USAID EPT-2
PREDICT PROJECT
COVID-19 EXTENSION SUMMARY

March - September 2020

Prepared by:
The PREDICT Consortium

PREDICT-2 COVID-19 Extension Summary

The **PREDICT Project** was initiated as part of USAID's Emerging Pandemic Threats Program in 2009 to strengthen global capacity for the detection and discovery of viruses with pandemic potential. Over the past decade, PREDICT teams around the world worked to identify and characterize emerging viruses. Our teams sampled over 160,000 animals and people in some of the world's most vulnerable hotspots for emerging viruses and performed more than 1.3 million tests for known and new viruses, including coronaviruses (PREDICT Consortium, 2020). Because of this foundation, the PREDICT project partners were crucial frontline responders and technical experts for emerging virus surveillance, detection, and response, especially in the early days of the COVID-19 pandemic.

In March 2020, PREDICT received an emergency supplement extension through September 2020 to assist our global network of collaborating laboratories in the initial detection of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), support national response plans to the emerging COVID-19 pandemic, and explore our specimen archives to further investigate SARS-related coronaviruses in animals.

Call to Action

Upon receiving the extension, select PREDICT Consortium partner awards in engaged countries were rapidly reactivated to:

1. Identify optimal SARS-CoV-2 testing procedures and support access to laboratory consumables and supplies necessary for testing
2. Support laboratory technicians and infectious disease experts called on to participate in local COVID-19 task forces
3. Implement risk communication and disease control strategies, such as community engagement and outreach, contact tracing, and surveillance
4. In collaboration with implementing partners and laboratories in the Asia region, test potential animal sources of SARS-related coronaviruses using prioritized archived specimens from wildlife species at highest risk of harboring SARS-related viruses

The re-activated PREDICT teams supported the training of expanded laboratory personnel, healthcare workers, and others on an array of topics including infection prevention and control, biosafety and biosecurity, PPE best practices, and COVID-19 diagnostic testing in compliance with established protocols (Table 1; Figure 1; Figure 2). PREDICT's legacy and leadership were clearly demonstrated by the work of our network in the earliest stages of the pandemic. As the virus emerged, PREDICT partners in Asia and Africa were among the first to deploy virus detection protocols before SARS-CoV-2 virus-specific assays were available. These laboratories were able to detect the new virus in some of the first patients that traveled outside China.

PREDICT leaders worked tirelessly to promote health security and support national prevention, detection, and response efforts for the pandemic.

Table 1. COVID-19 technical support to PREDICT host country governments (March -September 2020).

Support Provided	Africa	Asia
SARS-CoV-2 testing supplies	Cameroon, DRC, Côte d'Ivoire, Kenya, Rwanda, Tanzania, Uganda	Cambodia, Lao PDR, Myanmar, Nepal, Thailand
Salary support for SARS-CoV-2 testing	Cameroon, Ghana, Côte d'Ivoire, Rwanda, Tanzania	Cambodia, Lao PDR, Nepal, Thailand
Providing government with technical assistance	Guinea, Côte d'Ivoire, Liberia, Rwanda, Sierra Leone, Uganda, Tanzania	Lao PDR, Nepal
Training - Laboratory staff	Tanzania, Cameroon, Kenya	Nepal
Training - Healthcare workers	Senegal	Nepal
Training - Community members	Guinea, Senegal	–

