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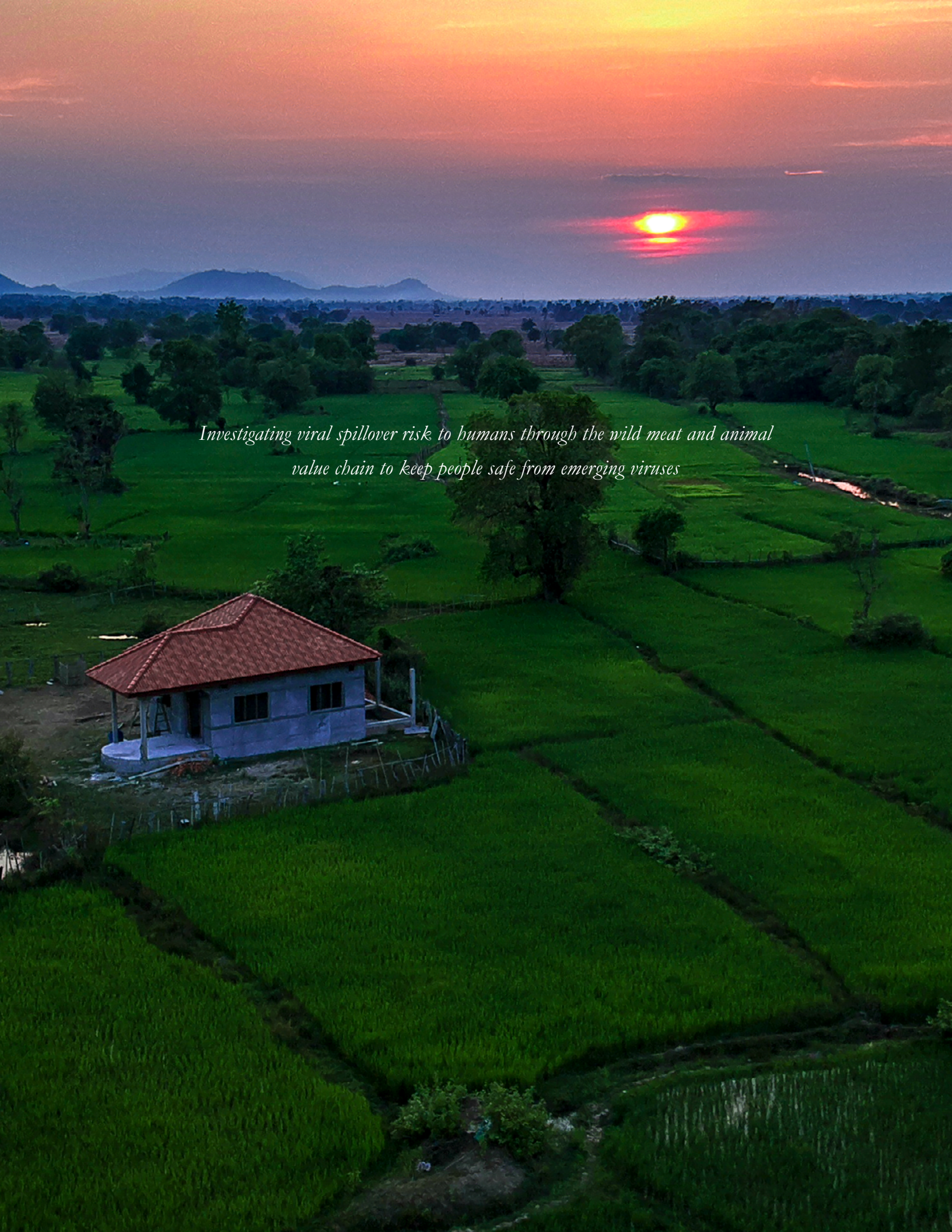
LAO PEOPLE'S DEMOCRATIC REPUBLIC

One Health in action (2009-2020)



Investigating viral spillover risk to humans through the wild meat and animal value chain to keep people safe from emerging viruses

LAO PDR

Since 2009, PREDICT/Lao PDR has worked to better understand the dynamics of how people interact with wildlife through hunting for food or medicines, purchase at wild meat markets, or through incidental contact and exposure in their homes.

In PREDICT-1 (2009-2014), our efforts focused on locating and identifying wild meat markets across the country, and then characterizing the animals available for purchase and the viruses that they carry. In PREDICT-2 (2014-2019), our team focused One Health surveillance in Champasak province, where local communities rely heavily on non-timber forest products to supplement both their income and their diets. Hunting for wild animals such as ground squirrels, giant flying squirrels, and muntjacs is common, with villagers using these animals as valuable sources of protein. Additionally, any wild meat that is not consumed in the village is often sold or traded to nearby wild meat markets, where people from all over the area come to buy live or dead wild animals.

