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COVID-19 SPECIMEN MANAGEMENT AND REFERRAL: EXPERIENCES FROM IDDS-SUPPORTED COUNTRIES



USAID's Infectious Disease Detection and Surveillance (IDDS) project improves the detection of diseases of public health importance and identification of antimicrobial resistance (AMR) in priority pathogens through an accessible, accurate, adaptable, timely, and integrated diagnostic network system. IDDS also improves the quality of real-time surveillance systems for priority zoonotic diseases.

Photo by IDDS

INTRODUCTION

Infectious diseases with epidemic potential such as COVID-19 have devastating effects on lives and livelihoods around the globe. The response to these outbreaks poses a unique challenge for laboratories in low- and middle-income countries (LMICs). Establishing functional laboratories at all tiers of health systems in LMICs remains an issue because of factors such as poor infrastructure, lack of trained human resources, lack of biosafety practices, and insufficient funding.

Real-time reverse transcriptase-polymerase chain reaction (rRT-PCR) is the preferred test to confirm COVID-19 cases, but in LMICs this test is usually performed only in central laboratories, which are typically in the capital cities. Because of this, many LMICs are reliant on the ability to transport specimens from remote areas to central laboratories. However, these systems are often fragmented and without formalized processes or an integrated approach to implementation. Most specimens, including COVID-19 specimens, are sensitive to time, temperature, and the transport methods required to ensure specimen integrity.

As one of the early implementers of USAID's emergency response to the COVID-19 outbreak, the Infectious Disease Detection and Surveillance (IDDS) project provides technical expertise to strengthen COVID-19 specimen referral systems (SRs). This support focuses on specimen integrity and transport methods. IDDS collaborates with host country governments, the World Health Organization, and other key stakeholders to identify challenges in specimen referral and transport. IDDS develops practical specimen transport models, tailored to real-time needs on the ground, to ensure that COVID-19 specimens are properly collected, referred, and sent to the designated COVID-19 laboratory in each country. IDDS also supports the decentralization of diagnostic capacity to ensure access to high-quality testing services and facilitates strategic planning for the introduction of GeneXpert® Xpress COVID-19 testing. Additionally, the project supports the procurement of essential laboratory commodities and develops training to empower frontline health workers to safely collect and rapidly transfer specimens to testing laboratories.



IDDS has implemented COVID-19 response activities in 13 countries—Bangladesh, Cameroon, Guinea, Indonesia, Kenya, Liberia, Mali, the Philippines, Senegal, Tanzania, Thailand, Uganda, and Vietnam. In nine of these countries (Bangladesh, Cameroon, Ethiopia, India, Indonesia, Madagascar, Mali, the Philippines, and Senegal), IDDS was specifically involved in specimen referral activities. The lessons learned and project results from selected countries are presented below.

SPECIMEN REFERRAL

An SRS is a coordinated network that enables a health facility or laboratory that lacks the capacity (whether it is human resources, supplies, infrastructure, or equipment) to perform a test to send a specimen to another laboratory that can carry out the requested test. Often, basic point-of-care tests are available at the lower tiers of the laboratory network such as health centers, with more complex testing capacities available at the regional or central reference laboratory level.

At the beginning of the COVID-19 pandemic, most countries were expanding diagnostics and surveillance, but quickly discovered that there were few laboratories with the capacity to test for COVID-19. To respond effectively, specimen referral and transport systems needed to be expanded and optimized in the areas of highest transmission. The overall goal was to transport specimens to a testing laboratory within 72 hours of collection and under appropriate temperature conditions. The referral and transport systems enable the required tests to be performed and the results to be returned to clinicians, veterinarians, and public health officials. To function optimally, SRSs must have adequate geographic coverage, maintain specimen integrity, protect the safety of those transporting the specimens, and have adequate financial resources to ensure sustainability.

Since the start of the pandemic, IDDS has played a major role in response activities by contributing to the transport of more than 60,000 COVID-19 specimens in 7 countries.

IDDS COUNTRY EXPERIENCES

To establish a functional specimen referral network, IDDS facilitates action with government counterparts, key stakeholders, and other implementing partners to identify the high-burden regions of each country and identify opportunities to improve specimen collection, packaging, referral, transport, and intake for testing. IDDS country teams identify the best mechanism on which to build the SRS and to identify the regions where the project activities would have the most positive impact. Then, depending on the needs of each country, IDDS country teams train drivers and specimen collectors on biosafety protocols, provide essential supplies and reagents, monitor the successes and gaps of the SRS, and monitor the overall impact. During the initial COVID-19 response, IDDS was able to pivot its ongoing, existing technical assistance to emergency response, while still supporting the other core functions of the project. By establishing these outbreak response processes and systems, IDDS is helping to ensure that countries are prepared for future outbreaks. In addition, these systems have proven to be adaptable to respond to outbreaks of other infectious diseases, such as Ebola virus disease, plague, mpox, and Marburg virus disease.