Technical Assistance

Technical Assistance, PCR Testing

Technical Assistance, Serology Testing
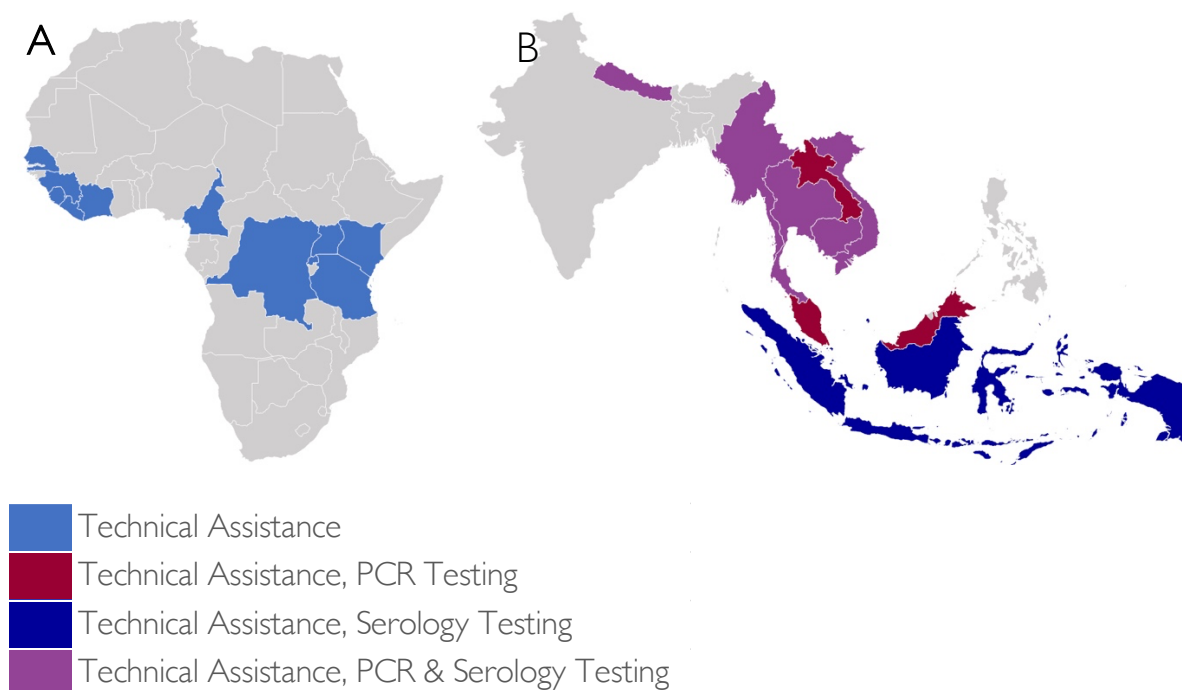
Technical Assistance, PCR & Serology Testing

Figure 1. COVID-19 technical support and SARS-CoV-2 testing by country in (A) Africa and (B) Asia (March - September 2020).
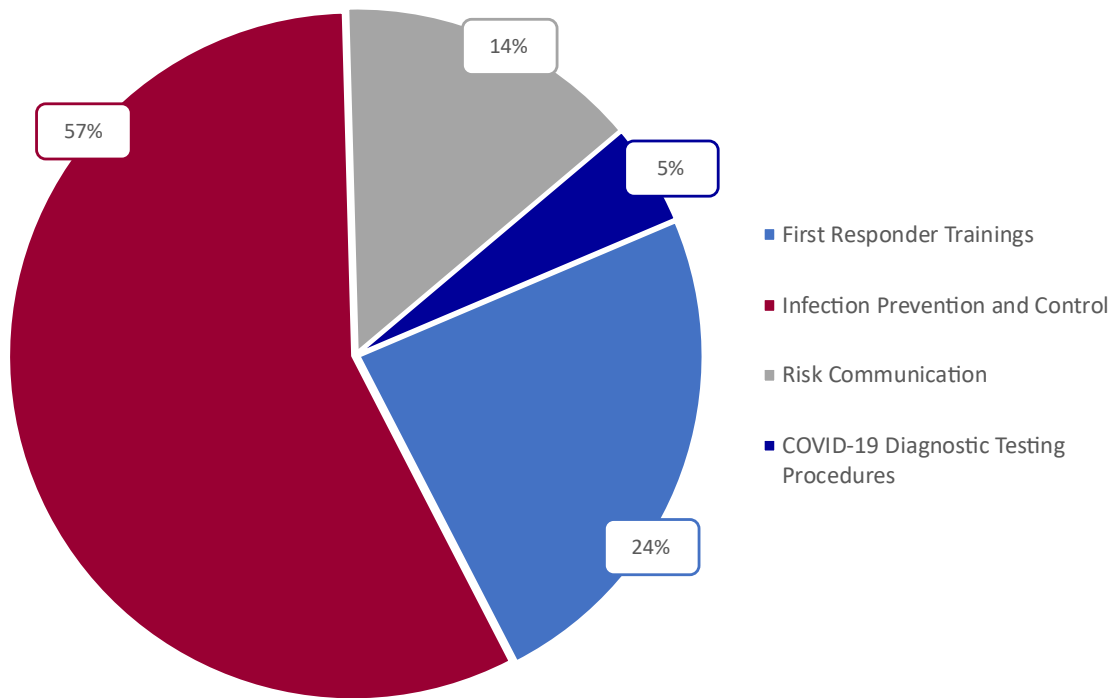
Figure 2. Training (including activities not supported by PREDICT-2 extension funds) by re-activated PREDICT partners in support of national COVID-19 response plans. Data summarized from the first monthly poll of PREDICT partners conducted in early June 2020.

