

Coordinated response to Cyclone Idai in Mozambique provides model for supply chain emergency response

October 2019



Contract No. AID-OAA-I-15-00004, Task Order No. AID-OAA-TO-15-00007; AID-OAA-TO-15-00009; AID-OAA-TO-15-00010; AID-OAA-TO-15-00018

The USAID Global Health Supply Chain Program-Procurement and Supply Management (GHSC-PSM) project is funded under USAID Contract No. AID-OAA-I-15-0004. GHSC-PSM connects technical solutions and proven commercial processes to promote efficient and cost-effective health supply chains worldwide. Our goal is to ensure uninterrupted supplies of health commodities to save lives and create a healthier future for all. The project purchases and delivers health commodities, offers comprehensive technical assistance to strengthen national supply chain systems, and provides global supply chain leadership.

GHSC-PSM is implemented by Chemonics International, in collaboration with Arbola Inc., Axios International Inc., IDA Foundation, IBM, IntraHealth International, Kuehne + Nagel Inc., McKinsey & Company, Panagora Group, Population Services International, SGS Nederland B.V., and University Research Co., LLC. To learn more, visit ghsupplychain.org

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Acknowledgements

The author acknowledges the support given by the Mozambican Ministry of Health (MISAU) and Central Medical Store (CMAM) for this natural disaster preparedness and lessons learned report.

Special appreciation is given to the Beira Regional Warehouse Manager, Dr. Nelson Candido, and his team. Despite personal material and immaterial losses caused by Cyclone Idai, they all put in an enormous effort to respond to the crisis, and to regularize and re-establish operations of the Beira regional warehouses.

The author also wants to thank the GHSC-PSM US and Mozambique office for the administrative and technical support provided during preparation and implementation of this assessment.

Acronyms

3PL	third-party logistics
AEM	Emergency Medical Store (Armazém de Emergência de Medicamentos)
APR	adjustable pallet racking
ARVs	antiretrovirals
CA	Supply Center for Medical Materials and Equipment (Centro de Abastecimento)
CMAM	Central Medical Store for Mozambique (Central de Medicamentos e Artigos Médicos)
DPM	Provincial Medical Store (Depósito Provincial de Medicamentos)
DPS	Provincial Health Directorate (Departamento Provincial de Saúde)
ESC	emergency supply chain
FNM	Drug National Formulary (Formulário Nacional dos Medicamentos)
GF	Global Fund to Fight AIDS, Malaria and TB
GHSC-PSM	USAID Global Health Supply Chain Program-Procurement and Supply Management
GOM	Government of Mozambique
GWP	good warehousing practice
H&S	health and safety
HIV	human immunodeficiency virus
HR	human resources
INGC	National Institute for Disaster Management (Instituto Nacional de Gestão das Calamidades)
IQC	indefinite quantity contract
INGC	National Institute for Disaster Management (Instituto Nacional de Gestão de Calamidades)
KPI	key performance indicator
LLIN	long-lasting insecticidal net
LMIS	logistics management information system
MHE	material handling equipment
MISAU	Ministry of Health (Ministério de Saúde)
NEML	national essential medicines list
NGO	non-governmental organization
POD	proof of delivery
PPE	personal protective equipment
RDT	rapid diagnostic test
RF	radio frequency
RW	regional warehouse

SCM	supply chain management
SITREP	situation report
SKU	stock-keeping unit
SOP	standard operating procedure
SUMA/LSS	humanitarian supply chain management system
TA	technical assistance
UPS	uninterruptible power supply
USAID	United States Agency for International Development
WHO	World Health Organization
WMS	warehouse management system

Executive summary

Global health supply chains are complex operations that involve multiple entities and moving parts, requiring specific expertise in procurement, logistics, and storage to keep the supply chain operating efficiently — and, most importantly, to ensure an uninterrupted supply of medicines and medical supplies to the people who need them.

In relatively normal circumstances, any number of factors can pose a challenge to the smooth, timely operation of a global health supply chain. But an adverse event, such as a natural disaster, often poses critical challenges to the public health supply chain that must be overcome quickly to ensure no interruption of treatment for patients.

In the case of a natural disaster, damaged storage infrastructure and the displacement of supply chain staff can overwhelm local and national entities aiming to restore service and respond to the disaster. Restoring commodity pipelines, supply routes, and infrastructure as quickly as possible is essential, as is replacing damaged commodities and equipment and providing staff for the emergency response.

Additionally, the typical influx of international aid after a natural disaster can be both a blessing and a curse. Donations often include supplies that are not useful, such as expired medicines and commodities that are inappropriate for emergency response or to the local context. Emergency responders often struggle to process the donations pouring in from local and international donors. A lack of coordination among the government, donors, and relief organizations can result in duplication of efforts and ineffective allocation of resources.

In Mozambique, however, the response to Cyclone Idai — which occurred in March 2019 — largely avoided many of the most significant challenges that can hinder a public health supply chain's response to natural disasters.

This report outlines lessons learned related to getting the supply chain functioning quickly after this adverse event in Mozambique, and provides a practical, comprehensive strategy and roadmap that the Government of Mozambique and other countries and organizations can use to prepare for and respond to natural disasters that cause damage and loss in the supply chain.

Background

On March 14, 2019, Cyclone Idai made landfall near the port city of Beira, Mozambique, with winds up to 177 kilometers per hour. The severe storm caused flooded roads and highways, impassable bridges, landslides, and mudslides, in addition to significant structural damage to warehouses and buildings managed by the country's Central Medical Store (Central de Medicamentos e Artigos Médicos, or CMAM), with the USAID Global Health Supply Chain Program-Procurement and Supply Management (GHSC-PSM) project's support.

CMAM is the Mozambique Ministry of Health's subordinated institution responsible for the procurement, importation, warehousing, and distribution of medicines used by the country's public health system. CMAM manages three regional warehouses locations in Nampula (north), Beira (center), and Maputo (south).

Immediate challenges

In the immediate aftermath of the cyclone, CMAM faced significant initial hurdles. Most staff were personally affected by the cyclone and worried for their relatives living in remote areas. Telecommunication was not operational for days. Electricity from the public source was cut for weeks, and some back-up energy sources (generators) needed to be repaired urgently.

In the week following the cyclone, Beira experienced a shortage of fuel critical for transportation and generators, creating long lines and long waits for supply. The road network was damaged; Sofala province could not be accessed by road during the first two weeks.

A field support assessment received by CMAM five days after the cyclone reported that affected infrastructure in the Beira region included the Pioneiros medicines regional warehouse, Munhava medicines regional warehouse, Beira long-lasting insecticidal net (LLIN) warehouse, and Manga-Sofala provincial store.

