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INTERNATIONAL DEVELOPMENT

Living Safely with Bats

PREDICT
CÔTE D'IVOIRE

One Health in action (2014-2020)

Empowering One Health teams to strengthen national health security and preparedness for pandemic threats

CÔTE D'IVOIRE

Since 2016, the PREDICT project worked to build national capacity and raise awareness of the importance of One Health surveillance for prevention, detection, and response to zoonotic disease threats. The PREDICT/Côte d'Ivoire team, locally based at Institut Pasteur du Côte d'Ivoire (IPCI) and the Laboratoire National d'Appui au Développement Agricole (LANADA), are key members of the technical working group on animal health. The PREDICT project provided a platform for partners to put One Health in action at the edges of the Marahoué National Park—an area that has been severely degraded by illegal agricultural activity and animal husbandry, increasing human-wildlife interaction. The team's surveillance and behavioral risk activities were focused in a 10km radius around a local village within the Bouaflé Department, a community at-risk of zoonotic disease spillover and spread. Through the project, >350 people across animal and human health sectors–from the national to subnational levels–received hands-on training in zoonotic disease surveillance and disease detection techniques, and gained valuable experience with multisectoral collaboration and in implementing the One Health concept.

In addition, the PREDICT/ Côte d'Ivoire team worked to operationalize One Health in-country, organizing a practical workshop on wildlife monitoring at the Abidjan Zoo, and a training workshop on laboratory techniques for national laboratory staff in the human and animal health sectors. The team, along with the partners at the USAID PREPAREDNESS and RESPONSE project, contributed expertise to additional trainings and workshops that developed and validated operating documents using the Côte d'Ivoire's One Health platform. Collaboration between the PREDICT project and human, animal and environmental health stakeholders in Côte d'Ivoire helped establish a dialogue with these groups, resulting in the signing of a One Health decree by the ministries.

LOCAL PARTNERS

- Institut Pasteur du Côte d'Ivoire (IPCI)
- Laboratoire National d'Appui au Développement Agricole (LANADA)
- Abidjan Zoo; Ministry of Environment, Water and Forestry (MINEF)

>350

DEVELOPED the One Health Workforce by training more than 350 people in Côte d'Ivoire.

>1.1K

OPERATIONALIZED One Health surveillance and sampled over 1.1K animals and people, helping minimize the spillover of zoonotic disease threats from animals into human populations.

LABORATORY STRENGTHENING

· Institut Pasteur du Côte d'Ivoire (IPCI)
· Laboratoire National d'Appui au Développement Agricole (LANADA)

14,030
TESTS
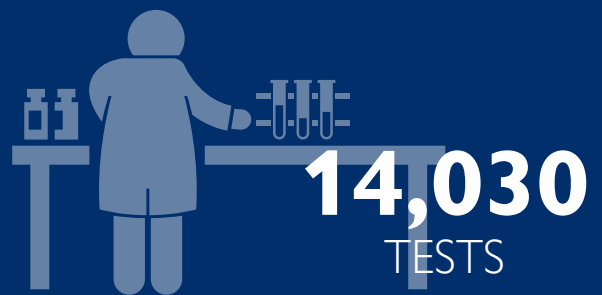
3
KNOWN

DETECTED 3 unique viruses in both animal and human populations.

Global Health Security Agenda

MIREILLE DOSSO
Director
Institut Pasteur du Côte d'Ivoire

"The PREDICT Project has made it possible to create a multidisciplinary One Health group at the national level, and to better operationalize the concept in Côte d'Ivoire. The project has helped everyone to understand that the boundary between human and animal health is not a big one, and that a degradation in the environmental health, including deforestation, can have a significant impact on other health sectors."

ANTOINETTE KOUASSI LOU
Senior Health Laboratory Technician
Laboratoire National d'Appui au Développement Agricole

"My participation in PREDICT was an exceptional opportunity to work in another laboratory, to work in a team and especially, to work in a One Health setting with my colleagues at IPCI. I acquired a greater mastery of nested-PCR and improved my performance, given the large number of samples that had to be processed in a limited amount of time. This will allow me to have endurance and speed in the event of an epidemic or epizootic requiring a rapid and continuous diagnosis and response."

ROMEO GUEU KPON
Junior Laboratory Technician
Institut Pasteur du Côte d'Ivoire

"On a technical level, I was able to strengthen my skills in molecular biology, particularly the nested-PCR technique, troubleshoot problems especially those associated with laboratory contamination. I also learned to barcode animal species,and to clean and analyze the produced DNA sequences with opensource software. This has allowed me to further enrich my knowledge in the field of research."

ACHIEVEMENTS

- Provided a proof of concept of the value of One Health for emerging diseases from wildlife, fostering discussion of nationwide wildlife disease surveillance programs.
- Built capacity for molecular identification of animal species, which can now be utilized to identify wildlife species seized in the context of wildlife trafficking.
- Detected a known Influenza A virus in people and two known coronaviruses in three bat species.
- Collectively engaged stakeholders involved in human, animal, and environmental research, which led to the signing of the One Health platform decree.
- Facilitated the creation of the Technical Working Group on Animal Health (GTTSA), a significant achievement in cross-sectoral collaboration and zoonotic disease surveillance.
- Together with the PREDICT/Liberia team and FAO, held a joint training to share experiences in the fight against epidemics and train Ivorian officers in wildlife monitoring, contributing to strengthened linkages between the teams and opening opportunities for collaboration and support in case of an outbreak in the border area.

- Held a training workshop on the "Operationalization of One Health in Côte d'Ivoire" in collaboration with FAO and the One Health platform, which improved collaboration among multiple sectors, and made strides towards greater integration of the environment, rural development, finance, and security sectors.
- Empowered local communities with knowledge and awareness of zoonotic diseases and worked with community members on risk reduction and behavior change communication strategies aimed at living safely with wildlife and balancing health and conservation goals.

ONE HEALTH SURVEILLANCE

In Côte d'Ivoire, the PREDICT project carried out One Health surveillance activities at the edges of the Marahoué National Park between Bonon and Bouaflé, safely sampling and testing 293 rodents, 483 bats, and 401 humans. Established in 1968, the park occupies an area of approximately 100,000 ha but was greatly impacted by an invasion of illegal cocoa planters and poachers. The subsequent intensification of agricultural activities and animal husbandry led to increased human-wildlife interactions. PREDICT project zoonotic disease surveillance activities were focused in a local village within the Bouaflé Department, which consists of three subsites within a 10km radius from the village center. The Bonon and Bouaflé clinics were chosen for human syndromic surveillance, since these clinics comprise the catchment area for the rural villagers included in our community-based surveillance efforts.

VIRUS DETECTION

In Côte d'Ivoire, viral screening of 2,554 specimens including oral, nasal, rectal swabs, and fecal samples from wildlife and humans was carried out predominately by IPCI, as well as LANADA. Both laboratories used standardized PREDICT protocols to screen for both priority zoonotic viruses of national public health concern, along with other novel and emerging viral threats. Wildlife and human specimens were tested using consensus PCR (cPCR) to screen for priority zoonotic viral diseases and emerging threats such as filoviruses (e.g. Ebola and Marburg), influenzas, coronaviruses, paramyxoviruses and flaviviruses. Virus findings were confirmed through genome sequencing and interpreted to better understand the relationship of the detected sequence to those from known animal and human pathogens.

SPECIES IDENTIFICATION

Animal species were morphologically identified in the field and confirmed by molecular techniques (genetic barcoding) at IPCI, a new method for this lab made possible through the PREDICT project that is also enabling accurate species identification of animals seized in wildlife trafficking.

VIRUS TABLE

VIRAL FAMILY	VIRUS	SPECIES	SAMPLING LOCATION	# OF POSITIVE INDIVIDUALS
Coronavirus	Chaerephon bat coronavirus/Kenya/2006	Little Free-Tailed Bat, Unidentified Molossid Bat	Rural village (Bouaflé area)	2
	Kenya bat coronavirus/ BtKY56/BtKY55	Buettikofer's Epauletted Fruit Bat	Rural village (Bouaflé area)	1
Influenza virus	Influenza A	Human	CSU Bonon Clinic	1
Total				**4**

VIRUS FINDINGS IN PEOPLE

A known Influenza A virus was detected in one adult female (out of 401 participants) sampled and tested from the Bonon clinic. Further investigation is required to determine the virus subtype. Influenza viruses are important pathogens in humans and animals. Viral discoveries will help hospitals in the Marahoué National Park region in their diagnosis when classifying any feverish patient with respiratory symptoms. No individuals from community-based sampling efforts were positive for any targeted viruses.

VIRUS FINDINGS IN WILDLIFE

Two known viruses were detected in three individual bats (of 483 sampled and tested) living in and around homes and communities in the Marahoué National Park region. The known Alphacoronavirus strain (Chaerephon coronavirus/ Kenya/KY22/2006) was detected in fecal samples from two free-tailed bat species, an unidentified *Mops* sp. and the little free-tailed bat, *Chaerephon pumilus*, both of which are insectivorous and found in human dwellings in the region. In addition, a known Betacoronavirus strain (Kenya bat coronavirus BtKY56/BtKY55) was found in Buettikofer's epauletted bat, *Epomops buettikoferi*, a frugivorous species observed feeding on mango trees in the community. The genus Betacoronavirus includes viruses that are important to public health such as SARS and MERS, but this particular virus is not considered to be closely related to either of these viruses. Therefore, at this time, there is no evidence that these two strains pose a threat to human health.

All virus findings are contributing to: i) risk analysis and characterization efforts to inform risk communication strategies and community awareness campaigns (leaflets, pooled results, posters explaining the risks); and ii) assessments of rodent and bat diversity and their role as disease carriers in disturbed habitats of the Marahoué National Park (due to land use change).

CAPTIONS (top-bottom): Romeo Gueu Kpon, PREDICT laboratory technician preparing samples at PREDICT laboratory, IPCI, Adiopodoumé, Côte d'Ivoire (credit: Tara Hoda); *Chaerephon pumilus* in a house of a patient sampled in PREDICT/Côte d'Ivoire concurrent site during field surveys in August 2018 (credit: Dr. Eugène Kouassi Koffi)

EPIDEMIOLOGICAL & BEHAVIORAL RISK

SYNDROMIC SURVEILLANCE

Since the beginning of the PREDICT project in Côte d'Ivoire, our team worked in the Bouaflé clinic and slaughterhouse, the CSU Bonon clinic, and several rural sites in the area, in addition to working with wildlife in the southwestern region at a rural site in Taï forest. Syndromic surveillance activities mainly focused on Bonon and Bouaflé areas. At the clinics, the PREDICT team enrolled 435 patients whom completed a questionnaire, 401 of which also consented to provide biological samples. Enrolled individuals were mostly women and adults residing in the communities around the main village, and in the catchment area of the Bonon and Bouaflé clinics. The most common symptoms of enrolled patients were fever with headache and severe fatigue or weakness, fever with muscle aches, cough, cold, sore throat, and fever with diarrhea or vomiting. Such illnesses were detected among all age groups, activities, and sites, but more often in individuals from rural than urban communities.

INSIGHTS FROM THE HUMAN QUESTIONNAIRE

Hunting and livestock breeding were carried out exclusively by men in both villages and urban areas. Men were also more involved in agricultural activities than women, who reportedly spent most of their time at home carrying out domestic tasks and activities not involving live animals (food preparation, cooking, trade). On the other hand, in more urban sites like the cities of Bonon and Bouaflé, women dominated the value chain related to animal business, namely game trade and wild animal restaurants. These findings suggest that wildlife-borne zoonotic agents might be introduced in family clusters by men at higher risk of contact with infected wild animals due to their hunting and farming activities and then spread via the game and meat trade in towns (including domestic and wild meat fresh products).

A total of 423 people in apparently good health were also surveyed in the rural community and surrounding camps. Individuals surveyed practiced farming and livestock breeding as main livelihood activities, with hunting reported as an alternative means of providing meat for their families; a few also reported being professional hunters or wild meat traders.

INSIGHTS FROM IN-DEPTH BEHAVIORAL RISK INVESTIGATIONS

Well, it was in the field, in a big tree. Someone had a slingshot and he killed them...once it is killed, we take it to the field and burn it a little and skin it, we wash it and then the women cook it...we do it with our bare hands and we touch the blood.

Adult male crop producers

Well, there's a tree called goyafa [guava]. Bats like to eat that. So, when it's evening, I go and sit underneath it and then I start shooting at them with a slingshot. I can kill 5 or even 6.

The local behavioral risk team also led investigations into the human drivers of zoonotic disease transmission across seven sites in Cote d'Ivoire. These in-depth, one-on-one interviews and focus group discussions gave local social scientists the opportunity to probe the different contexts in which people of varying backgrounds interacted with live animals and bushmeat. As a taxa of particular interest, participants were asked to discuss the different ways in which they came into contact with bats at home and during their work days.

