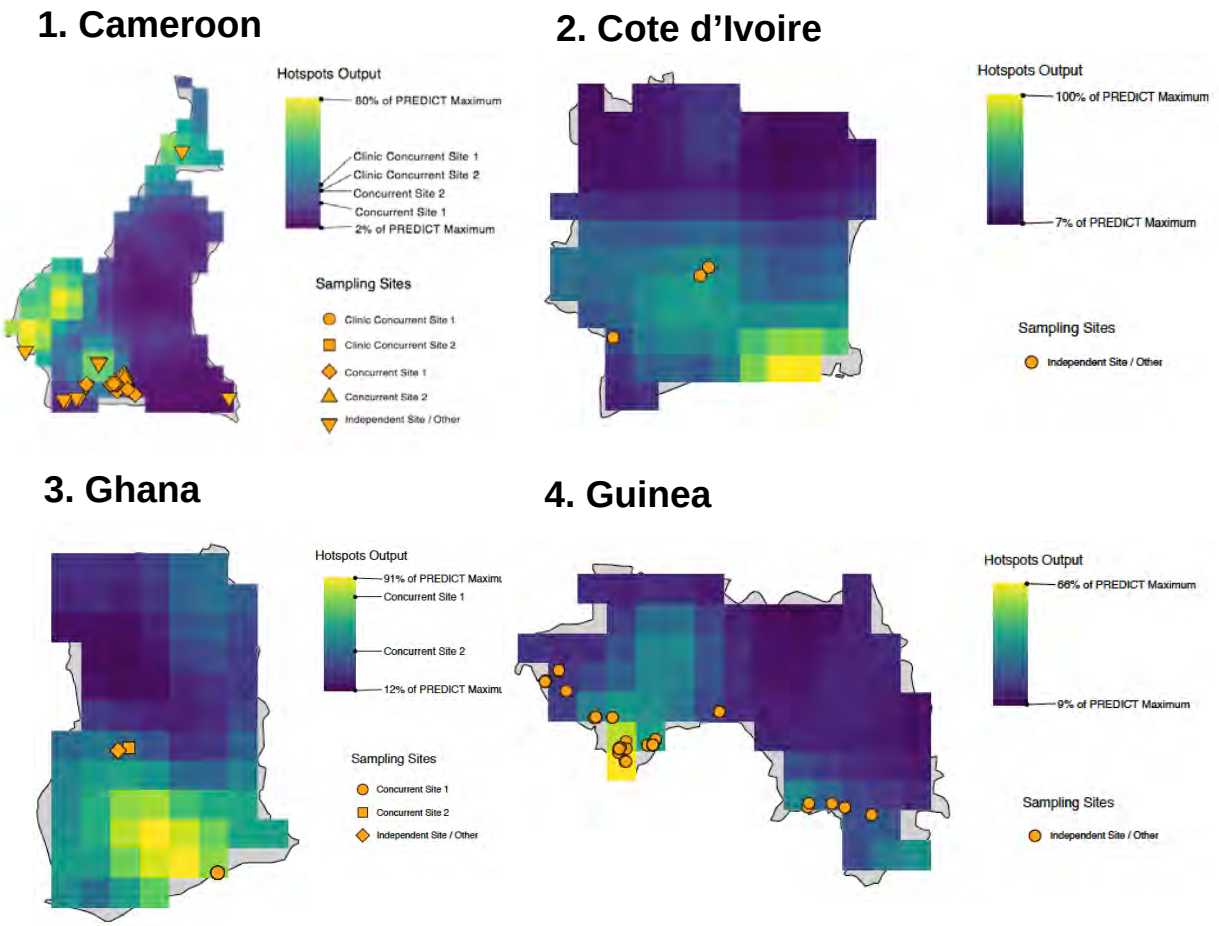
Mongolia	Influenza A	Birds			15	31
Myanmar	PREDICT_CoV-47	Bats			1	
	PREDICT_CoV-82	Bats			3	
Nepal	Influenza A	Birds		10		
		Humans				2
	Newcastle Disease Virus	Birds		8		
	PREDICT_PMV-83	Rodents/shrews		1		
	Strain of Duck Coronavirus	Birds		16		
	Strain of Infectious bronchitis virus (IBV)	Birds		3		
	Strain of Murine coronavirus	Rodents/shrews		3		
Rwanda	PREDICT_CoV-44	Bats		7		
	PREDICT_CoV-77	Bats		1		
	Strain of Chaerephon bat coronavirus/Kenya/KY22/2006	Bats		1		
	Strain of Human Coronavirus 229E	Bats		2		
	Strain of Kenya bat coronavirus BtKY33/2006	Bats		1		
Thailand	Nipah Virus	Bats			1	
	PREDICT_CoV-17	Bats			6	
	PREDICT_CoV-22	Bats		7		
	PREDICT_CoV-27	Bats		3		
	PREDICT_CoV-47	Bats		5		
	PREDICT_PMV-2	Bats			1	
	Strain of Bat Coronavirus 1	Bats		1		
Viet Nam	Influenza A	Swine				15
	Strain of Porcine Parainfluenzavirus 1	Swine	1			2

M&E 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.

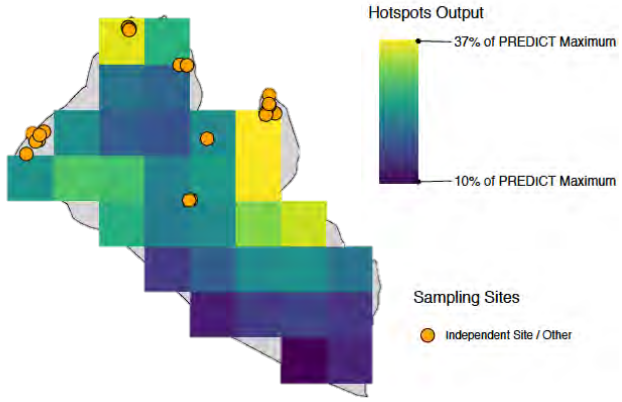
Country-level zoonotic virus spillover risk maps



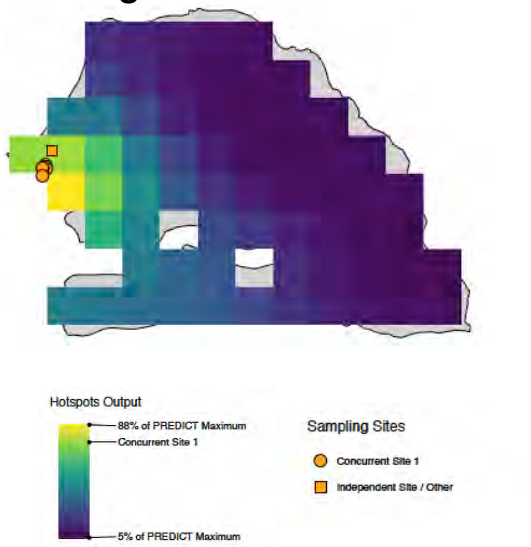
1-30. Country level zoonotic virus spillover maps. For PREDICT's All-country meeting in Brussels, Belgium in January 2018, we created country-specific relative spatial risk maps of novel zoonotic viral spillover, based on the PREDICT Hotspots 2.0 model, a global model fit to 224 new disease emergence events reported globally.

