Republic of Uganda

Ministry of Health

Strengthening Logistics Preparedness for Infectious Disease Response in Uganda

Baseline Report

September 2021

ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

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Executive Summary

Outbreaks of infectious diseases like Ebola virus disease (EVD), yellow fever, measles, or currently COVID-19, are regular occurrences in Uganda. If not detected early and effectively contained, these diseases threaten the health and economic well-being of the entire population, and beyond. Disease response is a top-priority for public health managers at the MoH Uganda, and Logistics Preparedness has been identified as one of its key success factors.

In 2017, the Joint External Evaluation (JEE) by the World Health Organization (WHO), concluded that the "priority one country" Uganda did not fully meet the core capacities specified by International Health Regulations (IHR), which are prerequisite to an adequate response to public health emergencies like EVD or COVID-19. In response to this evaluation Uganda developed a national MCM plan which has been approved and is being implemented. It also launched a project with a public research university in Switzerland, the ETH Zurich, to draw upon research to improve Logistics Preparedness.

Kicked off in November 2020 by the Ministry of Health and the Chair of Logistics Management at the ETH Zurich, the project took a multi-phased approach, the first of which was an assessment of the current state. Among the data gathered were 30 interviews with key informants, as well as process maps, and order fulfilment records from the eELMIS (electronic emergency logistics management information) system. This establishes a baseline measurement, against which later interventions can be designed and assessed. The findings are summarized in this report.

The current state reveals the performance gaps which arise when a regular healthcare supply chain is used to respond to an emergency. In particular, emergency orders take too long to fulfil and their status is not always transparent. Other features of the system are not optimally configured for emergency response. For example, approvals which are normal for regular orders, cause delays in emergency orders. At present, the regional prepositioning centers are not yet fully operational, but these would improve the response under certain conditions if they were activated. Transport must also be planned differently in an emergency. Standard operating procedures are not always clear, which leads to ad-hoc decision-making in an emergency. This is related to a need for training, in both procedures and the eELMIS system, on an ongoing basis. A robust process for the quantification of material requirements is not in place, which compromises planning. The current system is heavily dependent upon partners to function, which is not sustainable since it is not the mandate of these organizations to replace the national system.

The joint Ministry-University team considers these to be opportunities for learning and improvement. Several challenges can be addressed by logical or organizational changes. The baseline also acknowledges strengths (like local expertise and investments in infrastructure), which should be deployed for more impact. In the next phase of the project, stakeholders will be invited to support the development of implementable solutions.

Acknowledgements

Special acknowledgement is due to Ugandan Ministry of health leadership and for allowing access to the health personnel at all health system level during the baseline data collection. A special thank you goes to Ms. Akello Harriet (Ugandan Team lead) and Mr. Obua Ocwa Thomas at the Ministry of health, to Ms. Juliet Namugga Kasule and Mr. Milton Wetaka from the Ministry of Health Public Health Emergencies Operation Centre for their dedication, commitment, and leadership during the development, rollout and completion of the baseline report of the project

Special thanks goes to the team of researchers at the ETH Zurich headed by Prof. Dr. Stephan Wagner and including Dr. Bublu Thakur-Weigold, Ms. Laura Heuser, Ms. Eliane Müller and Mr. John Hans Wasswa for their technical expertise and commitment throughout the project . The team would like to thank all key informants, data sources, and Mr. A. Fink for advice on methodology.

Funding

This project is funded by an ETH4D Research Challenge Grant.

https://eth4d.ethz.ch/funding-opportunities/eth4d-research-grants/ETH4D-Challenges/previous-grantees/logistics-preparedness-for-disease-outbreaks-in-uganda.html

1. Project Description and Objectives

Outbreaks of infectious diseases like Ebola virus disease (EVD), yellow fever, measles, or currently COVID-19, are regular occurrences in Uganda. If not detected early and effectively contained, these diseases threaten the health and economic well-being of the entire population, and beyond. Disease response is a top-priority for public health managers at the MoH Uganda, and Logistics Preparedness has been identified as one of its key success factors.

In 2017, a joint external evaluation by the World Health Organization (WHO), concluded that the "priority one country" Uganda did not fully meet the core capacities specified by International Health Regulations (IHR), which are prerequisite to an adequate response to public health emergencies like Ebola or COVID-19. In response to this evaluation, Uganda developed a national MCM plan which has been approved and is being implemented.

Overall Objective

The objective of this project is to draw upon research in order to strengthen Logistics Preparedness for Infectious Disease Outbreaks in Uganda.

Specific Objectives

1. To analyze the current state of logistics preparedness for infectious diseases in Uganda
2. To carry out out process mapping and network modeling that will identify opportunities to improve logistics preparedness in Uganda
3. To determine a sustainable mechanism that will improve logistics operations in Uganda

Project implementation

The project was kicked off in November 2020 by the Ministry of Health of Uganda and the Chair of Logistics Management at the ETH Zurich and took a multi-phased approach, see figure 1.

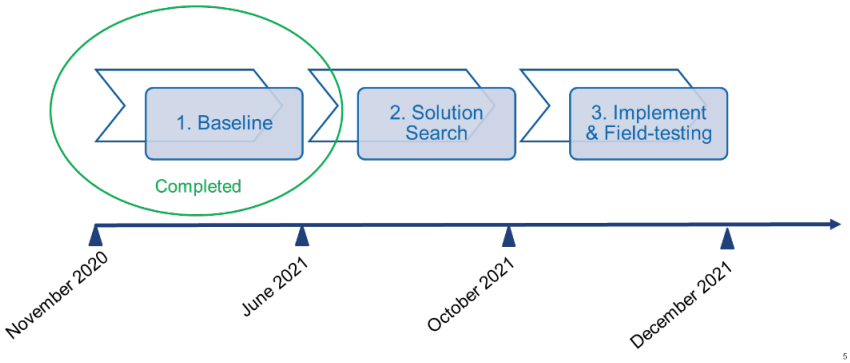

Figure 1: Schedule of 3 phases of the project, beginning with measurement of the current state.

Although it draws upon research on logistics preparedness and emergency response, the project has been set up to benefit from local expertise and leadership as well. In addition to reports, it will develop practical solutions which can be implemented in the Ugandan public health system. The three phases of the project build progressively towards customized solutions, which will be co-developed by the researchers and local stakeholders who will support their rollout.

The first phase was an assessment of the current state to establish a baseline measurement, against which later interventions can be measured. The analysis of a current state will prioritize the list of improvement opportunities. In the second phase, focus groups of subject-matter experts will design feasible solutions to be tested and implemented in the third phase. Under the leadership of project sponsors at the Ministry, change management activities will be carried out in parallel to the problem-solving.

2. Overview of Data and Analyses

To analyse the current state of logistics preparedness in Uganda, data were collected from multiple sources, each guided by a particular line of inquiry.

2.1 Key informant interviews

30 interviews were conducted with key informants from the public healthcare system and its stakeholders to gain direct insight from the actors on the ground into how the emergency response system has performed to date. A variety of functions and points of view were represented in the interviews, including ministry and other government actors, partners, regional and district actors, and specialists from procurement and finance in addition to logistics officers, see table 1.

No.	Role	Organization	Category	Region/subregion
1	Customer Relations Officer, Logistics	NMS	Central	-
2	SC Advisor	UNHCR	Partner	-
3	Logistics officer, procurement officer	WHO	Partner	-
4	Pharmacist	MoH (Kiruddu RRH)	Region	Central (Kampala)
5	Pharmacist	MoH (Lira RRH)	Region	Northern (Lango)
6	Pharmacist	MoH (Kabale RRH)	Region	Western (Kigezi)
7	Logistics coordinator	WFP	Partner	-
8	Logistics officer	PHEOC	Central	-
9	Logistics officer	UPDF	Central/NTF/LSC	-
10	Economist, Procurement head	MOH	Central/NTF/LSC	-
11	Procurement Specialist	MOH	Central/NTF/LSC	-
12	Economist	MOH	Central/NTF/LSC	-
13	Logistics officer	PHEOC	Central	
14	Logistics officer	Kyotera District	District	Central (south central)
15	Logistics officer	Mukono District	District	Central (North central)
16	Logistics Advisor	UNICEF	Partner	-
17	Pharmacist, Lab Advisor	MOH	Central	-
18	Logistics officer	Sembabule District	District	Central (south central)
19	Logistics Focal person	Lira Node	Region	Northern (Lango)
20	Stores Focal person	Arua Node	Region	Northern (West Nile)
21	Stores Focal person	Kotido Node	Region	Northern (Karamoja)
22	Logistics Focal person	Mbarara Node	Region	Western (Ankole)
23	Stores Focal person	Kasese Node	Region	Western (Tooro)
24	Logistics Focal person	Masindi Node	Region	Western (Bunyoro)
25	Logistics Focal person	Mbale Node	Region	Eastern (Bugisu)
26	District Health Officer	Tororo District	District	Eastern (Bukedi)
27	District Health Officer	Yumbe District	District	Northern (West Nile)
28	District Health Officer	Nebbi District	District	Northern (West Nile)
29	Public Health Specialist, emergency	UPF	Central/NTF/LSC	-
30	Pharmacist	JMS	Central	-

Table 1: List of key informants interviewed for the Baseline Assessment. Acronyms are explained in the glossary (section 5)

2.2. Process maps

To understand how the work is being executed at present, maps were drafted of the core processes and workflows, using a template taken from Lean Management ("swim lane" diagrams). The process maps help to visualize the inputs, outputs, and sequence of activities involved in completing any single process. They also identify the division of labour, enable the measurement of throughput times, as well as diagnose redundant or unnecessary work steps.
The process mapping was not concluded in the course of the present state analysis and is ongoing. Initial results are, however, included in this report.

2.3. Epidemic history

Historical data from past epidemic outbreaks in Uganda were analyzed in search of repeatable patterns, and to support the planning and forecasting of material requirements for future outbreaks.

2.4 Emergency order data from the eELMIS system

The project team examined order data from the electronic emergency logistics management information system, or eELMIS, to study order patterns and how the system has been used in past emergencies. The analysis of this data is ongoing.

2.5 Modeling of physical network configuration

Ongoing are analyses of the physical network configuration, to understand how the infrastructure has been set up to support distribution. These analyses are conducted using special software at the university which tests optimal configurations and models what-if scenarios by changing individual parameters and inputs. Because more data inputs are required to complete the model, the results of this analysis are not included in this report.

3. Results of Baseline Measurement

3.1 Key informant interviews

When asked about the performance of the current healthcare logistics system, the responses from key informants formed a combination of descriptive statements (*what is happening*), explanations (*why it is happening*), and articulations of requirements or recommendations (*what should happen*). When the interview data were coded by the university researchers, it emphasized 5 performance gaps which are summarized in this section and grouped by descriptive, explanatory, and requirement statements.

3.1.1. Prepositioning centres for emergency materials are not operational

Descriptive: Today, with the exception of a single node Arua, which is operated by partners, the decentral nodes are not operational and not supplying their catchment districts.

Explanatory: The nodes do not have adequate stock in place. Infrastructure, equipment and transport capacity are also inadequate in some cases. If the pre-positioning centres are properly stocked, equipped (shelves, data, fridges, skilled staff), and empowered, they will improve response times in an emergency like a disease outbreak.

Decentralization of stock is the right concept because the central location is too far away to respond in an emergency. The central warehouse is often congested and slow to respond in emergencies.

Requirements/recommendations: The local authorities must be integrated so nodes are not perceived as a central function and support the operations.

Logistics should be executed at a decentral level but with centralized visibility and control.

The processes and supplies for regular healthcare and emergency response must be separated.

3.1.2. Transport means are needed for emergency response

Descriptive: Transport is a limited resource and leads to delays in order fulfilment. There is not always transport available in the last mile of the system. Goods tend to pile up at intermediate locations waiting for distribution, with occasional spoilage and expiry.

It is not always clear who is responsible for transport: should the node distribute to the districts? Or should the districts pick up supplies? Is it necessary to coordinate with the NMS transport schedule?

Staff improvise ways to get the goods picked up.

Partners contribute a significant amount of transport capacity to move goods. Local staff depend on them to make things happen, but this is not a sustainable solution.

Explanatory: Especially fuel is needed. Unfunded operational costs in last mile can prevent completion of delivery.

Requirements/recommendations: To ensure efficiency and self-reliance of the regional system, transport capacity should be planned and budgeted for in advance. Better route scheduling could increase the efficiency of existing transport.

3.1.3. Partners currently enable system functions, especially transport

Descriptive: Partners have provided especially transport (project vehicles, trucks, ambulances) in the last mile to take supplies to districts. WFP provides access to its considerable logistics capacity.

Partners have also donated supplies, built infrastructure, and trained health workers to deal with Covid-19.

Explanatory: Without partners and depending only on NMS and local capabilities, there would be bottlenecks and delays in case of emergency.

Requirements/recommendations: The overdependence upon partners is not a sustainable solution because it is difficult to plan capacity which belongs to others. