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Strategies to Prevent (STOP) Spillover

Year 4 Semi-Annual Report

1 October 2023–31 March 2024

April 2024 Y4

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Strategies to Prevent (STOP) Spillover

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Project Title: Strategies to Prevent (STOP) Spillover

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This report was prepared by the Tufts University Consortium. Led by Tufts University, this consortium includes Africa One Health University Network (AFROHUN), Broad Institute of the Massachusetts Institute of Technology and Harvard University, Center for Wildlife Studies, icddr,b, JSI Research and Training Institute, Inc., Viet Nam One Health University Network (VOHUN), Tetra Tech ARD, the University of California at Los Angeles, and the University of Washington.

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Cover photograph: A butcher at a wild meat market in Sierra Leone (Photo credit: Bruno M. Ghersi Chavez)

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Acronyms & Abbreviations

AFROHUN	Africa One Health University Network
BFD	Bangladesh Forest Department
CDI	Côte d'Ivoire
CoV	Coronavirus
DARD	Department of Agriculture and Rural Development
DLS	Department of Livestock Services
DNCC	Dhaka North City Corporation
DOH	Department of Health
FAO	Food and Agriculture Organization
FGD	Focus Group Discussion
IEDCR	Institute of Epidemiology, Disease Control and Research
IPC	Institut Pasteur du Cambodge
IPCI	Institut Pasteur de Côte d'Ivoire
IRB	Institutional Review Board
KII	Key Informant Interview
KPIs	Key Performance Indicators
LANADA	National Laboratory for Agriculture Development Support
LBM	Live Bird Market
LoD	Limit of Detection
LWSC	Liberia Water and Sewer Corporation
MERS	Middle East Respiratory Syndrome
NGO	Non-Governmental Organization
NPHIL	National Public Health Institute of Liberia
OH-DReaM	One Health-Design Research and Mentorship
OHS	One Health Secretariat
OM	Outcome Mapping
PDAFF	Provincial Department of Agriculture, Forestry and Fisheries
PHD	Provincial Health Department
PPE	Personal protective equipment
SARS	Severe Acute Respiratory Syndrome
SARS-CoV-2	Severe Acute Respiratory Syndrome Coronavirus 2
SBC	Social and behavior change
SOP	Standard Operating Procedure
STOP Spillover	Strategies to Prevent Spillover USAID Program
TIPs	Trials of Improved Practices
UNMC	University of Nebraska Medical Center
USAID	United States Agency for International Development
UVRI	Uganda Virus Research Institute
VOHUN	Viet Nam One Health University Network

Practical wearing and removing of PPE by bat guano producers during demonstration-based education at the Varint pagoda in Khchau commune. Photo credit: STOP Spillover Cambodia/Tetra Tech

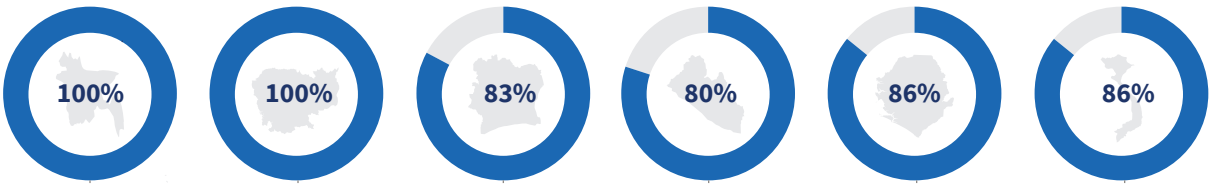
Introduction

Strategies to Prevent Spillover (STOP Spillover) is a five-year, U.S. Agency for International Development (USAID)-funded cooperative agreement to support priority countries in Asia and Africa to strengthen their capacities to identify, assess, and monitor risk associated with emerging zoonotic viruses and to develop and introduce proven and novel risk-reduction measures. STOP Spillover builds on more than 15 years of USAID investments in promoting a multisectoral, One Health approach to addressing emerging zoonotic viruses before they pose epidemic or pandemic threats to human health. Led by Tufts University, STOP Spillover is a global consortium of 9 partner organizations with expertise in human, animal, and environmental health who are taking the next step in understanding and addressing the risks posed by known zoonotic viruses that have the potential to spillover and cause pandemic crises.

STOP Spillover focuses on prioritized zoonotic viruses (Ebola, Marburg, Lassa, and Nipah), animal-origin coronaviruses (including SARS-CoV, SARS-CoV-2, and MERS-CoV), and animal origin zoonotic influenza viruses. In each STOP Spillover host country, the specific viruses to be addressed and the prioritized high-risk interfaces are determined with in-country stakeholders. By implementing locally designed interventions in each country over the life of the project, and evaluating the social, gender, economic, and environmental acceptability and effectiveness of each intervention, participating countries are strengthening their capacity to develop, validate, and implement interventions to reduce spillover of prioritized zoonotic viruses.

STOP Spillover currently supports six USAID priority countries. The goal of STOP Spillover is to enhance understanding of the causes of viral emergence from animals to humans and to use this information to reduce risk of zoonotic viral spillover, amplification, and spread. In support of this goal, STOP Spillover has three objectives: Objective 1 focuses on understanding the risk of spillover of zoonotic viruses and areas where interventions may be most effective at specific high-risk animal-human interfaces. Objective 2 focuses on utilizing that improved understanding to develop and test interventions that reduce the risk of spillover at the community level. Objective 3 focuses on assisting countries to limit the impact of spillover events should they occur.

Figure 1: Status of Deliverables Submitted to USAID during the reporting period (October 2023–March 2024)



	Bangladesh	Cambodia	Côte d'Ivoire	Liberia	Sierra Leone	Viet Nam
Deliverables due	2	2	6	10	7	7
Deliverables submitted	2	2	5	8	6	6

Reviewing zoonotic disease and spillover risk reduction activities at Varint pagoda in Khchau commune.
Photo credit: STOP Spillover Cambodia/Tetra Tech

Activities & Accomplishments

OBJECTIVE 1

Objective 1 focuses on assisting countries to improve their understanding of how priority zoonotic viruses spill over from animals to people. Improved understanding of risk directly feeds into and supports Objectives 2 and 3, including the development of risk-reduction interventions. This section outlines STOP Spillover's achievements and accomplishments for Objective 1 during the first half of Project Year 4.

Cambodia

Activity 1.2.6.1: Research on bat guano farm and prevalence of pathogens carried by these species

This study of bat urine and guano is a multi-seasonal effort timed to coincide with important life stages of bats. The aim of this work is to analyze and monitor viral shedding and assess potential virus transmission risks to human populations (bat-guano farming and non-bat-guano farming households) at different times of the year. The STOP Spillover Cambodia team completed winter sampling in December 2023. This phase coincided with the juvenile development stage of bat colonies. It provided valuable re-training and field practice in safe and effective sampling techniques for Cambodian government partners and community members (OH-DReaM working group members). Bat guano and urine samples were collected from bat guano farms in Kang Meas ditrict of Kampong Cham province.

OH-DReaM working group member collecting bat guano samples on a plastic sheet before sunrise.
Photo credit: STOP Spillover Cambodia/Tetra Tech

Bat guano sampling's outcomes

Six OH-DReaM working group members participated during December sampling. Team members showcased their improved skills and adherence to strict safety protocols during fieldwork. This fieldwork exemplified the One Health approach, fostering collaboration and knowledge exchange among researchers/scientists, government agencies, and local communities. This collaborative effort strengthens local capacity for monitoring potential disease threats at the bat-human interface.

Bat guano sampling's results

The team collected and labeled 250 samples (87 urine samples and 163 guano samples) from 14 bat guano farms. These samples were safely transported to the GDAHP/NAHPRI laboratory in Phnom Penh for coronavirus testing. Additionally, remotely operated camera systems were installed at four farms, providing valuable data on bat populations and their behavior. This information will contribute to a more comprehensive understanding of potential viral transmission risks and inform future prevention strategies.

Côte d'Ivoire

Activity 1.4.1: Disease surveillance and pathogen spillover risk monitoring at the human-wildlife interface

In Côte d'Ivoire, STOP Spillover focuses on human-wildlife interfaces where potential pathogen spillovers could occur. These interfaces are often not covered by existing surveillance systems. The Côte d'Ivoire government has begun to update and modernize its veterinary public health legislation. In Côte d'Ivoire, the government's interest in veterinary public health has attracted the commitment of multiple stakeholders and donors who have invested in surveillance. As part of the One Health approach, STOP Spillover supports the Côte d'Ivoire government in strengthening its capacity to monitor and respond to epidemics at the human-wildlife interface. The One Health National Platform Surveillance Technical Working Group (TWG) and in collaboration with FAO/ECTAD, will provide technical expertise to enhance the capacity of government agencies, line ministries and other relevant stakeholders to carry out disease surveillance, risk assessment and outbreak response at the human-wildlife interface. To achieve these objectives, a work plan including interventions approved by USAID was validated by national stakeholders in June 2023. This work plan comprises four major activities, including an activity titled "Disease surveillance and monitoring of pathogen spillover risks at the human-wildlife interface". It is in this context that the present project "Interactive mapping of human-wildlife interfaces in the District des Montagnes" was implemented.

Mapped data sources

Various cartographic data (vectors) and surveys were collected from the following government institutions and their branches at the departmental level: the Forest Development Corporation (SODEFOR); the Ivorian Parks and Reserves Agency (OIPR); the Ministry of Water and Forests (MINEF); the National Institute of Statistics (INS); Bureau National d'Etudes Techniques et du Développement/Centre de l'Information Géographique et du Numérique (BNETD/CIGN); the National Committee for Remote Sensing and Geographic Information; the University Center for Research and Application in Remote Sensing (CURAT); the National Institute of Public Hygiene (INHP); and the Ministry of Tourism and Leisure (MT). Refer to Interactive Mapping report submitted March 2024).

ArcGIS software was used for mapping and geospatial analysis as well as for the development of the interactive platform. In line with the data collected from stakeholders, five (5) indices for the characterization of Human-Wildlife interactions were determined.

To produce the final map of human-wildlife interfaces, the five maps of human-wildlife interaction indices were merged by adding them together. This fusion was carried out in two main steps (see Table 1). The geospatial database that was developed includes layers of vector information about administrative subdivisions, environment, demography, as well as maps of interaction indices and the final map of human-wildlife interfaces. This database was used to fill the interactive online platform. The development of this interactive database, which can be consulted online, is the product of effective collaboration among numerous stakeholders, who have contributed either by sharing their own data, or by providing input into the development and implementation of the approach.

Table 1: Merging the five Human-Wildlife interaction indices

Summary of human-wildlife interaction indexes				
1/ Sale and consumption of wildlife	2 / Road length within a 5km radius of classified Forests - Parks - Reserves	3/ number of localities within a 5km radius of classified Forests - Parks - Reserves	4 / Level of infiltration of Classified Forests - Parks - Reserves	5 / Sub-prefectural population density within a 5km radius of classified forests - parks - reserves)
Code 1 : Low 2 : Medium 3 : High	**Code** 10 : Low 20 : Medium 30 : High	**Code** 100 : Low 200 : Medium 300 : High	**Code** 1000 : Low 2000 : Medium 3000 : High	**Code** 10000 : Low 20000 : Medium 30000 : High

Pas

Addition of layers

Human-wildlife interface index table		
Low	**Medium**	**High**
Code : 11111	Code : 11112	Code : 11113, 11131, 11132, 13113, 21123, 21211, 21213, 21213, 21232, 21322 21323, 21332, 21333, 22331, 22332, 23111, 23112, 23113, 23132, 23213, 31111, 31113, 31132, 31222, 31223, 31223, 31331, 31332, 32113, 33222

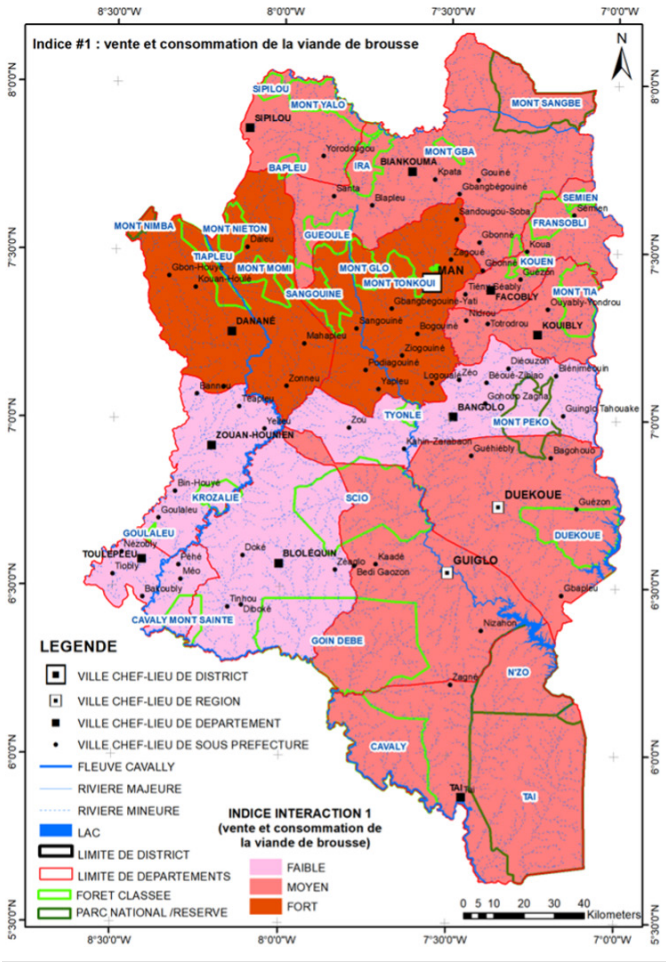
Reclassification code
1 : Low
2 : Medium
3 : High

STEP 2

One of the most important results of this project is the spatial database that has been compiled, which particularly highlights the level of interaction between humans and wildlife in District des Montagnes and allows us to conclude that the departments of Man and Danané have the highest levels of interaction between humans and wildlife. Added to these departments are the various classified forests, national parks and reserves, which also have a high level of interaction between humans and wildlife.

This interactive mapping project is intended as an important decision-support tool for government and stakeholders, enabling them to:

Figure 2: Wild meat sales and consumption outlets index map



- Locate areas of high human-wildlife interaction, and therefore potentially high zoonotic disease risk;
- Target additional data collection areas to refine the accuracy of the first maps of human-wildlife interfaces;
- Organize targeted risk-based surveillance of potential high-risk areas for zoonotic diseases as part of anticipatory strategies.

The richness of the information contained in the database, together with the possibility of enriching it with additional data and updating, make this interactive platform an important source for any further analysis of the physical, environmental and social environments of the District des Montagnes and Côte d'Ivoire. The mapping exercise will continue in the next six months to include socio-economic data.