The damaged warehouses meant that not much space was available to save the commodities that could be salvaged. Salvaging commodities was challenging too; at the Munhava regional warehouse, for example, two-thirds of the roof had collapsed onto storage racks, limiting access to salvageable commodities that could be transferred from Munhava to the less affected Pioneiros regional warehouse.

Additionally, most of the material handling equipment, such as forklifts and pallet stackers, were not operational and needed to be repaired.

The coordinated response to Cyclone Idai, by the numbers

- **14 percent** of the impacted area's health structures were lost.
- **14 countries and 24 organizations** donated commodities to support emergency response.
- **2 Rubb Hall tents** served as a temporary emergency warehouse.
- **1 warehouse management system** was employed to track stock on hand, donations received, and emergency supplies distributed.
- **706 different medicines** were donated.
- **1,351 pallets** of commodities were donated.
- The equivalent of **400 pallets of expired and damaged IV fluid** were identified for disposal.
- **75 additional workers** were mobilized to support supply chain response.

Finally, accessing emergency funds and working around lengthy CMAM and GHSC-PSM administrative processes — designed for routine activities or for the development context — was challenging because of the critical need for responsiveness in the emergency context.

The emergency response

Following Cyclone Idai, CMAM, in cooperation with GHSC-PSM, went into emergency mode, developing and implementing a plan of action.

The emergency response — which continued through the final infrastructure repair in December 2019 — encompassed the following activities:

- Assessed warehouse damage and needs
- Mobilized and relocated additional staff in Beira
- Allocated emergency funding
- Established a separate emergency warehouse (large Rubb Hall tents provided by the World Food Programme) to manage donated medicines
- Implemented warehouse management software, established standard operating procedures, and provided staff to the emergency warehouse
- Evaluated commodity and material needs, including IT equipment needs
- Procured IT equipment to replace damaged hardware
- Transferred all medicines from the damaged Munhava regional warehouse to the Pioneiros regional warehouse and emergency warehouse
- Initiated and monitored repairs of the damaged regional warehouses' infrastructure
- Repaired all material handling equipment
- Re-established warehouse management systems and regularized stock data reporting
- Shared data on donations with key emergency stakeholders
- Recovered and repacked medicines affected by damaged boxes
- Performed a general inventory exercise before closing the emergency warehouse at the end of June 2019.

Continue reading for a detailed look at how the emergency plan of action was implemented, lessons learned for future emergency responses, and steps that can be taken in advance to prepare for a natural disaster or other emergency.

Restoring the supply chain for critical commodities after Cyclone Idai in Mozambique

With three regional warehouses in Beira sustaining significant damage from Cyclone Idai, the public health supply chain in Mozambique risked serious disruption. GHSC-PSM coordinated with the Central Medical Store, the Ministry of Health, and the World Food Program to conduct emergency response efforts that leveraged the project's expertise.

The emergency response effort encompassed six areas, detailed below:

1. Immediately assessed the damage

To inform the process of restoring service at the damaged warehouses, GHSC-PSM conducted an assessment immediately following the storm, in concert with the Ministry of Health. Using cameras mounted on drones to take video and photos, GHSC-PSM evaluated damage to warehouse roofs and the surrounding area and provided landlords with the information they needed to initiate repair efforts.

“GHSC-PSM was one of the very first responders to the cyclone and have been sending daily updates with commodity- and supply chain-related news and activities since the day after the storm ... It is their support that is helping to ensure some organization of the chaos that is ensuing with a massive influx of ... humanitarian donations.”

*Leah Hasselback
Senior Health Commodities Advisor
USAID/Mozambique*

2. Provided additional staffing and materials for emergency warehouse and to manage donations

To facilitate receipt of the high volume of incoming donations, the World Food Programme quickly erected two Rubb Halls (large tents) at the site of the damaged Pioneiros regional warehouse in Beira to serve as an emergency warehouse (Armazém de Emergência de Medicamentos, or AEM). To support the emergency warehouse, GHSC-PSM secured an average of 75 workers daily, in addition to reassigning existing staff, to receive, register, and organize commodities, and load and unload transport vehicles. These staff also made determinations about which commodities were salvageable from the damaged warehouses and which donated commodities were redundant or unusable; for example, they identified the equivalent of 400 pallets of expired and damaged IV fluid and marked them for disposal.

The regional warehouse of Matola/Maputo had a stock of cardboard boxes used for quarterly malaria kitting. Within 24 hours, the Matola/Maputo warehouse, some 745 miles and 16 hours away from Beira by car, sent these cartons to Beira to aid in commodity salvage and repackaging, subsequently replacing the boxes for the malaria program. A yearly IQC that GHSC-PSM puts in place to transport commodities among regional warehouses and provincial stores to optimize commodity use allowed for this fast response during the emergency.

GHSC-PSM's post-Idai response

1. **Immediately assessed the damage** (photography and video using drones)
2. **Hired emergency staff** (loading/unloading, assessing salvageable commodities) and **reassigned resources** from other warehouses (personnel and containers)
3. **Transferred salvaged commodities** to the emergency warehouse
4. **Reestablished IT services**, including warehouse management system, and restored stock reporting
5. **Clarified roles**, responsibilities, and processes
6. **Repaired** infrastructure

3. Transferred salvaged medical commodities

In addition, salvaged product from the significantly damaged Munhava regional warehouse in Beira was transferred to the emergency warehouse at Pioneiros. At the time the cyclone hit, the Munhava warehouse contained 900 pallets of medicines and medical/surgical materials. While water had damaged most of the products, the existing staff and new workers were able to save some 26 million Mozambican meticals (MZN) (\$405,000 USD) of commodities from Munhava.

4. Restored IT services and stock reporting

After the storm, the MACS warehouse management software at the damaged Pioneiros warehouse was still functional, but the server there was beyond repair. However, at Munhava, the server remained functional. As a result, CMAM and GHSC-PSM transferred Munhava's server to Pioneiros and implemented Pioneiros's MACS software to conduct supply chain reporting for all of Beira's remaining operational regional warehouses and emergency warehouse.