In PREDICT-2, our One Health surveillance incorporated samping of both humans and livestock to identify viruses that may have jumped from livestock and wild animals into people. By partnering with the Khong District Hospital, the PREDICT project identified individuals who had illnesses that could be characteristic of zoonotic diseases. Detailed questionnaires gathered information about their previous history of illness as well as their exposure to wildlife and livestock. Qualitative, semi-structured interviews gathered even more information and focused on hunting practices within participating villages. A partnership with FAO allowed for the collection of biological samples from livestock populations and to assist in characterizing how people interact with their domestic and food animals.

In addition, the PREDICT team played a crucial role in the training of national, provincial, and district level government staff, Lao PDR's developing One Health workforce, to provide them with skills to better serve their communities and perform their duties. Our laboratory specialists held numerous trainings with national level human and animal health laboratorians, where they learned to perform consensus PCR assays, to prepare samples for genetic sequencing, and about how to keep themselves and others safe while working with biological materials. At the provincial and district levels, our PREDICT team helped teach local veterinary workers how to safely and humanely capture wildlife, collect biological samples, and to collect detailed metadata for future use. Additionally, local staff learned how to safely store biological samples for transport, how to protect themselves while working with animals, and about the diseases that can be shared between animals and people. When performing human surveillance activities, local staff learned more about the mechanisms by which viruses can move between animals and people, how to administer a detailed questionnaire, and techniques on how to perform non-scripted behavioural interviews to gather behavioral risk information from people most at-risk of zoonotic spillover and spread.

Through analysis of project data and findings, the PREDICT project was able to identify risks and educate communities and health professionals on behavior change and intervention strategies designed to protect people and wildlife from disease threats.

LOCAL PARTNERS

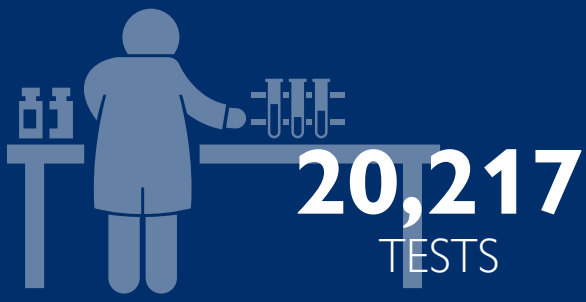
- Bachieng District of Agriculture and Forestry Office
- Champasak Provincial Health Office
- Champasak Provincial of Agriculture and Forestry Office
- Department of Communicable Disease Control
- Department of Livestock and Fisheries
- Food and Agriculture Organization (FAO)
- Khong District Health Office
- Khong District Hospital
- Khong District of Agriculture and Forestry Office
- Ministry of Agriculture and Forestry
- Ministry of Health
- National Animal Health Laboratory
- National Center for Laboratory and Epidemiology
- Soth Village Healthcare Center

DEVELOPED the One Health Workforce by training more than 150 people in Lao PDR.

OPERATIONALIZED One Health surveillance and sampled over 4K animals and people, to identify ways to help minimize the spillover of zoonotic disease threats from animals into human populations.

LABORATORY STRENGTHENING

- National Center for Laboratory & Epidemiology
- National Animal Health Laboratory



DETECTED 30 unique viruses in both animal and human populations.

SOUBANH SILITHAMMAVONG
Country Coordinator
Metabiota

"The PREDICT program has been a school of its own for me, from which I gained knowledge from both global and local teams of experts. Because of PREDICT, I have been given such a great opportunity to be a part of a program that has given me extensive expertise and the chance to grow my career that I had never had in my life. With almost ten years working on PREDICT, I have learned a lot from experts and practitioners who I have met and interacted with. I am very appreciative and give my sincere thanks to USAID for the last ten years."

SENGXAY PHONTHASY
Laboratory Technician
Dept. of Livestock& Fisheries, Ministry of Agriculture & Forestry

"The most valuable experiences I have gained from working on the PREDICT project was learning new techniques for preparing samples for testing, performing conventional PCR assays, and accurately reading PCR test results. PREDICT has supported Lao PDR in terms of technical assistance, equipment, and field and lab supplies for One Health surveillance. Because of this, PREDICT has made me knowledgeable of how wildlife diseases can be transmitted and threaten livestock and human health. If I have the opportunity in the future, I would like to continue my studies at the Master and PhD level, to be able to better serve this country, especially in the areas of early disease detection and quickly responding to outbreaks."