Among those who described hunting and slaughtering practices, the use of a slingshot, a catapult, or a gun/rifle were among the most cited ways to catch bats. Participants detailed how this method often necessitated killing the bat with a final blow of a machete once it fell onto the ground. Of note, some participants described specifically handing off the dead bats to children for preparation. When handling the dead bat, respondents described bare-handed contact with the body and with the bat blood. Several respondents detailed both current and previous bat consumption, many times regarding the taxa as appetizing. Some respondents also revealed that according to tradition, bat consumption was discouraged among pregnant women.

Possibly due to previous community messaging regarding Ebola transmission risk, respondents seemed uneasy discussing bats with the interviewers. Eating the animal was described by some as a custom of the past, with others limiting their discussion to a simple expression of distaste for the taxa. However, while some respondents reported bats as currently being rare or difficult to find, others described their regular presence around their homes and in their fields. These apprehensive or negative sentiments towards bats might possibly be linked to institutional and historical distrust from previous Western interventions, imprecise public health messaging, and a 'seeing is believing' understanding of Ebola.

The insights gained through the in-depth behavioral and social science work provided invaluable information for the development of culturally appropriate, livelihood sparing interventions and behavior change communication campaigns designed to reduce risk of viral spillover from wildlife hunting and bushmeat consumption while also promoting wildlife conservation and the critical ecosystem service roles bats play. Researchers and health workers need to remain mindful of previous education and awareness campaigns as brought up by the interview respondents, and the impacts lasting impressions, knowledge, and possible misunderstandings local residents have of well-intentioned messaging.

Yes, we heard about something like that, it is said that bats give Ebola and monkeys transmit AIDS, but I do not know if it is true...We heard about it. We were scared, we watched out, but then they said Ebola was over..

Focus group of adult male hunters, trappers and fishers

There are two kinds [of bats]. Those which are in the houses, we do not eat them...the little ones which are in the houses are the ones with a lot of diseases.

Bat book presentation at the Abidjan Zoo

COMMUNITY ENGAGEMENT & RISK COMMUNICATION

The PREDICT team engaged in risk communication and result dissemination at the community level to foster improved awareness of zoonotic diseases and transmission pathways, along with potential prevention and control strategies. At each field site visit, our team communicated the potential health dangers that wildlife, particularly bats, could represent. These discussions were beneficial to both the communities and the PREDICT team who learned from the villagers' perceptions of risk, and together worked to identify solutions to their concerns.

The villagers were encouraged to preserve the bats' roosting sites, but to avoid bats taking refuge in their houses and becoming a direct threat. Due to the proximity of bats to humans in some villages, the PREDICT team conducted community outreach using the *Living Safely with Bats* behavior change and risk communication resource published by the PREDICT consortium. Copies of the bat book were distributed to the representatives of the communities during the visit in April 2019, and a presentation of *Living Safely with Bats* was also conducted within the village via projector. In addition, during the joint FAO, IPCI, LANADA, DSV and PREDICT training mission, farmers were made aware of the disadvantages of wandering livestock farming, the advantages of vaccinating animals, and the economic importance of rural livestock.

Group picture of trainers and trainees from the joint PREDICT Cote d'Ivoire / PREDICT Liberia training at the Abidjan Zoo in June 2019
(photo credit: Kouamé Joel)

CAPACITY STRENGTHENING

In Côte d'Ivoire, the PREDICT project fostered discussion about the need for, and developed capacity for a nationwide One Health wildlife disease surveillance program. Before the PREDICT project, only isolated initiatives were dedicated to specific wildlife diseases, usually in the context of research programs.

LABORATORY SYSTEMS STRENGHTENING

The PREDICT project, in collaboration with Columbia University, organized training sessions to increase capacity within national laboratories for the detection of priority viral families. Key workers were trained in PREDICT project protocols, laboratory techniques, biosecurity and biosafety, sample storage and labeling, and database management. In addition, the PREDICT project was directly involved in the Ivorian laboratory system's capacity building through provision of equipment, reagents, and consumables, selection for optimal virus detection, and professional development of the laboratory staff. Portable freezers were provided to IPCI to ensure cold chain; allowing for the optimal conservation of viral material during an outbreak response. USAID, through FAO, also provided similar equipment to LANADA, allowing the country to possess strong cold chain capacity to work in remote areas, ensure samples were stored correctly and enable zoonotic disease surveillance in the field.