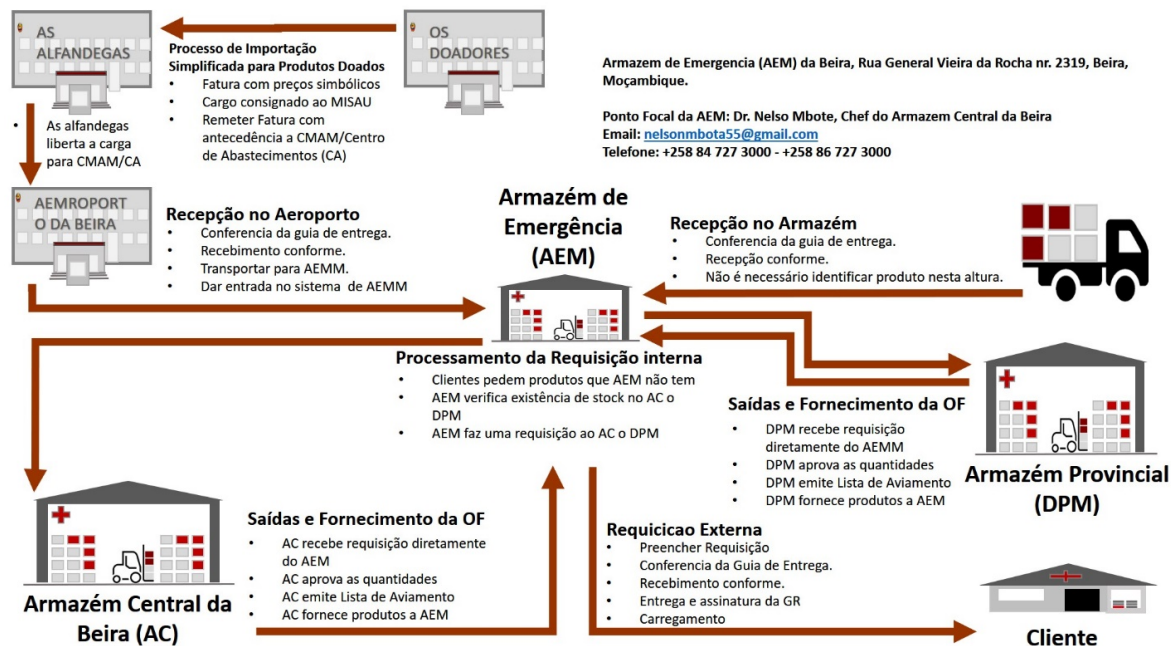
Using saved or undamaged equipment and computers from Munhava that were transferred to Pioneiros and the emergency warehouse, staff accounted for incoming supplies and generated stock on hand, received goods, and distributed goods reports on a daily basis. These reports were shared with Provincial Health Directorate (DPS) and the U.N. Office for the Coordination of Humanitarian Affairs at the end of each week to keep the office informed on recovery efforts.

5. Clarified roles, responsibilities, and processes


In the first month of the recovery, GHSC-PSM sent MACS specialists, additional warehouse personnel, and a driver from the Zimpeto warehouse near Maputo to assist in Beira. The project also dispatched an infrastructure advisor, a warehouse and transportation director, and a short-term team lead to conduct multiple visits to the area, alongside CMAM officials, to ensure that progress was being made and that the new warehouse was functioning efficiently. Together, GHSC-PSM and CMAM developed a process flowchart and commodity request form (see below and in Annexes H and I) for use at the emergency warehouse.

Total donations to CMAM

- Donations received from **14 countries**
- Donations received from **24 organizations**
- Donations contained **706 different medicines** and medical materials
- Donations could fill **1,351 pallets**, enough to fill 36 40-foot long containers.



Flowchart developed by CMAM with technical assistance from GHSC-PSM.

 REPUBLICA DE MOÇAMBIQUE MINISTERIO DA SAUDE CENTRAL DE MEDICAMENTOS E ARTIGOS MEDICOS		Armazem Emergência de Medicamentos (AEM) da BEIRA Pedido de Emergência/Emergency Request			
Fornecedor/Supplier: Armazem Emergência de Medicamentos (AEM)		Endereço/Address: Armazem Regional da Beira, Rua General Vieira da Rocha nr. 2319, Beira, Moçambique			
1) Beneficiário/Beneficiary:					
2) Numero de Requisição/Request #					
3) Data de Requisição/Request Date					
Item	4) Descrição do Produto/Product Description	5) Embalagem/Packsize	6) Quantidade de Embalagens/Quantity Packs	7) Total de Unidades pedido/Total Units Req.	8) Total de Unidades aprovado/Total Approved Units
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
9) Cliente/Client:		11) Nome do Gestor do Armazém/Name Warehouse Manager:			
10) Assinatura Cliente/Signature :		12) Assinatura GdA/Signature WM:			

Commodity request form developed by CMAM with technical assistance from GHSC-PSM.

6. Repaired infrastructure

With processes in place to salvage commodities and house incoming donations, GHSC-PSM then worked with CMAM to secure and rehabilitate damaged infrastructure. Project staff, along with the Ministry of Health, helped landlords coordinate extensive repairs to roofing and flooring, electrical rewiring, and repainting at warehouses in affected area. It took more than nine months to restore the warehouse back to its original condition.

At the Munhava complex, Pavilion I had lost a third of its roofing to the storm; in Pavilion 2, part of the roof had collapsed into storage racks inside the building, and one of the exterior walls was at risk of collapse. Further, most of the material handling equipment (e.g., pallets, cranes, crates, and industrial trucks such as pallet jacks and hand trucks) sustained damage.

Within four months, reinstallation of new roof sheets and insulation material in Munhava's Pavilion I was complete, and restoration of hot air extractors was underway. At Pavilion II, roof repairs had begun, and the damaged exterior wall was demolished to make way for repairs. By the end of August 2019, the roofing of Pavilion I and 2 were fully repaired.

In June 2019, the adjustable pallet racking was evaluated by the company Resolve as severely damaged beyond repair and needed to be discarded. Following the roof repairs, all APR were dismantled, allowing the landlord to start rehabilitation of the floor, which suffered tremendously from water infiltration (salty water from the floor and rain from the roof). The flooring of both pavilions and warehouse structures were fully completed in early December 2019.

All material handling equipment (MHE) was repaired within the first two month of the emergency.

Preparing for and responding to natural disasters: Lessons learned from Cyclone Idai

As stated in the PAHO document Humanitarian Supply Management and Logistics in the Health Sector, 2001: “Humanitarian supply logistics cannot be improvised at the time of the emergency.”

The emergency response to Cyclone Idai clearly showed that preparation and organizational readiness are important to counter the effects of adverse weather or natural disaster. Preparation enables time and resources to be spent directly on responding to the emergency quickly in the critical first days or weeks.

“Humanitarian supply logistics cannot be improvised at the time of the emergency.”

PAHO
*Humanitarian Supply Management and
Logistics in the Health Sector*

This section presents a basic overview of lessons learned and what could be put in place to prepare.

Detailed documentation that was developed during and after Cyclone Idai can be found as annexes to this document.

I. Commodities

Preventive and protective measures in advance

Preventive and protective measures need to be implemented from the moment official warning is received and before the weather or natural disaster arrives.

In the case of Cyclone Idai, early warnings were mostly ignored or at least not taken seriously. The extent of the possible impact was also generally underestimated by the government and people of Mozambique. A lot more could have been done to avoid damage to product, infrastructure, and humans.