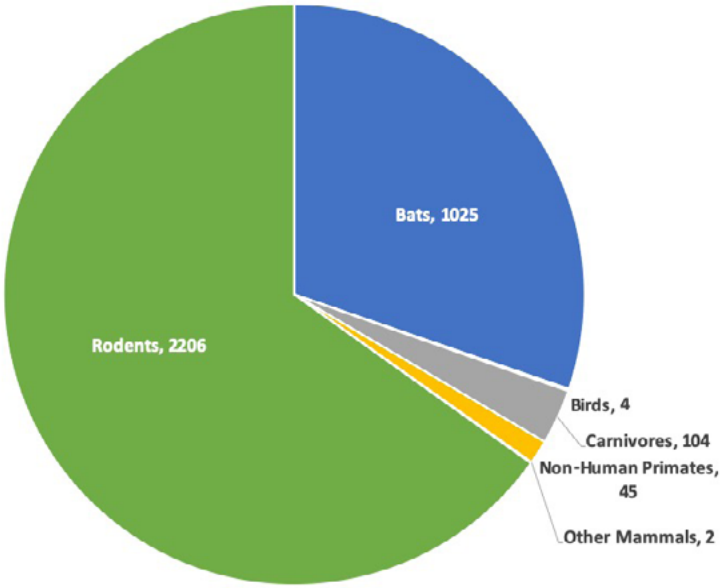
ACHIEVEMENTS

- PREDICT is the first program that has supported the Lao government in building capacity for zoonoses surveillance in wildlife.
- Since 2009, the PREDICT project has conducted disease surveillance in the wild meat value chain and on strengthening lab capacity for detection of viral threats.
- The PREDICT team expanded surveillance of the wildlife value chain to include upstream sources of wildlife harvesting, and implemented One Health surveillance and behavioral risk investigations, providing a platform for multi-sectoral collaboration between the animal and human health sectors.
- PREDICT is a proof-of-concept that wildlife, livestock, and human sectors can work together harmoniously to strengthen health security.
- While outside funding and foreign support remain important for sustaining gains, the PREDICT project has strengthened zoonotic disease surveillance and national laboratory system capacity empowering more independent and nationally-led disease surveillance and outbreak response efforts and leaving behind a foundation more resilient for overcoming current and emerging challenges.

Soubanh Silithammavong, the PREDICT/Lao PDR Country Coordinator, discusses methods for administering a questionnaire for gathering health and animal exposure information with nurses and doctors from the Khong District Hospital (credit: David McIver)

CAPACITY STRENGTHENING

In Lao PDR, PREDICT was the first initiative to successfully facilitate the implementation of One Health surveillance, bringing together the animal and human health sectors to launch simultaneous disease surveillance activities in human, livestock, and wildlife populations. For 10 years, the PREDICT project has provided capacity strengthening opportunities and trainings to the national health workforce, paving the way to fully integrated One Health surveillance capabilities. By using a common set of training materials, safety measures, and laboratory techniques, members of both the human and animal health authorities are now prepared to share data and information, assist and complement zoonotic disease surveillance, and collaborate during outbreak response efforts. Additionally, PREDICT was an active contributor to the first ever World Health Organization Joint External Evaluation to take place in Lao PDR, and provided technical assistance to the Lao government supporting gains in disease management capability. Finally, the PREDICT project's achievements and recommendations are supporting local and international stakeholders in identifying future opportunities and areas for further investment for strengthened global health security.



Number of animals sampled by taxa

CAPTIONS (opposite page): The PREDICT/Lao PDR animal sampling team safely takes biological samples and body measurements from rodents that are for sale in a bushmeat market in Champasak Province (credit: Soubanh Silithammavong); PREDICT/Lao PDR team meets with local villagers each time they arrive in the community, to keep them up to date and engaged on the project's progress (credit: Soukkanya Athitang); animals like this giant flying squirrel are commonly found in wild meat markets in Lao PDR. Some are bought for food, while others, like this squirrel, will probably be used for making local medicines from its bones (credit: David McIver).

