

In Mozambique, Meeting New Demands for PPE, Vaccines, Oxygen, and an Emergency Supply Chain Response



A temperature monitor for COVID-19 vaccines. Photo by Mickael Breard.

In Mozambique, the USAID Global Health Supply Chain Program-Procurement and Supply Management (GHSC-PSM) project provides technical and operational assistance to the Ministry of Health (MOH), Central Medical Stores (CMAM), the National Directorate of Medical Services, Central Laboratory Department, and provincial warehouses to manage the country's supply chain.

GHSC-PSM has been conscientious in establishing a strong footprint in the country, including having Mozambican staff embedded in the national system. However, its ability to react quickly in crisis was tested with the March 2021 outbreak of COVID-19.

Responding to COVID-19

To respond to COVID-19, the project primarily focused on four support activities: providing and distributing large quantities of personal protective equipment (PPE), supporting distribution of COVID-19 vaccines, procuring oxygen equipment to meet new and urgent demands for COVID-19 oxygen therapies, and developing a standardized guide to help maintain the commodity supply chain during health emergencies,

“We always had close involvement with the government here, working on systems strengthening for logistics since about 2015. When you already have a solid presence, you can have a big impact with fewer people. So, we were already well-positioned to attack the challenge.”

—Jan de Jong, Senior Logistics Advisor

Distributing Personal Protective Equipment

GHSC-PSM typically procures PPE and other consumables, but the pandemic required much more volume for healthcare workers and people working within the supply chain to help prevent them from falling ill.

Chief among the challenges of this new influx of commodities was the arrival of products and brands that had never existed in the country. Often, the same products had different names based on their origin, but donors required the stock they provide to be followed through the system and stored separately based on their donor source. As a priority, coding for these commodities needed to be harmonized.

Another challenge was that responsibility for the supply chain management of PPE was transferred to CMAM. This caused confusion, especially at the lower levels in the supply chain, because the logistic staff in



Supportive supervision for PPE in Mocuba District. Photo by Jan de Jong.

“When I first came to Mozambique, it was very evident that supply chain and health partners were working well together. People really stepped up in Mozambique during the COVID-19 pandemic, including GHSC-PSM, USAID, the Ministry and other partners.”

—Helen Pataki, USAID Mission Director for Mozambique

the provincial and district warehouses and hospital pharmacies were not aware of this change.

GHSC-PSM helped integrate COVID-19 commodities management into CMAM's supply chain. The warehouse management system (WMS) and electronic logistics management information system were adapted to provide visibility to donated commodities, while GHSC-PSM supported CMAM to develop, produce, and disseminate performance indicator reports on the COVID-19 commodities supply chain, including:

- ✓ Extracting and aggregating weekly stock-on-hand data
- ✓ Recording quantity received and distributed at the provincial level
- ✓ Coding COVID-19 commodities in existing systems
- ✓ Providing training on standard operating procedures
- ✓ Coordinating routine ordering, distribution planning, inventory, and outsourced transportation of PPE at national and provincial levels
- ✓ Developing a PPE pipeline database
- ✓ Participating in supervision visits throughout the country to make sure staff was aware of the new responsibilities and procedures

GHSC-PSM hired COVID-19 advisors who provided technical assistance to warehouse and clinical staff in the management of COVID-19 products for distribution at provincial levels and provided supervision at local levels. Taking a grassroots approach, the team established connections with 1,700 health facilities via site visits, phone or Whatsapp.

They also implemented e-supervision guidelines to continue providing uninterrupted technical assistance to provinces, districts, and health facilities. The project utilized reports produced by SIGLUS—an open-source electronic logistics management information system—which enabled provincial logistics advisors and intermediate warehouse advisors to remotely pinpoint facilities with supply risks as well as monitor overall provincial and district level trends to ensure commodity security and availability.



Lesson Learned: PPE

Preparedness is key. In the case of Mozambique, the systems and MOH staff were unprepared to receive and manage PPE products. Responsibilities were not well defined and the products did not exist in the country's LMIS. This initially caused overflowing warehouses at the central level and shortages at lower-level health facilities when they were most needed. In response to these challenges the MOH decided to integrate PPE into existing (supply chain and information) systems rather than creating new systems. They accomplished this by creating new codes and developing PPE-specific supervision guides/visits and supply chain SOPs.

“There are still ways to improve the system, but PPE availability has improved enormously. Everyone involved has been learning as we go, and these lessons will continue to pay off.” —Jan de Jong



Manual unloading of COVID-19 vaccines. Photo by Anselmo Sataka.



Packing vaccines for distribution. Photo by Bento Mahoque.



Receiving cold boxes for vaccine transport. Photo by Bento Mahoque.

Supporting Vaccine Distribution

GHSC-PSM provides technical and logistics support to CMAM on procurement, storage, transportation, and distribution of health commodities for HIV and malaria testing and treatment. During the COVID-19 pandemic, USAID allocated emergency transport funds to ease and increase distribution of COVID-19 vaccines from the central warehouse in Zimpeto to provincial medical stores. As part of this emergency relief, GHSC-PSM supports the Enlarge Program for Immunization (EPI/PAV) with transportation of COVID-19 vaccines in coordination with UNICEF.

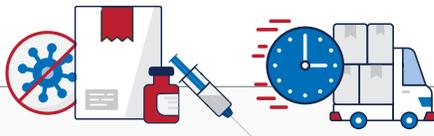
As a first step, in cooperation with EPI/PAV, the project evaluated the potential need for passive cold chain equipment (cold boxes and vaccine carriers), temperature monitors, and packaging necessary to transport the vaccines and related equipment (computers, printers, etc.) to reinforce MOH's capacity to manage vaccine logistics.

Based on the assessment, the project procured 100 high-capacity, 20-liter cold boxes, 600 temperature monitors, and 200 computers and peripherals for the various levels of the supply chain.

With these new assets, GHSC-PSM supported the transport of more than 1.7 million doses of Pfizer and 144,000 doses of Janssen/Johnson & Johnson COVID-19 vaccines. The MOH chose to centralize the ultra-cold chain at Maputo central warehouse, and all vaccines were transported under a controlled temperature of between 2-8 Celsius degrees.

In addition, the project supported the transport of more than 7.4 million syringes. The transport included reverse logistics of passive cold chain equipment from the provincial to central level.

The first phase of the Pfizer vaccination campaign, which was focused on children, was a success, with 80 percent of children between ages 12 and 17 receiving a dose. Today, the GHSC-PSM transportation team is continuing to provide support to the MOH toward transportation of the Pfizer vaccine to allow implementation of the second phase of the vaccination campaign.



Lesson Learned: Vaccines

Most of the learnings came from issues with logistics management and transport of the vaccines.

It's important to assess the potential needs for passive or active cold chain equipment (cold boxes, temperature log taggers, ice packs, etc.) and confirm with MOH that all or at least some cold boxes are equipped with temperature monitoring devices.

In addition, subcontracting should take into account the potential need for reverse logistics of the cold chain passive equipment. The subcontracting mechanism for transport should be as simple and flexible as possible to allow last-minute changes.



An oxygen concentrator.
Photo by Jan de Jong.



This oxygen receiver stores oxygen produced by the oxygen generator at Monapo District Hospital. Photo by Jan de Jong.



Delivery of an oxygen concentrator and spare parts for maintenance and repair. Photo by Jan de Jong.



Preventive maintenance training for oxygen concentrators.
Photo by Jan de Jong.

Meeting New Demands for Medical Oxygen

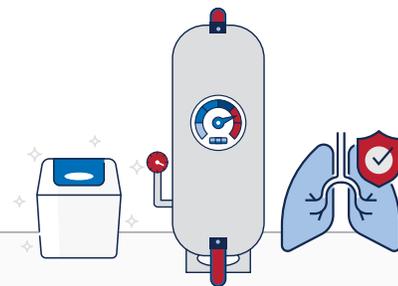
As a primarily respiratory disease, COVID-19 triggered an unprecedented demand for oxygen-related supply chain activities. In countries like Mozambique, with a younger population and relatively little existing demand for oxygen therapy, the MOH had few strategies in place for meeting the new requirements.

The MOH needed to respond quickly to develop new systems around oxygen delivery to healthcare sites and the capacity to maintain the equipment. Prior to COVID-19, the standard for supplying medical oxygen was procuring gas in cylinders from the private sector. However, this method is costly and depends heavily on outside parties. Mozambique needed ways to produce its own oxygen on demand.