JOINT WILDLIFE SURVEILLANCE TRAINING WITH THE PREDICT LIBERIA TEAM, IPCI, & FAO

In June 2019, 50 participants joined a workshop and field training, facilitated by PREDICT teams from Côte d'Ivoire and Liberia at the Institut Pasteur du Côte d'Ivoire and Abidjan Zoo. Participants from a range of stakeholders advanced their knowledge and skills for pathogen surveillance in wildlife, including attendees from headquarters and regional offices of the Director of Veterinary Services (DSV), the Director

of Wildlife and Hunting Resources (DFRC), the Ivoirian Office of Parks and Reserves (OIPR), the National Agency for Rural Development Support (ANADER), the Directorate of Health and Social Action of the Armed Forces (DSASA), Vision Verte, the IPCI, and LANADA.

The PREDICT teams conducted seminars on occupational health hazards linked to snake bites and venom, zoonotic agents circulating in wildlife in the region, and anesthesia of large mammals. Participants also completed hands-on field training in the PREDICT project's safe and humane wildlife surveillance techniques, including rodents at IPCI, and bats and rodents at the Abidjan zoo.

This workshop reinforced collaboration between cross-border teams and illustrated the possibility of working among sectors and agencies from all over the country to discuss issues and methods for improving sharing of epidemiological animal data.

OUTBREAK PREPAREDNESS & RESPONSE

DOMESTIC ANIMAL DISEASE OUTBREAK PREPAREDNESS

Due to successful trainings, the PREDICT project's functional viral testing platform, and the necessity for harmonized outbreak preparedness, FAO funded a training at our One Health surveillance site near Marahoué National Park to sample domestic animals with technical assistance provided by the PREDICT team. All participants were trained in PREDICT project biosafety and humane animal capture and sampling protocols, complied with occupational health best practices including required vaccinations, and operated under the direction of the Veterinary Services authority. During this training, several preventive veterinary interventions were implemented as domestic carnivores were vaccinated against rabies, poultry were vaccinated against Newcastle disease virus, and ruminants were given an anti-helminthic.

CROSS BORDER OUTBREAK PREPAREDNESS

PREDICT/Côte d'Ivoire and PREDICT/Liberia teams, with the support of FAO, organized a joint training to share knowledge and experiences in the fight against epidemics and to train Ivorian officers in wildlife monitoring. This unique training contributed to establishing strong links between the teams, and to harmonizing sampling techniques to facilitate working jointly in case of an outbreak in the border area, or in the interior of Côte d'Ivoire.

PRACTICAL IMPLICATIONS

- In Côte d'Ivoire, the PREDICT team contributed to the design of national global health indicators, and also worked to include wildlife surveillance in the national health safety plan.

- The PREDICT project brought together stakeholders involved in human, animal, and environmental health to research and reach consensus and sign the One Health platform decree in Ivory Coast.

- The PREDICT project and partners facilitated the creation of the Technical Working Group on Animal Health (GTTSA). GTTSA is a significant achievement in cross-sectoral collaboration and zoonotic disease surveillance in Ivory Coast.

- Rich insights gained from the in-depth behavioral work are invaluable for designing culturally appropriate messaging and community engagement campaigns on wildlife conservation and spillover risk reduction

- To sustain our community outreach and risk communication efforts, the National Rural Development Support Agency (ANADER), the government entity that works closely with rural communities on agricultural and livestock issues, continues to use the *Living Safely with Bats* resource as a tool to communicate with villagers about potential risks from bat-borne zoonoses and balancing health and conservation goals.

- The PREDICT project directly contributed to strengthening the national laboratory system's capacity for zoonotic disease detection through provision of equipment, reagents and consumables, and training for laboratory staff from both the IPCI and LANADA, Bingerville laboratories.

SPECIAL FEATURE
Operationalizing One Health in Côte d'Ivoire

PREDICT organized a workshop at the Institut Pasteur du Côte d'Ivoire (IPCI) on operationalizing One Health in the country. Putting the World Bank One Health Operational Framework to use, the workshop focused on practical, value-added ways to integrate multi-sectoral collaboration, bringing together authorities from Ministries of Health, Veterinary Services, Wildlife, Environment, Security, Rural Development, and Economics and Finance as well as local NGOs and academic partners. An exercise on investing in One Health used three case studies to examine multi-sectoral impacts of African Swine Fever (ASF), lagoon pollution, and impacts from construction of the Soubre dam. The workshop identified the need for formalizing support for One Health at the level of the Prime Minister's Office and an optimal mechanism to manage and coordinate the One Health platform and promote additional collaboration in daily functions and planning processes, both in emergencies and peacetime.

Read more at **bit.ly/2X7vCbx**

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