Country-level zoonotic virus spillover risk maps

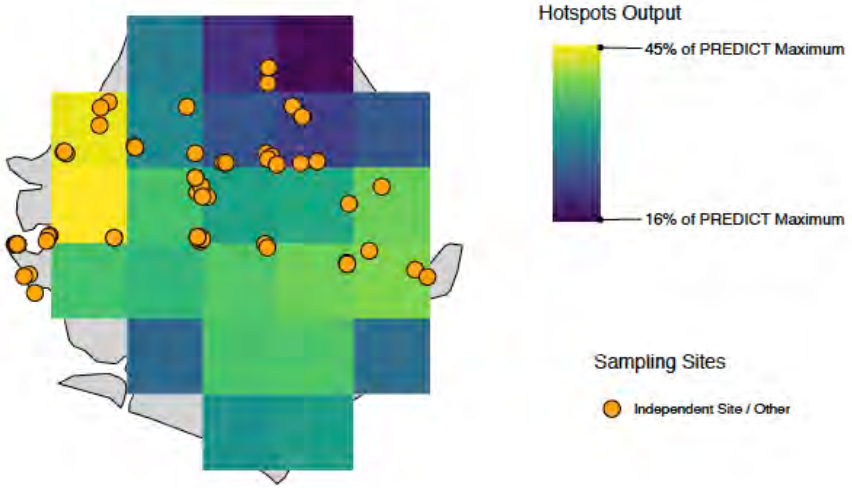
5. Liberia



6. Senegal

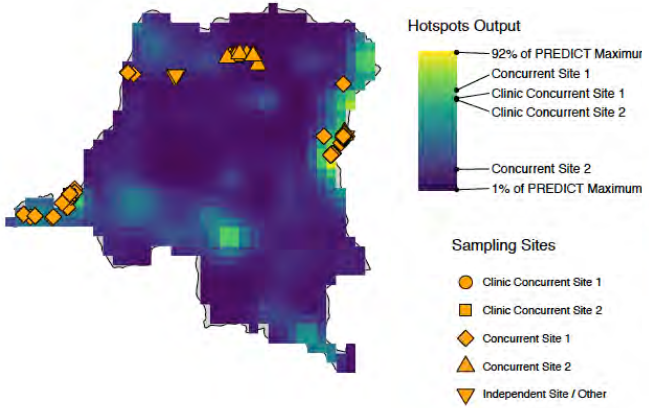


7. Sierra Leone

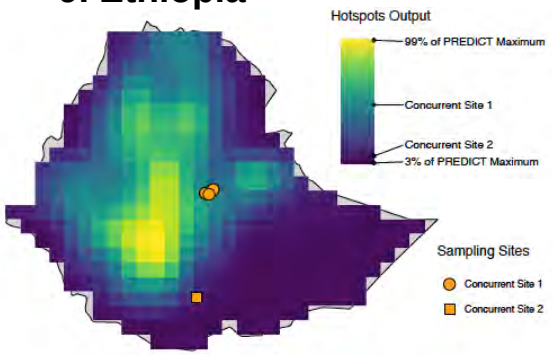


Country-level zoonotic virus spillover risk maps

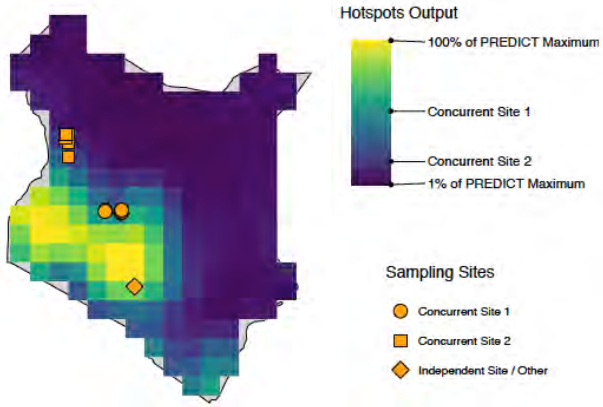
8. Democratic Republic of Congo



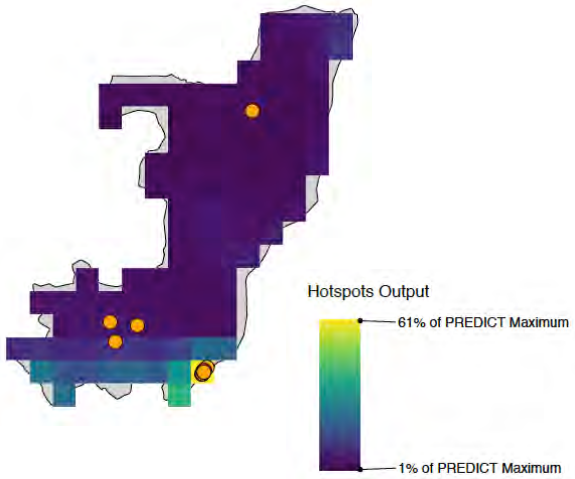
9. Ethiopia



10. Kenya



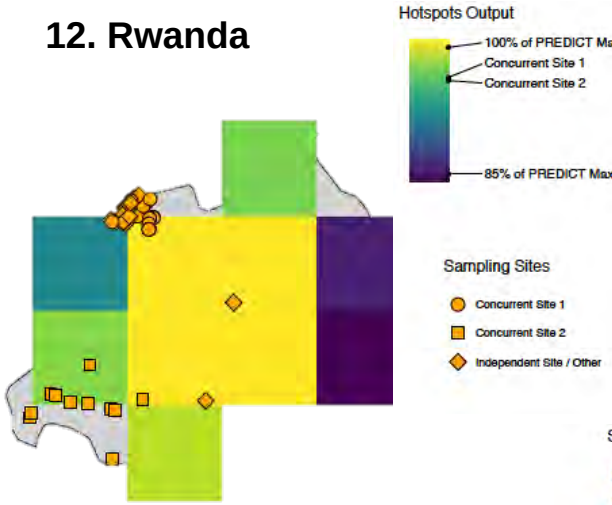
11. Republic of Congo



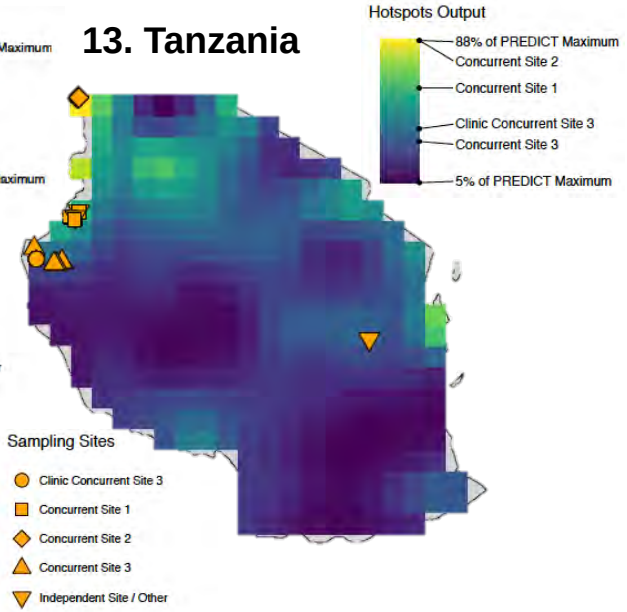
12-14 East & Central Africa

Country-level zoonotic virus spillover risk maps

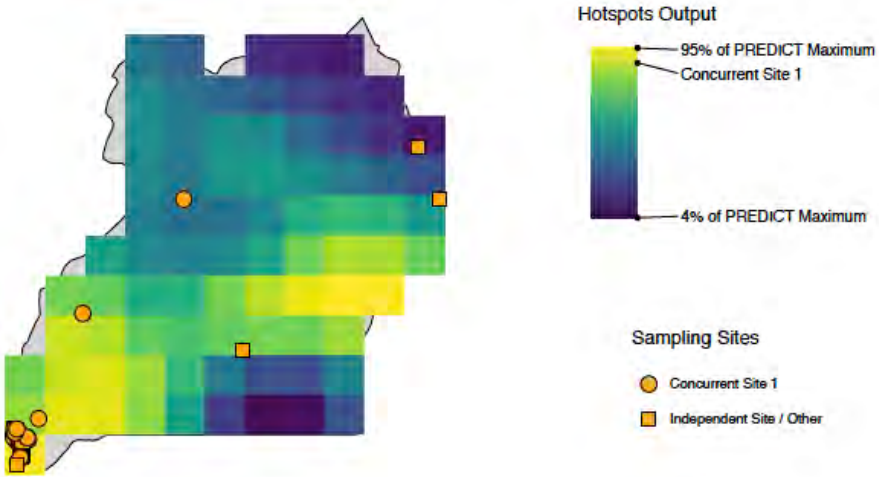
12. Rwanda



13. Tanzania

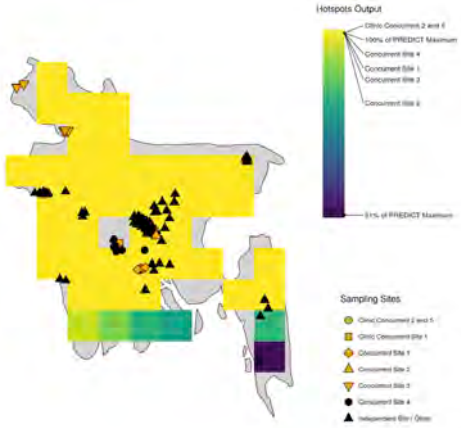


14. Uganda

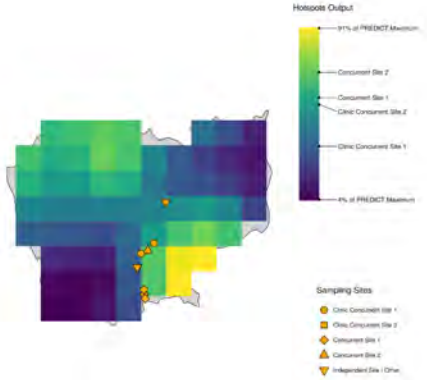


Country-level zoonotic virus spillover risk maps

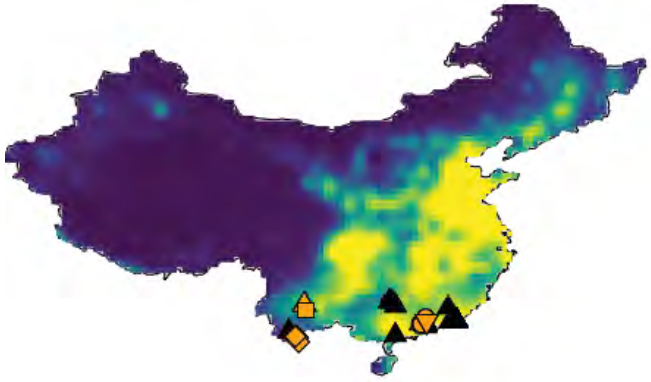
15. Bangladesh



16. Cambodia



17. China



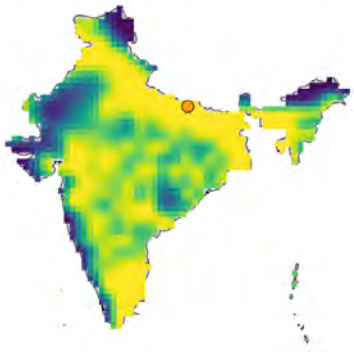
Hotspots Output

- 100% of PREDICT Maximum
- Concurrent Site 4
- Clinic Concurrent Site 1
- Concurrent Site 5
- Concurrent Site 3
- Concurrent Site 1
- Concurrent Site 2
- 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

18. India



Hotspots Output

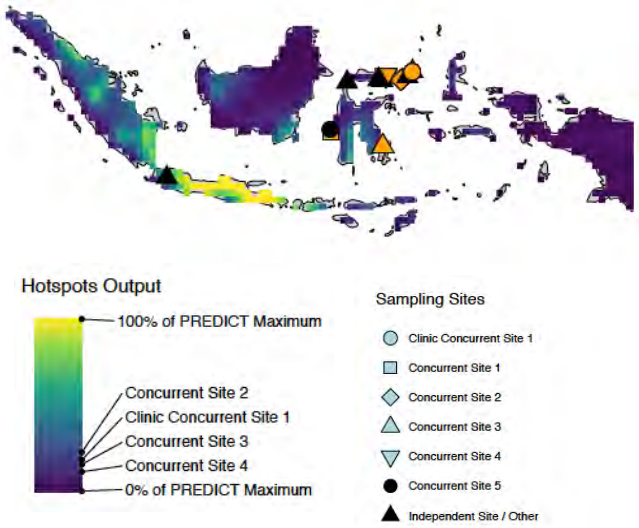
- 100% of PREDICT Maximum
- Clinic Concurrent Site 1
- 1% of PREDICT Maximum