ONE HEALTH SURVEILLANCE

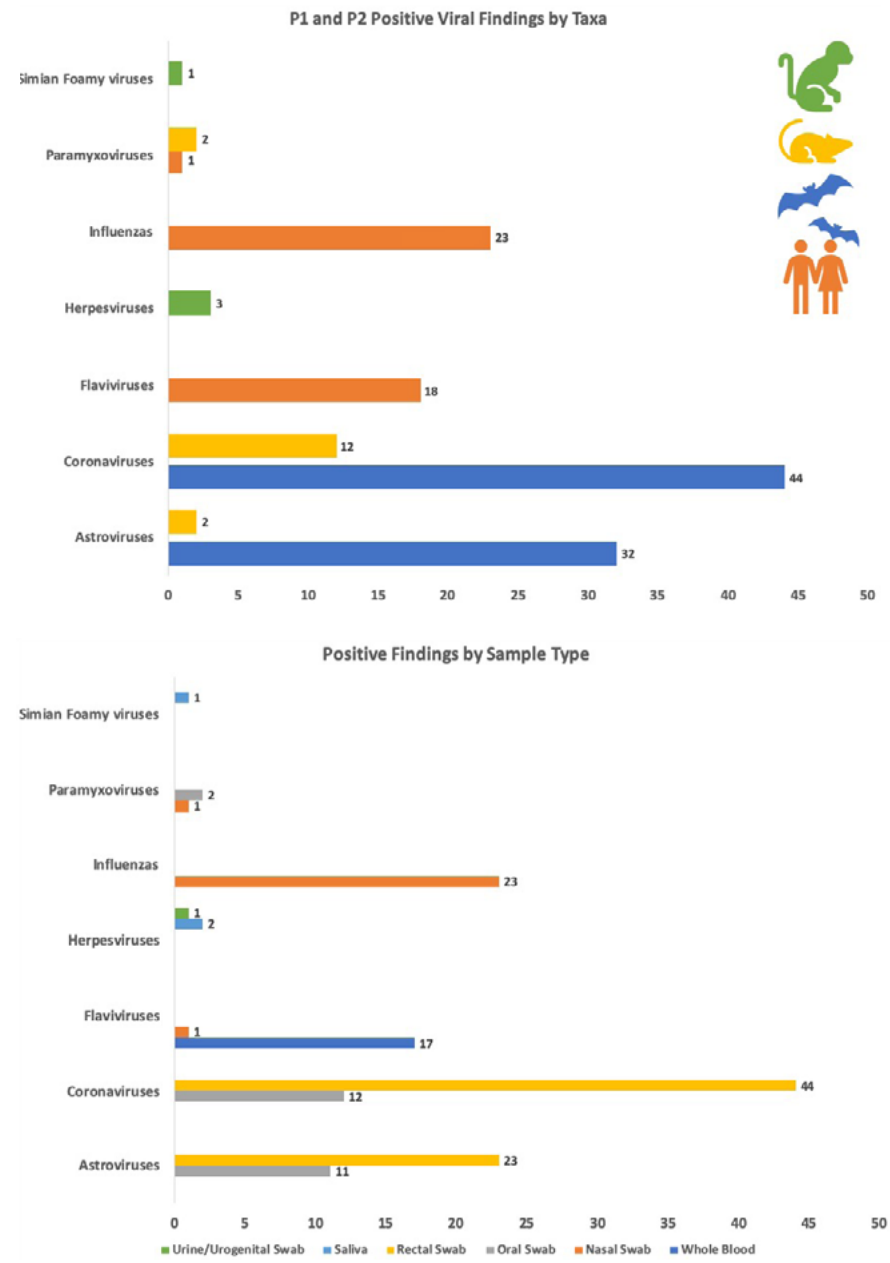
The PREDICT/Lao PDR team led highly successful scoping visits and active surveillance activities in close partnership with both human and animal health ministries, and with the Food and Agriculture Organization (FAO). This partnership allowed for the simultaneous input of information and experiences from individuals from the human health sector, wildlife sector, and livestock sector, enabling a more complete perspective of the potential disease transmission environment in these at-risk communities. In partnership with FAO, the PREDICT team was able to identify key locations where there is significant interaction between all animal and human populations, enabling investigations into their relationships and potential zoonotic disease transmission dynamics. While the PREDICT team discussed with village hunters, butchers, and wild meat transporters about the hazards of handling wild animals, the FAO team held discussions with livestock owners and farmers about ways to keep themselves healthy while continuing to raise healthy livestock.

COMMUNITY ENGAGEMENT

PREDICT/Lao PDR is committed to community engagement and worked with local villages and partners to raise awareness of zoonotic disease threats and strengthen capacity for prevention, surveillance, and detection. Sensitization meetings were held in all PREDICT project sites over the life of the project. At these meetings, our team introduced the One Health approach and provided a platform for learning and dialogue about risky behaviors and practices associated with viral spillover and spread. In addition, PREDICT provided summaries of project findings and shared resources and strategies to prevent infection and live safely with wildlife.