For commodities specifically, these are measures that should be taken ahead of a natural disaster:

- All pallets need to be wrapped in stretch pallet wrap, including the top of the pallet.
- Block stacking pallets need to be raised off the floor and, if space allows, pallets on adjustable pallet racks should be transferred to the lowest levels as much as possible, as this will prevent the pallets from falling and will give more stability to the APR structure.
- Additional plastic sheeting should be used to cover the pallets in the racks.

Central staging area

In Beira after Cyclone Idai, it was difficult to establish the quantity of donated medicines and medical materials entering the country. Although the MOH was often the consignee, the donors and original suppliers of those commodities often received the items and entered them into their own warehouses, making it very difficult to have a consolidated overview of what was available.

A central staging area at the main ports of entrance can enable a better overview. This staging area should operate efficiently and process commodities quickly to avoid delays in providing donors and implementing partners with the shipments and, most importantly, to avoid delays in getting the products to people who need them.



Inside the emergency warehouse at Pioneiros provided by the World Food Programme. *Photo Credit: GHSC-PSM*

Additionally, paperwork should be consolidated and registered. A software package called SUMA, which was developed by PAHO, can help perform this function. See Annex E for more information on SUMA. (Note: SUMA might not be the best option for Mozambique; more research and discussion is needed to identify a similar type of software solution more suitable to the country's needs.)

Emergency warehouse for managing donations

Because it is difficult to anticipate the quantity of donated products that will flow through the emergency warehouse, the best guidance is to find the largest warehouse location that is available and affordable, and that provides acceptable standards for storage conditions, operationality, and security.

If available infrastructure is in short supply in the aftermath of a disaster, a good alternative can be Rubb Hall tents. These should ideally be set up within a secure compound and as close as possible to other storage facilities.



Installation of the first Rubb Hall tent for the emergency warehouse for medicines. *Photo: Jan de Jong*

The minimum requirements for materials needed to establish a well-functioning emergency warehouse are:

- 2 Rubb Hall tents (10m x 24m)
- 2 large office tables
- 4 office chairs
- 3 laptop computers with Windows Office and a WMS (in the case of Mozambique, MACS) installed
- 1 laser printer
- 2 boxes of standard-size (for the location) printing paper
- Extra toner cartridges
- 2 uninterruptible power supply (UPS) units
- 3 extension cords
- 2 fans
- Internal lights

- 1 functional telecommunication device (a phone with credit and/or a VHF radio with associated licenses)
- 2 padlocks
- 5 warehouse management software (MACS) licenses
- Stationary
- Boxes for packing (these can also be used as repacking boxes)
- 180 Euro standard pallets (800mm x 1200mm)

Communication of the National Formulary to donors

The National Formulary should be communicated to the donor community to help ensure that medicines and medical supplies received are recognized and used by the country's public health system and avoid receiving those that are not.

In addition, donated goods need to comply to the following standards:

- At least one year of shelf life remaining (apart from products like RDTs and reagents)
- The generic name referenced
- The label and instructions in English or Portuguese (in the case of Mozambique)
- No mixing of different items in the same boxes
- No open items

SOPs on managing emergency kits

Many donors donate and use emergency kits specifically designed for disaster response/humanitarian assistance. These kits are specified for a certain purpose (e.g., health, trauma, cholera) for a certain population size (e.g., 50,000) and time. They can vary in size from one box to several pallets consisting of multiple boxes or parcels. Each kit consists of modules and comes with a packing list of complete contents. Kits can be found online and can be part of the emergency preparedness. See Annex G to learn about World Health Organization (WHO) emergency kits.

Emergency kits are generally designed for use in the beginning of an emergency response; they are not intended to resupply existing health units and should not replace routine resupply. An SOP should be developed on how to manage these kits and should be included in routine SOP training activities.

The main decision to make about kits is whether to manage them as a whole or unpack them and store the items as different stock-keeping units (SKUs). From a logistics point of view, the first option is easier and clearer. Also, clients should be informed that cherry-picking from emergency kits is not allowed because it results in incomplete kits, which then need to be unpacked and reentered in the system under a different SKU, which is time and labor intensive.

Warehouse inventory SOPs

Existing warehouse inventory SOPs, which staff are trained in and accustomed to, are generally sufficient for use during emergency circumstances with the addition of SOPs for managing emergency kits. What should change is working/opening hours of the warehouse and the speed at which approvals for requesting and delivering products are processed. Approval/sign-off procedures should be simplified and decentralized if needed.

Additional SOPs should be developed on how to categorize emergency items upon arrival in the staging warehouse into those that are immediately useful, will be useful after the emergency phase, and will never be useful (because, for example, they are expired or there is no readable label or easy identification). This helps avoid burdening the supply chain with non-essential products and avoids ineffective use of scarce resources (time, transport).

Repackaging of product in damaged boxes

If outside boxes are damaged but internal packaging and products are still intact, products can be salvaged and repackaged. Repackaging required sufficient staff and packing materials.

Repackaging materials that should be kept on hand are:

- A minimum of 10,000 carton boxes (double flute for strength, 400mm W x 400mm D x 300mm H); a total of 30 boxes on a Euro pallet (total height of pallet: 1.65m)
- A minimum of 500 roles of boxing tape
- 10 packaging tape dispensers
- Permanent markers (50 each of green, red, black, blue)
- 500 roles of stretch pallet wrap (for hand-wrapping pallets)
- 4 hand pallet jacks
- 20 rims of A4 printing paper

Regular destruction of expired products

Expired products that are already in warehouses take up scarce space in the aftermath of a disaster. Therefore, regular destruction of expired drugs is necessary to avoid build-up and occupation of valuable space. Moving and destroying expired drugs during an emergency pulls away valuable resources needed for the emergency response.

Commodities in stock ahead of time

For future emergency interventions, having emergency response-specific forecasting, procurement, stockpiling, and pre-positioning of essential medicines and medical supplies is ideal. Establishing this list of commodities needed should be a part of a larger effort to develop an emergency supply chain preparedness plan. This is covered further in a section below on developing a national logistics emergency response plan.

2. Infrastructure

Preventive and protective measures in advance

As with commodities, preventive and protective measures need to be implemented for infrastructure from the moment official warning is received and before the weather or natural disaster arrives.

Key measures to help prevent damage infrastructure include:

- Covering windows and unused doors with plywood boards
- Reinforcing roofs at the edges with additional clamps/nails/screws, if possible
- Using sandbags to protect areas prone to flooding (such as entrances of warehouses)

Warehousing

After a natural disaster, using a drone with camera to assess damage to infrastructure (especially roofs) is recommended. Drones are now relatively affordable and user friendly, and they can also be used in normal circumstances for routine maintenance on buildings. Drones must be properly licensed.

Storage space in the aftermath of a disaster will likely be scarce and available only at a premium. As future volumes of commodities are difficult to establish initially, it is best to obtain as large of a space as possible. As a backup, tents can be used, specifically a type of large tent called Rub Halls (see Annex C). The location of the tent(s) should be within existing warehouse premises, if possible, to improve security, ease of logistics, and operations management.

As part of the emergency preparedness plan, these Rub Hall structures could be acquired and pre-positioned at the central and/or regional levels. In addition, roles of heavy-duty plastic sheeting and duct tape need to be pre-positioned at warehouses. The plastic sheeting should be used to cover pallets of commodities, IT equipment, and material handling equipment ahead of a natural disaster to prevent water damage.

Each warehouse should also have a basic toolbox to take care of small repairs after a natural disaster. The following tools should be included:

- A hammer
- Hardware (screws and nails)
- Combination pliers
- Needle-nose pliers
- Vise grips
- A screwdriver set
- A tape measure
- Utility knives
- A power drill
- A level

- Duct tapes

3. Human resources

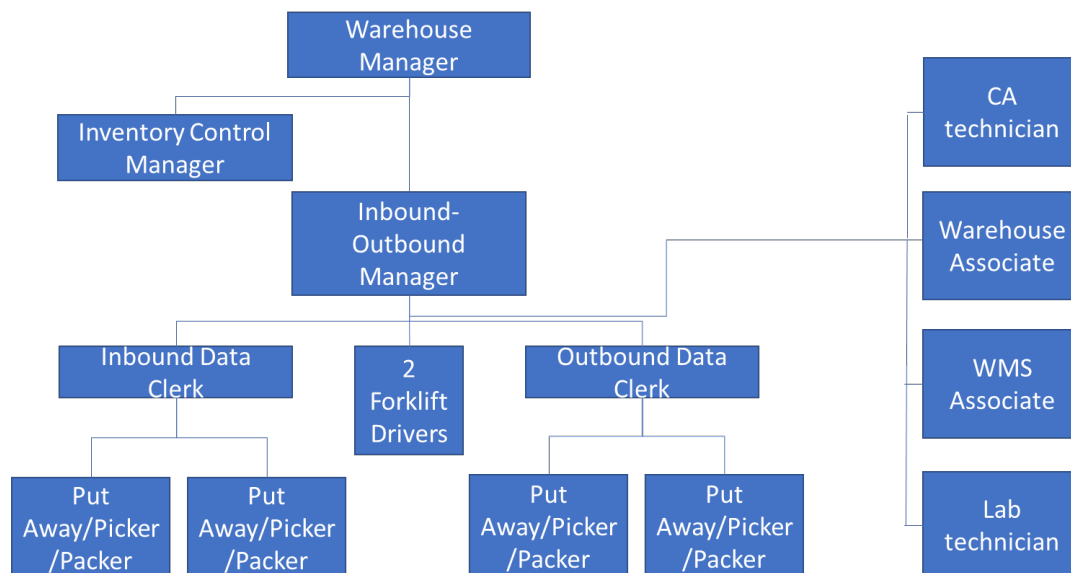
Organogram and job profiles

Establishing an emergency warehouse is beneficial for the efficiency and effectiveness of operations after a natural disaster. The organizational structure for human resources does not need to be very different than for a non-emergency warehouse, as it has the same basic functions. The biggest difference is that, due to the large quantities of donated products that may not be in line with the National Formulary, additional staff are needed to identify, sort, and categorize donations. This is a time-consuming and technical process.

Additionally, many of the donated products arriving may not be medicines, so it is important for technical staff from the laboratory and the medical materials and equipment warehouse to be available to assist.

Due to the need for new databases in an emergency response, at least one experienced IT/WMS staff member is needed to set up users, re-establish networks and the internet, and set up new computers and servers. (see Annex B).

The need to repackage and relocate damaged products or salvaged products from damaged exterior packaging requires one or two warehouse associates to help with the work and with managing additional temporary workers at various sites (e.g., the emergency warehouse and staging warehouse at the airport).



Organogram for the emergency medical store.

Apart from a core team of technical staff, a large number of daily workers are needed who can perform the majority of the non-technical labor required. Each day, four to five teams of 15 staff each should be available to perform such tasks as on- and off-loading containers, repackaging products, and cleaning. One team also needs to be on standby at the main airport to assist with unloading airplanes.

Health and safety in the workplace

The working conditions in the aftermath of Cyclone Idai were precarious. The city and buildings were full of debris, shattered glass, and exposed and fallen electrical cables. In the first few weeks of the emergency response, there was a shortage of food and water and an increased risk for contaminated food and water.

As the emergency response continued, exhaustion and the psychological well-being of staff became a concern. Warehouse staff and other responders were working very long hours while at home still experiencing the consequences of the cyclone. Often, staff had no roof over their heads at home and had not started repairs on their dwellings months into the response.

To protect staff working in these conditions, the following are needed at a minimum:

- Security guidelines and procedures regarding communication, transportation, staff movements, and penetration of damaged infrastructure
- Reflective identification vests, including the logo of the staff member's organization
- Safety helmets
- Safety shoes with steel noses
- Emergency HR kits that contain:
 - Water
 - Oral rehydration salt
 - Milk
 - Canned items (sardines, tuna, beans)
 - Pasta/rice
 - Crackers
 - Cookies
 - Oil
 - Personal hygiene items
 - Emergency first aid items (stitching kit, bandaids, disinfectant)
- When possible, advance of salary to staff can help them starting the most urgent repairs

Health and safety measures during an emergency response can only work when a body of health and safety procedures and infrastructural adjustments are already in place and staff are trained in those procedures and supervised by the management. (Note: In Mozambique, a technical document on health and safety was produced in 2015 for all regional warehouses: “Avaliação de Saúde e Segurança nos Armazéns da Central de Medicamentos e Artigos Médicos (CMAM),” Moçambique, Joana Carneiro, 2015.)

4. Material handling equipment, generators, adjustable pallet racking, and transport

One of the challenges in the Cyclone Idai response was the shortage of motorized MHE. This was not caused only by the cyclone; most of the equipment was already obsolete or needed proper maintenance. In the first weeks of the emergency response, several machines were repaired for minor issues (e.g., deflated or punctured tires). But with proper regular and preventive maintenance, more equipment would have been available in the critical beginning of the response.

A key way to ensure routine maintenance and avoid having non-working equipment in an emergency is to establish a long-term relationship and/or maintenance contracts with the equipment suppliers/representatives or identify pre-qualified suppliers who can perform maintenance and repairs.

Material handling equipment

When official warning of a weather or natural disaster is first received, MHE should be relocated to the most secure part of the warehouse, positioned on blocks, and covered in plastic sheeting. Chargers and spare batteries should be moved there as well. All batteries and chargers should be disconnected from the equipment.

Management should be responsible for:

- Planning all maintenance and repair work
- Monitoring and controlling external maintenance contractors' work
- Budgeting and allocating sufficient funds for maintenance/repair costs
- Organizing timely payment of maintenance providers to avoid service interruption
- Maintaining stock of spare parts/consumables
- Projecting future equipment needs
- Hiring suitably skilled operators and maintenance staff.
- Facilitating in-service training to improve the skills required for equipment operation
- Ensuring that staff performance in using and maintaining equipment is monitored
- Identifying training resources and that staff are trained in a timely fashion
- Adhering to warehouse and adjustable pallet racking specifications when renting additional MHE (e.g., aisle size, adjustable pallet racking configuration, height of mast and doors)

Equipment users are responsible for:

- Performing their jobs according to their job descriptions
- Taking good care of equipment
- Operating equipment properly and safely
- Undertaking a user-initiated pre-shift daily checklist to ensure safety for operator and staff (care and cleaning of equipment, filling out checklist and log book)

- Reporting faults promptly to their supervisors
- Educating and supervising new users

For a more detailed explanation on how to improve the productivity of MHE please refer to the technical document “Material Handling Equipment Maintenance Assessment and Planning, A Current State of Affairs in Mozambique,” Jan de Jong, GHSC-PSM, USAID, 2017.

Generators

The likelihood of power outages after a natural disaster is high. Re-establishment of the electrical lines and grid can take weeks, if not months. Therefore, generators are needed at each warehouse location with sufficient capacity/size to run the IT network, lighting, and MHE charging points. Fuel can also be scarce during an emergency, so a reserve tank with enough fuel to last until fuel supply normalizes is needed. In addition to providing fuel for generators, this tank can also be used to fuel MHE or vehicles.

Adjustable pallet racking

If the racks have been exposed to the elements or in any other way compromised, a specialist company should evaluate them because corrosion and impact damage could affect the integrity of the racking parts, which could affect stability and weight bearing capacity. Damage or corrosion might not be easily visible, so samples need to be taken and/or beams need to cut to establish corrosion from within. A professional evaluation is crucial to maintaining safety by ensuring that the racks are not at risk of collapsing.

Transport

To ensure that transportation is readily available for transfer and distribution of commodities:

- Maintain a list of pre-qualified transport providers in the country.
- Have flexible indefinite quantity contracts (IQCs) in place with transport providers with national coverage.

5. Management

Single command

To be effective in an emergency situation, a clear management structure should be in place and a single entity should be responsible for the warehouse and management of daily activities. In the case of Mozambique, the Central Medical Store, CMAM, should lead the response to be able to make decisions on the ground (single command).

Emergency funds

Additionally, the person responsible for the warehouse at the location of the disaster should be given temporarily increased independence and the authority to make decisions. This should be formalized in the larger national emergency response plan. The Central Medial Store and Ministry of Health should provide funds to the warehouse manager so that small payments can be made without delay. SOPs should be developed that detail what the funds can be used for and how to manage and report on the

funds, and the local administrator (in Mozambique, the CMAM Beira warehouses manager) should conduct the management and reporting.

Logistics clusters

When a government issues an international request for disaster support, many NGOs and international and governmental organizations that specialize in disaster response — such as the National Institute for Disaster Management (Instituto Nacional de Gestão das Calamidades or INGC), UN Office for the Coordination of Humanitarian Affairs, the World Food Programme, UNICEF, Red Cross, and Médecins Sans Frontières — will arrive in the country. A standard procedure is to create several logistics clusters to help manage the emergency response effectively.

In Mozambique, INGC leads and guides all the clusters. CMAM is included in the logistics clusters, with a senior representative participating in the (initially) daily meetings to share the products and stock levels in the AEM and provide any other helpful information. This is also a platform where requests can be formalized rapidly, as the main stakeholders are normally there to approve and sign.

The Central Medical Store and Ministry of Health sharing logistics information from the emergency warehouse is important because it not only facilitates the speed of getting medicines and materials to the people who need them, but also increases credibility among donors and other stakeholders. A daily situation report (SITREP) helps keep CMAM and MOH apprised of the extent of the disaster, progress made, and challenges faced. The SITREP is also useful to inform the post-emergency report.

See Annexes H and I for an emergency request form and flowchart for the management of donated goods, both developed and approved by the Mozambique MOH.

6. Information technology and communication

Mobile networks and landlines were all down in the immediate aftermath of Cyclone Idai. Mobile networks were restored in the weeks following but the service was intermittent and spotty for months.

To help prepare for IT and communication challenges following a natural disaster:

- Have a satellite phone (with license) available and charged in the first weeks.
- Have a set of very high-frequency (VHF) radios (including licenses) in vehicles.
- Provide cell phone pre-paid sim cards and credit to staff from different mobile telephone providers to create redundancies and capitalize on the strength of each one (voice, data, geographic coverage). These should be pre-registered and ready to go.
- Use smartphones with WhatsApp installed so that a WhatsApp group can be used to share important information.
- Procure mobile WIFI/hotspots for use in the temporary office locations that may have a lack of hardwired alternatives.
- Pre-position IT equipment (UPS, laptops, printer, WIFI access points) at the Central Medical Stores

Warehouse management software

In Mozambique, the WMS, MACS, was functional and based in the emergency warehouse to manage donated products.

To prepare for a natural disaster, it is highly recommended to create a WMS database with a complete list of products/emergency kits that can be always expected as donations.

The following activities should also be assigned to appropriate staff and completed:

- Creating codes for products not included in the National Formulary of medicines
- Creating customer/client identification codes authorizing request and reception of products stored in the emergency warehouse
- Creating donor identification codes to associate with donated commodities
- Creating warehouse locations within the emergency warehouse to ease inventory and identification of commodities

Donated commodities then need to be received and data entry conducted. After Cyclone Idai, 706 different types of health commodities (known and unknown) were received. The emergency warehouse also received laboratory, medical, and surgical equipment; emergency kits; tents; and hygiene and cleaning supplies.

The National Institute for Disaster Management was the recipient/consignee for all donations, but CMAM and GHSC-PSM managed the reception of products and data entry in the system (pack size 1). Due to the difficulty of entering the batch number in the system — because the products were not organized to allow such an activity in a timely manner — Mozambique used the supplier (donor) as the batch.

Distribution of commodities was done based on supply orders or requisitions, which were created and authorized by local higher health authorities (chief physicians, heads of reception/accommodation center). Distribution to the authorized clients was done using MACS, which generated an electronic bill of lading and was signed by those responsible for the delivery, the carrier, the beneficiary, security, and the warehouse manager.

Physical inventories of the commodities were conducted regularly to know stock on hand and to identify unknown products that had not been identified upon arrival in country, using a team of nurses, pharmacists, laboratory technicians, and medical doctors.