PREDICT COVID TESTING OF ANIMALS PREVIOUSLY SAMPLED IN ASIA

Over the course of the PREDICT project, surveillance teams in Asia and Southeast Asia collected specimens and data on animals and humans, including bat species that we determined are especially likely to carry SARS-related coronaviruses. These specimens that were archived safely in local and regional laboratories working on the PREDICT project were of value to provide insight into potential animal hosts.

During the extension, PREDICT's collaborating laboratories in the Asia region conducted SARS-CoV testing on archived specimens from priority wildlife species that likely represent the highest risk of harboring SARS-related coronaviruses at animal-human interfaces where people were in contact with high-risk species. We analyzed project data to identify animal species, value chains, and animal-human interfaces that would be most likely to inform on SARS-related coronavirus spillover and spread in the region.

With partner labs in seven countries (Cambodia, Lao PDR, Malaysia, Myanmar, Nepal, Thailand, and Viet Nam), we performed 7,997 tests on 4,510 archived specimens from 3,631 animals (bats, civets and other carnivores, pangolins, and non-human primates) using two consensus-based PCR assays for coronaviruses (PREDICT Consortium, 2020). Early testing efforts during SARS-CoV-2 emergence in the Southeast Asia region before WHO protocols or CDC tests

were available confirmed that one of these assays was sensitive for SARS-CoV-2 detection. In addition when available, we screened these specimens with the Berlin SARS-CoV-2 real-time PCR assays, considered the global standard for detection (WHO, 2020), as well as with US Centers for Disease Control and Prevention real-time assays.

Preliminary findings to date

We detected SARS-related coronaviruses in specimens from nine animals and non-SARS-related coronaviruses in specimens from 72 additional animals. Detailed results by country and taxa are shown below (Table 2; Table 3; Figure 3). In this period, the PREDICT Consortium detected SARS-related coronaviruses in two Shamel's Horseshoe Bats (*Rhinolophus shameli*) and seven Sunda pangolins (*Manis javanica*), expanding insight on species shown to host SARS-related coronaviruses. Previous insights from PREDICT and others have shown that insectivorous bats belonging to the Hipposideridae and Rhinolophidae families are known to have a close association with SARS-related coronaviruses (Anthony et al., 2017), and strains of SARS-related coronaviruses have been isolated from several *Rhinolophus* bat species including *R. affinis, R. ferrumequinum, R. macrotis, R. pearsoni, R. pusillus,* and *R. sinicus* (Lau et al., 2005; Li et al., 2005), Sunda pangolins (Liu et al., 2019; Lam et al., 2020; Xiao et al., 2020), and Himalayan palm civets (Guan et al., 2003). The SARS-related coronavirus (bat strain) we found is 97.2% similar to Bat coronavirus RaTG13 (GenBank Accession No. MN996532; the closest known relative to SARS-CoV-2 across the genome) and 95.8% similar to SARS-CoV-2 (GenBank Accession No. NC_045512).

Table 2. Summary of animals tested for SARS-related and other coronaviruses (March to September 2020) using samples collected between October 2009 and September 2019 in Asia.

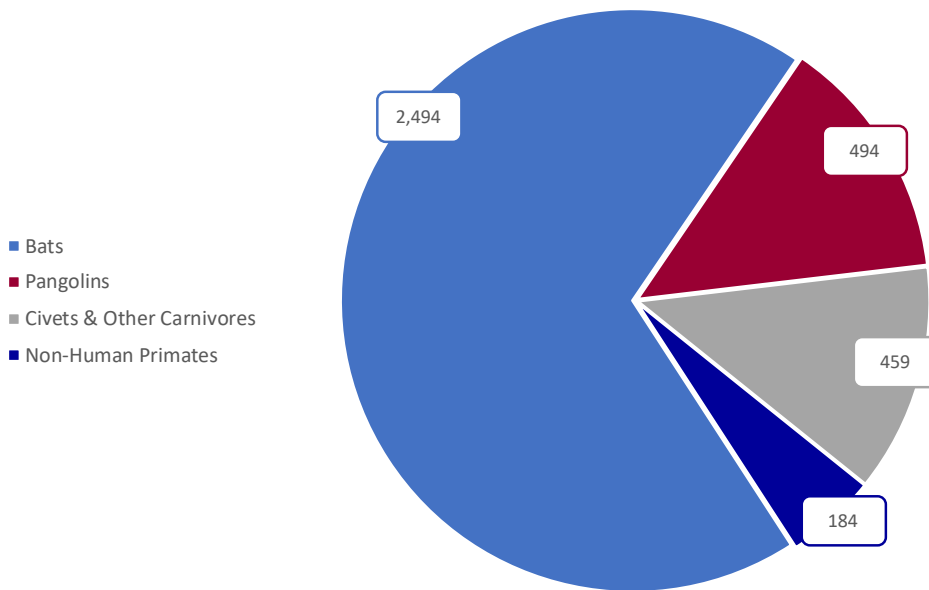|	Specimens Tested	Animals Tested	No. of Animals with SARS-related Coronaviruses (Sarbecoviruses)	No. of Animals with Other Coronaviruses
Cambodia	485	282	2	12
Bats	450	264	2	12
Civets	32	17	0	0
Other Carnivores	3	1	0	0
Lao PDR	446	287	0	7
Bats	322	196	0	7
Civets	124	91	0	0
Malaysia	1,221	1,207	0	0
Bats	925	925	0	0
Civets	60	51	0	0
Pangolins	236	231	0	0
Myanmar	351	240	0	0
Bats	351	240	0	0
Nepal	438	337	0	0
Bats	254	153	0	0
Non-Human Primates	184	184	0	0
Thailand	334	194	0	7
Bats	310	182	0	7
Pangolins	24	12	0	0
Viet Nam	1,235	1,084	7	46
Bats	539	534	0	46
Civets	299	299	0	0
Pangolins	397	251	7	0
Total	4,510	3,631	9	72