Sampling Sites

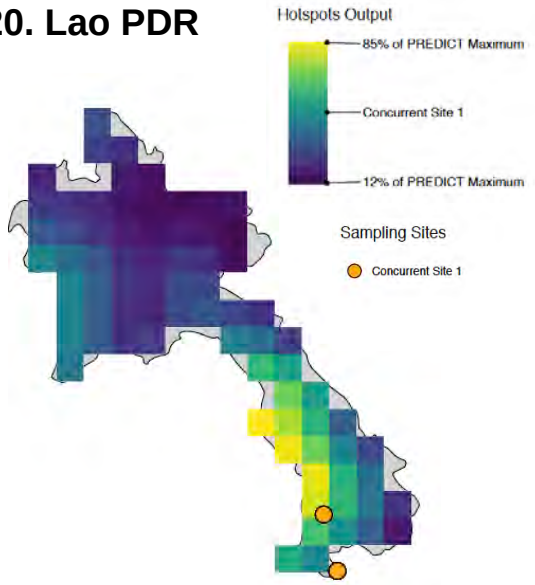
- Clinic Concurrent Site 1

Country-level zoonotic virus spillover risk maps

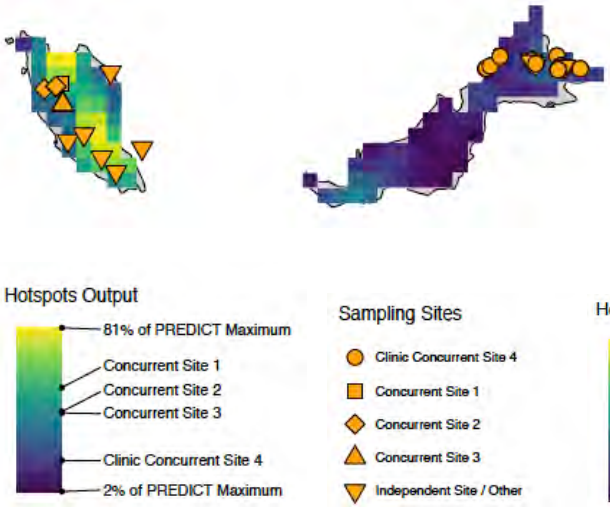
19. Indonesia



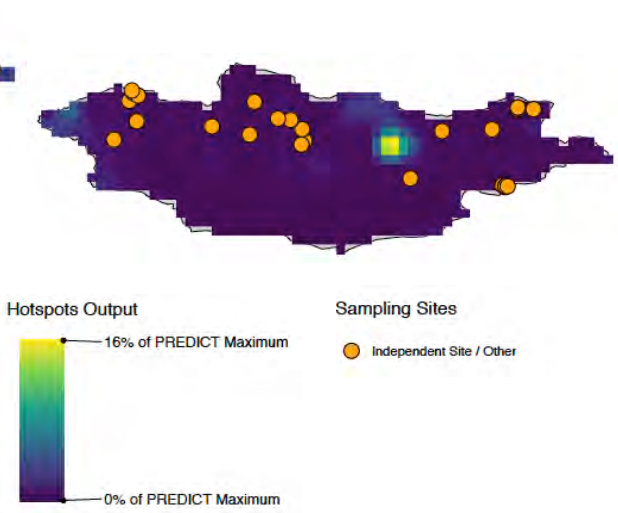
20. Lao PDR



21. Malaysia

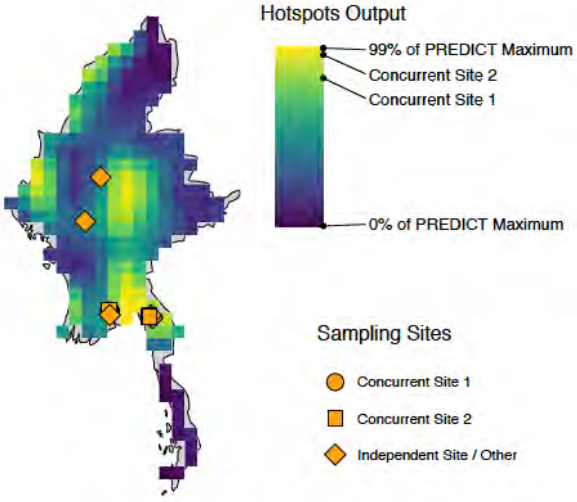


22. Mongolia

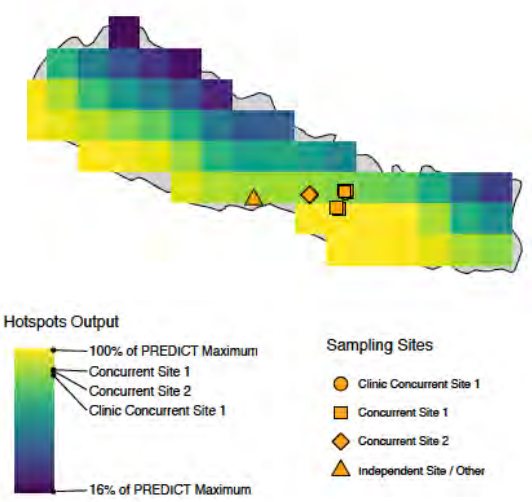


Country-level zoonotic virus spillover risk maps

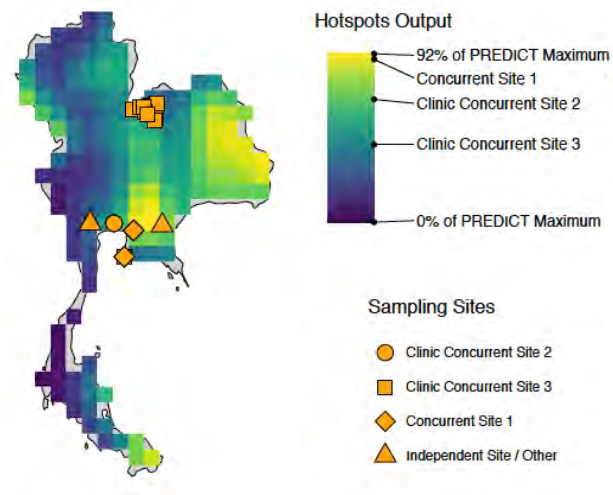
23. Myanmar



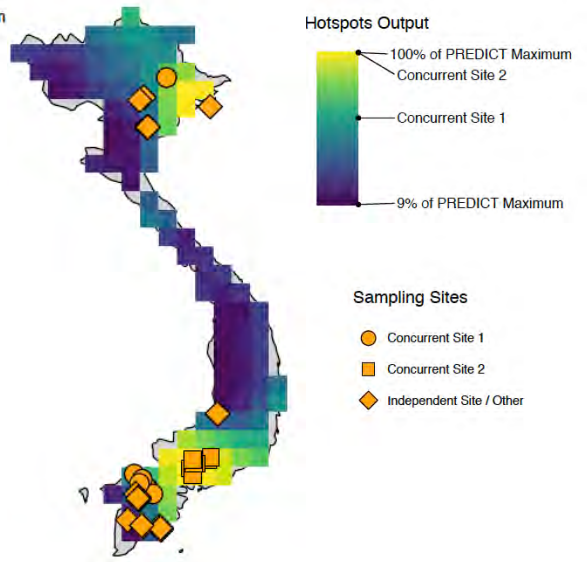
24. Nepal



25. Thailand

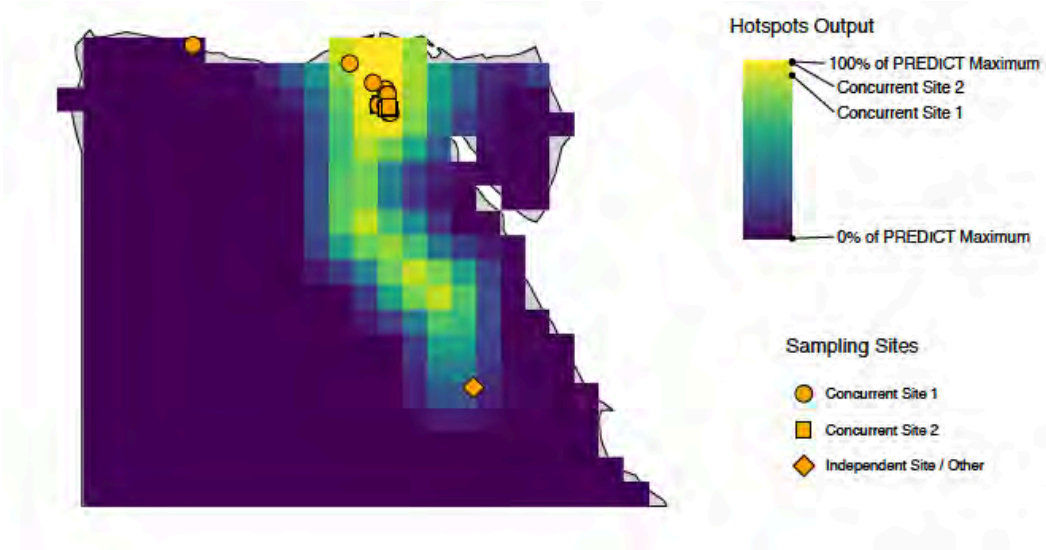


26. Vietnam

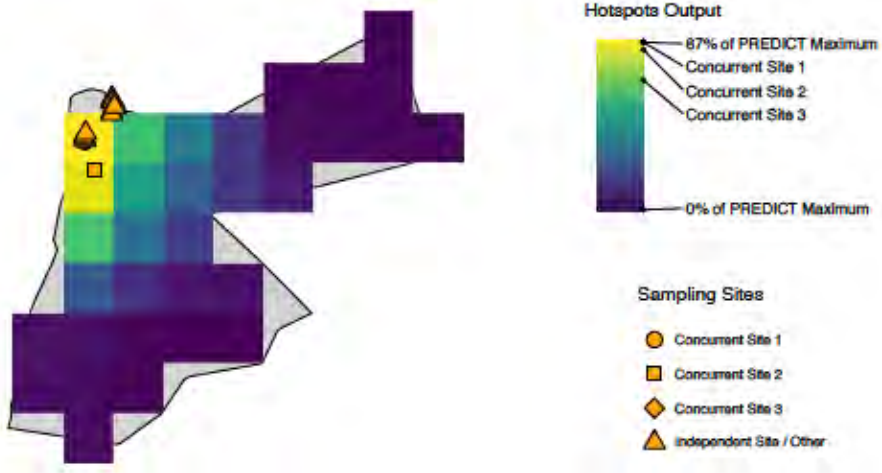


Country-level zoonotic virus spillover risk maps