Separate reports were produced daily from MACS, showing reception of commodities, stock on hand at the emergency warehouse, and distribution. These reports provided transparency in how donated products were being managed. The reports were shared with various stakeholders, such as CMAM, the Provincial Health Directorate in Sofala, PSM, and the United Nations Office for the Coordination of Humanitarian Affairs (OCHA).


7. Development of a national logistics emergency response plan

One of the key lessons learned from the Cyclone Idai response is that humanitarian supply chain logistics should not be improvised at the time of the emergency. A national logistics emergency plan

should be developed to ensure preparation in advance and a quicker and more effective response in the aftermath. The preparedness process will take several months of significant effort by a dedicated core team of 5 to 10 people, with participation from a broader range of stakeholders as well, and then the preparation measures will need to be maintained on an ongoing basis.

See below for USAID's explanation of why emergency supply chain preparedness is important:

WHAT IS EMERGENCY SUPPLY CHAIN PREPAREDNESS AND WHY DOES IT MATTER?

 **Definition of emergency supply chain preparedness:** Establish a system ahead of an emergency to manage all the commodities necessary to respond to an outbreak and ensure they get to the point of care as efficiently as possible.

WHY IS EMERGENCY SUPPLY CHAIN IMPORTANT?

Emergencies present unique supply chain challenges



Demand is unpredictable and requires timely delivery to save lives



Emergencies put a strain on existing logistics systems



Resources required to respond to emergencies are complex and expensive



Investments in preparedness pay off



Preparedness saves lives by getting essential medicines to the front lines rapidly



Money invested in preparedness reduces the amount of response funds by 2x



Time invested in preparedness speeds response by over a week on average

SOURCE: UNICEF/WFP Return on Investment for Emergency Preparedness Study, January 2015. Emergency management logistics must become emergency supply chain management, Young and Peterson.



USAID | Global Health Supply Chain - Technical Assistance Francophone Task Order

Emergency supply chain preparedness encompasses three areas:

People and processes:

- Governance and organizational structure
- Triggers
- Financing
- Data visibility

Commodity planning:

- Commodity forecasting
- Procurement and sourcing

- Stockpiling

Logistics and transport:

- Warehousing and storage
- Transport and logistics

See Annex F for more detailed information on emergency supply chain preparedness.

References

Avaliação de Saúde e Segurança nos Armazéns da Central de Medicamentos e Artigos Médicos (CMAM), Moçambique, Joana Carneiro, 2015.

Emergency Supply Chain Preparedness Overview Guide, USAID, June 2018.

Humanitarian Supply Management and Logistics in the Health Sector, PAHO, 2001.

Material Handling Equipment Maintenance Assessment and Planning, A Current State of Affairs in Mozambique, Jan de Jong, GHSC-PSM, USAID, 2017.

Annex A. Job description — warehouse associate

Principal duties and responsibilities (essential functions):

- Support and/or supervise random daily stock count (by product or by rack zone); inventory control; and stock take procedures.
- Assist CMAM in implementing approved SOPs and training in inbounds and outbounds.
- Adhere to maintenance of material handling equipment and report all breakdowns with detailed root cause as priority.
- Adhere to implementation of MHE daily checklist.
- Inbounding: Check that all documents are correct, according to procedures, when offloading products.
- Verification: Quantitative and qualitative inspection of the goods after picking as per the document (supply order, packing list, delivery note) to avoid discrepancies.
- Outbounding: Check that all documents (packing list, delivery note, driver credentials) are correct, according to procedures, when loading products.
- Verify truck capacity according to the transport plan.
- Check if the stock issued follows the stock rotation, accuracy, and transaction transparency according to procedures.
- Register any damages that occurred during offloading or loading or during normal operations, and have the document signed by the CMAM checker, security personnel, and the driver if required; the CMAM warehouse manager must be informed of the damage for system processing.
- Lead the operators when allocating products to the bins (physically); the bin allocations system should be provided by the CMAM warehouse manager (inbound) according to the entry document.
- Lead the operators when picking products from the bin (physically); the document "Pick & Ship" should be obtained from the CMAM warehouse manager following a commodities request or routine distribution.
- Check if pallets are completely identified on all sides according to procedures.
- Provide on-the-job training to CMAM human resources for all warehouse-related duties.
- Monitor warehouse housekeeping and pest control.
- Assist with the coordination, supervision, and payment of daily/temporary workers.
- Perform other tasks as directed by management.
- Maintain a good knowledge and understanding of all office rules and procedures as set forth in the field office policy manual.
- Support achievement of the overall project goals as required to ensure project performance.

Skills, knowledge, and attributes:

- Bachelor's degree in a relevant field preferred
- At least three years of relevant work experience
- Experience working on a USAID or donor-funded project required
- Language skills: working knowledge of Portuguese and English
- Strong management skills, strategic planning skills, knowledge of processes/procedures, operations management experience
- Highly motivated individual with strong leadership, people, and problem-solving skills
- Proficiency with Microsoft Office, specifically with Excel, Word, and PowerPoint
- Proficiency with the warehouse management system MACS

Annex B: Job description —information technology (IT) warehouse associate

Principal duties and responsibilities (essential functions):

- Ensure that the MACS and advantage database system infrastructure, servers, network, firewall, and wireless networks are working properly.
- Support major time-sensitive operations, such as quarterly distributions, including the importation of the electronic requisitions from the logistics management information system (SIMAM) into MACS.
- Manage the radio frequency (RF) equipment in the assigned warehouse
- Supply CMAM with the reports needed for analysis
- Provide regular training to existing CMAM staff, new employees at CMAM warehouses, IT staff, warehouse staff, and CMAM headquarters staff.
- Help CMAM manage the first point of contact for MACS inquiries, such as system errors, transaction queries, and correction of transaction errors.
- Manage all communication and error logs with the MACS helpdesk to report problems and implement solutions.
- Coordinate between the MACS helpdesk and CMAM to implement fixes and upgrades of the system.
- Perform other tasks as directed by the MACS manager.
- Maintain a good knowledge and understanding of all office rules and procedures as set forth in the field office policy manual.
- Support achievement of the overall project goals as required to ensure project performance.

Job qualifications:

- Bachelor's degree in a relevant field
- At least four years of relevant work experience
- Experience working on database management for warehouses required
- Experience working on a USAID or donor-funded project required
- Fluency in Portuguese and advanced English required

Annex C: Rubb Halls

A Rubb Hall is a commercial name for large, relocatable tent-like structure often used in emergency responses (e.g., humanitarian) and temporary industry (e.g., construction projects). The name derives from Rubb Building Systems and Hall Engineering of Bergen Norway, manufacturers of this kind of structure. Another type of similar structure is Wiik Halls.