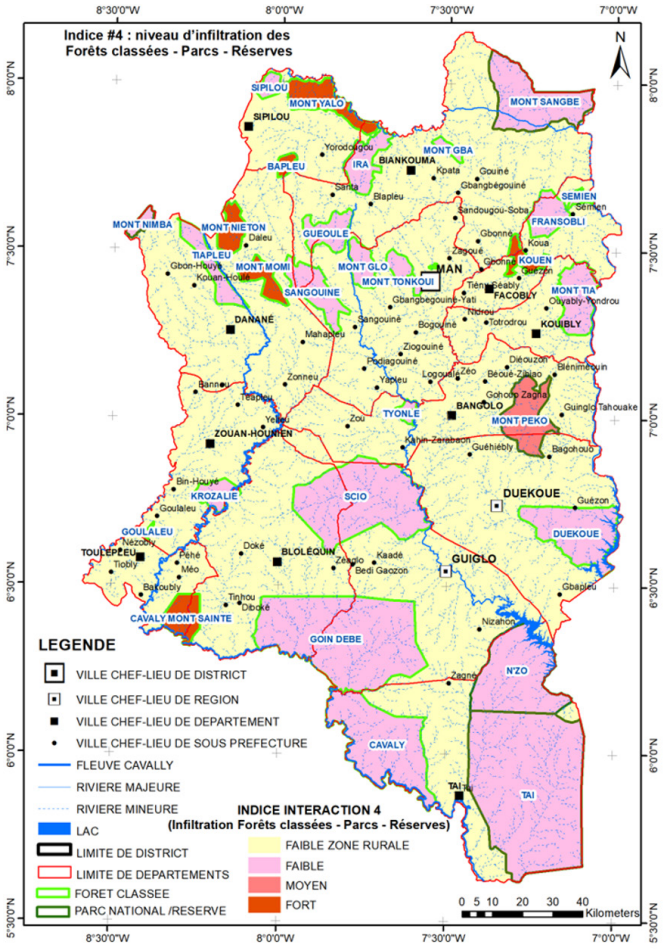
Strengthening surveillance and zoonotic disease risk monitoring at human-wildlife interfaces

STOP Spillover organized a high-level workshop through the National One Health Platform to discuss collaboration and ways to strengthen the multisectoral surveillance of key pathogens at Human-Animal-Environment interfaces. The workshop brought together fifty-six (56) experts from the fields of human health, animal health, environmental health and other stakeholders from universities, communities, associations, projects, the national one-health platform and partners for three days, from March 13 to 15, 2024, at the "Hôtel Suprême" in Grand-Bassam. As part of the workshop, participants mapped key interfaces where humans and wildlife interact the most in the Tonkpi Region – The Western region. 10 key Human-Animal-Environment interfaces were identified. These were: (1) Wildlife value chain, (2) Wildlife farming, (3) Aquatic animal resource sites, (4) Poultry and swine farming, (5) Free ranging farming, (6) Abattoirs, (7) Live animal markets, (8) Peri-domestic rodents at human habitats, (9) Touristic sites, (10) Utilization of animal manure in agriculture. Overall, disease surveillance seldom occurs or is weak at these interfaces with elevated risk of pathogens spillover. Participants identified the following pathogens for surveillance: Filoviruses, Avian Influenza, Crimean-Congo virus, Lassa virus, Monkeypox virus, and antimicrobial resistant enterobacteria. The participants identified the following potential activities for implementation at these interfaces such as (1) document and map the identified interfaces, (2) assess zoonotic disease risks, (3) conduct event-based, wastewater, surface, and effluent water surveillance, (4) Identify through serology and PCR circulating pathogens in humans and animals. The proposed joint activities were later included in the National Action Plan for Health Security for implementation. Outcomes of the workshop included:

Plenary discussion with OH experts during the high-level workshop. Photo credit: STOP Spillover CDI/AFROHUN

1. Identification of 10 key interfaces for multisectoral zoonotic disease surveillance
2. Validation of a multi-sectoral approach to strengthening multi-sectoral collaboration in surveillance at the Human-Animal-Environment interface
3. Recommendation for the implementation of a framework for joint risk analysis of zoonotic diseases as required by the JEE report
4. Development of a roadmap for strengthening surveillance at the Human-Animal-Environment interface, to be operationalized by the Surveillance and Notification TWG.
5. Popularization of STOP Spillover initiatives on surveillance, risk assessment at the Human-Animal-Environment interface as well as biosafety and biosecurity along the bushmeat value chain necessary for ongoing regulatory reforms.

Figure 3: Wild meat sales and consumption outlets index map



Côte d'Ivoire

Activity 1.4.6: Wastewater surveillance (WWS) and liquid waste effluent surveillance

Prior work shows that wastewater surveillance can help identify disease clusters and provide two to three weeks of early warning of emerging trends in the prevalence of certain pathogens, including viruses. In Activity 1.4.6, the STOP Spillover CDI team is actively conducting surveillance that involves sampling wastewater and liquid waste effluents in high-risk hotspots in Côte d'Ivoire. We have identified four high-risk hotspots for testing wastewater and liquid waste effluent in the country. Liquid waste effluent sample collection and testing for Influenza A viruses started on December 6, 2023, with LANADA in the Grand Bassam poultry market, using the passive collection technique. Sample collection for wastewater started on November 20, 2023, with IPCI in the open canal containing wastewater from the Yopougon district, using active and passive collection techniques. In this reporting period, we identified high-risk hotspots for wastewater and liquid effluent testing: the open sewage canal in Yopougon (Abidjan) and the liquid waste streams from the Grand Bassam chicken slaughter markets At the Yopougon site, we sampled wastewater to test for SARS-CoV-2 once a week for 12 weeks, using active and passive collection techniques at two locations. We collected 4 samples each week resulting in 48 samples over the 12 weeks. Samples were prepared, RNA extracted and processed by PCR. At the end of this collection period, we obtained 22 samples, of which 13 and 9 were collected respectively using the active and passive methods. In total, 45.83% of samples tested positive for SARS-CoV 2 with Ct threshold values ranging between 28.2 and 3.5.1.

At the Grand Bassam poultry market collection site, passive effluent sampling for Avian Influenza virus was conducted at two separate locations. Samples were prepared, RNA extracted and processed by PCR. Out of 24 passive samples, three (12.5%) tested positive for Avian influenza, with Ct values ranging between 29.3 and 32.4. This work provides proof-of-concept for sampling priority pathogens in waste effluent streams in non-sewered contexts without wastewater infrastructure. In the second half of this fiscal year, we will start sampling hospital wastewater in the City of Man to identify Lassa virus over a period of 12 weeks.

Liberia

Activity 1.2.6.1: Assess the extent of Lassa virus infection prevalence in rodents & Activity 1.2.6.2: Conduct research to understand the movement of the rodent reservoir hosts of Lassa fever

In Liberia, Lassa fever cases have predominantly been reported within the "Lassa belt" (Bong, Lofa and Nimba counties). A distribution model using Lassa case locations and environmental conditions (precipitation, vegetation cover and mean and maximum temperatures) predicted the presence of the virus outside the "Lassa belt" (Fichet-Calvet, 2009), and recent outbreaks in Grand Bassa, Margibi, Montserrado and Grand Kru Counties have confirmed this. Based on these findings, STOP Spillover hypothesized that the true distribution of Lassa fever in Liberia extends well beyond the Lassa belt. To test this hypothesis, we are working together with the MOH, NPHIL, the MOA and local communities to collect and test samples from Mastomys natalensis and other rodents for the presence of Lassa virus RNA (an indication of infection) in and outside the area historically considered the "Lassa belt" in Liberia.

Rounds two and three of the Lassa virus prevalence and movement study was conducted in February and March 2024 across the eight (8) communities in Bong, Grand Bassa and Nimba Counties (Table 2 & Figure 4). To capture rodents from diverse habitats and locations within each community, Sherman live traps were placed in homes, and bushes within the communities and outside the communities for three nights. This approach gave a comprehensive representation of the local rodent population, enabling a more robust analysis of their distribution and potential disease reservoir status.

Captured rodents were identified by sex. Females were captured twice as often as males (195 vs 90), suggesting a high likelihood of rodent population growth in the study communities. All specimens collected from the study communities were transported to the National Reference Laboratory for storage and testing.

Table 2: Sites where research was conducted. L = Lassa cases have been reported in humans in the last 5 years, NL = Lassa cases have not been reported in the last 5 years.

COMMUNITY	LASSA STATUS	COUNTY
Blegay Pa Community	L	Nimba
Behplay	NL	Nimba
Bong Mines	NL	Bong
Compound 3	L	Grand Bassa
Barclayville	NL	Grand Bassa
Naglay Town	NL	Grand Bassa
Yolota Clinic	NL	Bong
Camp II	NL	Bong

Figure 4: Map of sites sampled. Red crosses indicate Lassa communities, blue circles indicate non-Lassa communities

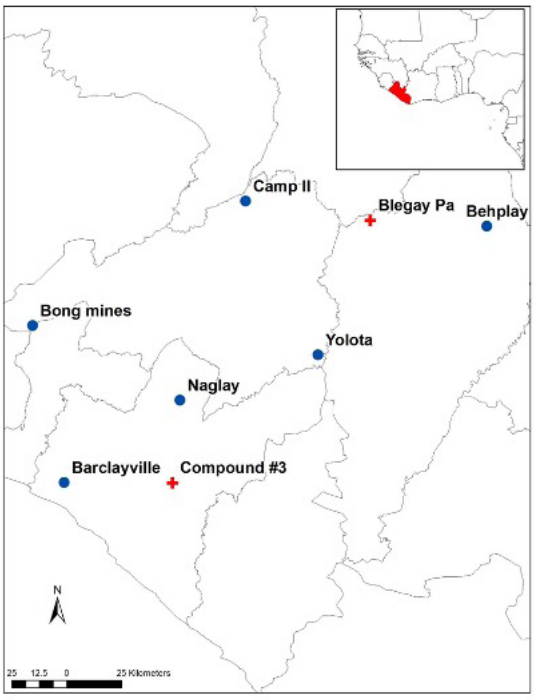
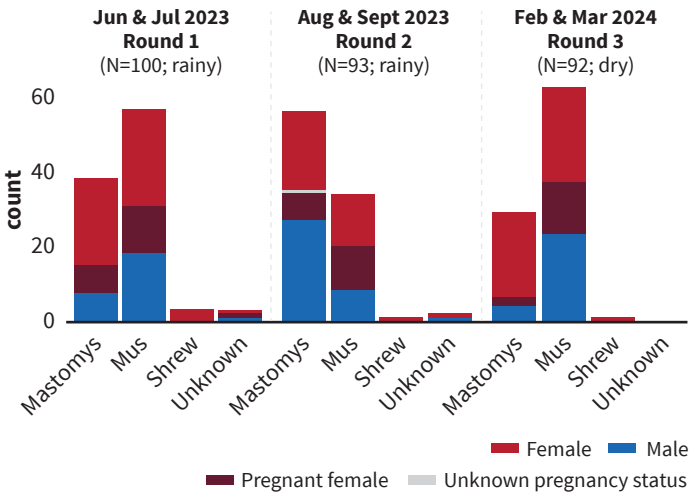


Figure 5: Number of rodents, species, and trap location trapping periods. June–July 2023 (round one), Aug–Sept 2023 (round two), Feb–Mar 2024 (round three).



A total of 184 rodents were captured and released after the sampling process across the eight study communities in Bong (N=41), Nimba (N=59) and Grand Bassa Counties (N=84) (Figure 5). While Bong county communities face a sanitation challenge as household waste is disposed of in bushes or sometimes burned, discussions with residents reveal they are taking preventive measures to try to keep rodent numbers low, such as keeping their homes clean. This hygienic practice may explain the low numbers captured in the communities, especially in households. However, we hope to make a better determination by the end of the study.

Grand Bassa county had the highest number of captured rodents. The study communities are mostly rural and semi-urban, with a lack of basic social services, including hand pumps for safe drinking water. Open defecation in bushes is a common practice. There are set community by-laws, however, public compliance and enforcement is a major issue.

In Nimba county, the main economic activity is farming and petty trade. Observing the community, we identified piles of waste in various locations, which could be attributed to a non-organized waste management mechanism.

Liberia

Activity 1.2.6.3: Exposure to zoonotic diseases in Liberian national parks

The purpose of the study is to understand the exposure of communities in and around Liberian national parks and protected areas, to high-priority zoonotic pathogens and to identify associated risk factors. The key objectives of the study are:

1. Determine the seroprevalence of antibodies against high-priority zoonotic pathogens (e.g., Lassa fever virus, Ebola virus, Marburg virus, Henipaviruses, Mpox virus, Rift Valley Fever virus, Malaria, Yellow fever virus, rickettsia, Crimean-Congo Hemorrhagic Fever) in communities in and around protected areas

2. Identify risk factors associated with seropositivity, such as occupation, location of the village, and contact with wildlife.

3. Collect and analyze data from local health centers (through MOH/HMER DHIS2 data run) on febrile cases for additional context.

The study will take place in communities near one or more Liberian protected areas and national parks (e.g., Bong Mountain, Cestos-Senkwehn, Gbi, Gola, Grand Kru River Gee, Kpo, Lake Piso, Margibi, East Nimba Nature Reserve, Nimba West, Wonegizi, and/or Sapo), starting with East Nimba Nature Reserve (ENNR).

Understanding zoonotic disease exposure is crucial for public health, especially in areas with significant wildlife-human interaction. Given the potential for zoonotic diseases to have global implications, insights gained from this research can contribute to global health preparedness efforts. Understanding the dynamics of zoonotic diseases in specific ecosystems can enhance our ability to anticipate and respond to emerging infectious threats. This study aims to provide valuable insights into potential health risks and inform preventive measures in communities around protected areas in Liberia.

Results from the study will provide critical information to the Liberia One Health Platform and will guide their development of a comprehensive disease prevention and containment strategy. It is expected that this study will contribute to strengthening surveillance, promoting data sharing, enhancing laboratory testing capabilities, and fostering joint outbreak responses in both the human and animal health sectors thus improving the Government of Liberia's ability to effectively prevent, predict, detect, and respond to emerging health threats, thus promoting global health security. Additionally, it will contribute to the identification of potential hotspots for zoonotic disease transmission, provide valuable insights into potential health risks, and aid in targeted public health interventions and wildlife conservation efforts in communities around protected areas in Liberia.

During the period under review, the following were achieved:

- All relevant documents were developed, finalized, and submitted to the Tufts University IRB and University of Liberia IRB including the study protocol, questionnaire, consent form, and venipuncture Standard Operating Procedure (SOP) (specimen collection, management, storage, transport). University of Liberia IRB approved the study and therefore it can commence.

- Reconfirmed arrangements and timing with Dr. John Berestecky's (University of Hawaii) laboratory located at the University of Liberia for their support in running collected blood specimens using the MagPix system.

- Contacted local EPI supervisors in communities near the ENNR to identify local, trained phlebotomists to recruit onto the field team, and met with One Health Institute, the partner that will be conducting the field based work

- Site selection process is ongoing and talking points for community engagement have been developed. This community engagement has recently started.

In the next period, and prior to any fieldwork, the country team will meet with USAID (Armando Cotrina/Global Health Security Advisor (GHSA)) to confirm the pathogens to be included in the study. The pending IRB protocol includes all potential pathogens that might be of interest and locally relevant: Lassa fever virus, Ebola virus, Marburg virus, Henipaviruses, Mpox virus, Rift Valley Fever virus, Malaria, Yellow fever virus, Rickettsia, Crimean-Congo Hemorrhagic Fever. Thus, final pathogen selection is not expected to require a resubmission to the IRB.

Liberia

Activity 1.4.5.1: Validate a Point of Care diagnostic test for Lassa fever

Ongoing conversations have taken place between the Broad Institute and the STOP Spillover leadership team, country team, and country and technical advisors to discuss next steps in the implementation of workplan activity 1.4.5.1. In Year 4, STOP Spillover will build on the CRISPR/SHINE technology training from Year 3 (which used SARS-CoV-2 samples) and Liberia-specific Lassa assays provided to National Public Health Institute of Liberia (NPHIL) by the Broad Institute to support NPHIL to 1) assess the relative sensitivity and specificity of CRISPR/SHINE and two PCR assays – Altona and Nikisins, in detecting Lassa virus in samples, and 2) determine whether CRISPR/SHINE can be used to detect Lassa virus in known Lassa virus positive human blood samples and rodent saliva (+/- fecal) samples. This will require timely availability of human Lassa samples and of the Liberia assay developed by the Broad Institute in country.

Conversations have taken place with the Broad Institute about the stability of the reagents and to ensure appropriate timing of shipping of the additional assays (i.e., when samples are available and the National Reference Laboratory (NRL) staff available to conduct the testing). Also, during this quarter, ongoing conversations have been taking place with NPHIL to secure access to human Lassa samples and ensure adequate PCR tests are pre-purchased and available at the same time.

The STOP Spillover team continues to discuss the expected availability and timing of the Sherlock Biosciences Lassa CRISPR test with the plan to run field trials of the point-of-care technology in Liberia health facilities. In addition to Lassa, it is hoped that this assay will include LASV, CCHF, and maybe other pathogens.

The Broad Institute Sabeti Lab is ready to produce the Liberia-specific Lassa SHINE assays for research purposes as soon as access to the necessary number of samples is confirmed by NPHIL/NRL. The STOP Spillover Liberia country team is working with NPHIL and other collaborators to prepare for the validation of this assay using samples from human cases. These specimens will be used to compare the SHINE assays with traditional qPCR tests to detect Lassa virus. An expected outcome is increased capacity in Liberia to test, through PCR and newer CRISPR-based assays, for the Lassa virus.

Liberia

Activity 1.4.6: Environmental surveillance

Lassa virus is one of the STOP Spillover high priority pathogens and is the pathogen of focus in Liberia. To our knowledge, Lassa has not been identified in environmental surveillance programs such as wastewater sampling, an approach which has been highly successful in early detection of high priority zoonotic viruses such as SARS-CoV-2 (Sinclair et al. 2008). Instead, Lassa virus surveillance in humans has been limited to serosurveys and syndromic surveillance of patients in health care facilities (Fichet-Calvet, 2014; Grant et al. 2023, Rohan et al. 2022). Initial research shows that Lassa survives for 1–2 days in water and wastewater and can be inactivated by chlorine (unpublished data from Kyle Bibby provided by authors).