27. Egypt



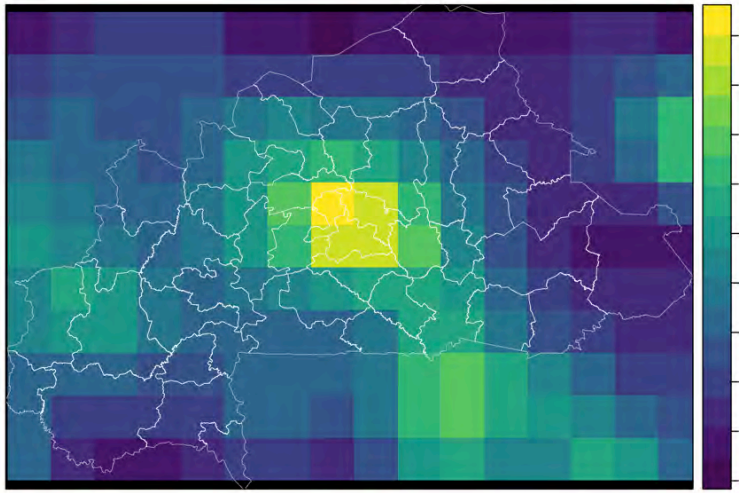
28. Jordan



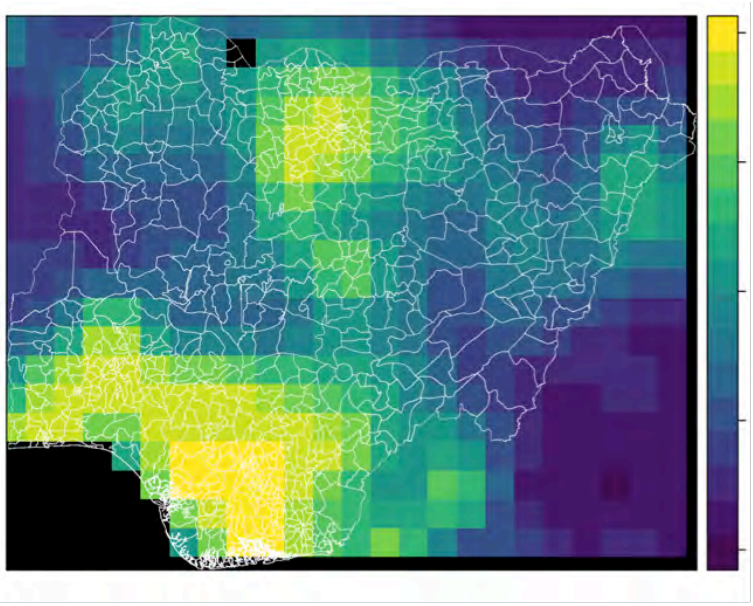
29-30 ASL2050 Countries

Country-level zoonotic virus spillover risk maps

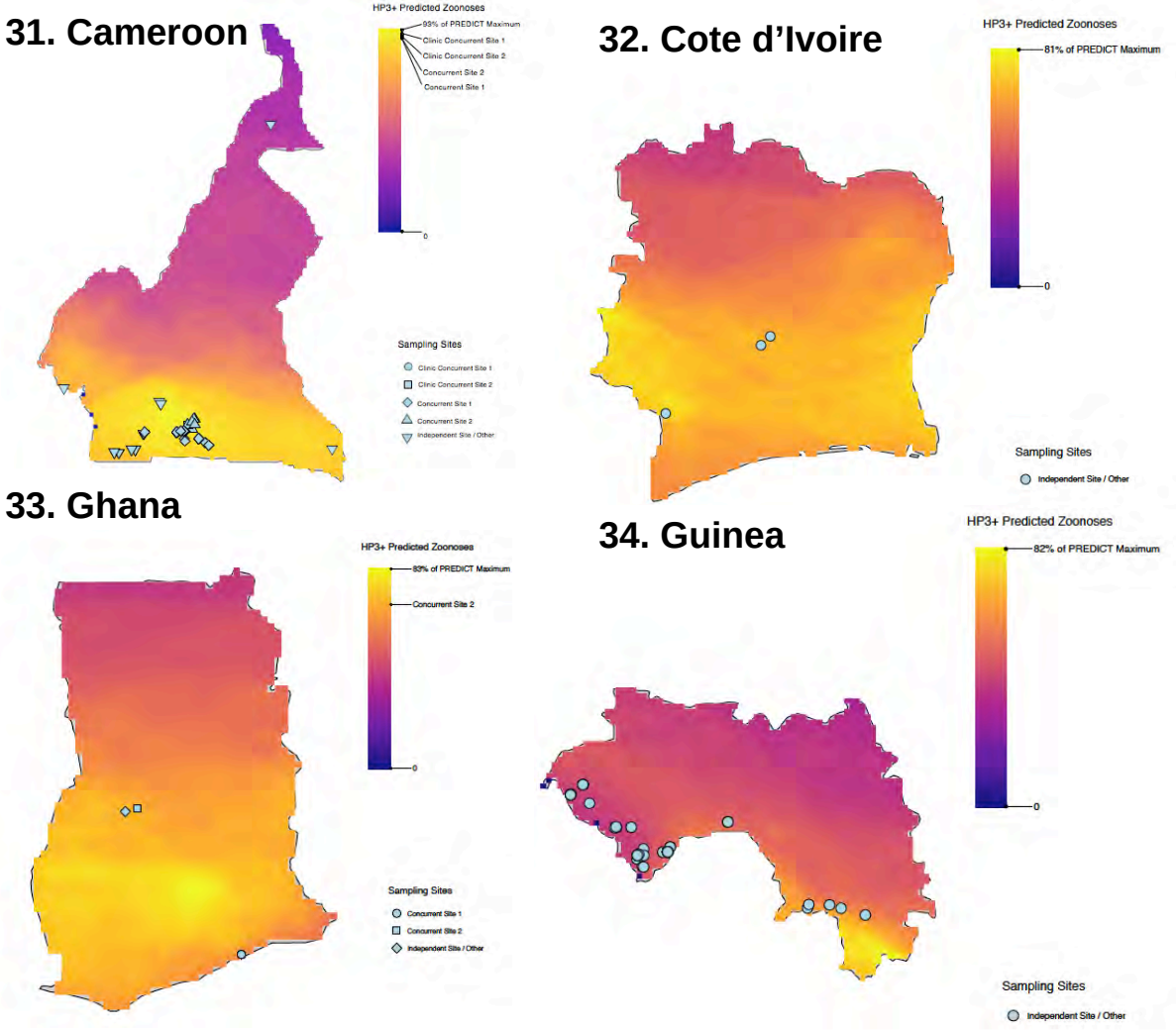
29. Burkina Faso



30. Nigeria



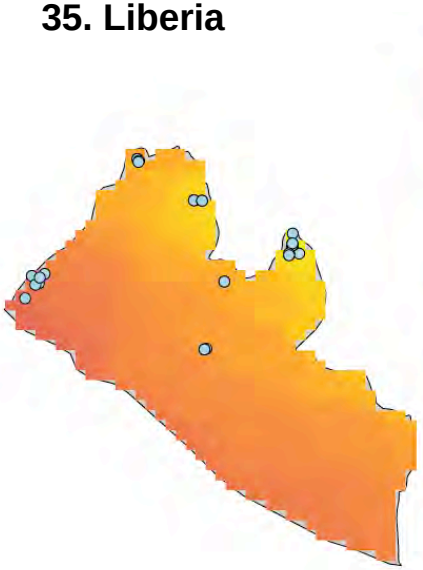
Predicted zoonotic diversity risk maps



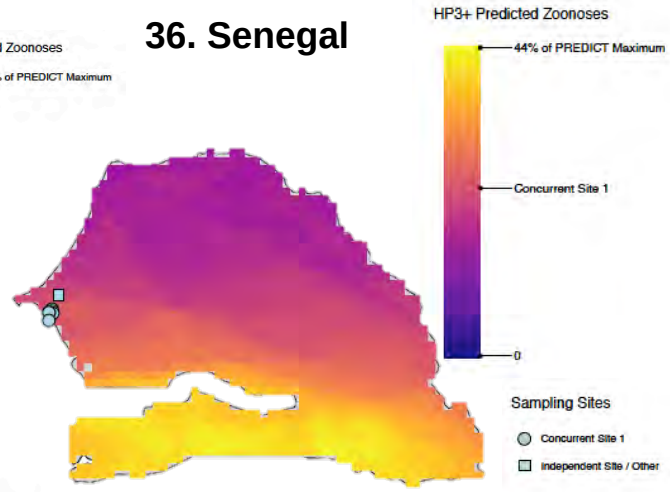
31-58. Country-level predicted zoonotic diversity risk maps. For the PREDICT All-country meeting in Brussels, we created per-country distribution maps of predicted total diversity potential of zoonotic viruses within mammals, based on Olival et al. 2017.

Predicted zoonotic diversity risk maps

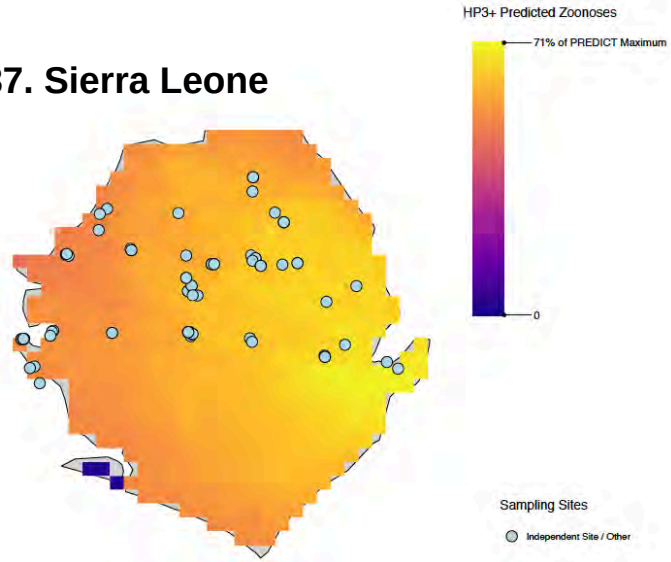
35. Liberia



36. Senegal

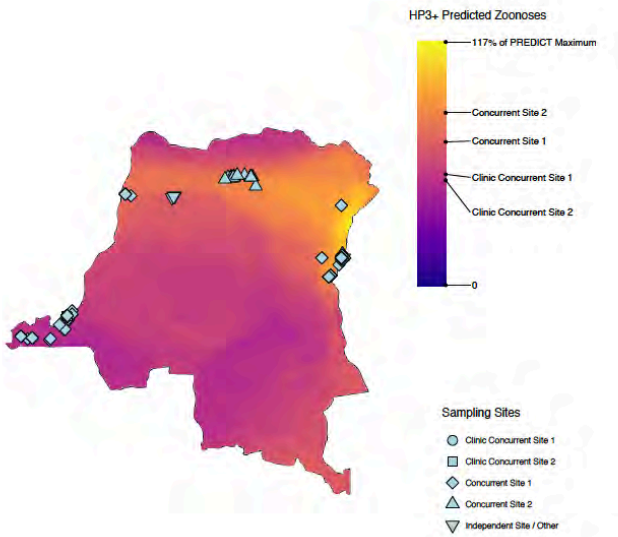


37. Sierra Leone

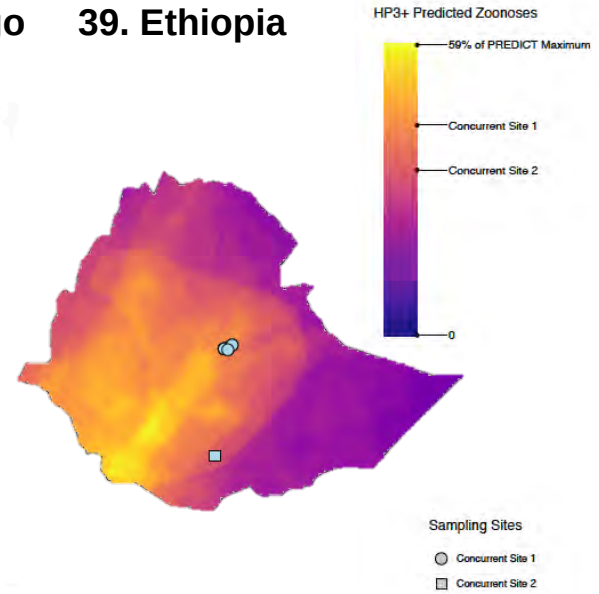


38-41 East & Central Africa Predicted zoonotic diversity risk maps

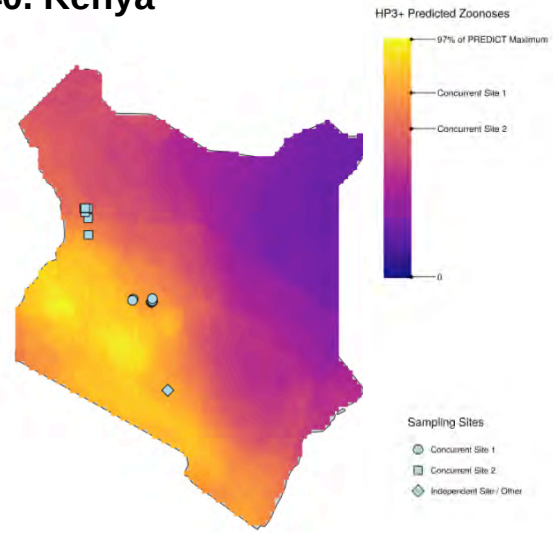
38. Democratic Republic of Congo



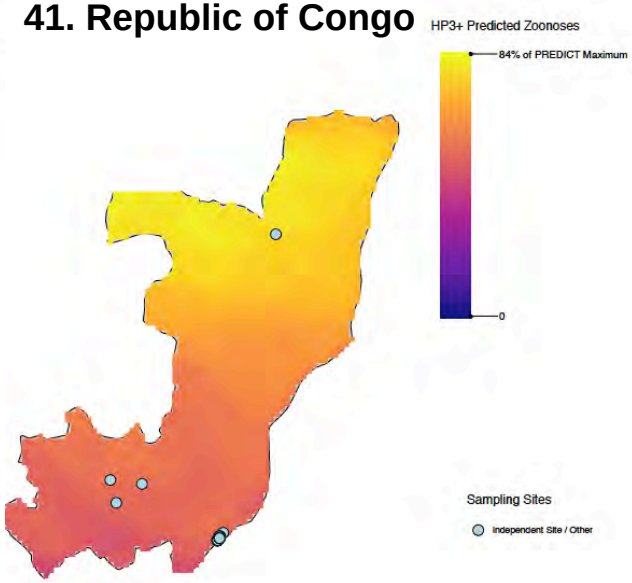
39. Ethiopia



40. Kenya

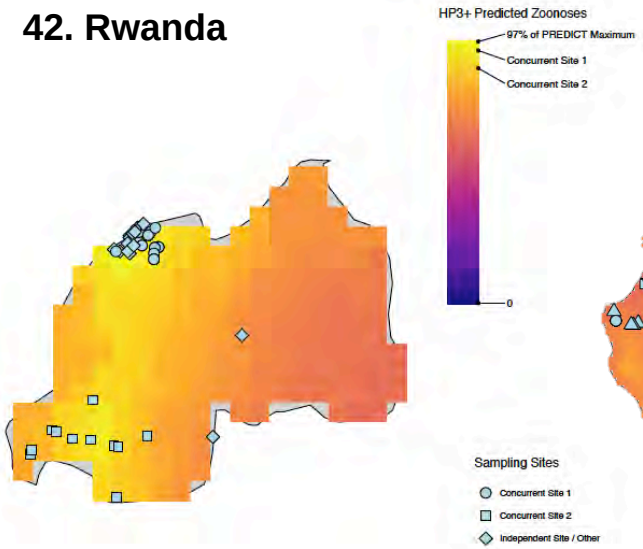


41. Republic of Congo

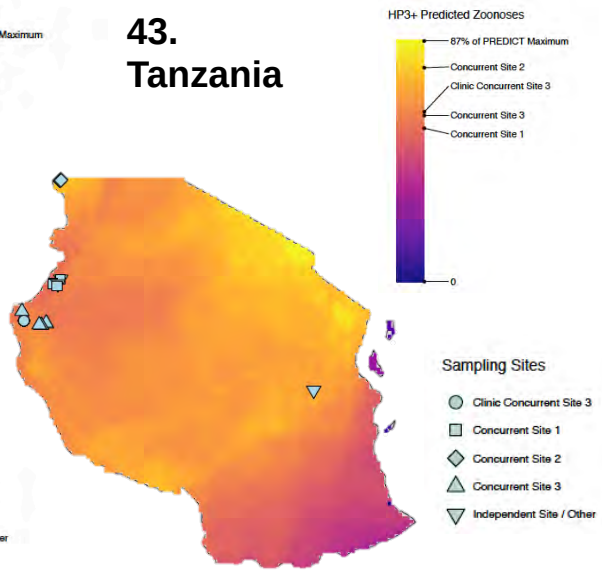


Country-level predicted zoonoses maps

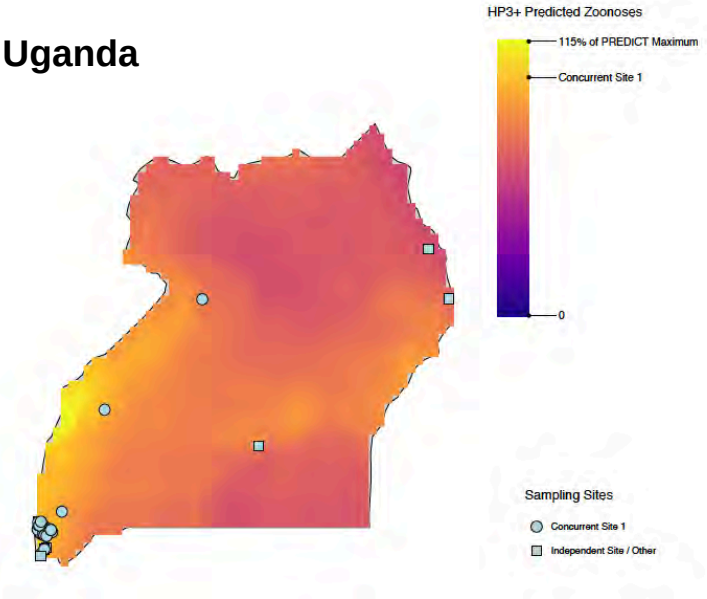
42. Rwanda



43. Tanzania

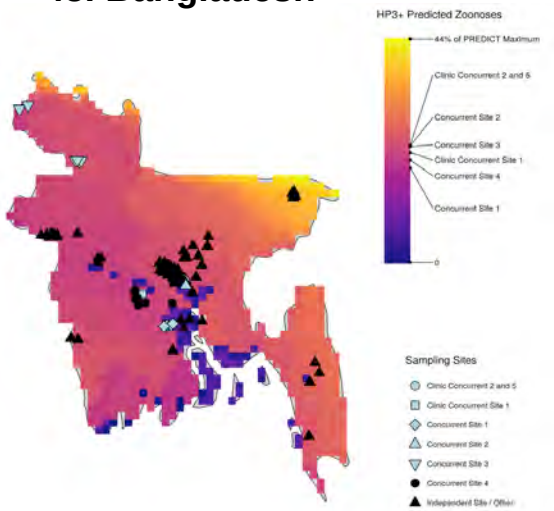