To improve access to oxygen treatment, GHSC-PSM arranged the delivery of 15 portable oxygen concentrators—machines that pull in air from the environment, filter out the nitrogen, and deliver purified oxygen to the body through nasal cannula or face mask—as well as technical assistance. Fifteen low-flow concentrators were procured and handed over, in an official ceremony, to the Provincial Health Department officials in Nampula province.

To ensure the longevity and uninterrupted use of the equipment, GHSC-PSM developed training for MOH maintenance staff. The provincial head of maintenance for hospital equipment, several technicians and clinical staff received hands-on instruction on how to perform preventative maintenance so the equipment will always perform as intended.

To verify the effectiveness of the interventions and training, the project conducted an assessment and refresher training for 12 of the concentrators. They learned that although some hospitals had taken good care of the equipment, others did not perform a single cleaning or change of filters. The project is currently working with the MOH to develop a multi-year strategic oxygen equipment maintenance, training and sustainability plan. This will be the starting point for practical activities geared to improving the lifespan and availability of hospital equipment, saving lives in the process.



Lesson Learned: Oxygen

Before procuring and installing O2 equipment (liquid O2 tanks, O2 cylinders, PSAs, and concentrators) a proper site assessment needs to be carried out to establish the capacity of the staff, physical readiness, and, most importantly O2 usage of the health facility. With this information, the appropriate technology, equipment capacity, and training needs can be determined before making the decision on what to install. This would avoid the consequence of mismatched situations with limited sustainability.

GHSC-PSM also procured 1,100 additional liquid oxygen cylinders, including accessories like spanners and transport carts, allocating 100 cylinders for each provincial hospital. GHSC-PSM supported direct-drop delivery to the hospitals instead of using CMAM warehouses, so handling these heavy items can be limited to one-time unpacking and offloading.

Another cost effective and efficient method for delivering oxygen to hospitals and patients is pressure swing adsorption (PSA) technology—where an onsite plant is installed to deliver an uninterrupted supply of oxygen to fill cylinders or even pipe oxygen directly to the patient’s bedside.

Monapo Hospital, in a relatively remote location—130 km from the provincial capital Nampula and 2,000 km from Maputo—was selected for the PSA site. At the time, the hospital’s oxygen equipment was in poor condition and unmaintained. A new PSA plant could produce 30 cylinders of oxygen a week for the hospital as well as surrounding health facilities, improving efficiencies and producing considerable cost savings.

Over the course of just nine months, GHSC-PSM and its partners procured the PSA equipment for delivery to the MOH in December 2021. By March, with site preparation almost complete, the team trained non-clinical maintenance staff to operate and sustain the plant. In April 2022, in a high-profile public ceremony, USAID Deputy Mission Director Martin McLaughlin officially handed over the plant to Griso Lubino, Mozambique’s Permanent Secretary for Health.

“This new oxygen plant is a physical symbol of what the U.S. and Mozambican partnership can build together. We have invested more than \$94 million in COVID assistance nationwide, including here in Nampula, to build the capacity of health workers and strengthen the health system.”

—McLaughlin, Handover Ceremony

The plant at Monapo has the capacity to produce enough medical oxygen to simultaneously treat 25 severe COVID-19 patients and to meet the medical needs of up to 150 patients, such as treating childhood pneumonia, safe births, basic surgeries and beyond.

Among the lessons learned for GHSC-PSM was the need to perform a feasibility study before deciding on the location and type of equipment/technology, including considering other sources of oxygen, like local suppliers and liquid oxygen instead of gas.

To ensure the investment continues to pay off, the team created a sustainability plan, which included:

- ✓ **A two-year outsourced maintenance contract**
- ✓ **A plan to use the plant’s over-capacity to provide oxygen to neighboring health facilities to maximize cost efficiencies**
- ✓ **Ongoing advocacy to include operational costs in government/MOH budgets**
- ✓ **Refresher training after 6-12 months of use and a potential national training program in oxygen equipment**
- ✓ **Creation of a MOH maintenance program for equipment and a maintenance dashboard to streamline maintenance and repair requests and management of third-party providers**

Today, this district hospital and more than a dozen nearby health centers in several districts have access to oxygen so they can treat patients who otherwise would have been compromised.

“Sustainability is key,” said de Jong. “This plant, and others like it, can only be viable compared to other technologies if it is used and maintained over its 20-year expected lifespan and operates at sufficient capacity.” In addition, he said, “We need to ensure that we have maintenance funding starting at year three, and the government has funds available for operational costs like electricity, as well as for trained staff.”

The support GHSC-PSM provided for oxygen “is not a one-off contribution, but now and in the future will help people in need of oxygen,” said Monique Mosolf, USAID’s Integrated Health Team Lead in Mozambique.



Mariam Umarji facilitating the emergency supply chain simulation exercise. Photo by Jan de Jong.



Participants in the emergency supply chain simulation exercise. Photo by Jan de Jong.



Julie Boccanera from USAID and Almiro Tivane from the National Health Institute at the emergency supply chain closing meeting. Photo by Jan de Jong.

Emergency Supply Chain (ESC) Unit and Manual

The pandemic exposed a clear need for an emergency supply chain response guide that could be shared with stakeholders across the country. Such manuals prepare a country's health supply chain to respond more efficiently to a health emergency by:

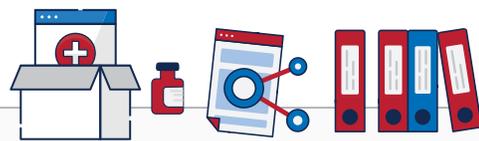
- ✓ Clarifying the governance structure in case of an outbreak or pandemic
- ✓ Providing tools and clear instructions (SOPs) on how to manage medicines and medical materials needed
- ✓ Preparing a database with information on transport and warehousing capacity in the country
- ✓ Making sure the right products are in the country and reach the people affected by the disease when needed

The planned manual was also intended to fulfill the objectives of the [Global Health Security Agenda](#)—a group of more than 70 countries, international organizations, non-governmental organizations, and private-sector companies that promotes a coherent preparedness response to global health threats posed by infectious diseases.

GHSC-PSM had initially planned to contract with a third-party consulting firm to adapt an existing emergency supply chain guide, but ultimately determined that for better sustainability, the project would work with a mix of local, national and international consultants based in Mozambique. Leveraging local expertise can help ensure the document will continue to evolve as the local situation changes.

Faced with a short timeframe and a global health landscape crowded with other government priorities, GHSC-PSM quickly recruited people and embarked on a five-month exercise to develop the content. The exercise culminated with a two-day simulation exercise led by GHSC-PSM, with the active involvement of key staff from the National Institute of Health (INS), MOH, Ministry of Agriculture and Rural Development, the Red Cross of Mozambique, the National Institute of Disaster Management, and other partners.

Developing the manual came with challenges and lessons learned.



Lesson Learned: Emergency Supply Chain Unit and Manual

During GHSC-PSM's work on the ESC, clarity was needed on where the ESC Unit will be located. This required high-level, political buy-in in addition to the technical work that was happening. Only after responsibilities were clearly defined was it useful to develop manuals and standard operating procedures, perform simulation exercises, and work on further rollout of the ESC training modules to the provinces.

First, many competing priorities at Mozambique's highest level of government meant that decisions were difficult to make—including agreeing on a governmental structure for managing outbreaks. GHSC-PSM learned that instead of trying to develop content with high-level officials in a workshop setting, the project got better results by developing a stakeholders' analyses and governance proposals, then approaching officials one-on-one for interviews and presenting a complete proposal to the group.

By the same token, not knowing where the ESC unit would be located within the Mozambican government structure made it difficult to develop the manual and clarify the governance structure. To get high-level involvement from government officials, there needs to be a clear direct benefit for the institution/staff involved. The ESC activity no longer being an “orphan” would facilitate the creation of higher-level awareness and interest needed to institutionalize the ESC. To ensure sustainability, the ESC working group will be a sub-group of the Grupo Temático da Cadeia de Abastecimento e Logística (GTCAL or Supply Chain Working group), which is chaired by CMAM.

The first version of the manual based on an existing tool was not practical enough and needed to be adapted completely to reflect the Mozambican context.

Finally, the team discovered that the technical team needed additional skills to advance the governance structure discussion. Understanding the legal environment especially is key to making any advances in the institutionalization of the ESC Unit and Manual.

The impact of the future unit and manual goes beyond its use on the ground, said de Jong. “What we've done is create an awareness that you need to have an established plan and a clear governance structure to respond effectively to sanitary emergencies.”

“It is an instrument that came to serve not the INS, not the Ministry of Health, not the Ministry of Agriculture, but everyone.”

—Almiro Tivane, Co-coordinator of One Health Platform