VIRUS DETECTION

PREDICT's viral detection uses broadly reactive consensus (genus/family level) PCR supplemented with high throughput sequencing. These powerful tools produce specific, high-resolution data, allowing for detection of known and new potential pathogens. In Lao PDR, our laboratory team detected viral RNA in 14 rodents that were either for sale in markets or hunted in villages. In 12 of these animals, coronaviruses closely related to known isolates from rodents were confirmed by sequencing. In the two additional animals, unique and novel paramyxoviruses were sequence confirmed, viruses only distantly related to other currently known rodent paramyxoviruses. Viral RNA from known viruses was also detected and sequence confirmed in 41 humans. Most of these individuals, patients at hospitals where the PREDICT team conducted syndromic surveillance for febrile illnesses, were either positive for Influenza A or Dengue virus, with one individual showing coinfection of both. The Dengue virus serotypes detected were serotypes 2 and 4. In one patient, our team detected viral RNA of the human parainfluenza virus 2.



Viruses detected by taxa (upper) during PREDICT-1 and PREDICT-2 (2009-2019); unique viruses detected according to sample type (lower; 2009-2014)

Dr. Bounsavane Dounangboubpha, from the National University of Laos (center), leads the PREDICT animal sampling team deep into the Lao forests to demonstrate the best locations for trapping bats that visit nearby villages in the evenings (credit: Soubanh Silithammavong)

VIRUS TABLE

VIRAL FAMILY	VIRUS	SPECIES	SAMPLING LOCATION	# OF POSITIVE INDIVIDUALS TOTAL	WET SEASON	DRY SEASON
Coronavirus	Longquan Aa mouse coronavirus	Indochinese Ground Squirrel, Polynesian Rat, Red-Cheeked Squirrel	Khong	11	0	11
	Murine coronavirus	Indochinese Ground Squirrel	Khong	1	1	0
Paramyxovirus	Human parainfluenzavirus 2	Human	Khong Hospital	1	0	1
	PREDICT_PMV-151	Finlayson's Squirrel	Khong	1	0	
	PREDICT_PMV-153	Phayre's Flying Squirrel	Khong	1	0	1
Influenza virus	Influenza A	Human	Khong Hospital	23	8	15
Flavivirus	Dengue virus serotype 2	Human	Khong Hospital	4	4	0
	Dengue virus serotype 4	Human	Khong Hospital	14	12	2
Total				**55***	**24***	**31**

*Numbers do not total due to one individual having a co-infection with two viruses

For more information view the interactive report at
p2.predict.global

CAPTIONS (previous page): Field sampling teams are well trained in PREDICT protocols to collect high quality samples from animals humanely, while at the same time ensuring their own safety (credit: Soubanh Silithammavong); Sinakhone Xayadeth works with human biological samples at the National Center for Laboratory and Epidemiology (credit: Soubanh Silithammavong); Lao PDR village meeting at a temple in the Soth Village Cluster.

BEHAVIORAL RISK, & RISK COMMUNICATION

Community engagement and outreach are critical for effective prevention, detection, and response to disease threats. When working with community stakeholders, PREDICT held community meetings at the local temple to inform residents of plans and to provide updates on project progress and success. These participatory meetings empowered our communities to learn about zoonoses, One Health, and disease detection and prevention. To supplement data collection, our PREDICT team recruited villagers to help provide in-depth knowledge on the social and behavioral risks that may be associated with virus spillover and spread. We conducted semi-structured interviews and focus groups with people reporting routine wildlife and/or livestock contact targeting key at-risk populations (e.g., wildlife hunters/trappers/traders, wildlife market workers, and livestock farmers). In addition, questionnaires were administered to healthy individuals from the Soth Village Cluster with routine animal contact, and with sick individuals recruited during syndromic surveillance at Khong District Hospital. In total, 13 individuals completed a semi-structured interview, 9 individuals participated in a focus group, and 234 individuals completed questionnaires, 34 from the community and 200 from the hospital.