44. Uganda

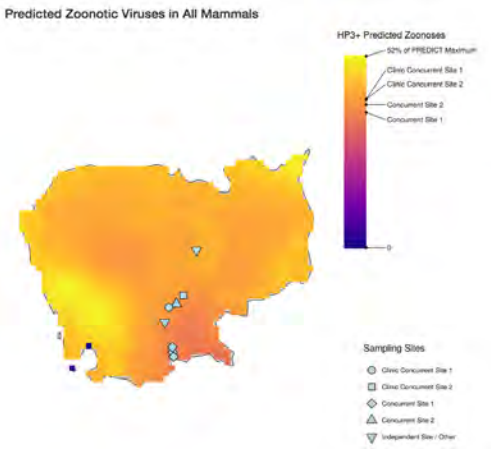


Country-level predicted zoonoses maps

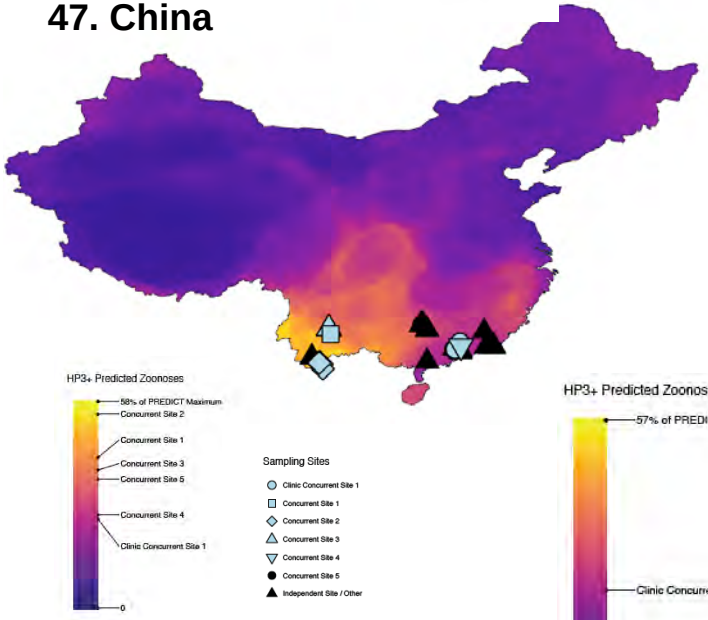
45. Bangladesh



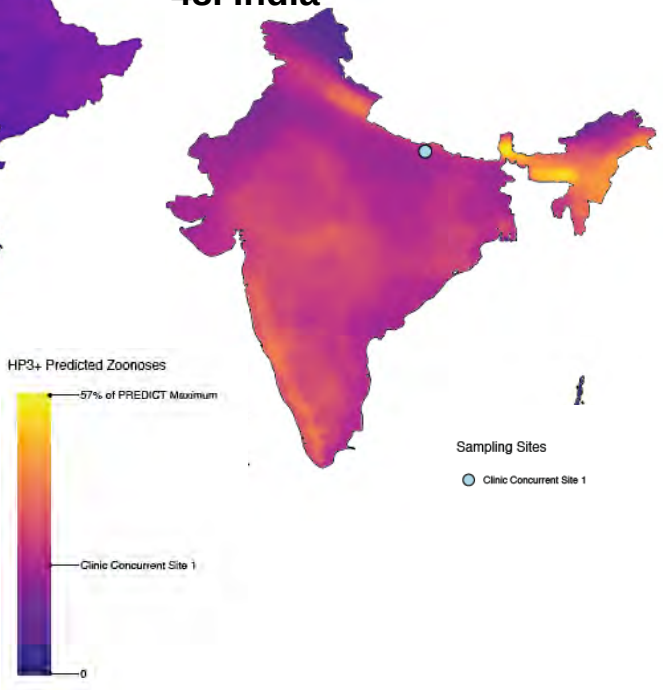
46. Cambodia



47. China

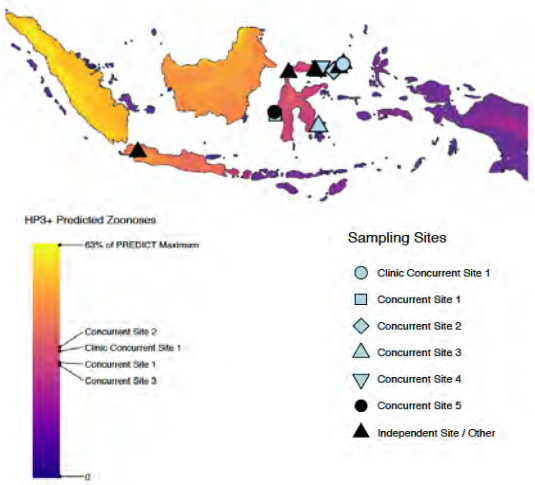


48. India

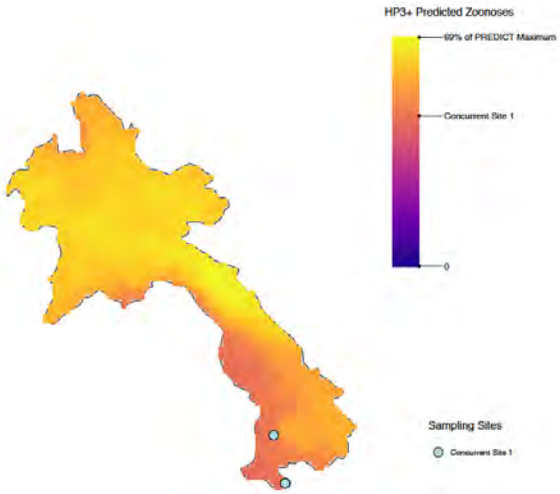


Predicted zoonotic diversity risk maps

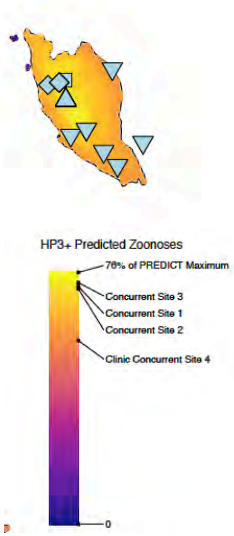
49. Indonesia



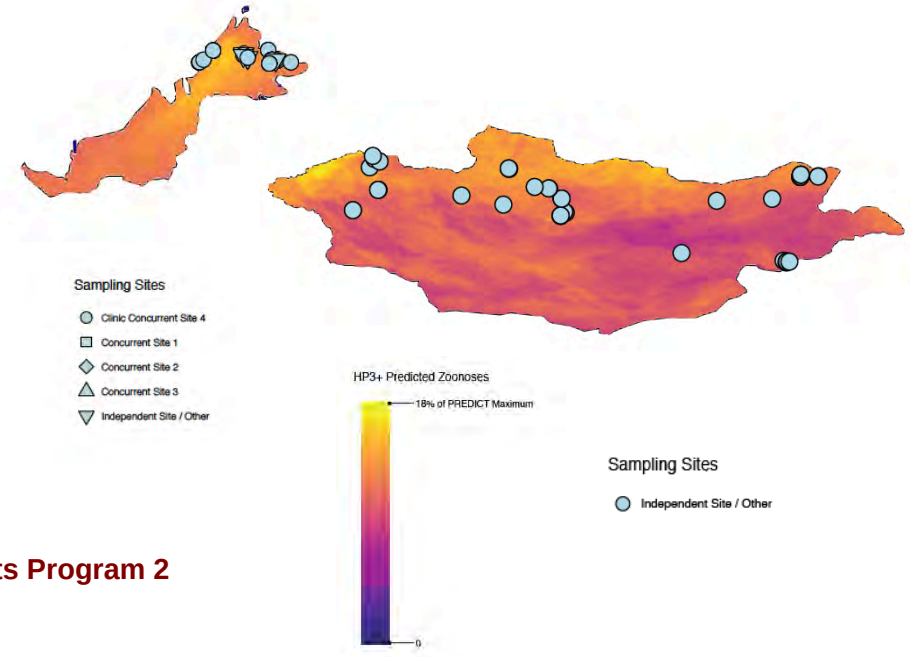
50. Lao PDR



51. Malaysia

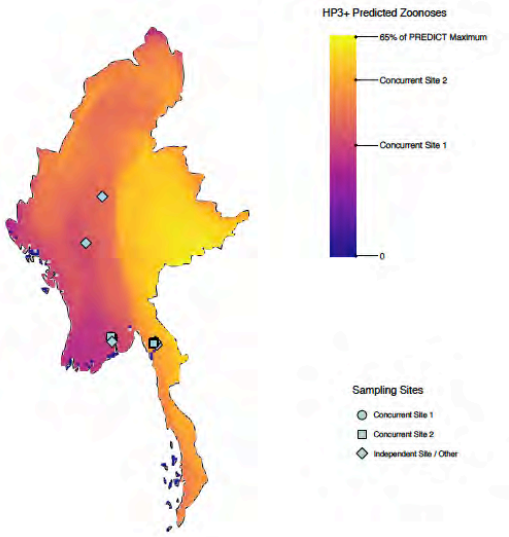


52. Mongolia

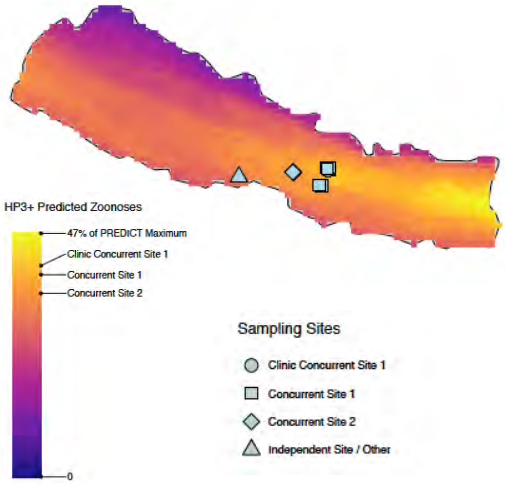


Predicted zoonotic diversity risk maps

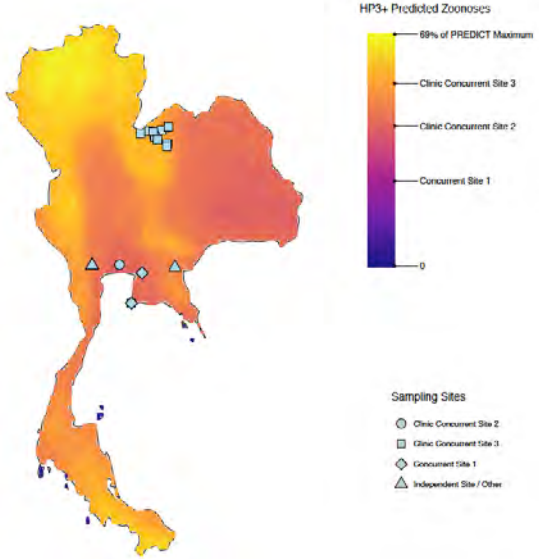
53. Myanmar