Rubb Halls are usually made of aluminum frames with steel tension wires and polyester skins. They typically come in sections, so the length can be determined by the number of sections employed. A common standard size is an area of 240 square meters (10m x 24m). Doors at either end are made from the same material as the walls and are drawn back like curtains. More secure and longer-lasting structures include Flospan - frameless steel structures.

Various specialized modifications are possible, including the fitting of artificial ceilings inside, together with doors in end walls, to facilitate heating. It is also possible to have a frame erected inside to provide a second floor.

In humanitarian aid situations, Rubb Halls are often used as warehouses for items such as food and medicine. They are also used for temporary emergency shelter for large numbers of people and as spaces for activities such as registration of people.



Source of picture and text: Wikipedia



Pioneiros regional warehouse with two Rubb Hall tents; the inside view of a Rubb Hall tent.



Example of a Flospan structure.

Annex D: Personal protection equipment (PPE)

Safety shoes with steel nose



Safety vest



Safety helmet and glasses



Annex E: SUMA

LSS/SUMA (known as SUMA) is a humanitarian supply chain management system developed by PAHO to assist disaster-stricken countries in managing donated supplies, from the time pledges are made through distribution of supplies. SUMA is comprised of software, equipment, and trained personnel.

Information on supplies is collected at different points of entry, such as an airport, seaport, or border. The SUMA team assigns a priority to each item based on how it meets the needs of the disaster victims. Items are classified by category, subcategory, and item.

Other SUMA teams work at warehouses and distribution hubs, managing information on the distribution of items from central to peripheral points. Information gathered in the field is forwarded in an electronic format to the central level, where the emergency is being managed. Standard or customized reports can be easily generated for disaster coordinators, assisting them in monitoring pledges from donors and identifying gaps or duplications.

SUMA can be a valuable tool for providing transparency and accountability in relief operations.

Annex F. Key elements of emergency supply chain preparedness

WHAT ARE THE KEY ELEMENTS OF EMERGENCY SUPPLY CHAIN PREPAREDNESS?

There are three major areas of ESC preparedness: people and processes, commodity planning, and logistics and transport. Under these three areas are nine key elements involved in building an in-country emergency supply chain preparedness capability. The journey of implementing this capability will involve doing work in each of these components.

PEOPLE AND PROCESSES: CLEAR STRUCTURES OF GOVERNANCE, ACCOUNTABILITY, AND PROCESSES THAT ENABLE THE ESC TO FUNCTION



Governance and organizational structure: Develop a governance system with roles and responsibilities for ESC structure to ensure accountability. Map stakeholders and put in place collaboration mechanisms to define how they will work together. Train staff and stakeholders.



Triggers: Identify and prioritize diseases for ESC to plan for and determine what events will trigger ESC's activation.



Financing: Calculate the amount of funds necessary for ongoing preparedness and emergency response, identify funding sources, and appropriate funds.



Data visibility: Put in place a system to track supply and demand data during an emergency to ensure timely and sufficient resupply

COMMODITY PLANNING: PRE-DEFINED COMMODITIES THAT THE ESC WILL BE RESPONSIBLE FOR AND PLANS FOR HOW TO GET THEM



Commodity forecasting: Identify the types of commodities that the emergency supply chain will be responsible for in the event of an emergency based on the prioritized list of diseases that the country is at risk of.



Procurement and sourcing: Identify and document sources for each of the necessary commodities and put in place agreements ahead of time to procure the commodities



Stockpiling: Determine the quantity of commodities necessary to respond to prioritized diseases and plan where to stockpile those commodities to ensure they're readily accessible by examining existing stockpiles, building national stockpiles where necessary.



Warehousing and storage: Determine how much warehousing and storage will be necessary in an emergency response, map all existing resources, and plan to fill any capacity gaps through permanent or temporary storage.



Transport and logistics: Update customs procedures for emergency commodities, estimate transport needs for a response, and put in place agreements to secure sufficient transport capacity. Map out waste disposal capabilities and determine protocols for priority diseases.









Annex G. WHO emergency health kits


An emergency health kit is a complete set of drugs, supplies, and equipment needed to either provide basic health care for a stated population size or manage a certain set of health conditions. Emergency kits are intended only to fill gaps created in an emergency situation, not to replace existing supply chain mechanisms (resupply).

More information can be found at <https://www.who.int/emergencies/kits/en/>, including several training presentations.

Below are the WHO standard emergency health kits:

<p>Interagency Emergency Health kit 2017 (IEHK)</p>	<p>Cholera kits (formerly known as IDD kits)</p>	<p>Severe Acute Malnutrition with Medical Complications Kit</p>
 <p>IEHK Each kit serves 10,000 people for 3 months.</p>	 <p>Cholera kit 2015 Each kit serves 100 patients.</p>	 <p>SAMMC Each kit serves 50 children (less than 5 years).</p>
<p>– Interagency Emergency Health Kit 2017</p>	<p>– Revised cholera kits – Cholera: Revised cholera kits and calculation tool 📄</p>	<p>– Severe Acute Malnutrition with Medical Complications Kit (SAM/MC kit)</p>
<p>Non communicable diseases kit 2016 (NCDK)</p>	<p>Major trauma backpack (for medical doctors)</p>	<p>Trauma & Emergency Surgery Kit</p>
 <p>NCDK 2016 Each kit serves 10,000 people for 3 months.</p>	 <p>Major trauma backpack 34,000 components.</p>	 <p>TESK 2019 Each kit serves 50 trauma patients hospitalized.</p>
<p>– Non communicable diseases kit 2016 (NCDK)</p>	<p>– Care of the injured – 📄 View the content of the backpack pdf, 211kb – 📄 View the backpack pdf, 254kb</p>	<p>– WHO Trauma & Emergency Surgery Kit (WHO TESK) 2019</p>

Annex H. Emergency request form

 <p>REPUBLICA DE MOÇAMBIQUE MINISTERIO DA SAUDE CENTRAL DE MEDICAMENTOS E ARTIGOS MEDICOS</p>		Armazém de Emergência (AEM) da BEIRA Requisição de Emergência			
		1) Beneficiário (Cliente)		4) Aprovação DPS/ DDS	
Fornecedor: Armazém Emergência (AEM)		Endereço: Armazém Regional da Beira, Rua General Vieira da Rocha nr. 2319, Beira, Moçambique		2) Número de Requisição	5) Assinatura DPS/ DDS
		3) Data de Requisição		6) Visto da Comissão Logística	
Nº	7) Descrição do Productu	8) Embalagem	9) Quantidade de Embalagens	10) Total de Unidades Pedido	11) Total de Unidades Aprovado
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12) Cliente:		14) Nome do Gestor do Armazém (GdA):			
13) Assinatura Cliente :		15) Assinatura GdA:			

Annex I. Fluxogram for management of donated goods