As part of the approved Year 4 activities, STOP Spillover is currently executing environmental surveillance to identify Lassa virus presence in highly contaminated environments such as hospital sewage, food, water, and surfaces from homes in communities with high rodent abundance and known Lassa virus cases reported in humans in the last five years.

Given concerns over rodent-to-human Lassa virus transmission in Liberia, and considering the sensitivity, timeliness, and cost-effectiveness of sampling hospital wastewater, this initiative serves as a robust early warning surveillance system for otherwise undetected cases of spillover into the human population. It would enhance Liberia's response to Lassa fever outbreaks and provide crucial insights into disease dynamics, facilitating rapid, evidence-based interventions and safeguarding public health.

In late January and early February, the country team supported by OH-DReaM working group members from NPHIL and the Liberia Water and Sewage Corporation (LWSC) completed the modification of sewage lines to create access points for passive sampling at both Phebe and LAC Hospitals. This was done in preparation for the actual sampling work which will commence in April 2024. In addition to this, we completed the revision of the SOP (in collaboration with the NRL) for the collection and testing of wastewater. This SOP revision has been submitted to USAID.

During the period under review, the following were obtained:

STOP Spillover collaborated with the OH-DReaM working group from NPHIL and the Liberia Water and Sewer Corporation (LWSC) to work with the hospitals' plumbers to create access points in the pipes connected to the sewages of the isolation centers in Phebe and LAC hospitals for wastewater sample collection. These access points were modified for easy access to concentrated wastewater to determine whether LASV can be detected in wastewater in these areas. The hospitals' plumbers were trained to conduct the activity safely with supportive supervision from the hospital administrator, OH-DReaM working group, and country team.

The wastewater SOP was reviewed with support from the NRL and has been approved by USAID.

Supplies and equipment needed for the implementation of the activity were procured in the United States and delivered to the NRL by the activity lead and co-lead. These will be used for the wastewater sample collection and testing.

The necessary kits for testing 170 surface samples collected last year have been acquired and delivered to NPHIL. We hope this will facilitate prompt PCR testing.

Sierra Leone

Activity 1.2.6.1: Lassa Research Study

To understand the environmental and sociodemographic factors and practices that increase the risk of human exposure to Mastomys rodents (and potentially to Lassa virus), the STOP Spillover Sierra Leone team is conducting research in eight communities around the Gola Rainforest National Park (GRNP) in eastern Sierra Leone. The team will trap rodents to determine the seasonal abundance of rodents and changes in LV incidence in rodents over time in the high risk interface. We

will compare differences in rodent abundance and LV incidence with environmental variables (rainfall, temperature, humidity, etc.) that may be linked to them.

In December 2023, the team completed the second round of rodent trapping, capturing a total of 13 rodents in four communities over a 12-day period. Rodent numbers in round one (September, during the rainy season) were about five times higher than in round two. The team will continue to examine trends in rodent numbers in relation to environmental variables.

In March 2024, the team conducted the third round of rodent trapping in four forest-edge communities along the Gola Rainforest National Park. The team completed trapping in four communities, capturing 20 rodents. Oral and rectal swab samples were collected from each rodent for Lassa virus testing. All captured rodents were tagged with a microchip and released. During the third round of trapping, one rodent previously microchipped was recaptured. Njala University will test rodent samples at their Biological Sciences Laboratory. Testing will start in April 2024.

IMPLEMENTATION SPOTLIGHT

Strengthening Surveillance and Monitoring the Risk of Zoonoses at Human-Animal-Environment Interface in Côte d'Ivoire

Activity 1.4.1: Disease surveillance and pathogen spillover risk monitoring at the human-wildlife interface

Introduction

A great deal of surveillance expertise exists in Côte D'Ivoire, particularly in the fields of public health and animal husbandry, but wildlife disease surveillance capacity is minimal at present, though the country has planned to remedy this deficiency. Effective surveillance and risk monitoring of diseases at the human-animal interface requires effective coordination of the actions of the sectors in charge of human and animal health, as well as environmental agencies, the private sector and research institutions, which would all play important roles in sustaining this work.

This activity falls into the domain P5.1 and D3.1 of the Joint External Evaluation tool of the International Health Regulation (IHR) related to "Surveillance of zoonotic diseases and Multisectoral workforce strategy" contributing to improving prevention of zoonotic disease spillover and multisectoral collaboration between Human-Animal-Environment actors.

STOP Spillover aims to support the surveillance and risk monitoring of zoonotic diseases at the human-wildlife interface. It is in this context that STOP Spillover supported the high-level workshop facilitated by STOP Spillover and the National One Health platform. The Technical Working Group on Surveillance (TWG-SS) and the various stakeholders helped in the planning for this workshop on strengthening surveillance and monitoring the risk of zoonoses at Human-Animal-Environment interface organized in Grand-Bassam from March 13 to 15, 2024.

Achievements

The workshop brought together fifty-six (56) experts from the fields of human health, animal health, environmental health and other stakeholders from universities, communities, associations, projects, the national one-health platform and partners for three days, from March 13 to 15, 2024, at the "Hôtel Suprême" in Grand-Bassam.

The workshop focused on the following steps: (1) Identify ten key Human-Animal-Environment interfaces; (2) Analyze the current status of the ten Human-Animal-Environment interfaces on the basis of eight proposed evaluation criteria; (3) Share a presentation on the coordination framework for joint zoonotic disease risk assessment and the presentation on Ebola and Lassa training and risk assessment in the Tonkpi Region; (4) Develop a roadmap for collaboration in surveillance and monitoring of zoonotic disease risks at the Human-Animal-Environment interface; and (5) Share presentations on STOP Spillover activities carried out over the past twelve months, and discuss ways of integrating them into existing programs and projects. These topics were reinforced through group and plenary discussion.

At the end of the workshop, 10 key interfaces were identified that needed monitoring and the stakeholders developed a roadmap for collaboration and coordination of surveillance along the human animal environment interface with roles and responsibilities of different partners, clearly articulated.

"The fight against these zoonoses must be based on a holistic approach involving good multi-sectoral and multi-disciplinary collaboration. As a result, the human health, animal health and environmental sectors share responsibility for zoonosis control, and must coordinate their actions through the One Health approach"

- Minister of Animal Resources and Fisheries, Côte d'Ivoire

Workshop Participants and governmental and local authorities
Photo credit: STOP Spillover Côte d'Ivoire

Wild meat market in Côte d'Ivoire.
Photo credit: STOP Spillover CDI/AFROHUN

Activities & Accomplishments

OBJECTIVE 2

Objective 2 focuses on assisting countries to design and implement interventions to reduce the risk of priority zoonotic viruses spilling over from animals to people. Risk-reduction activities implemented as part of STOP Spillover are informed by Outcome Mapping (OM) and research conducted under Objective 1. STOP Spillover works with country-level partners to design, implement, and validate interventions to reduce spillover. STOP Spillover's validation process will focus on whether interventions are effective, low cost, sustainable, scalable, context appropriate, gender responsive and/or culturally acceptable. This section of the report outlines STOP Spillover's achievements and accomplishments related to Objective 2 during the first half of the project's Year 4.

Bangladesh

Activity 2.2.2.1 Support LBM stakeholders to develop and implement a holistic, multi-pronged design for LBM aimed at improved biosecurity and biosafety measures that reduce the risk of spillover

The country team developed a holistic intervention to improve biosecurity and biosafety of live bird markets (LBMs) based on the findings of two research studies. Through workshops involving national and local stakeholders, the team created a holistic biosecure LBM design, which includes principles for infrastructural improvements, biosafety guidelines, a compliance monitoring plan, a sustainable funding mechanism, and an advocacy strategy. Key stakeholders from various sectors participated in the workshops, resulting in biosecure LBM designs tailored for the context of Dhaka city.

With funding support from Islam Group (a private sector partner) and technical support from STOP Spillover, the

intervention was implemented in a poultry shop in Dhaka North City Corporation area.

On March 18, 2024, a formal inauguration event was held to mark the launch of the biosecure poultry shop, with representatives from USAID, the Institute of Epidemiology Disease Control and Research and the One Health Secretariat, Tufts University, the Islam Group, and icddr,b. Representatives found a renovated, clean, and attractive shop where biosafety standards are implemented to reduce risks to vendors and customers alike.

In summary, the following tasks were accomplished as part of this activity

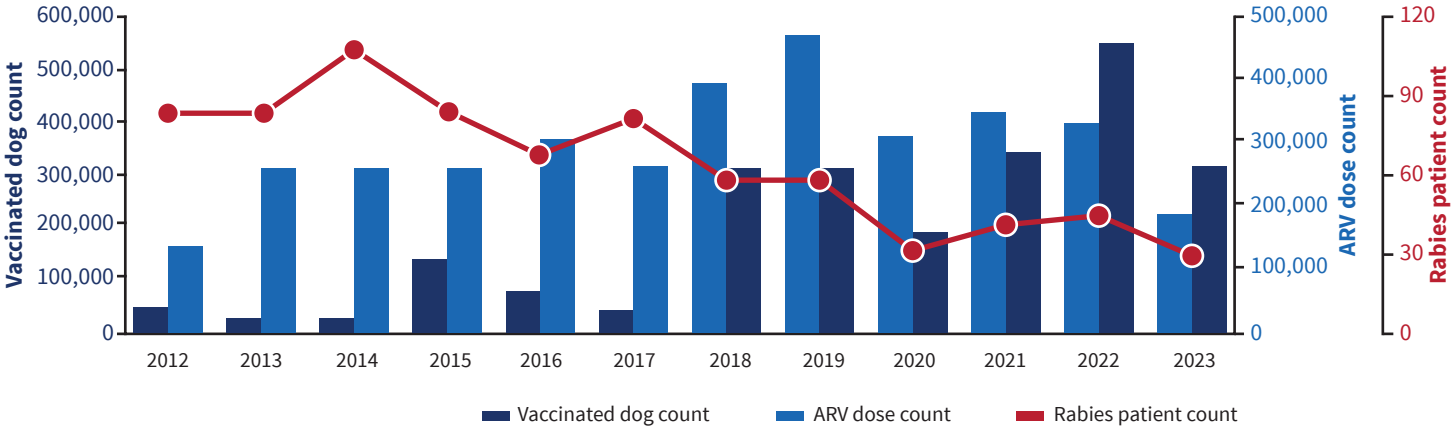
- Finalized biosecure LBMs designs with local and national stakeholders and relevant experts;
- Conducted pretesting of different options for each of the intervention components (e.g., ventilation systems, slaughtering and processing equipment, and posters and other communication materials) to assess their feasibility and usefulness for LBM workers and consumers and made modifications as necessary;
- Completed infrastructural renovation at single-shop LBM intervention and procured poultry keeping cage and slaughtering and processing equipment manufactured as per the biosecurity guidelines, using funds from industry partners;
- Monitored shop construction work with consulting engineers and biosecurity experts throughout implementation;
- Conducted training for the poultry workers of the single-shop LBM on biosafety and biosecurity guidelines and conducted troubleshooting;
- Produced pre-intervention virtual reality (VR) video and a video awareness message to be broadcasted on TV screen for training purposes; and;
- Completed consumer survey, qualitative exploration, sample collection, and lab testing and initiated data analysis of pre-intervention assessment.
- Post-intervention, a field team collaborated with LBM workers to address any issues with the use of renovated infrastructure, provided equipment, and adherence to biosecurity and biosafety recommendations, offering troubleshooting support as needed. Different ventilation systems were trialed to assess their impact on air movement and thermal comfort of poultry and workers. Design of feeders and drinkers were revised based on feedback from the vendor to reduce loss of poultry weight and prevent waste of feed. The team also extensively observed practices and discussed feasibility of use of disinfectant with the vendor and workers. These extensive efforts are expected to ensure the long-term success of the intervention.
- Communication materials developed for social and behavior change (SBC) were pretested with small groups of targeted audiences, such as LBM workers and consumers, to assess comprehension, attractiveness, acceptance, and relevance

The country team is currently analyzing data collected pre- and post-intervention to evaluate the effect of intervention in reducing avian influenza and its feasibility and acceptability among LBM workers. According to the preliminary data analysis, the team observed a significant decrease in pathogen presence in the intervention shop as compared to control settings. For instance, the intervention shop had significantly fewer waste effluent samples testing positive for Influenza A virus (31% [n=16] vs 88% [n=31], $P<0.05$) compared to the control market. Overall, the intervention effectively reduced influenza A viral load in air, environmental swabs, and waste effluent samples in the intervention shop compared to pre-intervention levels and control shops, however complete data will be reported separately. The team also collected observational data on biosecurity and biosafety practices and found minimal use of masks and gloves due to discomfort, however, substantial use of aprons and changing of clothes.

The team is currently conducting a comprehensive analysis of data related to cost of physical infrastructure renovations, operational equipment and materials, branding, recurring expenses, and profit increases resulting from the intervention.

Inauguration of renovated LBM with improved biosafety conditions. Photo credit: STOP Spillover Bangladesh/icddr,b

Figure 6: Integration of human rabies cases and vaccinated dogs into data sharing platform



This cost-benefit analysis of the intervention will inform the development of a shared business model for future interventions in single and multiple-shop LBMs.

To implement the biosecure LBM design in a multiple shop LBM, the country team has been actively engaging with key stakeholders from the DNCC. The country team also consulted with vendors from a selected city corporation LBM to gather their input on the renovation design. Additionally, representatives from poultry industry donors visited the renovated single-shop LBM to gain insights into the requirements for the multiple-shop private LBM renovation. Overall, the country team has maintained open communication with shop owners, vendors, market committees, city corporation representatives, and poultry industry donors to ensure successful implementation of the multiple-shop LBM in the coming months.

Smart Poultry Shop Video

Bangladesh

Activity 2.2.2.2: Support stakeholders to prevent zoonotic spillover through establishing an integrated, coordinated and sustainable platform for information sharing, advocacy, and co-designing, co-implementation, and co-monitoring of surveillance activities and interventions at the LBMs

This activity involves two platforms – one is an integrated data sharing platform for surveillance and early detection activities, and the other is a coordinated information sharing platform between different stakeholders for co-designing, co-implementation and co-monitoring of surveillance and intervention activities.

Given that the One Health Event Based Surveillance Data Dashboard (OHEBSDD) is not solely dedicated to monitoring LBM or avian influenza activities but encompasses all types of zoonotic diseases, the country team's approach has been rooted in the One Health perspective. Instead of limiting the efforts to LBM-related surveillance activities, the country team has focused on enhancing the overall data sharing platform. Utilizing insights and recommendations from previous group discussions and stakeholder meetings, enhancements have been made to the dashboard. One significant improvement involved consolidating the display of rabies cases into a single graph (figure 6), combining both human and animal cases for better visualization. Furthermore, following discussions with the Department of Livestock Services (DLS), they began sharing anthrax animal case data on the OHEBSDD. For avian influenza data sharing, the team collaborated with DLS and One Health Secretariat (OHS) officials to secure the necessary authorization for sharing this sensitive data. By the end of this activity, the team confirmed the issuance of the required letter to the Director General of DLS to allow the inclusion of avian influenza data on the OHEBSDD.

Regarding the information sharing platform, STOP Spillover successfully relaunched the One Health Bangladesh (OHB) website and enhanced it with integration of various sections for information sharing, including resource dissemination, publications, and One Health-related document sharing. Additionally, the website now has dedicated sections to disseminate news and information, provide details about committee members, share contact information, and manage both upcoming and past events. To ensure smooth operation, a comprehensive user manual was prepared to guide users through website navigation. Furthermore, a security testing system was integrated on the website. For the development of the OHS website, it was resolved that the OHS will explore a government-led approach for the development.

Beyond enhancing coordinated data and information sharing platforms, the country team supported various IT functions to assist the One Health Secretariat (OHS), including development of a website for the 11th One Health Bangladesh Conference.

Training session on early event reporting system.
Photo credit: STOP Spillover Bangladesh/icddr,b

Collection of cloacal and tracheal swab from dead poultry.
Photo credit: STOP Spillover Bangladesh/icddr,b

Bangladesh

Activity 2.2.2.3: Support stakeholders in the development and use of an integrated and coordinated app-based system to report poultry workers' health status and mortality in poultry and wild birds in and around LBMs

The Country Team developed a mobile phone-based reporting system (SMS and app) where the live bird market (LBM) workers, cleaners, market committee members and consumers are able to report influenza-like illness (ILI) among LBM workers and mortality of poultry, wild birds, and pet birds in and around LBMs. The team has engaged in extensive discussions with government partners, city corporations, Department of Livestock Services (DLS), Institute of Epidemiology Disease Control and Research (IEDCR), One Health Secretariat (OHS), and Bangladesh Forest Department (BFD) to finalize the target population, design the early event detection system, and secure endorsement to ensure system uptake in future.