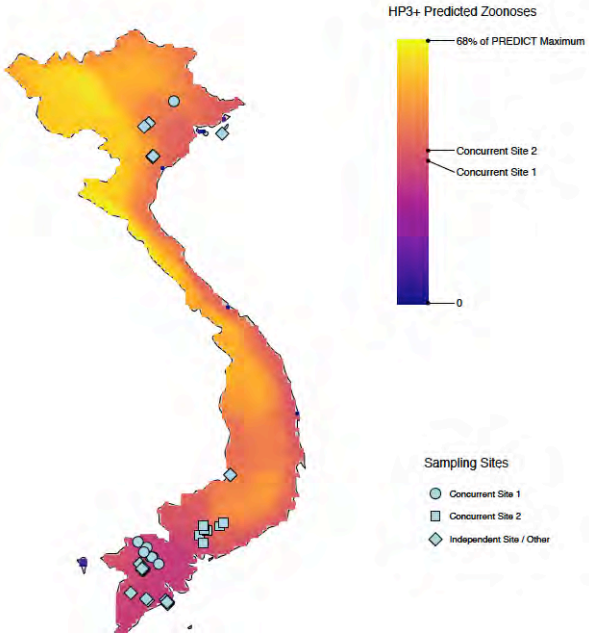
54. Nepal



55. Thailand

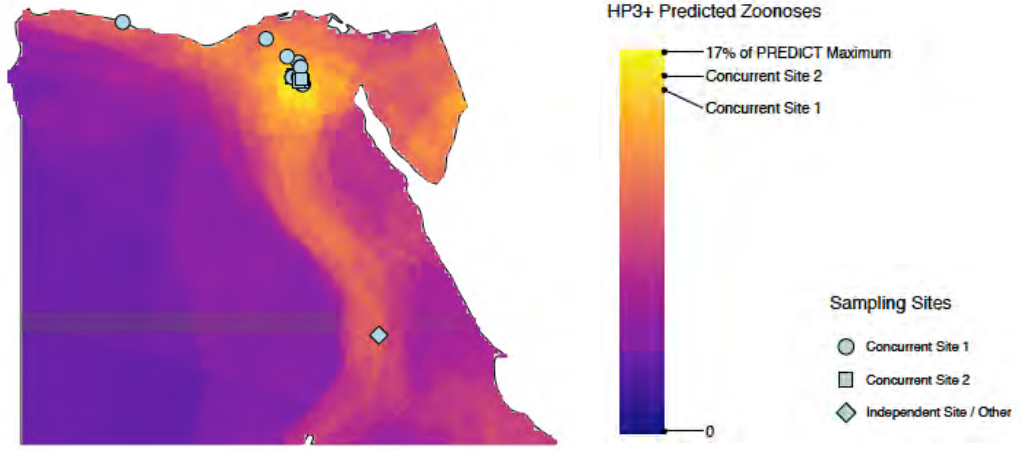


56. Vietnam

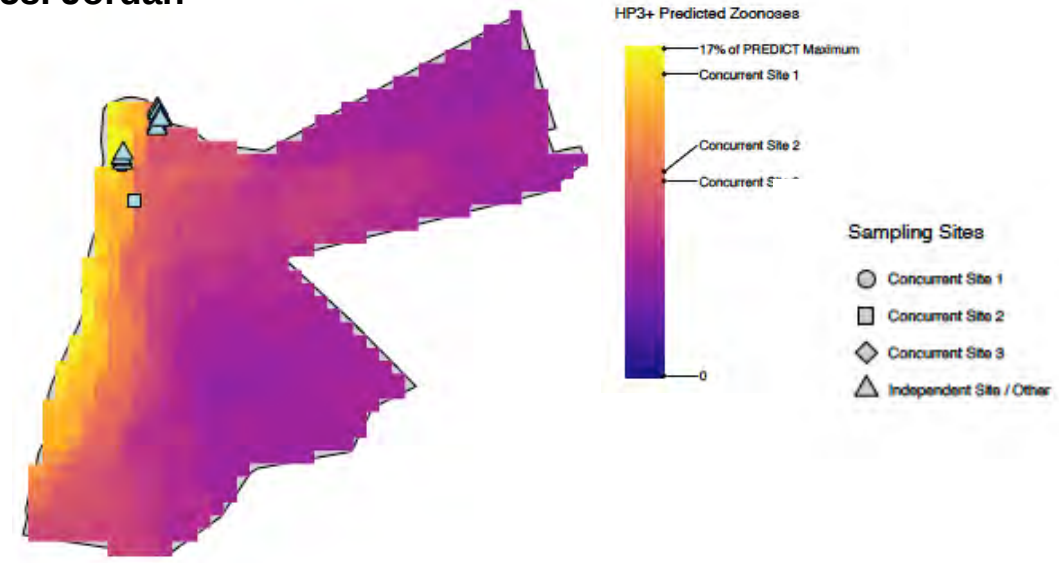


Predicted zoonotic diversity risk maps

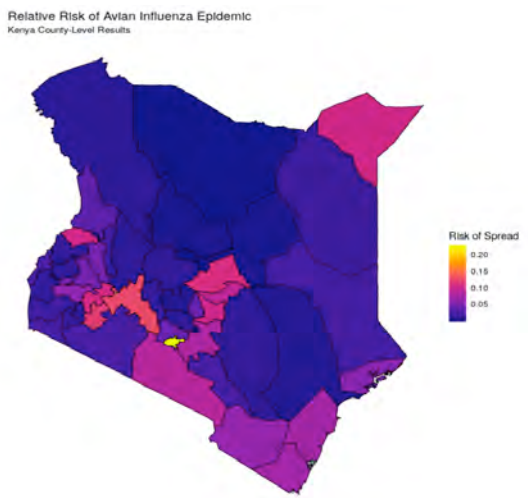
57. Egypt



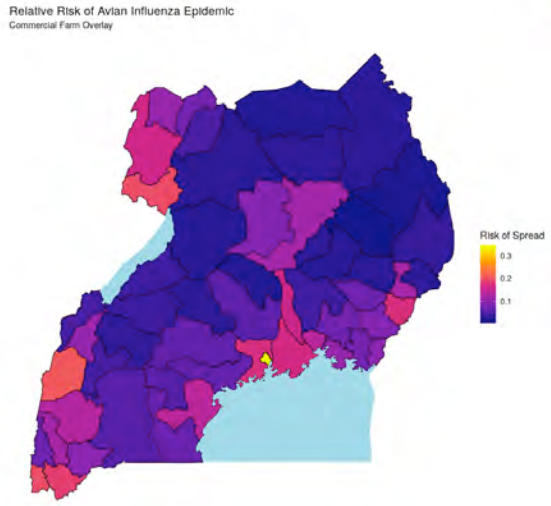
58. Jordan



59. Kenya

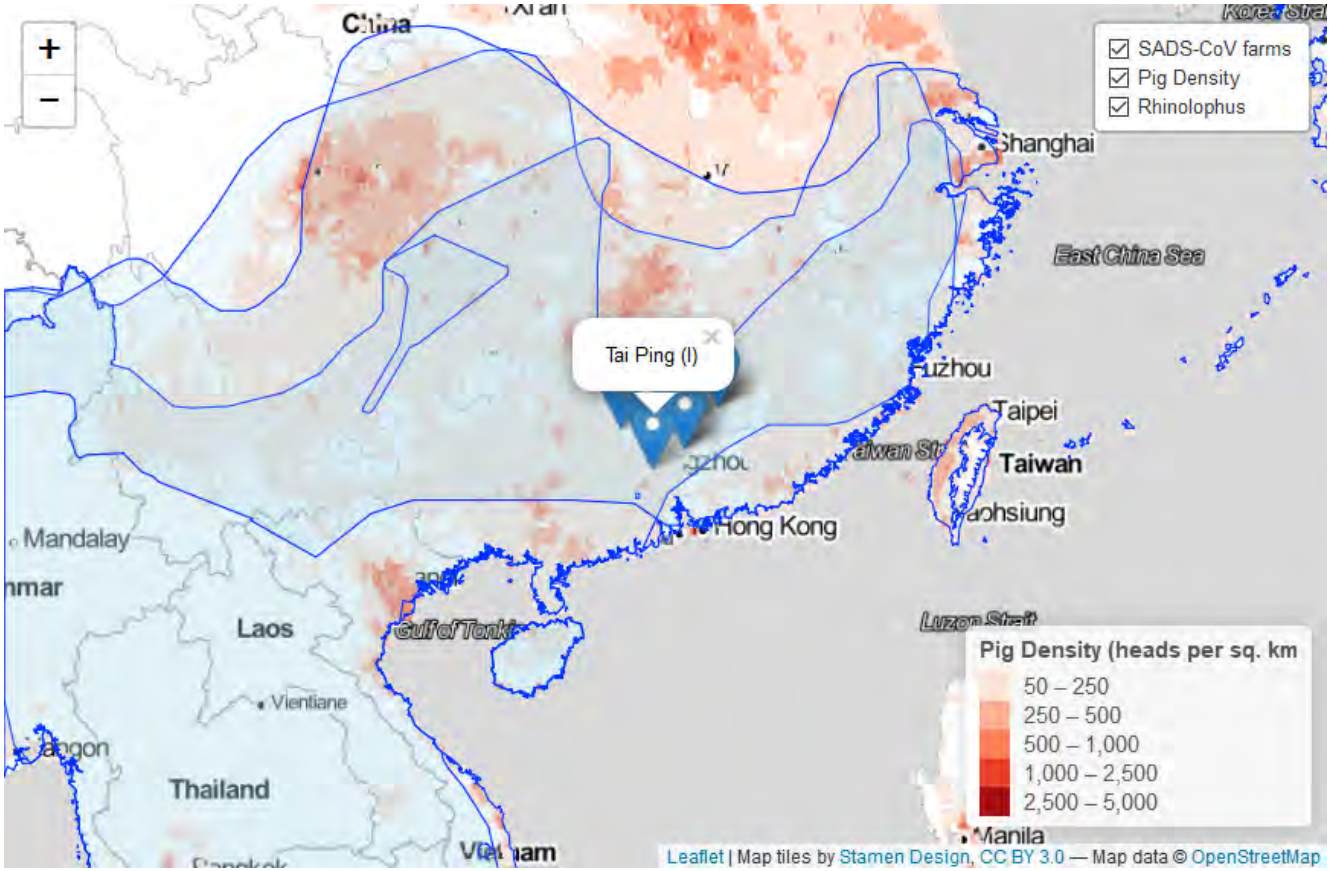


60. Uganda



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.

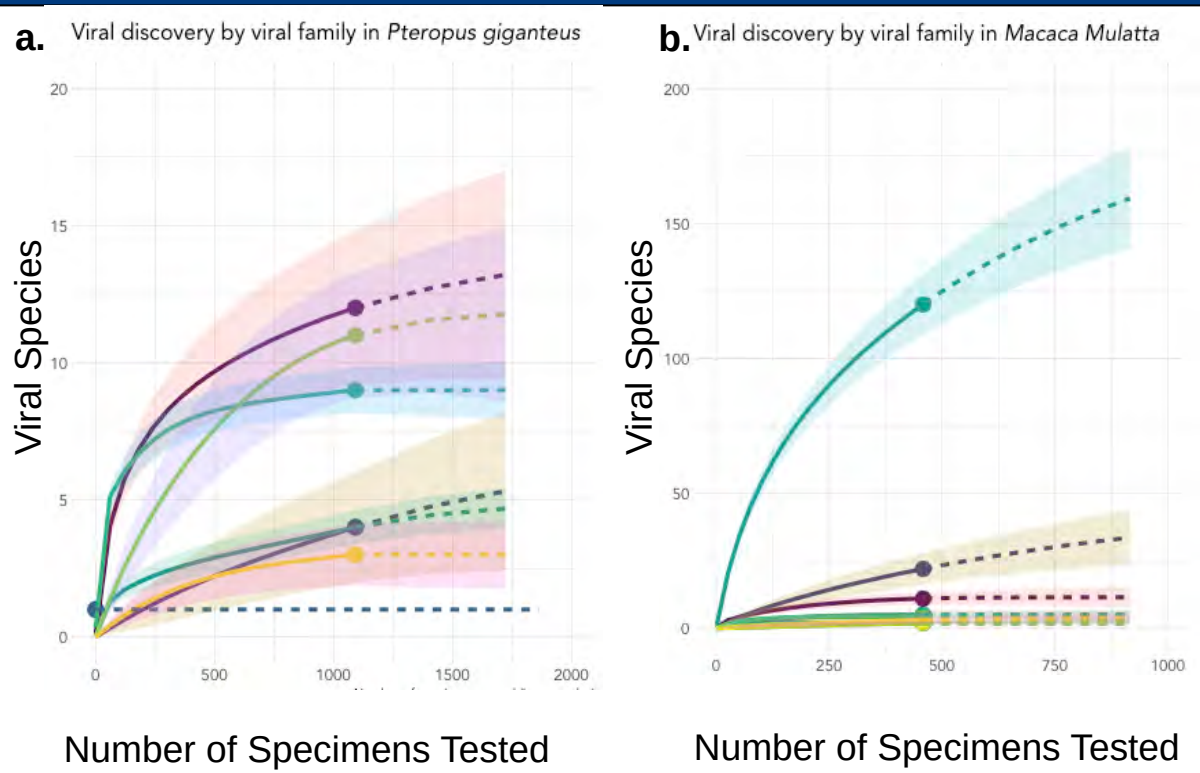
Regional bat-pig overlap maps



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.

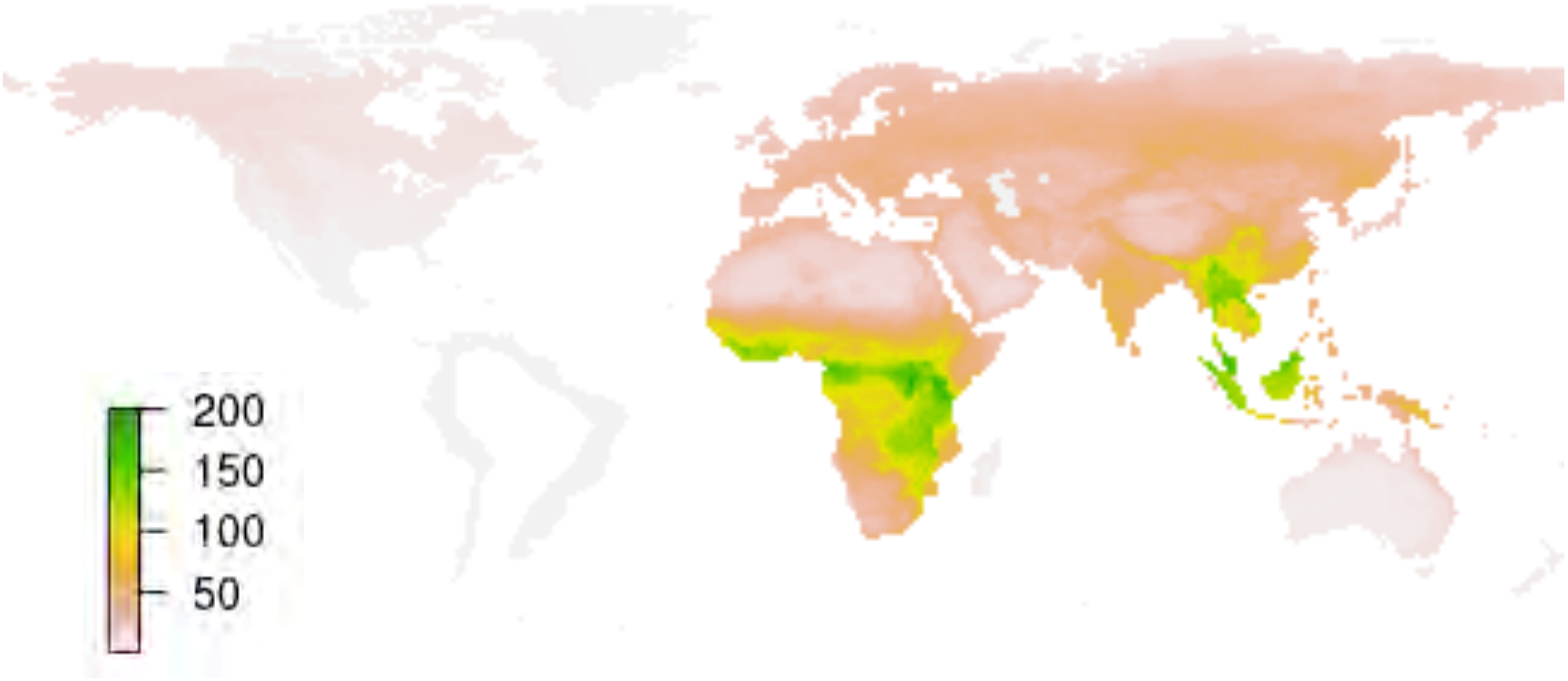
62. Global

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.

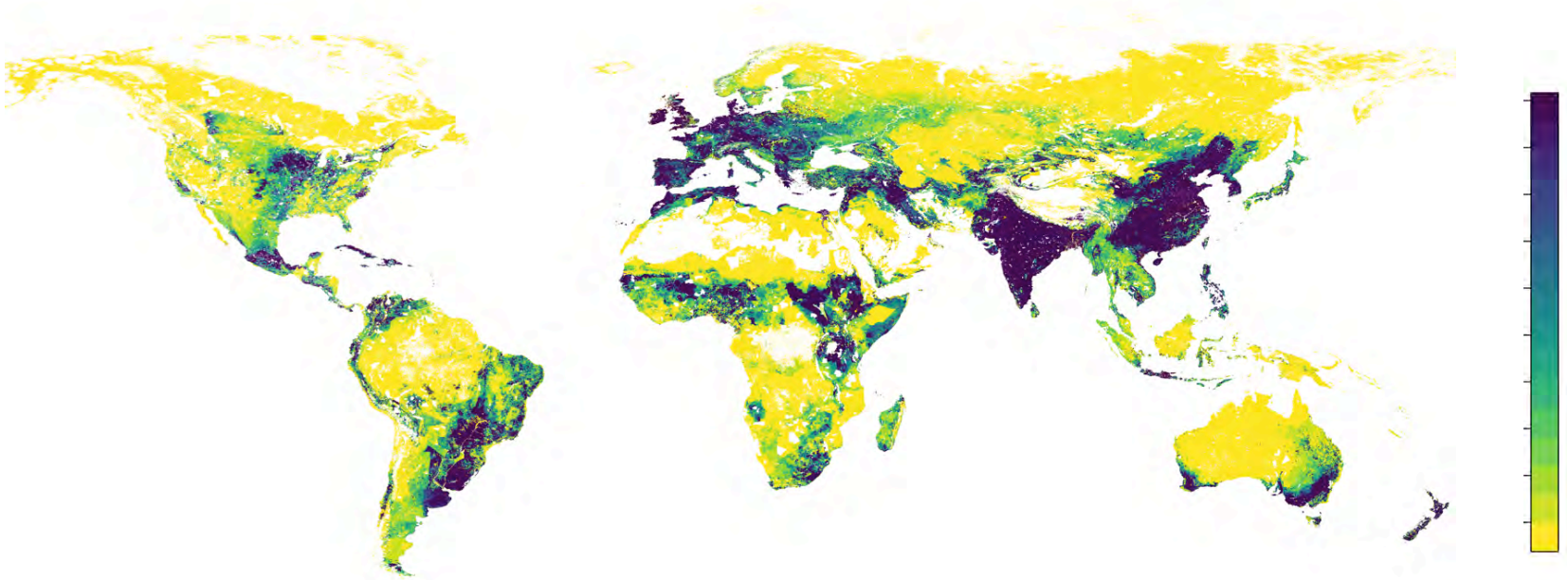
63. Global PREDICT wild mammal species richness map



63. Global distribution of wild mammals in PREDICT countries. As part of the country reports presented at PREDICT All-country meeting in Brussels 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.

64. Global

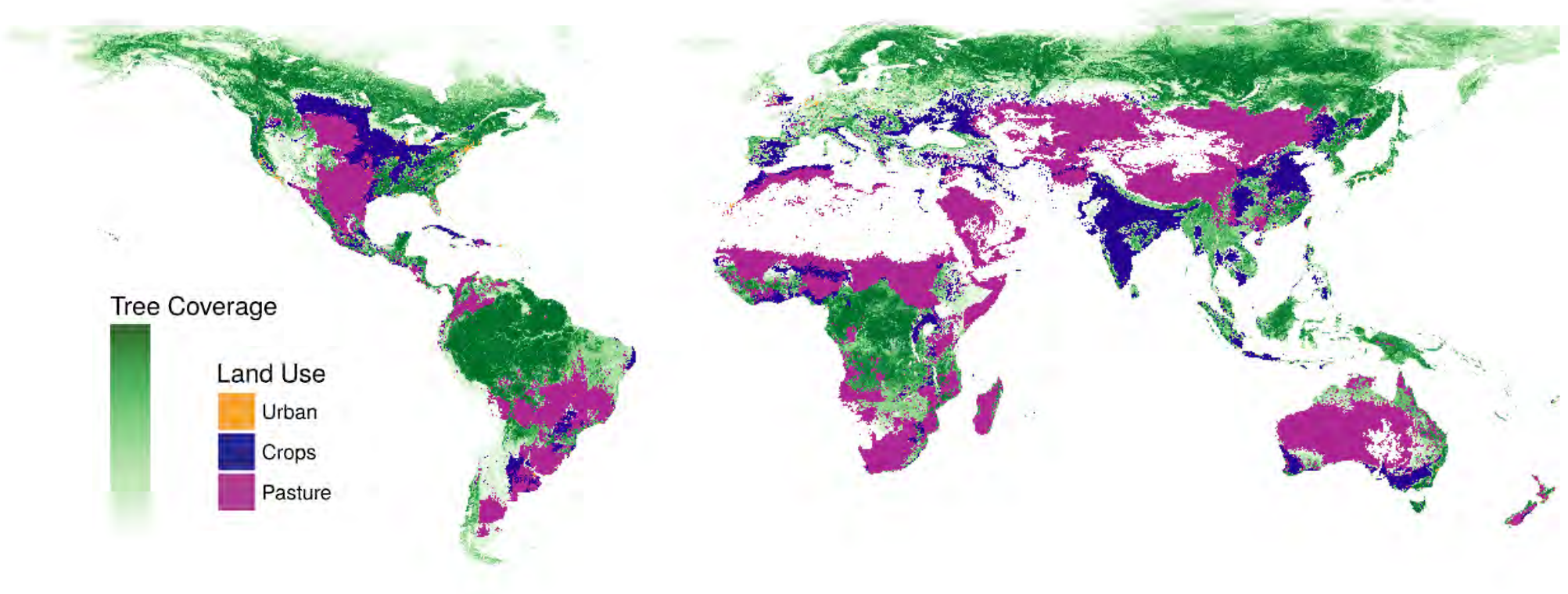
Domestic animal density map



64. Aggregated global mammalian livestock density. For the PREDICT All-country meeting in Brussels 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.

65. Global

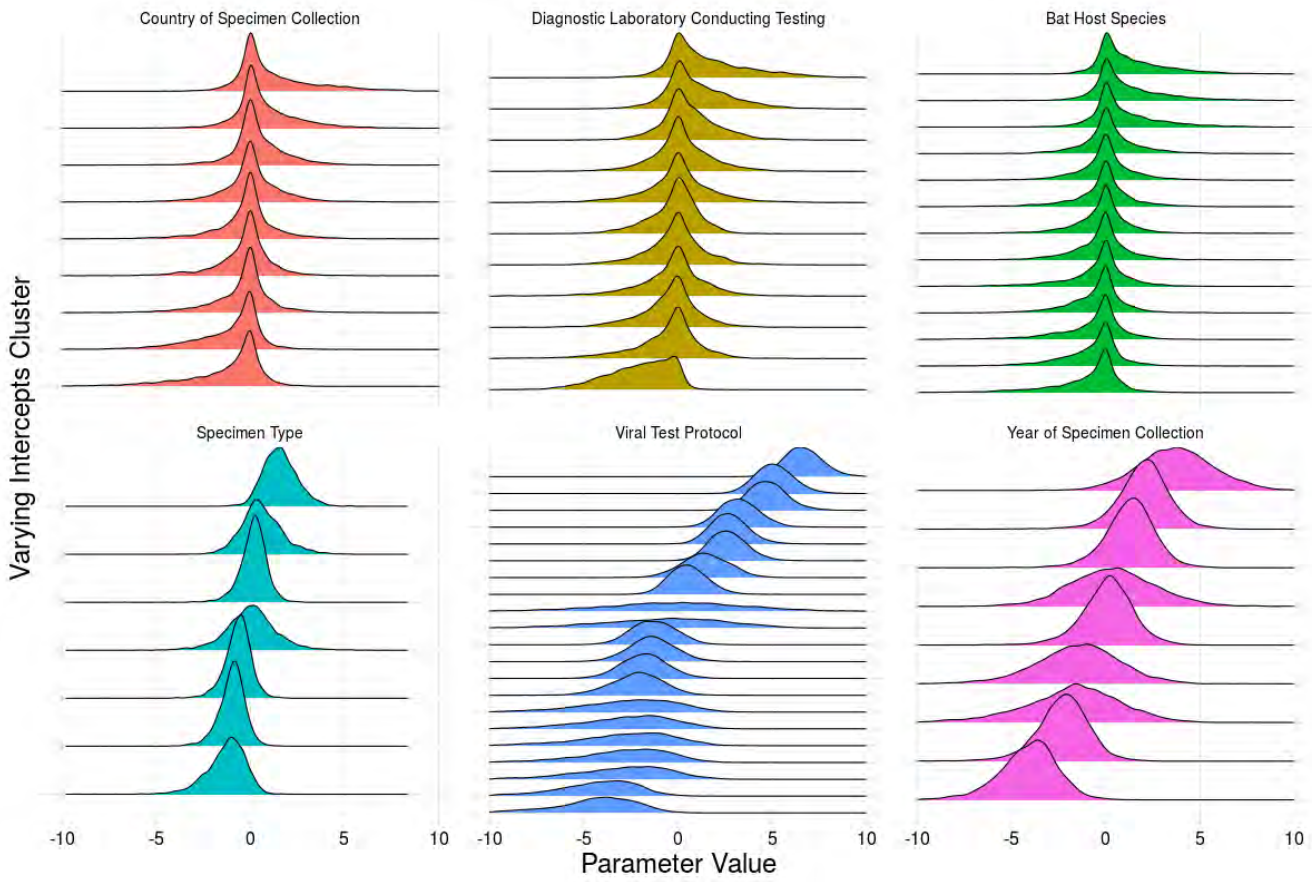
Urban, pasture, crop, land-use with tree cover



65. Global map of land-use. For the PREDICT All-country meeting in Brussels 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.

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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