IDDS worked closely with host country governments to identify their priority needs: increased testing capacity, procurement of laboratory and transport supplies, training on safe specimen collection and transport, and specimen transport and logistics. IDDS provided training and developed tools and job aids for quality specimen collection, preparation, and handling. Specifically, IDDS conducted specimen collection, packaging, and transport (SCPT) training in Indonesia, Mali, the Philippines, Senegal, Tanzania, and Thailand, and developed a job aid that was shared broadly across the laboratory network in Ethiopia. The training sessions, which reached 2,553 participants, greatly improved specimen transport in these countries by

increasing the total number of specimens collected, maintaining specimen integrity, and decreasing turnaround times.

For the countries that identified transport as a priority, IDDS coordinated with the respective governments to identify the places with the greatest need for specimen transport support. In some countries, IDDS contracted courier services or recruited local health staff and rented vehicles to transport specimens from collection facilities to designated laboratories. IDDS developed and implemented standardized transport logs in all countries that conducted specimen transport. These logs documented the locations and times of specimen collection and drop-off at the testing facility.

Bangladesh

Bangladesh reported its first confirmed COVID-19 case in March 2020. With the influx of migrant workers and the gradual increase in positive COVID-19 cases, the Institute of Epidemiology, Disease Control and Research (IEDCR), the leading government entity for the response to COVID-19, found it difficult to expand specimen collection and transport due to limited surveillance sites and resources for PCR testing. IDDS supported IEDCR to expand its capacity for specimen collection and transport from hotspot areas in and around Dhaka, covering approximately 20 million people.

IDDS recruited and placed four medical technologists at IEDCR. Each day these medical technologists were given the names and contact details of patients suspected of having COVID-19 located in high-transmission communities in Dhaka. The medical technologists visited the patients, collected the required specimens, and transported the specimens to IEDCR. To facilitate this effort, IDDS rented four vehicles and hired four drivers to support specimen transport from April through September 2020.



Specimen transfer technician, Bangladesh. Photo by IDDS

Cameroon

The country experienced a rapid spread of COVID-19 across its 10 regions after the identification of the first case in March 2020, with most of the cases reported from the Central and Littoral regions. Because of the growing number of reported cases, the government launched a risk management activity at the community level to help identify suspected cases of COVID-19 for testing. Initially, specimens from suspected COVID-19 cases were tested only in Yaoundé at the Centre Pasteur. To address the increasing need for testing, the government began to decentralize the COVID-19 response and operationalize new testing laboratories in each region. With this new strategy, there was an urgent need to establish transport services to and from these newly designated regional facilities. IDDS collaborated with the government to identify priority regions to support procurement of laboratory supplies, training on safe specimen collection, and specimen transport. IDDS



Specimen transfer boxes, Philippines. Photo by IDDS

IDDS held 16 training sessions for 299 laboratory personnel from April to June 2020. Training objectives included developing skills in safe COVID-19 specimen collection, storage, packaging, and transport from collection sites to testing sites.

arranged for couriers to transport specimens in the Far North (Maroua), Central (Yaoundé), and Adamawa regions, which include 69 districts. With reports of concern about the integrity of specimens being transported from lower health centers to the district level, IDDS procured thermometers and trained the courier company’s staff to properly use thermometers to monitor temperatures to retain the quality of specimens. IDDS implemented specimen transport from June through September 2020.

Indonesia

Indonesia announced the first confirmed cases of COVID-19 on March 2, 2020, and the first possible community transmission on March 9, 2020. Initially, the National Institute of Health Research and Development was the only COVID-19 testing site. However, by the end of March 2020, 45 additional laboratories were assigned to conduct COVID-19 PCR testing, with results released by the National Institute of Health Research and Development to ensure validity and quality. By engaging a courier company, IDDS supported the transport of specimens from district-level hospitals and health centers (across 11 districts) to the provincial reference laboratory in South Sulawesi province. IDDS supported this process from September through December 2020.



COVID-19 testing training, Cameroon. Photo by IDDS



COVID-19 external quality monitoring panel, Indonesia. Photo by IDDS

Mali

As the outbreak was quickly spreading after the identification of the first case on March 25, 2020, the Ministry of Health and Social Affairs established a national committee, led by the director of the National Institute of Public Health, to coordinate the implementation of COVID-19 response activities. The only four laboratories in Mali with the capacity to perform COVID-19 testing were all located in the capital, Bamako. Through the Regional Health Directorate, the government supported the transport of specimens from the regions to the testing laboratories in Bamako. The specimen transport mechanism, although functional in some regions, required additional support to ensure that all regions were covered. IDDS contracted three rental vehicles to transport specimens from Kayes, Koulikoro, and Bamako to the testing laboratories in Bamako. This process was supported by IDDS from May 2020 through December 2020. IDDS also developed a guide for drivers on specimen handling and management during transport. Finally, IDDS developed and implemented a commodity tracking system to monitor the supplies used for transport, such as triple packaging materials and transport media.