PRELIMINARY FINDINGS

Our team continues to analyze biological and behavioral risk data to learn more about risks for zoonotic disease transmission in targeted communities. As of this report, our preliminary findings indicate that reported contact with animals was very common among both community and hospital groups. Among the community group, 100% reported contact with animals in the last year; among the hospital group, 99% reported contact with animals in the last year. In the community group, 53% reported slaughtering animals in the last year, while in the hospital group, only 28% reported recent slaughtering. Of those who reported slaughtering animals in the last year, many said they did not know if there were risks associated with slaughtering or butchering with an open wound (67% community vs. 36% hospital). 54% of the hospital group thought there was some risk associated with slaughtering or butchering with an open wound, compared to only 17% of the community participants.

Reported contact with bats, non-human primates, and rodents/shrews was somewhat uncommon. Among the community group, 3% (n=1) reported contact with bats, 3% (n=1) reported contact with non-human primates, and 18% (n=6) reported contact with rodents/shrews within the last year. Among the hospital group, 4% (n=7) reported contact with bats, 1% (n=2) reported contact with non-human primates, and 9% (n=18) reported contact with rodents/shrews within the last year. Among the community group, 3% (n=1) reported hunting/trapping bats and 3% (n=1) reported hunting/trapping rodents/shrews within the last year; among the hospital group, 1% (n=1) reported hunting/trapping bats, 2% (n=4) reported hunting/trapping rodents/shrews, and 1% (n=1) reported slaughtering rodents/shrews within the last year.

Locations of One Health surveillance and behavioral risk interviews

PRACTICAL IMPLICATIONS

The PREDICT project's work in Lao PDR has been pivotal in establishing the premise of a One Health platform in the country. While Lao national labs are well-established, the PREDICT virus family-level assays brought important disease detection capability and new tools for virus discovery to the country. PREDICT brought into focus the importance of zoonotic disease spillover in Southeast Asia, a hotspot of infectious disease emergence. With its emphasis on capacity strenghtening, the PREDICT project has reinforced national human and animal health preparedness and response capabilities, and through close working partnerships and collaborations across the global PREDICT consortium, Lao health experts now have access to regional networks enabling sustained collaboration, consultation, and cooperation.

QUALITATIVE RESEARCH

Thirteen semi-structured interviews and one focus group were conducted with villagers in the Soth Village Cluster reporting animal contact. Most villagers reported rice production and/or livestock rearing as their primary occupation. Consumption of raw blood was common, but not universally practiced.

The PREDICT team holds a meeting with villagers in the Soth Village Cluster, one location where the project conducted One Health surveillance. (credit: David McIver).

Villagers reported that the majority of wildlife hunting/trapping conducted in the neighboring forest was subsistence oriented: animals were primarily captured as a supplemental protein source. While some hunting/trapping did lead to sale at market, this was said to be an exception. Most villagers reported using traps to capture small animals, including flying squirrels, tree shrews, and monitor lizards. The majority of these types of animals were reported dead upon retrieval; consequently, few hunters/trappers reported animal bites or scratches. A minority of hunters/trappers reported using guns to hunt muntjac. Villagers frequently explained that the hunting of larger animals was more common in the past, as populations of animals like primates have dramatically decreased in recent years. Many of the hunter interviews said that if the primate populations were to return, they would once again hunt them. On multi-day trips, some hunters/trappers reported butchering captured animals in the forest and drying the meat before bringing it back. Personal protective equipment (PPE) was rarely reported being used during hunting or butchering.

RISK IDENTIFICATION

- Use of PPE such as leather gloves, proper footwear, or dedicated clothing were rarely used by hunters capturing wild animals. While in these resource poor settings it might be difficult for people to have this type of equipment available, it was found that many people were unaware of the potential for disease transfer between animals and humans by cuts, bites, or scratches, so providing information on how best to protect themselves is important.
- The consumption of raw blood appeared to be a fairly common practice. The risks associated with the consumption of raw/undercooked blood and meat should be communicated and methods for killing any microorganisms in the blood should be discussed.
- Though bat hunting was not a common practice in the villages focused on by PREDICT, people did report occasional interactions with bats in crop fields or in homes. The PREDICT-created book *Living Safely With Bats* will be presented and discussed with communities to increase their awareness of the potential dangers of living with bats, and how they can keep themselves safe from exposure while at the same time ensuring the health and safety of the bats.

PREDICT's *Living Safely With Bats* risk reduction and behavior change communication resource was shared with local communities to increase their awareness of the importance of bats to the ecosystem, and how to be safe and prevent infection when interacting with them.

This rich multidisciplinary, transborder fabric empowered by PREDICT will persist, we hope, in strengthening national and global health security through continued vigilant surveillance of zoonotic disease threats.

As we say in Laos

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[Working together, we succeed]

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