Both the mobile app and SMS gateway are integrated with a web platform, allowing the Country Team to verify reports and 'signals' from the source, ensuring accuracy and notifying the appropriate departments as necessary during the project period. The Country Team organized training sessions for LBM workers and conducted pilot tests of the app in two selected LBMs, providing internet access to registered users and ongoing support within the markets. Communication materials like posters have been used to encourage LBM workers and consumers to send reports using the system. Simultaneously, the team continues to manage consumer registration and training on the early event reporting system in the same LBMs. Verification of reports and environmental sample collection for reported cases of poultry mortality are ongoing in these locations. Moreover, a meeting with the consultant from the Smart City program of Dhaka North City Corporation (DNCC) has initiated interest in collaborating on the early event detection system. The team is currently producing monthly summary reports for sharing with OHS and other relevant authorities (poultry workers' illness to IEDCR, poultry mortality to DLS, and pet bird and wild bird mortality to BFD).

During this period under review, the team accomplished the following:

- Completed user acceptance test for the latest version of the Android app and
- web platform and shared feedback with the software developer company
- Conducted training sessions for LBM workers and piloted the app at two selected LBMs,

- Provided internet access for registered users to facilitate reporting, and providing
- ongoing troubleshooting support within the LBMs;
- Initiated verification of reports and collection of environmental samples for reported cases of poultry mortality from a selected LBM;
- Conducted a meeting with the Consultant of the Smart City program of Dhaka North City Corporation (DNCC), during which he expressed interest in collaborating on the early event detection system

The structural intervention adopted by the community - food boxes and tables wrapped with zinc.
Photo credit: STOP Spillover Liberia/AFROHUN

Liberia

Activity 2.2.2.2: Rodent-proofing intervention

During the reporting period, the project team refined implementation documents for activity 2.2.2.2 and scaled up the structural rodent-proofing and waste management interventions in four additional communities: Gbarpa and Nuopea in Nimba County and Gokai and Phebe Airstrip communities in Bong County.

The interventions were refined based on the findings from the rapid assessment conducted in the previous quarter in two piloted communities (Compound three and Blagay Pa) and a comprehensive concept note was developed. Other essential documents, including contracts for Community Health Volunteers (CHVs), local radio stations, TikTok influencers, script artists, and town criers have been finalized and ready for signing.

In collaboration with the County Health Teams (CHTs) and communities, the interventions were scaled out to four additional communities across Bong and Nimba Counties by a team comprising three STOP Spillover/AFROHUN team members (two technical team leads (RAC/FWA) the Country Administrator/ Finance Officer) and two OH-Dream members from the National Health Promotion Division of the Ministry of Health (MOH) and National Public Health Institute of Liberia. The scale-up meeting brought together a total of 92 individuals from across the four communities in the two counties (Bong & Nimba). Participants in these meetings included local community leaders, community health workers, religious leaders, carpenters, town criers, and household heads in each community. During the meetings, several presentations were made including the overview of STOP Spillover, the findings from the 2.2.2.1 research in the pilot communities and introduction of the tested 2.2.2.2 solutions. At the end of each presentation, the team provided feedback on questions and concerns raised by the community. The communities enthusiastically accepted the structural interventions (food boxes and tables wrapped with zinc) and pledged their support to work with the team in implementing these interventions.

Following the meetings with the communities, the Community Health Volunteers (CHVs) and town criers were orientated on the key Social and Behavior Change (SBC) activities they will be leading in communities and schools. This includes messages on food handling, water and sanitation, and other activities such as community meetings, distribution of Information, Education, and Communication (IEC) materials, schools' visits for awareness purpose, and planning radio talk shows in collaboration with influential leaders to raise awareness on Lassa Fever preventive measures.

Additionally, CHVs were taught on how to prepare the trackpad, monitor the presence of rats in homes using the trackpad and data collection method. Installation of the structural interventions were carried out three days after the trackpads were introduced in the homes. The team worked with local carpenters and the community chair lady/chairman to design samples of the food boxes, tables wrapped with zinc, and wall mesh grid wire to use during the trackpad exercise.

Furthermore, the STOP Spillover team collaborated with the Material and Message Development Team of the Ministry of Health to revise the existing Lassa Fever preventive messages and materials based on the findings from the behavioral research (2.2.2.1). The updated audio message is a radio spot that promotes new Lassa Fever preventive measures, such as using tables with zinc around legs, food boxes for proper food covering, and environmental cleanliness, as ways to prevent Lassa Fever. The print materials display graphics of Lassa preventive measures. The materials and messages have been turned over to the graphic artist and scriptwriters to produce revised audio and print materials. After everything is finalized, the audio

messages will then be sent to the contracted county local radio stations to be broadcast. The plan is to conduct radio talk shows twice a month, along with airing jingles daily in the morning and evening over a period of eight months. These activities will be conducted in English as well as in one of the local dialects in each community. Additionally, we will collaborate with town criers to disseminate messages twice a month in each community over a period of eight-months. Community Health Volunteers (CHVs) will incorporate key Lassa messages into their existing outreach work and visit schools in each of their communities to engage children. They will also facilitate eventual focus groups with children to evaluate the effectiveness of the Social and Behavioral Change (SBC) messaging. Furthermore, work has begun with the TikTok influencer on integrating the messaging into her posts, including the frequency of posts.

Cambodia

Activity 2.2.2.1: Community-level risk reduction interventions at bat guano farms

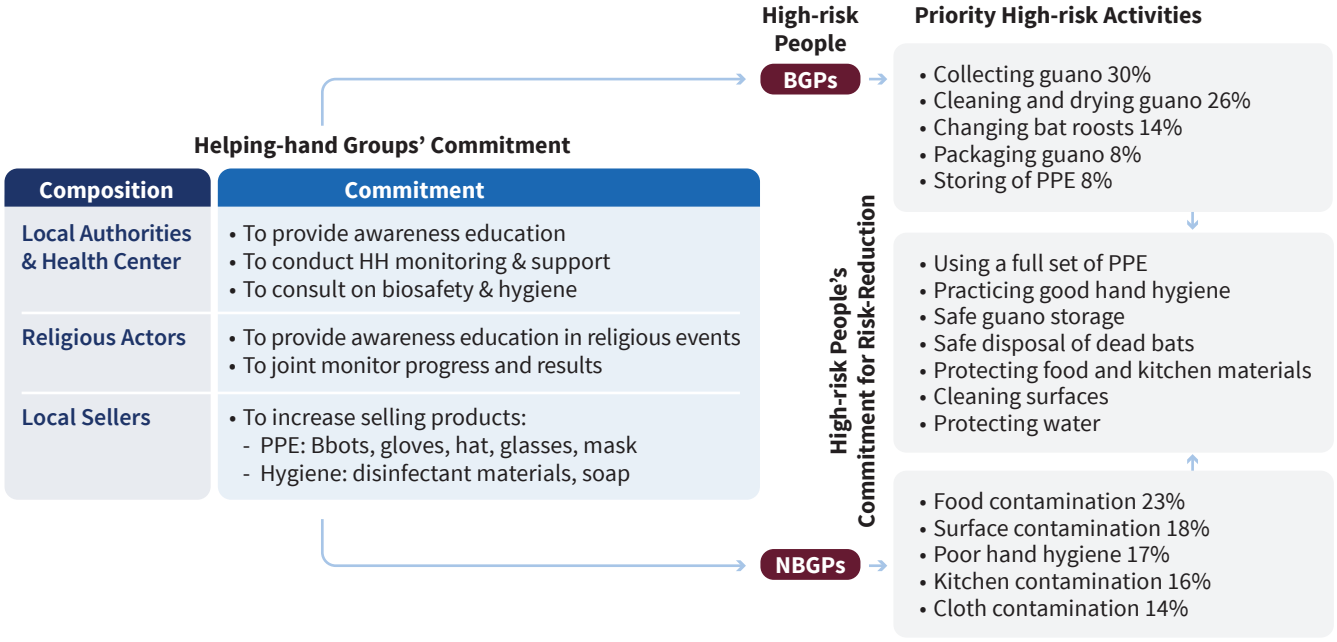
Bat guano, which farmers use as a nutrient-rich fertilizer, is an important livelihood for households in Kang Meas district, Kampong Cham province. But it comes at a cost. Bat guano producers and their neighbors are living and working in constant contact with bats. As a result, they are at risk of exposure to by bat-borne zoonoses. In 2023, the STOP Spillover team in Cambodia conducted several studies to understand community practices and the risks communities face related to known risk pathways. Studies also explored the presence of infectious agents from bats along these risk pathways. This research was followed by trials of improved practices (TIPs) to allow farmers and their neighbors to participate in the identification of socially, culturally and economically acceptable and feasible solutions to reduce these risks.

Informed by findings from these TIPs, the team returned to Kang Meas in mid-January to conduct a community dialogue with a broad group of community participants, and to organize a demonstration on safety practices to reduce risks from bat-human contact. The dialogue brought together 42 local stakeholders (60% female) including bat guano producers (BGPs), neighboring non-bat guano producers (NBGPs), a vendor, religious actors (Buddhist monks and pagoda committee members), local authorities, health center staff, and officials from district, provincial and national institutions to share results of the TIPs and jointly identify future actions to reduce risk. Through facilitated dialogues, participants identified and prioritized solutions and actions they are willing and able to apply, to effectively and sustainably mitigate the risk of viral spillover from bats to humans. In addition, OH-DReaM working group members guided 50 (64% female) local participants in practical, effective ways to use each risk reduction practice, such as hand washing with soap, safe storage of guano, use of personal protection equipment (PPE), etc.

- All participants confirmed that they improved their understanding of zoonotic diseases and committed to improving biosafety and hygiene practices when working and living with bats.

- BGPs and NBGPs prioritized high-risk activities, solutions, and committed to implementing key risk reduction activities (Figure 7).

Figure 7: Stakeholders' high-risk prioritization and commitment for reducing the risk of viral spillover from bats to humans in bat guano producing communities.



Surveillance team members collecting naso- and oropharyngeal swabs from a symptomatic case at Khchau Commune Health Center
Photo credit: STOP Spillover Cambodia/Tetra Tech

- All participants demonstrated their knowledge and ability to apply risk reduction techniques and steps to improve biosafety and hygiene.
- "Helping-hand" groups including local authorities, religious actors and sellers prioritized key activities, and committed to helping BGPs and NBGPs reduce zoonotic disease risks and risks of viral spillover risk from bats to humans (Figure 7).
- All local OH-DReaM working group members proved that they have the capacity to monitor, educate and support BGPs and NBGPs to adopt and sustain risk reduction practices.
- A refresher Training of Trainers (ToT) for local OH-DReaM working group members on the implementation of community dialogues and demonstration-based education was completed with 11 attendees, including officials from the Provincial Department of Agriculture (PDA), the Provincial Health Department (PHD), the Provincial Department of Rural Development (PDRD), the Operational District (OD), the District Administration (DA), commune and village authorities, the health center, and a BGP representative.
- Next steps include an intervention validation assessment study.

Cambodia

Activity 2.2.2.2: Coordination and capacity building of sentinel surveillance team

The first round of participatory syndromic and active surveillance (SAS) was undertaken at the bat-human interface in Kang Meas district, Kampong Cham province, from January 8–12, 2024. The surveillance system employed a combined approach of participatory case finding using symptom-based case definitions and active monitoring to identify individuals with signs suggestive of viral infections, particularly respiratory illnesses linked to coronaviruses and exposure to guano farming. As a result, a case of coronavirus HKU1 infection was detected in a human patient, demonstrating the effectiveness of this approach in detecting coronaviruses in patients with respiratory illness. Environmental samples, including bat guano, and livestock samples, were collected from the home areas of cases meeting the syndromic case definition, to determine if there was a spillover linkage from wildlife and livestock. The approach uses participatory risk-based detection of cases followed by targeted sampling and testing. As opposed to screening surveillance, it is a highly targeted method that makes efficient use of sampling and testing resources.

To facilitate early detection, surveillance teams were trained in participatory methods and actively interviewed community members to search for cases. For cases that met the syndromic case definition for respiratory infections, specimen collection for coronavirus detection and sequencing was conducted from the suspect cases, their environment and associated livestock. This activity targeted both patients who met the case definition of febrile respiratory illness, and family members linked to the index case. Viral detection in bat guano has been shown to be an indicator of bat infection, and these specimens will be used to determine if the same virus cluster is circulating at these guano farms. Three pre-designated sentinel sites – Kang Meas Referral Hospital, and Roka Ar and Khchau Health Centers – served as sample collection points. Identified cases were asked to travel to the collection point for sampling.

This participatory activity triggers timely identification of potential coronavirus spillover events occurring at the bat-human interface. By analyzing findings from both syndromic and active surveillance from people, the environment and livestock, this pilot program improves our understanding of transmission dynamics and potential spillover agents such as coronaviruses at the bat-human interface, ultimately contributing to enhanced prevention and preparedness efforts for potential disease outbreaks.

a) Syndromic and active surveillance at bat-human interface in Kang Meas district, Kampong Cham Province

A team of 15 trained individuals from an OH-DReaM Working Group led the syndromic and active surveillance effort. STOP Spillover Cambodia established and trained this team in 2023 specifically to complete this work.

Leveraging their expertise complemented by project training, the team demonstrated their sampling and participatory surveillance skills. Throughout the operation they adhered to SOPs developed by the project and wore personal protective equipment (PPE) for their safety. Their professionalism extended to sample collection, covering not only human and domestic animal samples but also bat guano and urine samples from farms connected to identified human cases.

Samples were gathered from Varint 1, 2, and 3, villages within the designated high-risk zone. These villages share the Khchao Commune Health Center, where local residents typically seek health care services. The team collected samples from humans within the center, to identify potential coronavirus infections linked to the index case, particularly during the ongoing bat lactation season (October–January). To track potential transmission, livestock, bat guano and urine from symptomatic case farms were sampled.

A total of 155 samples were collected for analysis, including 22 human samples, 36 chicken samples, 14 duck samples, 24 cattle samples, 40 bat guano samples, and 19 bat urine samples. Adhering to established protocols, human-related samples were prepared and dispatched to the Institut Pasteur du Cambodge for the detection of and subsequent sequence analysis for coronaviruses. Concurrently, livestock and bat samples were transported to the National Animal Health and Production Institute for identical investigative procedures.

Upon completion of the fieldwork, all biological waste was dispatched to the Khchau Commune Health Center's incinerator for complete and safe destruction.

b) First-round surveillance findings at the bat-human interface in Kang Meas District, Kampong Cham Province

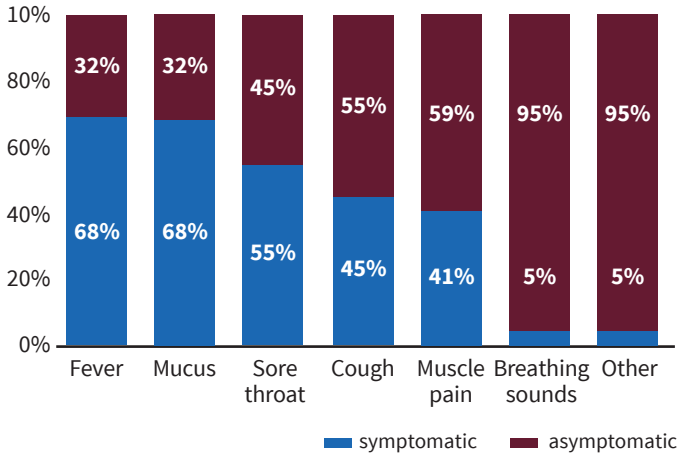
The surveillance team interviewed community members and identified 22 individuals (11 suspected cases and 11 family members) for testing potential coronavirus infection. All samples collected from these individuals were sent to the IPC laboratory. Laboratory results detected a positive case of coronavirus HKU1 strain S2628. Coronavirus HKU1 (along with coronaviruses 229E, NL63, OC43) is a common human coronavirus (HCoV). Though also a member of the genus beta coronavirus, it is different from SARS-CoV-2, the causative agent of COVID-19. Common human coronaviruses typically cause mild-moderate upper respiratory illness often referred to as a 'common cold.' In rare cases, infection can progress to pneumonia.

HCoVs are common in human populations all over the world and are transmitted from humans to humans, generally by contact and droplet modes. Transmission peaks in fall and winter in temperate climates. Zoonotic transmission of HKU1 has not been recorded, and this virus is known only from human specimens. Findings were reported to public health authorities and shared with study participants, who expressed appreciation for the surveillance initiative and their willingness to participate in future efforts to prevent disease outbreaks. The STOP Spillover team appreciated the opportunity to exchange experiences and perspectives with colleagues from diverse One Health sectors, contributing to a more comprehensive understanding of surveillance pathways and risks.

The SAS team collected 22 samples from humans, 74 samples from livestock, and 59 samples of bat guano and urine. As of March 2024, complete testing results are only available for human samples. Arrangements with the national animal

laboratory are being finalized for testing samples from livestock, bat guano and urine. Information on demographics, human contact with livestock and bats, and symptoms was collected using case information sheets.

Figure 8: The percentage of the human participants exhibiting specific symptoms of febrile illness (flu-like illness).



More than half of SAS participants (59%; n=13) were female, with ages ranging from 6 to 71 years. Interestingly, 68% of participants (n=15) experienced symptoms such as fever and mucus (Fig. 8). 22 human specimens were tested for coronavirus RNA using two different RT-PCR tests: a broad-spectrum pan-CoV test, and a more specific test targeting E and N genes unique to Sarbecoviruses. The pan-CoV test yielded a positive result for one sample, which was confirmed by Sanger sequencing and a search in GenBank determined that it is identical to beta coronavirus HKU1 strain S2628. Results were shared with the community by an OH-DreaM working group member from Khchau Health Center, following consultations with relevant public health institutions. Through individual result-sharing visits, community participants gained valuable insights into community infectious disease patterns, leading to increased awareness and proactive health behaviors.

The SAS team appreciated both the participatory syndromic and active surveillance approaches, recognizing their effectiveness. The team shared that STOP Spillover-supported training on participatory methods empowered them with new tools to effectively work in the community. They also stated that they found the new approach personally rewarding and they offered valuable insights for improvement, specifically regarding the use of biosafety practices. They highlighted the importance of using full PPE (aprons, face shields, face masks, gloves, and scrubs) during surveillance to minimize their anxiety during sample collection and shared their expertise packaging and transporting samples while maintaining biosafety protocols. On the other hand, community participants indicated that the use of full PPE contributed to their anxiety and negative community perceptions regarding the surveillance process, especially when samples from livestock are collected directly in the community. They suggested that surveillance teams should rather use just face masks, gloves and plastic-based kitchen aprons.

Cambodia

Activity 2.2.2.3: Community-level risk reduction interventions at cave-associated bat guano harvest sites in Kampot and Battambang provinces

A Community Dialogue Process to Co-Design Bat Spillover Risk Reduction Interventions

In November 2023, after a thorough site selection process, bat caves in two locations were identified and selected for interventions: Mount Kuhear Loung in Kampot province and Mount Reach Trob in Battambang province. Both caves are under the stewardship of well-established community-based organizations.

Building on the approved site selection report, the STOP Spillover team held a community dialogue in January 2024. This dialogue involved key stakeholders, especially those involved in bat guano handling, in two critical steps:

- **Understanding baseline risks and practices:** The dialogue allowed for a comprehensive assessment of existing risk factors and current practices related to bat guano handling in the communities.

Training the facilitators for the Community Dialogue Process
Photo credit: STOP Spillover Cambodia/Tetra Tech

- **Co-designing effective interventions:** By actively involving community members, the dialogue facilitated the collaborative design of effective risk reduction interventions tailored to the specific needs and context of each location.

Members of the newly established OH-DReaM working group were fully engaged as facilitators for the process. To ensure productive and inclusive discussions, they received prior training in best practices and guidelines for facilitating community dialogues. Their active participation helped foster a collaborative and productive dialogue process.

- The community dialogue was successfully facilitated by the OH-DReaM working group members from the Communicable Diseases Control Department, the General Department of Animal Health and Production, the Provincial Department of Health, the Provincial Department of Environment, the Forestry Administration's Cantonment, and a dedicated community leader.
- Stakeholders gained a clear understanding of the project's objectives and potential benefits.
- Stakeholders readily embraced the community dialogue's purpose and processes, actively participating in discussions and sharing their insights.
- The dialogue effectively gathered valuable baseline information on zoonotic disease awareness, existing risk factors, and current risk reduction practices.
- Through collaborative discussions, participants identified and co-designed potential risk reduction interventions, culminating in a prioritized list of actions.
- A roster of individuals committed to implementing the chosen risk reduction interventions was established, paving the way for tangible actions and sustained impact.
- Twenty-three OH-DReaM working group members (11 in Kampot and 12 in Battambang province) were trained in community dialogue techniques and processes. They were exposed to concepts, tools, relevant questions and steps, and mock exercises during the training.
- In Kampot province, the community dialogue was conducted with 34 bat guano harvesters, traders, and transporters (50% women).
  - Two plenary sessions were organized on:
    - problem and solution identification and analysis, and
    - intervention co-design
  - Three breakout group discussions were organized with male bat guano harvesters (14 pers.), female bat guano harvesters (14 pers.), and bat guano traders and transporters (3 men, and 3 women).
  - Nine potential risk reduction interventions were identified and prioritized.
  - Four interventions were selected and co-designed.
  - All bat guano harvesters and traders expressed their commitment to implementing prioritized interventions. Each bat guano harvester and trader decided to try at least one and up to all four interventions, covering up to 50% of the costs on their own.
- In Battambang province, 25 bat guano harvesters, carriers, packers, and transporters actively participated in the dialogue.
  - One plenary session was organized, with similar themes as those covered in Kampot province.
  - Two breakout group discussions were organized with female bat guano harvesters (13 pers.), and male bat guano harvesters (12 pers.) .
  - Seven potential risk reduction interventions were identified and prioritized.
  - Five interventions were selected and co-designed.
  - All bat guano harvesters expressed their commitment to implement prioritized interventions, from at least one intervention up to five interventions, covering 20–50% of associated costs on their own.

Cambodia

Activity 2.2.2.4: Community-level risk reduction interventions related to Nipah virus spillover risk: Site ID phase

This is a new activity included in the approved revised Year 4 work plan. No activity was planned for the first half of Year 4. The forthcoming activities include a stakeholder workshop that will occur in May 2024 followed by a site visit mission which will propose potential interface sites.

Côte d'Ivoire

Activity 2.2.1: Development of district level capacity for wildlife carcass identification, reporting and disposal

This activity aims to build the capacity of the Ministry in charge of animal health and the community to dispose of dangerous wildlife carcasses. In 2023, STOP Spillover conducted a

training of 15 government agents in carcass disposal and one community engagement on reporting wildlife events. This year we want to extend both activities to further train more government agents and communities. During this reporting period, we worked to identify 25 agents for the training in 3 communities. In addition, we followed up the development of the reporting tool which will serve for community engagement.

Côte d'Ivoire

Activity 2.2.2: Safe handling and processing of wildlife meat using appropriate biosafety practices

Reducing Risk of Pathogen Spillover in Wild Meat Processing

After observing the current processing, handling and selling practices in markets and restaurants in the District des Montagnes, the STOP Spillover team convened with local stakeholders to develop guidelines for safe wild meat processing and handling. The team then conducted a training, along with facilitators from research institutions and universities, on safe handling and processing of wild meat for the processors and workers handling wild meat at markets and restaurants in the District des Montagnes. Wild meat hygiene and proper handling are crucial to ensure the safety of handlers, processors, consumers and the environment. The two-day practical, interactive training focused on biosafety and hygiene measures to reduce harm related to zoonotic diseases in the meat value chain.

Survey of restaurant wild meat processors who received the STOP Spillover biosafety training, Man in the District des Montagnes, February 2024.
Photo credit: STOP Spillover Côte d'Ivoire/AFROHUN

The expected outcomes of the training were that:

- Participants understood how to safely handle wild meat, dispose and manage waste.
- Participants acquired knowledge on zoonotic viruses, the risks and behaviors that increase exposure to zoonotic diseases through wild meat handling and how to minimize that risk.
- Participants gained skills in the correct use of PPE and methods of cleaning, disinfecting and sanitizing surfaces and equipment.
- Participants were able to identify any endangered species and gained understanding of the importance of protecting them.

In September 2023, 15 wild meat processors from markets and restaurants from cities in the District des Montagnes were trained on the use of biosafety measures and received biosafety equipment and material including PPE. The trainees committed to adopting biosafety measures to protect themselves and other workers and to using the biosafety materials and equipment that were demonstrated and given to them. The STOP Spillover country team conducted a field visit in February 2024 to follow up with the trainees about five months after the training. During the visit, the team collected data on the adoption of new practices, any challenges, and support needed to improve their practices. The field visit also aimed to brainstorm with trainees to guide the introduction of the chatbot and to identify "champions" among the trainees to support their peers in adopting the hygiene and biosafety practices. Chatbots are computer programs that present a conversation-like interface and operate on multiple platforms like WhatsApp through which the wild meat handlers could communicate any questions and receive feedback to any questions that they may have on biosafety related issues.

The team conducted the survey using a questionnaire. All 15 wild meat processors who were trained in September 2023 were included in the survey but only 13 of these trainees were available during the data collection. The questionnaire included closed and open questions on the frequency of use of the new equipment, their willingness to pay for the equipment in the future, their feedback about the content and impact of training they received, as well as challenges or barriers encountered in using this equipment.

Table 3: Proportion of participants using the various biosafety intervention (N=13)

MATERIAL AND EQUIPMENT	EVERYDAY/ REGULARLY N (%)	SOMETIMES/OFTEN N(%)	RARELY N (%)	ONLY ONCE/NEVER N (%)
Nitrile Gloves	11 (84.6)	2 (15.4)	0	0
Household Gloves	7 (53.8)	2 (15.4)	1 (7.7)	3 (23.1)
Washable shoes	8 (61.5)	1 (7.7)	1 (7.7)	3 (23.1)
Face shield	6 (46.2)	1 (7.7)	2 (15.4)	4 (30.8)
Mask	8 (61.5)	0	1 (7.7)	4 (30.8)
Cutting board	7 (53.8)	15.4%	1 (7.7)	3 (23.1)
Apron	13 (100)	0	0	0
Hair covering	13 (100)	0	0	0
Bleach	12 (92.3)	1 (7.7)	0	0
Hydroalcoholic gel	11 (84.6)	1 (7.7)	0	1 (7.7)
UV sanitizer	1 (7.7)	0	0	12 (92.3)

RESULTS OF THE ASSESSMENT

Frequency in Using the Biosafety Measures

Table 3 shows the number (n) and proportion (%) of respondents using the material and equipment at various frequencies. Material and equipment the most used were nitrile gloves, apron, hair covering, bleach and hydroalcoholic gel: more than 80% of the respondents reported using it every day or regularly. While household gloves, washable shoes, masks, and cutting boards were used regularly among about 50–60% of the respondents. Less than 50% of the respondents reported regularly using the face shield and the UV sanitizer: 92.3% reported never or only once using the UV sanitizer and 30.8% reported never or only once using face shields.

Open questions allowed discussions of reasons for less regular use of some equipment. Regarding the UV sanitizer, instructions given during the training course stipulated that children and animals needed to be kept out of the kitchen during the disinfection process for safety reasons. Some actors appeared frightened by this and preferred not to use it at all.

Concerning face shields, the comments received from interviewees highlighted that the quality of this equipment was weak and that it was damaged when it was first used. In addition, they were not familiar with it, so they felt uncomfortable when putting it on for work. This last comment was also noted regarding the use of masks and household gloves.

About the cutting board, feedback indicated that it was too fragile to support the regular cutting of large animal carcasses and wore out quickly. Instead, some people preferred to use it for cutting vegetables.

Regarding use of the washable shoes, some respondents said that they were mocked by their peers for wearing the shoes worn by the nurses at the hospital, which made them less inclined to use them.

Furthermore, even though it was not part of the equipment provided, we noted the presence of hand washing stations in most restaurants, but this was not available in the markets.

Willingness to Pay for the Equipment

At least half of the interviewees expressed a willingness to pay for each biosafety equipment, except for the UV sanitizer for which only 2 (15.4 %) of respondents were willing to pay in the future. All respondents (13, 100%) expressed a willingness to pay for bleach, and hair covering, followed by nitrile gloves (12, 92.3%) and apron (11, 84.6%) (Figure 9).

Feedback from the Training and Experience in Adopting the New Biosafety Practices

Eleven of the 13 trainees (84.6%) shared what they learned during the training with: their peers (6, 46.2%); their family (5, 38.5%) including partner, children, and other family members; their employees (4, 30.8%); their friends (2, 15.4%); their providers meaning hunters and intermediary traders (2, 15.4%) and their customers (1, 7.7%). In addition, in the wild meat market of Man, two trainees organized a feedback meeting with their peers and their ethnic association to share what they learned during the training. Another wild meat restaurant owner made aprons and hair coverings for all her employees.

Furthermore, the trainees who were interviewed offered some suggestions. They wished to continue to be trained through:

- Monitoring the application of the practices that were learned;
- Use of supporting materials like job aids, leaflets, or posters, to recall certain aspects of training, such as how to properly use the equipment;
- Reminders to use equipment; and
- Regular advice and information about risks in processing wild meat.

They also wished that the training be extended to more people to allow many of their peers who wish to receive the training in turn; to receive technical and financial support to engage in alternative activities other than wild meat; to have a suitable space to allow slaughtering and wild meat processing in appropriate conditions; and continue receiving biosafety equipment.

Challenges and Barriers in Adopting Biosafety Practices and Tools

Challenges and barriers that the interviewees expressed are the following:

- The main difficulty mentioned was the physical discomfort when using equipment to which they are not accustomed, such as gloves, washable boots, face shields and masks. One respondent commented about household gloves: "It's a bit heavy, I'm not used to it, so it bothers me."
- The restaurant owners who received the training had difficulty making their employees aware of the risks they were informed about during the training. As a result, these employees refused to regularly use the equipment. In addition, trained people neglect to use the equipment and do not always wear it when necessary.
- The quality of some materials did not allow for their sustainable or appropriate use. This is specifically about the face shield and the cutting board. Moreover, it appears that instructions relating to the use of the UV sanitizer were not mastered which meant that most of the actors had not used it.
- The gaze of others was also a hindrance. For example, for some people, wearing PPE was attributed to agents working in the hospital. Therefore, the trainees were embarrassed to put PPE on because others might laugh at them.

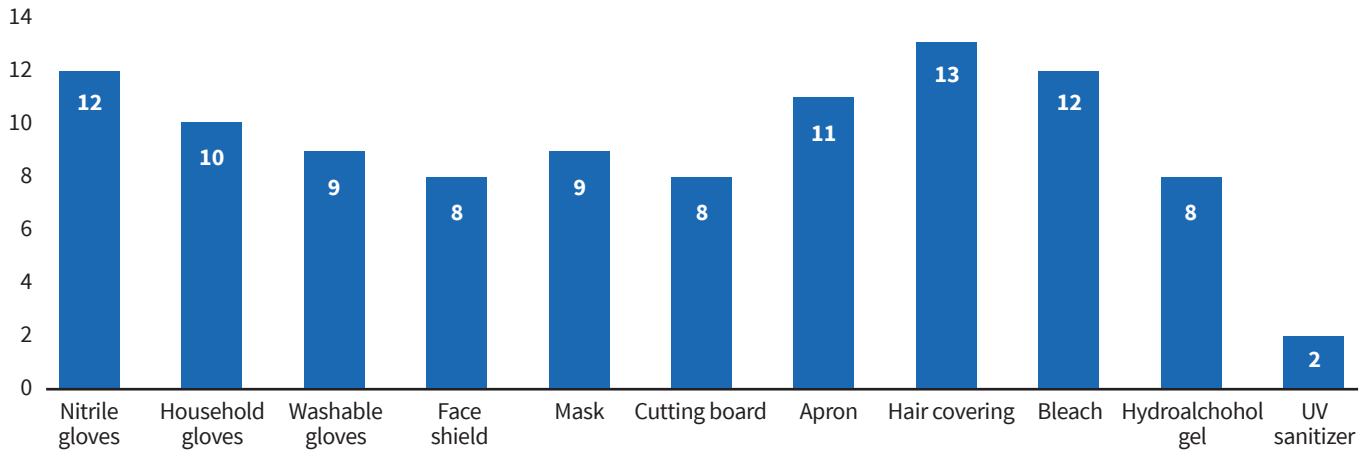
Feedback about the introduction of a chatbot

The results of the survey showed that none of the interviewees knew anything about chatbot before. Nevertheless 12 of the 13 interviewees (92.3%) expressed interest in using the chatbot. The main interests were in receiving further information about risks in wild meat handling, hygiene, and endangered species. In addition, almost all of them (12, 92.3%) had a smartphone and were familiar with using WhatsApp and expressed the willingness to pay internet credit to access the chatbot.

RECOMMENDATIONS TO OVERCOME CHALLENGES AND NEXT STEPS

Assessment of the adoption of biosafety practices among the first group of trainees enrolled in the intervention showed that most of the various interventions introduced were well used. Nevertheless, they were faced with some challenges and barriers that limited the full implementation of the biosafety equipment, material, and protocol. Feedback, challenges, and expectations expressed by the intervention participants are useful for informing the next steps. To maintain and increase the appropriate behaviors and use of biosafety tools among processors, essential to prevent pathogen transmission or

Figure 9. Number of respondents expressed a willingness to pay for the equipment



spillover during the wild meat operations, STOP Spillover Côte d'Ivoire team recommends to:

- Continuously encourage wild meat handlers to use biosafety practices by introducing incentives such as recognizing the best biosafety wild meat establishments through a labeling program or creating competitions for the best safe trader.
- Use the restaurant association (RUPACI) to implement strong advertising and media coverage of the biosafety actions using local radio or any other relevant communication channel, as well as social events.
- Extend biosafety training to more people handling wild meat in restaurants and markets and provide easy-to-use training materials. For example, self-adhesive leaflets with the list and images of endangered species that they could stick up in their markets and restaurants.
- Provide materials more suitable to their operating conditions, particularly as regards the butcher block. Failing that, use alternative materials that would play the same role, for example: make reusable fabric hair cover in place of the disposable one that was distributed.
- Develop a chatbot to allow all trainees and their peers to recall any training information, and to ask biosafety-related questions and to receive advice, instructions, or further information.
- Encourage feedback from trainees by supporting regular meetings between peers, led by the most motivated who will become champions.

A LABELING PROGRAM FOR RESTAURANTS MARKETING WILD MEAT IN THE DISTRICT DES MONTAGNES, CÔTE D'IVOIRE

In Côte d'Ivoire, one of STOP Spillover's main areas of intervention is biosafety education for wild meat processors. Interventions focus mainly on restaurants where most of wild animals intended for consumption are processed, presenting opportunities for transmission of zoonotic pathogens as well as for cross-contamination. Thus, processors and handlers from restaurants and markets received training on good biosafety practices in wild meat processing, as intervention.

To achieve a wide adoption of new interventions introduced and maintain a high-quality of biosafety and responsible hygiene practices likely to reduce risk of infectious diseases, a strong social and behavior change (SBC) component is essential. In that framework, a compliance program is being developed to ensure that good biosafety practices are adopted and maintained. Instead of certification, which is a process attesting to a company's conformity to specific standards issued by a public body (such as ISO) and which involves the State, the present conformity program will be based on labeling.

A label is a sticker or marker affixed by a private or public actor (trade union or professional association) guaranteeing the conformity of a product or service to certain specific standards, which may be /or may not be necessarily recognized by a public authority. Examples of labels include markers on organic products, stickers on certain types of packaging for food, esthetic slaughter of poultry etc.

Working closely with the United Restaurants and Associated Professionals (RUPACI), STOP Spillover, through the labeling program, aims to create incentives for restaurant owners who adhere to regulations or improve biosafety protocols. RUPACI will also ensure ownership and sustainability of the biosafety actions of this labeling program, beyond the life of the project.

Furthermore, this program prefigures the ongoing revision of the law on fauna which will promote the organization of the value chain of meat from hunted or farmed wild animals and the application of the veterinary public health code about meat from wild animals. In addition, the implementation of such program is aligned with the indicator P7.2 "Biosafety and biosecurity training and practices in all relevant sectors (including human, animal and agriculture)"

The labeling process will include five main steps:

1. **Establishment of the labeling commission**
2. **Development of the labeling criteria**
3. **Labeling application and approval process**
4. **Delivery of the labels and Regular monitoring process**

The labeling program will be implemented by RUPACI, in collaboration with STOP Spillover. The steps will include:

- The establishment of the labeling commission
- A communication campaign around the certification program within the network of both RUPACI and actors involved in STOP Spillover's biosafety activities (Activity 2.2.2). Following a snowball effect, the information will be disseminated to more wild meat restaurants.
- A program launch workshop.
- Opening of the program for the enrollment of the first wave of establishments requiring certification.

- Evaluation and decision of the certification commission
- Graduation ceremony and celebration of establishments having received the label.
- Follow up of the labeled restaurants.

The main actors identified at the start of this program are the owners of wild meat sales establishments operating in the District des Montagnes, RUPACI and local authorities.

The label primarily is intended for restaurants that sell meat, particularly meat from hunted or farmed wild animals. Candidates for labeling will therefore be owners of these establishments. Restaurants that display the label will benefit from greater visibility, customer trust and confidence, and, in turn, an increase in their profits. Labeling may extend to sellers in markets with the collaboration of market associations and to the whole country.

SBC message dissemination using CHVs.
Photo credit: STOP Spillover Liberia/AFROHUN

The United Restaurateurs and Associated Professionals of Côte d'Ivoire (RUPACI) is a private organization which aims, among other things, to mobilize economic actors and operators in the catering sector around subjects of common interest. The RUPACI network to date has been mainly present in the south of Côte d'Ivoire where it conducts most of its activities. The implementation of this labeling program will allow RUPACI to expand into the western regions of the country, which in turn will maintain its sustainability.

Local authorities could seize this opportunity to have a (regularly updated) map of the actors operating in the wild meat marketing sector, which will facilitate their support from an economic and social point of view, while ensuring the public health for the entire population within their area.

Côte d'Ivoire

Activity 2.2.3: Containment and disposal of fluids and solid waste from wildlife at key processing sites and markets

STOP Spillover activity 2.2.3 titled "Containment and disposal of fluids and solid waste from wildlife at key processing sites and markets" aims to reduce risk of infectious contamination from solid waste and effluents stemming from wild meat processing sites. We worked closely with engineers from the Institut National Polytechique de Yamoussoukro and veterinarians from Universitè Nangui Abrogoua and government agencies in charge of the environment to design the blueprints of improved wild animal meat processing units in accordance with the CDI veterinary sanitary code and international biosafety and food safety standards. We will submit the blueprints to USAID in the second half of this fiscal year.

Liberia

Activity 2.2.2.2 Promote proper food and water storage, and rodent-proofing households and commercial and agricultural storages

From January to March 2024, the project team refined implementation documents for activity 2.2.2.2 and scaled up the structural rodent-proofing and waste management interventions in four additional communities: Gbarpa and Nuopea in Nimba County and Gokai and Phebe Airstrip communities in Bong County.

In February 2024, interventions were refined based on the findings from the rapid assessment conducted in the previous quarter in the two pilot communities and a comprehensive concept note was developed. Other essential documents,

including contracts for Community Health Volunteers (CHVs), local radio stations, TikTok influencers, script artists, and town criers were also developed, reviewed, and finalized during the reporting period.

In March 2024, a team comprising three STOP Spillover/ AFROHUN team members (two technical team leads and an administrator/finance officer) and two OH-DReaM working group members from the National Health Promotion Division of the Ministry of Health (MOH) and NPHIL scaled up the interventions in the four additional communities in collaboration with the county's health teams. The scale-up meeting brought together a total of 92 individuals from the four communities across the two counties, including local community leaders, community health workers, religious leaders, carpenters, town criers, and household heads in each community. During these meetings, we presented the overview of STOP Spillover, findings from the 2.2.2.1 research in the initial two pilot communities and introduced the tested 2.2.2.2 solutions to the community. At the end of each presentation, the team provided feedback on questions and concerns raised by the community. Having addressed all questions, the community enthusiastically accepted the structural interventions (food boxes and tables wrapped with zinc) and pledged their support to work with the team in implementing these interventions.

Following a one-day meeting, the team oriented the CHVs and town criers on the key Social and Behavior Change (SBC) activities they are expected to lead in the communities and schools. This included focusing on key messages, food handling, water and sanitation, and other activities such as meetings, distribution of Information, Education, and Communication (IEC) materials, visits to schools, and planning radio talk shows in collaboration with influential leaders to raise awareness on Lassa Fever preventive measures.

We also oriented the CHVs to monitor the presence of rats through trackpad preparation and deployment and subsequent data collection in homes three days before the installation of the structural interventions. The team worked with local carpenters and the community chair lady/chairman to design samples of the food boxes, tables wrapped with zinc, and wall mesh grid wire to use during the trackpad exercise.

Additionally, in collaboration with the Material and Message Development Team, Ministry of Health the team revised the existing Lassa Fever preventive messages and materials based on the findings from the behavioral research. The updated audio message is a radio spot that promotes new Lassa Fever preventive measures, such as using tables with zinc around legs, food boxes for proper food covering, and environmental

Figure 10: SBC posters in Liberia for community awareness.

cleanliness, as ways to prevent Lassa Fever. The print materials display graphics of Lassa preventive measures (figure 10). The materials and messages have been turned over to the graphic artist and scriptwriters to produce revised audio and print materials. When updated, the materials will be sent to the USAID communication team to ensure proper marking and branding. The audio messages will then be sent to contracted county local radio stations to be broadcast. The plan is to conduct radio talk shows once a month, along with airing jingles daily in the morning and evening over a five-month period. These activities will be conducted in English as well as in one of the local dialects in each community. Additionally, we will collaborate with town criers to disseminate messages once a month in each community over a five-month period. CHVs will incorporate key Lassa messages into their existing outreach work and visit schools in each of their communities to engage children. They will also facilitate eventual focus groups with children to evaluate the effectiveness of the SBC messaging. Furthermore, work has begun with the TikTok influencer on integrating the messaging into her posts, including the frequency of posts.

Sierra Leone

Activity 2.2.2.1: Multi-faceted Lassa Food Storage and Farming Systems Intervention

Using results from formative research conducted in February 2023, the STOP Spillover team and OH-DReaM working group members developed two Lassa fever risk reduction interventions:

Improved grain storage facilities to reduce rodent contamination and improve food safety (e.g., rubber drums to store grains and wooden boxes lined with zinc to store cooked food);

Improved community hygiene and waste management systems (e.g., developing and enforcing community hygiene and sanitation bylaws by local authorities; constructing compost pits with fences located far away from houses; and covering leftover food and water in homes).

The STOP Spillover team identified six rural communities around the Gola Rainforest to test improved household grain storage facilities and community hygiene/solid waste management systems. Below are the Lassa risk reduction grain storage interventions reviewed and approved by local experts:

1. The use of rubber drums for grain storage: This approach was selected because it can solve the problem of rodent infestation, as well as insect, pest, and abiotic factors such as bacteria, fungi, and mold. The rubber drums are airtight, and prevent oxygen, moisture, and pests from entering, reducing spoilage. Farmers will dry their grains to 13% moisture before storage to prevent spoilage. Farmers were also encouraged to elevate rubber drums on pallets and keep them in well-ventilated areas to prevent spoilage. Rubber drums are easily affordable and accessible.

2. Wooden boxes lined with metal or zinc: The Melicia regia tree (a Mulberry relative) was recommended for making wooden boxes. This wood is strong and durable, resists termites, pests, and insects, and repels rodents. The dimensions of the box were designed to contain 15–20 bushels of rice. Although it is not readily available in the market like rubber drums, it can be locally produced by resident carpenters.

Eight communities were selected for the collection of baseline data on the grain storage intervention. Two of these communities (Kokoru and Kpuwabu) were selected as control communities, and four communities (Sandaru, Nyadehun Taniman, and Ngayawaima) were selected for grain storage interventions and two communities (Sembehun, and Lalahun) were selected for hygiene and sanitation interventions. Data collectors used KII, FGD and observation checklists to collect data in all eight communities. The data collected indicates that there are many women involved in farming in these communities. Grains are commonly stored in sacks in houses or in locally made barns, which are also used as kitchens. There are few demarcated areas for disposing of waste, and no community structure for managing hygiene and sanitation. In the six communities where baseline data was collected, hygiene and sanitation conditions were very poor in two communities, with one community having no improved sanitation facility (no toilet or latrine). That community practiced open defecation and often used a nearby stream, which was also a source of drinking water.

STOP Spillover launched the grain storage activity in three communities in Gaura chiefdom in Kenema district. The launch ceremony brought together representatives from the Ministry of Agriculture, OH-DReaM working group members, chiefdom representatives, enrolled farmers, STOP Spillover project staff and community members.

During the ceremony, the religious leaders offered prayers for the success of the project and for the farmers to use the grain storage techniques wisely. The chiefdom representative appreciated the kind gesture of the project for selecting their chiefdom for implementation of the grain storage items. He cautioned the farmers to comply with the project by effectively using the storage items so that they can prevent their community from Lassa fever spillover transmission and thus ensuring that the farmers stay healthy and contribute to the food production in the country.

The representative from the Ministry of Agriculture commended STOP Spillover for identifying safer grain storage options for farmers and moving a step forward in distributing the storage options to 200 farming households. He noted that other organizations should emulate the partnership and collaboration in advancing this activity, which helps promote the government of Sierra Leone's overall developmental agenda (Feed Salone). According to the farmer's representative, farmers have been struggling with post-harvest loss because of high rat infestation in their homes, barns, and farms. He further explained that introducing these improved grain storage intervention options would help store grains more safely. Singing and dancing accompanied the distribution of the grain storage options as the farmers showered praises on STOP Spillover for supporting them in protecting their grains from post-harvest loss caused by rat infestation, insects, and other factors. The grain storage techniques will minimize rat infestation in homes that might lead to Lassa fever, while also preventing post- harvest losses and promoting safer food practices within the home and farms.

The rodent tracking activity was carried out to determine the abundance of rodents in houses in the targeted communities. The selected sample included eight different communities and 112 households in equitable distribution across the eight communities. These communities, in tracking activity sequence, included Sandaru and Tanima; Nyandehun and Sembehun; Nganyawama and Lalehun; Kpuwabu and Kokoru.

Two teams conducted the entire exercise; each team was allocated to one community for every tracking effort. The exercise proceeded with a pair of communities being covered simultaneously through coordinated tracking for each given session over four consecutive days. The first day of tracking was dedicated to community engagement and deployment of track pads. The subsequent three days focused on evaluating the track pads for any rodent paw prints, tail marks, and scratches. Each team was composed of a supervisor and two chiefdom animators.

The first round of rodent tracking was conducted before the grain storage materials were distributed to the farming households. This served as a baseline to evaluate the effectiveness of the intervention.

The rodent print intensity counts recorded in the morning hours were observed to be greater than those determined in the evening hours. This assertion can be seen to stand in disregard to its validation by statistical analytical tools. If this is proved to be significantly true by means of statistical analysis, it will show that the rodents are more nocturnal than diurnal in their invasive activities.

Although statistical analysis has not been performed yet, it was observed that rodent prints were more common in dwellings located in the periphery than in the center of the community. This gives an indication that the community edge dwellings, which are in proximity to the natural habitats of the rodents, are easier for the pests to access than those who are farther away from the forests and farming fields. Similarly, trap plate scores appear to be higher in households located in the periphery showing that houses in the periphery are more likely to have rodents and have higher infestations than houses in the center of the community. Mud houses with grains located in the center of communities, however, were observed to have high rodent infestation as opposed to cement houses with grains located in the center of the community. Thus, an inference can be made that the inhabitants of the peripheral dwellings in the communities are at greater risk of exposure to any possible zoonotic spillover than those at the central areas of the communities. Similarly, mud houses with grains are at higher risk of zoonotic diseases than cement houses with grains.

The house inspections revealed that mud-built houses had higher frequencies of rat burrows in dwelling rooms, sitting rooms, and food stores than cement dwellings. Sebum deposits from rodents were observed and cadavers of either dead rats, poisoned rats, or rats captured by cats were seen in houses. When asked, many household respondents affirmed the sighting of rats in their dwelling rooms, sitting rooms, stores and vertical walls, and most of the respondents claimed to perceive squeaking sounds from rats due to their movement more frequently in the ceilings at night, while others claimed to hear such sounds under their beds. However, it was reported that most houses with cats had no frequencies of rats' infestation as opposed to houses without cats. Finally, the study observed that track pad perturbations were more frequently recorded with higher trackpad scoring in houses found to contain stored husk rice in sacs than those without them, particularly for dwellings where the stored rice was placed on the floors of the house.

To ensure effective implementation and coordination of the intervention, a taskforce was established in six selected pilot communities comprising representatives from the Ministry of Environment and Sanitation, the Chiefdom Health Overseer, the Block Extension officer, the sanitary officer, community leaders, and local volunteers. The taskforce is responsible for overseeing the intervention's activities, facilitating communication and collaboration among stakeholders, and addressing any challenges that arise during implementation.

The task force, in consultation with relevant stakeholders, developed a comprehensive plan of action to guide the implementation of hygiene and sanitation interventions. The plan outlined specific steps, responsibilities, and timelines for each intervention. It emphasized the importance of community participation, engagement, and accountability. One of the activities identified by taskforce members was the identification, digging, and fencing of a designated dumpsite and monthly community clean-up exercises.

To address the waste management issue, a designated dumpsite was established and fenced off to prevent unauthorized dumping. This initiative aimed to promote responsible waste disposal practices and minimize environmental pollution. The establishment of the designated dumpsite has led to improved waste management practices, resulting in a cleaner and safer environment for all community members.

To ensure the sustainability and enforcement of the interventions, bylaws were developed. These bylaws included:

regulations on proper waste disposal

sanitation practices (community clean-up exercise)

penalties for non-compliance

The taskforce worked closely with chiefdom health overseers and local authorities to draft these bylaws, ensuring their alignment with existing community laws.

Sierra Leone

Activity 2.2.2.2: Ebola Biosafety with Wildmeat Market Traders and Processors

Using lessons learned from previous SBC interventions (Activity 2.3.1.1), and data from formative research conducted in February 2023 (Activity 1.2.6.2), the STOP Spillover team developed an SBC strategy to facilitate the adoption of these biosafety practices by wild meat processors and traders at the Kingsway Corner market. SBC approaches were used to promote the adoption of biosafety practices from July–September 2023.

In November 2023, OH-DReaM working group members began collecting quantitative monitoring data on the continued adoption of biosafety measures by wild meat traders and processors over time. This information is shared with market actors during monthly meetings. Monthly meetings are used to discuss and address key findings from monitoring exercises. They focus on topics including reviewing follow-up action points from previous meetings, sharing key findings from data collected on the adoption of biosafety practices by wild meat actors, discussing challenges hindering biosafety practice adoption, and notable successes and changes made since previous meetings. Each meeting concludes with action items and the next steps to be taken over the following month.

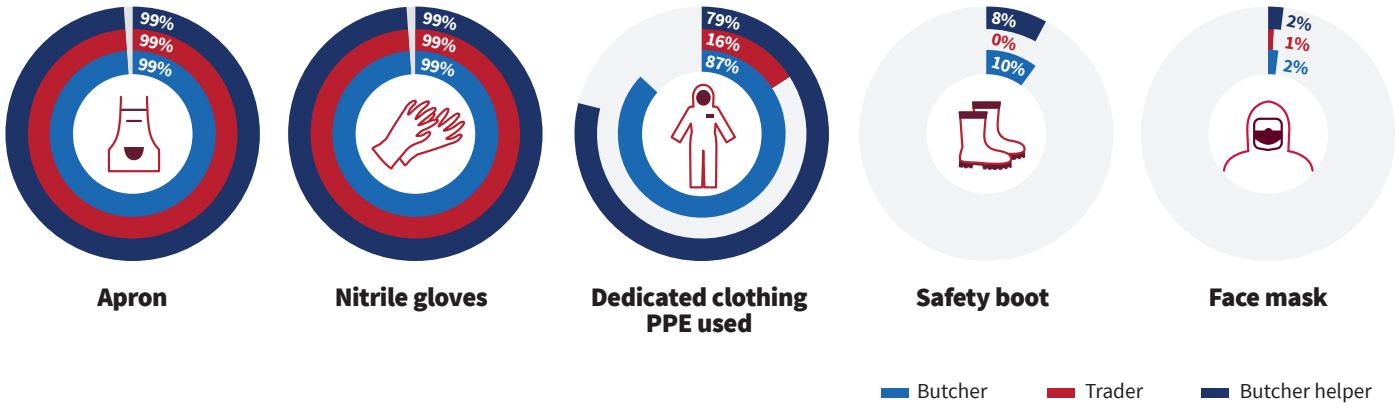
Participants represented stakeholders including the Ministry of Health and Sanitation (MOHS), the Ministry of Environment and Climate Change (MECC), The Ministry of Agriculture and Food Security (MAFS), the Kenema city council, and local authorities such as the traditional chief and mammy queen. The meeting included presentations, discussions, and brainstorming sessions. It encouraged active participation from all stakeholders to gather diverse perspectives and insights.

Data on the adoption of biosafety measures (PPE use) are collected weekly by OH-DReaM working group members who also undertake weekly observation/monitoring of wild meat market actors in the market (figure 11). In addition, one-on-one talks with the chief, woman leader, and wild meat actors provide further insights into the effectiveness of SBC strategies and biosafety measures.

Observations and monitoring data indicate a positive trend in the adoption of some biosafety measures (handwashing, apron usage and butcher block cleaning). Key achievements and findings include:

- With support from OH-DReaM working group members and the city council, waste collection in the market will now shift from one day a week to four days a week (i.e., from Tuesday, Wednesday, Thursday and Saturday).
- Increased awareness among wildmeat traders and processors on the importance of biosafety measures and their role in preventing the spread of diseases from wildlife to humans.
- Improved hygiene practices among wildmeat traders and processors, such as wearing gloves, aprons and washing hands regularly.
- Improvement in waste management practices in the market, with support from the city council for regular collection of waste.
- Increased support and involvement and cooperation between wildmeat actors and local authorities, such as the mammy queen and chief, in enforcement of bylaws and implementing biosafety measures.

Figure 11: Summary of usage of various PPEs by wildmeat traders and processors in month of March 2024

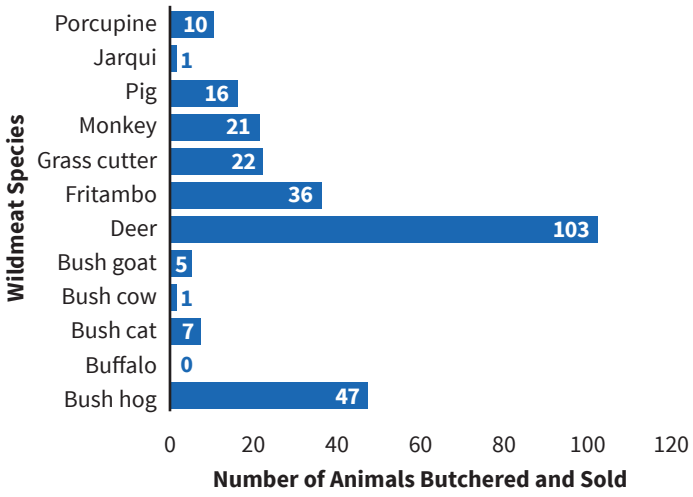


- During the monthly meeting, chiefdom authorities (the traditional chief, women's leader, metropolitan police and OH-DReaM working group members) discussed key findings from monitoring data presented and noticed low compliance in certain biosafety measures in the market. Consensus agreements were made by wild meat actors, OH-DReaM working group members and local authorities to elect a new market executive.

- OH-DReaM working group members commended the effectiveness of Bluetooth speaker messages in disseminating biosafety information to market vendors.

To enforce compliance of biosafety measures in the wildmeat market, STOP Spillover Technical Leads and the OH-DReaM working group members engaged an interim executive on the need for activating / instituting bylaws that would guide the activities of all members of the wildmeat market. The bylaws, which apply to all individuals involved in the trade and processing of wild meat within the Kingsway corner market, were established to enforce biosafety measures in the wildmeat market to protect the health and well-being of traders and processors, consumers, and the public. Bylaws on wearing PPEs, cleaning the market, butcher block table, standing pipe water, waste management and handwashing practices were drafted, approved and adopted by local authorities, including traditional chiefs and women leaders, members of the OH-DREAM Working Group, the trader's union, and wild meat traders and processors.

Figure 12: Species* and Quantity of Wildmeat Sold at the Market on Observation Days in March



*Jarqui = African Golden Cat
*Grass cutter = *Thryonomys swinderianus*
*Fritambo = *Neotragus pygmaeus*

The traditional chiefs and women leaders, the OH-DReaM working group members and the trader's union are responsible for overseeing the implementation and enforcement of these bylaws.

The market is dominated by the trade of deer meat, with bush hog and duiker also being significant but less common. Other species such as grass cutters, monkeys, pigs, and porcupines are present in smaller numbers, while certain species such as bush cows are nearly absent. Buffalo meat is reportedly not found in the market. This information can provide insights into consumer preferences, supply chains, and potentially inform conservation efforts.

Viet Nam

Y4 Implementation

Recognizing the potential role of wildlife farming and wildlife markets in the spillover risks associated with COVID-19 and other zoonotic diseases (ZDs), the captive wildlife farming sector in Dong Nai province has been specifically identified as a high-priority, high-risk interface for STOP Spillover interventions.

Year 3 was characterized by active engagement with key partners and communities in Dong Nai province, leading to the successful implementation and completion of one core intervention and four supporting activities. Building on the results and achievements from the activities and interventions conducted in Year 3, the STOP Spillover team will continue applying a stakeholder-driven, multisectoral One Health, and OH-DReaM approaches to design, test, and validate interventions focused on reducing zoonotic spillover risks in Year 4. From January 23–26, 2024, a series of technical consultation events were organized in Dong Nai province for Year 4 activities implementation at the provincial, district and community levels.

By engaging provinces, districts, and communes, the consultation seeks to enhance community involvement, promoting a localized perspective for the successful implementation of five activities in Year 4, including: 1) strengthening coordination in prevention and control of zoonotic diseases; 2) developing and piloting a biosafety certification program for wildlife farms; 3) preventive healthcare for farmed wildlife; 4) mitigate spillover risk in marketed wildlife and wildlife products; and 5) community-based risk reduction campaign to mitigate zoonotic disease spillover.

The consultations successfully engaged diverse stakeholders, including local authorities and partners from sectors such as Agriculture and Rural Development, Health, Environment, and Culture. Representatives from various unions, including

Consultation on community-based risk reduction campaign to mitigate zoonotic disease spillover at District and Commune levels. Photo credit: STOP Spillover Viet Nam/VOHUN

youth, women, livestock, and farmers, as well as those from private pharmacies, were also involved. In total, 159 delegates participated across all levels, with 50 attendees at the provincial workshop, 51 at the district workshop, and 58 at the community consultation in the three districts (Tan Phu, Dinh Quan and Vinh Cuu) of Dong Nai province.

Strengthening coordination in prevention and control of zoonotic diseases

Based on the draft plan for preventing infectious diseases in humans within the health sector and in animals within the agricultural sector, the workshop discussed specific inter-sectoral coordination activities outlined in the 2024 Joint Plan for the prevention and control of zoonotic diseases between the health and agriculture sectors. These activities include monitoring and information sharing, investigation and response to outbreaks, as well as training and communication. Additionally, the workshop proposed locations and outlined specific activities to be carried out in the pilot model of comprehensive interdisciplinary coordination.

After several follow up meetings and effort from OH-DReaM working group members and implementing partners under Dong Nai DARD and DOH, a draft Joint Plan has been developed by the end of March 2023. The plan aims to increase efficiency and comprehensiveness in implementing activities to prevent and control zoonotic diseases through strengthening cooperation and coordination between the health and agriculture sectors.

Developing and piloting a biosafety-biosecurity certification program for wildlife farms

Three models of biosafety-biosecurity certification were discussed, including VietGAP (Vietnamese Good Agricultural Practices), Disease Safety, and Veterinary Hygiene. The workshop agreed that, in the first phase, the most feasible and easy-to-implement model to be tested would be the modified VietGAP model. 22 of 28 criteria from the VietGAP model will be selected and tested. Additionally, the workshop proposed that the Department of Agriculture and Rural Development of Dong Nai province would be the focal unit responsible for issuing and awarding certificates to households that meet the standards in wildlife farming.

Preventive healthcare for farmed wildlife

The workshop discussed vaccines and antiparasitic drugs for preventive healthcare in wildlife, including civets, deer, porcupines, and bamboo rats. Simultaneously, the workshop proposed priority options for piloting, such as vaccination against canine distemper virus (also known as Carré's disease or Care's disease in Vietnam) or deworming in farmed civets, using locally available vaccines and drugs.

Implementing measures to minimize the risk of disease spread from wildlife and wildlife products circulating in the market

To enhance health inspections for farmed wildlife, the workshop proposed a plan to formulate a set of clinical criteria for health inspections and to test this set of criteria. The workshop also addressed key aspects of coordination and the roles of rangers and veterinarians in these activities.

Animal handling demonstration during the Preventive Wildlife Healthcare, Treatment, and Management of Common Diseases in Targeted Wildlife training course in Dong Nai province, Viet Nam.
Photo credit: STOP Spillover Viet Nam/VOHUN

Community-based risk reduction campaign to mitigate zoonotic disease spillover

The consultations explored communication channels and suggested messages regarding disease prevention and biosecurity in wildlife farming. Numerous delegates showed keen interest in a communication plan utilizing videos and brief news updates on Facebook, disseminated through various wildlife farming groups, and other social media pages.

Viet Nam

Activity 2.2.2.3: Essential Preventive Healthcare Initiative for Farmed Wildlife (vaccination, deworming, rational antibiotic use, and endemic disease reporting)

Essential preventive health care, which includes core measures such as vaccination, rational antibiotic use, deworming, and effective disease monitoring and reporting, has been widely adopted in traditional livestock farming. These practices have been proven to effectively control infectious diseases among farmed domestic animals, reduce the risk of zoonotic diseases and antimicrobial resistance for humans, and bring financial benefits to farmers. The same attention and implementation, however, has not been given to captive wildlife and wildlife farmers. Commercial farming of civets, porcupines and bamboo rats has developed in Vietnam in the last few years and wildlife farmers have less farming experience than livestock farmers. Diseases in civets, sambar deer, porcupines, and bamboo rats are not fully documented in textbooks and not typically included in veterinary curricula. Wildlife farmers rely on experience, and veterinary agencies do not provide specific instructions on farmed wildlife diseases and their treatment. Veterinary staff are familiar with how to identify and treat diseases in livestock based on industry guidelines, but lack confidence, knowledge, and practice with wildlife. The solution is to consolidate disease management in farmed wildlife under the responsibility of veterinary agencies through intensive training on diseases and specific treatments and preventive measures for veterinary staff, community health workers, and farmers.

STOP Spillover collaborated with Dong Nai province to organize three training courses on Preventive Wildlife Healthcare, Treatment, and Management of Common Diseases in Targeted Wildlife from March 4–30, 2024.

Course 1: Advance training on Preventive Wildlife Healthcare, Treatment, and Management of Common Diseases in Targeted Wildlife for One Health officials (35 participants)

Course 2: Essential Preventive Wildlife Healthcare, Treatment, and Management of Common Diseases in Targeted Wildlife for COHW in Tan Phu and Dinh Quan Districts (47 participants)

Course 3: Essential Preventive Wildlife Healthcare, Treatment, and Management of Common Diseases in Targeted Wildlife for COHW in Vĩnh Cửu District (40 participants)

IMPLEMENTATION SPOTLIGHT

Activity 2.2.2.1: Lassa Food Storage and Community Hygiene Interventions in Sierra Leone

Introduction

STOP Spillover formative research revealed that farmers package their harvested grains and crops in sacks, boxes, jerry cans, barrels, or wrapped in old clothes, and store crops in kitchens, barns, or in their houses until the next planting season. As a result of these storage practices and farmers' proximity to the forest, rodents frequently enter people's homes, eat and contaminate food.

Grain storage methods proposed for testing

Based on the outcome of STOP Spillover formative research, community representatives and One Health Design, Research and Mentorship (OH-DReaM) working group members designed and developed improved grain storage techniques and improved hygiene and waste management systems to reduce rodent-human contact and reduce Lassa virus spillover risks

Achievements:

Conducted community engagements a total of 200 out of 511 farming households in 6 communities around the Gola Forest, in Guara chiefdom in Kenema district were enrolled for testing grain storage intervention. Criteria for selection of the households were:

- Female-led farming households
- Farming households closest to the forest
- Farming households that harvest more than 6 bushels of rice/ season
- 4Youth farming households
- Mud and thatch houses (the most vulnerable to rats)

Out of the two hundred farming households selected in the four communities, 113 were female-headed households (57%) and 87 were male-headed households.

Launching of food safety interventions and distribution of grain storage technologies

STOP Spillover is testing grain storage techniques in three communities in Gaura chiefdoms in Kenema district. The launching ceremony brought together representatives from the Ministry of Agriculture, OH-DreaM working group members, chiefdom representatives, enrolled farmers, STOP Spillover staff and community members.

Participants reflections

"As OH-DReaM working group members, our participation in trainings and community engagements has enhanced our capacity in research and community mobilization."

- OH-DReaM working group member

"Partnering and collaborating with the STOP Spillover project is a laudable approach that has helped us support more farmers in derived communities in Sierra Leone."

- Ministry of Agriculture representative

"We have been struggling with post -harvest loss because of high rat infestation in our homes, barns, and farms. With the introduction of these improved grain storage intervention techniques our grains will be safely stored with limited Lassa fever risks."

- Farmers



A group discussion during the scenario simulation exercise in Nomo Chiefdom, Kenema District. Photo credit: STOP Spillover Sierra Leone/Tetra Tech

Activities & Accomplishments

OBJECTIVE 3

Recognizing that it will not be possible to prevent all spillover events from wildlife, Objective 3 focuses on assisting countries to limit the impact of spillover events should they occur. Minimizing the amplification and spread of zoonotic viruses within a human population, and containing the spillover event as much as possible, will limit the public health impact of such events. This section outlines STOP Spillover's achievements and accomplishments for Objective 3 during the first half of Project Year 4.

Sierra Leone

Activity 3.5.2: Scenario Development for Outbreak Risk Management

During interface-level OM discussions at the community level in Kenema district, stakeholders described important lessons learned during the Ebola outbreak. This included strong local leadership roles and responsibilities including drafting and implementing local bylaws that helped mitigate continued Ebola amplification and spread (Sierra Leone Outcome Mapping Report, 2022). Recently, the Ministry of Health and Sanitation (MOHS), in collaboration with other line ministries in the One Health Platform, conducted a tabletop simulation exercise to test emergency preparedness and response capacity for all district- and national-level systems. Pandemic preparation and response systems at the high spillover risk interface level, however, have not yet been tested. There is a need for increased training and simulations to maintain capacity at all levels (WHO 2017).

One Health partners (including the Ministry of Agriculture and Food Security, the Ministry of Environment and Climate Change, and the MOHS), with support from STOP Spillover, conducted a simulation exercise to test community readiness to respond to a specific known zoonotic disease (Lassa Fever) outbreak, building on scenarios developed in 2022 in collaboration with the University of Nebraska Medical Center (UNMC, a former STOP Spillover consortium partner). The exercise focused on responders' responsibilities and responses to the presence of a patient with suspected Lassa Fever within a community and healthcare setting. Furthermore, it explored the coordination and interplay between the multiple agencies and emergency response disciplines that make up the district and community emergency response team. By conducting a tabletop simulation exercise, interface level response teams tested existing procedures and stakeholder awareness of actions needed to prepare for and respond to Lassa Fever cases.

Tunkia Chiefdom

A simulation exercise was conducted in Tunkia chiefdom, Kenema district from December 14–15, 2023, with the objective of testing outbreak risk management (epidemic preparedness and readiness) at a high-risk interface (forest edge communities around Gola Rainforest National Park).

A total of 38 participants took part in the exercise and were drawn from community stakeholders, healthcare workers, and district teams from the ministries of health, agriculture, and environment. National-level staff formed part of the exercise evaluation and management team. Scenarios covered vital areas such as community alerts, epidemic responses, resource allocation, de-escalation, and outbreak conclusion and deactivation. Group discussions, plenary presentations, and evaluation feedback were used in the exercise.

The simulation exercise in Tunkia brought out several strengths in the response at the community level including alert, reporting, response and recovery. Some of these positive responses were referenced in the structures and activities implemented during previous Ebola and COVID-19 outbreaks. Key gaps were identified in the response system, however, as well as in responses from participants. These gaps range from sample collection and testing and coordination of community response to treatment of cases in the community. Most of the gaps are associated with inadequate resources (human and material resources) especially at the community level, which can be addressed by district teams making additional resources more available in high risk communities.

The tabletop exercise served as a refresher training for most community participants who are engaged when there is an outbreak. Some of the structures they mentioned, such as the Facility Management Committee, exist, and they have regular meetings to address concerns or issues between health facilities and community members. Other structures like the chiefdom task force, however, are only activated during outbreaks even though this task force is supposed to have regular meetings to get updates on health issues and related animal and human health related risk factors within the chiefdom.

The community-based simulation exercise offers a significant step forward in the country's preparedness, alert, reporting and response strategies. Results from this exercise demonstrate community readiness to respond to and manage a VHF outbreak. It also refreshed the memories of community and health workers concerning their roles in preparedness and response, which served as a refresher training for all participants. Building on these positive results and addressing gaps identified through this exercise will produce better outbreak response plans that will ensure better coordination between community stakeholders and relevant actors in outbreak risk management. Greater preparedness at the community level will foster plans and structures that enhance preventive measures, limit risky behaviors in the community, and result in more healthy and resilient communities.

Nomo Chiefdom

The STOP Spillover Sierra Leone Scenario Simulation Exercise in Nomo Chiefdom, Kenema District, which was conducted January 9–11, 2024. This exercise represents a significant milestone, enhancing the region's preparedness for health-related emergencies using a One Health, multisectoral surveillance and response paradigm. This exercise was supported by One Health partners and USAID STOP Spillover, as a collaborative effort aimed at evaluating and improving the local stakeholder capacity to respond to emergencies. The initiative brought together a total number of 40 participants from a diverse group of stakeholders, including health professionals, government officials, community leaders, and various sector representatives, reflecting a comprehensive approach to emergency management.

The Nomo Simulation Exercise was designed in the context of increasing global and national health threats and the need for robust, multisectoral, coordinated response mechanisms at the local level. The primary objectives were to assess the readiness of local health systems, enhance inter-sectoral coordination, and identify gaps in emergency response strategies. The exercise aimed to foster a culture of continuous learning and adaptation, ensuring that the region's emergency response is both effective and efficient. A scenario-based tabletop simulation was employed, providing a realistic and challenging environment for participants to engage in. This method facilitated the identification of strengths and weaknesses in current response strategies. The simulation presented a hypothetical public health emergency, requiring participants to navigate complex decision-making processes, allocate resources, work as part of multisectoral teams, and overcome

communication challenges. This approach was instrumental in revealing practical insights into the operational aspects of emergency management in the region.

The exercise witnessed active participation from a wide range of stakeholders, highlighting the exercise's inclusive nature. Participants were drawn from various backgrounds, including health care, environment, agriculture, animal husbandry, local governance, emergency services, and community organizations. This diverse participation ensured a multi-faceted perspective on emergency preparedness and response, essential for developing a comprehensive approach to health emergencies. The exercise revealed a strong sense of community engagement and a willingness to collaborate across different sectors. It also brought to light, however, the varying levels of preparedness and resource constraints faced by different stakeholders. One of the primary challenges observed during the exercise was the disparity in resources and preparedness levels among participants. This situation highlighted the need for more equitable resource distribution and capacity building across all sectors. Additionally, limitations in existing communication channels and coordination strategies were evident, pointing to areas where improvements are essential.

Based on the exercise's insights, several recommendations have been proposed to address identified gaps. These include the implementation of regular training programs for emergency response teams to enhance their skills and preparedness levels. Developing a comprehensive cross-agency and inter-sectoral communications plan is also crucial to ensure effective coordination during emergencies. An action plan with specific responsibilities and deadlines (see Appendix A) has been formulated to operationalize these recommendations. The Nomo Simulation Exercise was an invaluable endeavor to reinforce Kenema District's capabilities to handle multi sectoral public health emergencies. The exercise not only provided critical insights into the current state of emergency preparedness but also laid the foundation for ongoing improvements and collaboration in the region. As such, it stands as a model for future initiatives aimed at building a more robust and resilient emergency response framework in Sierra Leone and beyond.

Koya Chiefdom

This simulation exercise was conducted in Koya chiefdom, Kenema district from January 17–29, 2024, with the objective of testing outbreak risk management (epidemic preparedness and readiness) at the high-risk interface level.

A total of 42 participants took part in the exercise and were drawn from community stakeholders, healthcare workers, and the district team from the Ministries of Health, Agriculture, and Environment. National level staff formed part of the exercise evaluation and management team. Scenarios covered vital areas such as community alerts, epidemic responses, resource allocation, de-escalation, and outbreak conclusion and deactivation. Group discussion, plenary presentations, and evaluation feedback were used in the exercise.

The simulation exercise in Koya several strengths in the response at the community level including alert, reporting, response and recovery. Some of these positive responses were referenced to the structures and activities implemented during the previous Ebola and COVID-19 outbreaks. Key gaps were identified in the response system, however, as well as the responses from the participants. These gaps range from sample collection and testing, coordination of community response to treatment of cases in the community and functionality of community structures including the chiefdom taskforce. Most of the gaps are associated with inadequate resources (human and material resources) especially at the community level. These can be addressed to ensure that district teams make these resources available in the communities.

The tabletop exercise served as a refresher training for most of the community participants, since they are the ones who are mostly engaged when there is an outbreak. Presently, there is no regular training for community stakeholders concerning outbreak risk management. Training on this topic or this type of simulation exercise needs to be done regularly at the community level.

Lower Mamabara Chiefdom

The table top simulation exercise, which was conducted in Lower Bambara Chiefdom, was a strategic initiative aimed at bolstering public health emergency preparedness and response capabilities concerning Viral Hemorrhagic Fever (VHF) outbreaks. This exercise, which took place from February 29–March 2, 2024, in Panguma Community, was orchestrated by STOP Spillover, and coordinated by the One Health partners from the government of Sierra Leone. Its primary aim was to enhance the preparedness and response strategies of community-level responders, including healthcare workers, local authorities, and community leaders, against known zoonotic disease threats through a meticulously designed tabletop simulation. There was a total of 40 participants, comprising representatives from the chiefdom (21), District level participant (10), National level (6), STOP Spillover (3). The chiefdom participants comprise representatives from the chiefdom headquarter town and also from one of the towns within the chiefdom.

This exercise focused on testing the efficiency of emergency recognition and management at the interface level, evaluating inter-sectoral and inter-community collaboration, examining risk communication mechanisms, and conducting a comprehensive review and evaluation of the community's readiness to tackle public health emergencies involving VHF. By simulating a VHF outbreak, the exercise presented a sequence of progressively challenging scenarios. These scenarios tested

Group photo after the completion of A Chiefdom Level Outbreak Simulation Exercise: Noma Chiefdom, Kenema District.
Photo credi: STOP Spillover Sierra Leone/Tetra Tech

the participants' operational capabilities in various facets of outbreak response, ranging from initial detection and reporting to the implementation of de-escalation strategies and the conclusion of the outbreak response.

The simulation helped foster a collaborative learning environment, as evidenced by the constructive discussions and actions it spurred. This was particularly notable in the context of community engagement, hygiene practices, healthcare utilization, awareness of disease transmission, and the adoption of preventive measures. The exercise, however, also laid bare several areas requiring improvement. Key among these were the challenges related to communication infrastructure and the training needs of community-based surveillance teams. It became evident that enhancing these areas is crucial for improving early detection and management capabilities within the community. Furthermore, the feedback underscored the need for more robust inter-sectoral and inter-community collaboration, highlighting the importance of establishing formal mechanisms for cooperation among different sectors and communities.

In addition to identifying gaps, the simulation exercise unearthed several good practices that could serve as benchmarks for future simulations and real-world applications. These practices emphasized the effectiveness of using local languages for communication, the engagement of diverse community stakeholders, and the use of innovative approaches for fostering inter-sectoral and inter-community collaboration. Such practices underscore the value of community-led initiatives and the significance of adopting inclusive and participatory approaches in emergency preparedness and response efforts.

In conclusion, the community level table top simulation exercise has laid a solid foundation for continuous improvement in public health emergency preparedness and response within the community. Moving forward, leveraging the lessons learned, addressing identified gaps, and replicating good practices will be imperative for building a resilient community capable of confronting future health crises with confidence and competence. This exercise serves not only as a model for future public health preparedness efforts but also represents a crucial step towards safeguarding public health and well-being through enhanced community engagement and collaboration.

Dodo Chiefdom

Conducted in Dodo Chiefdom, Kenema district, from March 5–7, 2024, the exercise was a collaborative effort under STOP Spillover.

The exercise underscored the necessity of preparedness and emergency response operations, highlighting Sierra Leone's strengths in emergency response operations despite identified gaps in preparedness plans and multisectoral risk profiling at local levels. It built upon lessons learned from the Ebola

outbreak and the ongoing COVID-19 pandemic, demonstrating the critical role of Public Health Emergency Operation Centers (PHEOCs) and the importance of local leadership and community engagement in outbreak response. The primary goal was to enhance public health emergency preparedness and response capabilities at the community level to a VHF outbreak, emphasizing sustainable relationship building and improving readiness for outbreak risk management. Objectives included testing emergency recognition and management, assessing inter-sectoral and inter-community collaboration, testing risk communication strategies, and identifying lessons for improving public health emergency preparedness. A total of 42 participants attended the exercise comprising representatives from the national, district and community levels. There were seven females and thirty-five females in attendance.

A hands-on, non-computer-based tabletop simulation exercise was designed around a realistic scenario of a VHF outbreak initiated by a hunter in a farming community. It tested various aspects of outbreak response, including detection, reporting, activation of emergency response teams, risk communication, and community engagement. Participants were drawn from local communities, including health workers, traditional leaders, youth representatives, and government officials, ensuring a comprehensive response perspective. The exercise was well-received, with all participants acknowledging its effectiveness in achieving its aim, generating valuable discussions, and identifying essential lessons. Key learning themes included health practices and awareness, community engagement, reporting channels, environmental management, collaboration, and personal and public health measures. The simulation highlighted the importance of community-based surveillance, the integrated disease surveillance and reporting system, and the role of chiefdom task forces in enhancing outbreak preparedness.

The simulation exercise revealed significant strengths in community readiness and response to health emergencies, emphasizing the value of local knowledge, language considerations, and the strategic use of role plays to enhance learning. There were, however, challenges in organizing role plays and realizing gender parity in participation. Recommendations for future exercises include targeting more community participants and providing briefings on role plays to ensure organized activities. This exercise demonstrates Sierra Leone's commitment to building resilient health systems capable of responding to public health emergencies.

STOP Spillover Sierra Leone Lassa Fever Tabletop Simulation Exercise Video

Sierra Leone Close Out Plan

STOP Spillover submitted a close out plan outlining timelines for specific activities that will be completed between April 1, 2024 and September 30, 2024 to close out the project in Sierra Leone. This plan includes the following components:

i) Technical review of project activities; ii) Budget review iii) Timeline review; iv) Scope changes; v) Resource review/transfers/disposition; vi) Project documents; vii) Communication with stakeholders about close-out with the approval of USAID.

IMPLEMENTATION SPOTLIGHT

Intervention to Improve Biosecurity at Live Bird Markets (LBM)

Activity 2.2.2.1: Support LBM stakeholders to develop and implement a holistic, multi-pronged design for LBM with improved biosecurity and hygiene measures that reduce the risk of spillover

Introduction

The STOP Spillover Country Team at icddr,b collaborated with national and local stakeholders to develop a holistic intervention to improve biosecurity and biosafety of live bird markets, including infrastructural renovation, biosecurity and biosafety guidelines, compliance monitoring, funding mechanism, and advocacy. Stakeholders from diverse sectors contributed, resulting in customized designs suitable for the context of Dhaka city. With funding support from Islam Group (a private sector partner) and technical support from USAID's STOP Spillover project, the intervention was implemented in a poultry shop in Dhaka North City Corporation area.

On March 18, 2024, a formal inauguration event was held to mark the launch of the biosecure poultry shop, with representatives from USAID, Institute of Epidemiology Disease Control and Research and One Health Secretariat, Tufts University, Islam Group, and icddr,b. Representatives found a renovated, clean, and attractive shop where biosafety standards are implemented to reduce risks to vendors and customers alike.

Photo credit: STOP Spillover Bangladesh Team

Expected Outcomes

- LBM Stakeholders able to utilize single-shop and multi-stall LBM designs with improved infrastructure and biosecurity and biosafety measures that reduce the risk of spillover
- Functionality and effectiveness of biosecure LBM intervention are assessed, and barriers and enablers, and advantages and disadvantages are explored
- This activity contributes to JEE Indicators: R1.6. Research, development, and innovation and P7.1. Whole-of-government biosafety and biosecurity system is in place for human, animal, and agricultural facilities

ACTIVITY AT A GLANCE

Activity 2.2.2.1 Single-shop LBM–Phase 1

During the visit of Dr. Jonathon Gass and Dr. Bernard Arulanandam along with a representative from USAID-Washington, STOP Spillover country team and representatives from USAID Bangladesh Mission engaged in the following activities:

- Visited the single-shop LBMs (both control and intervention) and participated in the inauguration ceremony
- Members of the STOP Spillover country team presented updates and results of various aspects of the intervention's implementation and evaluation
- Participated in a meeting at the USAID Mission to discuss project updates and future directions
- Participated in a meeting at Dhaka North City Corporation (DNCC) to discuss future planning for improving LBM biosecurity and biosafety

Africa One Health
University Network

Vietnam One Health
University Network

icddr,b

JSI Research &
Training Institute, Inc

Tetra Tech

University of Washington

University of
California, Los Angeles

Broad Institute

Center for Wildlife Studies