Figure 3. Animals tested by PCR for SARS-related and other coronaviruses by taxa.

Table 3. SARS-related coronaviruses (Sarbecoviruses) and other coronaviruses detected during the extension period (March to September 2020) in samples collected between October 2009 and September 2019 in Asia.

Virus	Species	Country	Number of Positive Animals
SARS-related betacoronavirus (Bat strain)*	Shamel's Horseshoe Bat	Cambodia	2
SARS-related betacoronavirus (Pangolin strain)*	Sunda Pangolin	Viet Nam	7
Alphacoronavirus 1	Unidentified Vespertilionid Bat	Viet Nam	1
Bat coronavirus 1	Croslet Horseshoe Bat, Malayan Horseshoe Bat	Thailand	3
Bat coronavirus 512/2005	Unidentified Vespertilionid Bat, Lesser Asian House Bat	Cambodia, Viet Nam	50
Bat coronavirus HKU2	Shamel's Horseshoe Bat	Thailand	1
Bat coronavirus HKU9	Dawn Bat, Unidentified Rousette Bat	Lao PDR	2
Bat coronavirus HKU10	Large Asian Roundleaf Bat	Thailand	3
PREDICT_CoV-35	Unidentified Vespertilionid Bat, Lesser Asian House Bat	Cambodia, Viet Nam	4
PREDICT_CoV-56	Greater Nectar Bat	Cambodia	1
PREDICT_CoV-89	Unidentified Rousette Bat	Lao PDR	4
PREDICT_CoV-118*	Shamel's Horseshoe Bat	Cambodia	2
PREDICT_CoV-119*	Thomas's Horseshoe Bat	Lao PDR	1

Newly detected viruses by the PREDICT Consortium during the extension period (March-September 2020).

Conclusions and Future Directions

Given the diversity of coronaviruses increasingly recognized in wildlife, including the likelihood of undiscovered coronaviruses, further investigation of viruses closely related to SARS-CoV-2 is urgently needed. Through our work and that of colleagues working on animal coronaviruses, we know that coronaviruses are often able to spillover into new species and adapt to new hosts, characteristics common to pathogens that pose a threat to health security. For over 10 years, PREDICT teams around the world worked to identify and characterize coronaviruses, searching for them in hotspots like live animal markets, caves where bat guano is harvested, and communities that border wildlife habitats. We advanced the world's knowledge of coronaviruses, detecting 181 coronaviruses in animals and people (Table 5; PREDICT Consortium, 2020). Of these, 115 were coronaviruses previously unknown to science. As a result, the coronaviruses we detected have been used by other scientists to develop countermeasures, to test the potency of antiviral drugs, and to help in the rapid assessment of the only antiviral currently in use for COVID-19 patients.

As our world becomes more globalized, identifying and combating pandemic threats should be a global priority. Investments in preparedness allowed the PREDICT project to prepare laboratories and countries to be able to react and effectively respond to a coronavirus threat in real-time.

Table 5. Coronavirus surveillance effort throughout the PREDICT project (2009 – 2020).

Host Taxa	No. of Individuals Tested	No. of Positive Individuals	No. of Distinct Viruses Detected
Bats	38,553	3,050	151
Rodents/Shrews	18,090	817	18
Non-Human Primates	9,957	4	2
Humans	16,101	73	4
Domestic Species	3,931	321	9
Other Wildlife	2,050	32	5
Total	**88,682**	**4,297**	**181***

*Numbers do not total as some viruses were found in more than one taxa

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