Senegal

Senegal reported its first confirmed case in March 2020. Given the increasing number of COVID-19 cases, there was an urgent need to increase specimen transport to the limited number of testing laboratories, because the required capacity (e.g., trained staff, required supplies and consumables) was lacking. During stakeholder meetings, the Ministry of Health and Social Action determined that the highest priority was to support increased specimen collection and transport in the Dakar region. IDDS contracted a courier service that retrieved specimens from facilities across 12 health districts and transported them to the Pasteur

Institute for testing. IDDS used standard transport logs that health district staff completed, and the courier signed off to verify the number of specimens transported. The information on the logs was then checked against the number of specimens received from the testing laboratory. IDDS conducted specimen transport from June through September 2020.



Cooler boxes for specimen transfer, Senegal. Photo by IDDS



Specimen transfer vehicles, Mali. Photo by IDDS

The Philippines

The first confirmed case of COVID-19 was documented on January 30, 2020. Prior to IDDS support, there were no dedicated health care workers or modes of transport in Mindanao to move specimens from the collection facilities to the Southern Philippines Medical Center, the only laboratory in Mindanao with rRT-PCR capacity for COVID-19 testing. The health care workers were not trained on specimen collection and packaging, and transport took place in any vehicle that was available (e.g., ambulance or government car), which posed a high risk of contamination and infection due to a lack of quality control standards.



With emergency response funding, IDDS implemented specimen transport from May 2020 through September 2021 across the Mindanao, Mimaropa, and Bicol regions (and the project continues to support specimen transport with funds from the American Rescue Plan). Mindanao was the priority region from May to December 2020 and Mimaropa and Bicol regions were prioritized from March to September 2021, based on regional needs and a local surge in COVID-19 cases. IDDS rented vehicles and hired field coordinators who were responsible for collecting specimens from facilities and transporting them to the regional laboratories for testing. IDDS supported the transport of nearly 15,000 specimens in fiscal year 2020 and held 11 specimen collection and transport training sessions, reaching 271 health care personnel. IDDS also introduced a model to speed up transport by using relay vehicles at checkpoints, which significantly reduced specimen transfer time in the Mindanao region, despite civil unrest. As a result, transport time in North Cotabato decreased from 2 or 3 days to an average of slightly more than 1 day, and in Davao City from 1 day to only 30 minutes. In addition, the Government of the Philippines requested that IDDS support specimen transport for genome sequencing. The specimens were collected at sites where IDDS already supported specimen transport to the Philippines Genome Center in Manila. As a

Site	# of Specimens Transported*	Baseline Transportation Time	Average Transportation Time after IDDS
Davao City	5,265	1 day	30 min
Davao del Norte	2,074	1 day	2h 3 min
Davao del Sur	1,388	1 day	2h 27 min
Lanao del Sur**	453	NA	17h 43 min
North Cotabato	522	2-3 days	25h 31 min
TOTAL	9,702		

*data as of August 25, 2020

**No existing specimen transport prior to IDDS; Lanao del Sur referred patients to Amal Pakpak Medical Center

result, from April to September 2021, IDDS supported the transport of 2,353 specimens for genome sequencing.

RESULTS

U.S. Centers for Disease Control and Prevention (CDC) guidelines recommend that specimens should be collected and transported to a testing laboratory within 72 hours. For specimens handled by IDDS, the project measured this referral time as being from the time the call to collect the specimen was received to the time it was delivered to the testing location. Table 1 outlines the results of the SRS by country from inception through the end of the first quarter of fiscal year 2021 (December 31, 2020).

Table 1. Number of specimens collected and transported as of December 31, 2020, by country

Country	Implementation period	Specimens collected and transported	Specimens collected and transported ≤72 hours	Specimens collected and transported >72 hours	Specimens collected and transported – no TAT reported
Bangladesh	6 months	4,341	4,250 (98%)	0	91 (2.1%)
Cameroon	4 months	753	753 (100%)	0	0
Ethiopia	3 months	13,313	13,313 (100%)	0	0
Indonesia	4 months	4,434	4,434 (100%)	0	0
Mali	8 months	12,947	12,947 (100%)	0	0
Philippines	17 months	29,333	29,247 (99.7%)	86 (0.3%)	0
Senegal	4 months	4,063	4,063 (100%)	0	0
TOTAL		69,184	69,007 (99.7%)	86 (0.1%)	91 (0.1%)

Of the 69,184 specimens collected and/or transported, the project achieved 99.7 percent compliance with CDC guidelines. In the Philippines, less than 1 percent of specimens were not transported within the CDC-recommended timeframes. In these instances, laboratory supply shortages at the closest primary testing laboratory meant that specimens had to be transported to a different laboratory that was further away, which increased transport time. In Bangladesh, the first batch of specimens to be transported contributed to approximately 2 percent of the specimens with no turnaround time data recorded at a time when processes were still being established.

In addition, IDDS provided training on proper specimen collection, packaging, and transport to laboratory staff in several other countries, which are listed in Table 2.

Table 2: Specimen Collection, Packaging, and Transport (SCPT) training

Country	SCPT training sessions	SCPT participants
Cameroon	16	299
Indonesia	1	32
Kenya	22	391
Mali	6	81
Philippines	27	1,248
Senegal	4	131
Tanzania	11	280
Thailand	2	91
TOTAL	89	2,553

CHALLENGES AND SOLUTIONS

Challenges

Each country experienced similar challenges, including:

Workforce

- Due to competing priorities, government staff availability was limited, which often delayed the finalization of processes or documents, such as standard operating procedures, guidelines, or contracts with couriers.
- Limited training opportunities for laboratory technicians and couriers was a challenge.
- Staff shortages were experienced across several programs due to staff resignations or exposure to COVID-19.

Systems and infrastructure

- Countries were unable to decentralize testing capacity and had to rely on specimen transport systems. However, the process and physical infrastructure to undertake specimen transport were not in place.
- Unprepared and strained health care infrastructure coupled with a rapidly evolving pandemic required quick decision-making to adjust strategies to accommodate unanticipated problems, gaps, and evolving needs.
- Weakened supply chain and mobility restrictions for commodity transport due to insufficient in-country transport systems contributed to activity implementation challenges.
- Lack of locally available laboratory supplies and consumables, such as testing kits and essential reagents, resulted in reliance on international procurement, involving strict customs clearance protocols and delayed entry of commodities into recipient countries.
- Ongoing security concerns or history of conflict in certain geographies (including conflict targeting relief distributions) required changes to priority activities and approaches to distribution.

Specimen transport and testing

- The quality and integrity of specimens being transported from peripheral health centers to the district level was inconsistent due to lack of temperature control, an insufficient number of trained couriers, and other factors.
- Remoteness of areas served and distance between locations, as well as local and national travel restrictions, hindered speed and ease of specimen transport.
- In some instances, the government imposed a COVID-19 testing fee at public laboratories to reduce the number of unnecessary tests, which deterred people from seeking out testing and contributed to a decrease in the number of specimens tested.
- During an influx of national and international response efforts, IDDS experienced coordination challenges, because partners were not able to streamline their activities and funds, causing significant delays.

Solutions

Though challenges are inevitable during emergency outbreak response work, each country found local solutions and was able to overcome initial challenges. Some observations and recommendations to improve the specimen transport pathway include:

- Establishing and maintaining strong relationships and effective communication with government stakeholders, development partners, multilateral organizations like the World Health Organization and the Food and Agriculture Organization of the United Nations is critical to success.



- Ensure access to critical supplies and equipment to maintain the quality and integrity of specimens collected.
- Strategic coordination across multiple partner organizations and establishment of a COVID-19 point of contact would minimize duplication of efforts and identify synergies across technical assistance activities. (A COVID-19 point of contact may reside within the country's emergency operations center, ministry of health/International Health Regulations focal point, or within the executive branch.)
- Establishment of continuous follow-up with government officials to gather sufficient documentation for customs clearance of commodities supports the delivery of essential supplies and other procurement.
- Maintaining flexibility and adjusting strategic approaches will accommodate unanticipated problems, gaps, and evolving needs on the ground.
- Developing stronger business relationships with regional vendors contributes to accelerated procurement of goods within the region or internationally.

CONCLUSION

Strong specimen referral networks are essential for public health and foundational to health systems. They enable clinicians to quickly deliver accurate diagnoses and empower governments and other decisionmakers with the information they need to issue policies to contain local outbreaks before they become global pandemics. IDDS played a major role in responding to one of the most pressing public health challenges seen in recent decades, by contributing to the transport of more than 60,000 COVID-19 specimens in 7 countries. In addition, the project developed a training package for the safe and secure collection and transport of COVID-19 specimens and conducted 89 training sessions for 2,553 people. With the project's support, nearly all specimens were transported to the testing sites in 72 hours or less. Applying best practices for specimen collection, packaging, and transport helps to minimize pre-analytical errors (those that occur before testing at the laboratory) and leads to better decisions in patient diagnosis and treatment—with lessons learned that will outlast the COVID-19 pandemic and inform future public health responses.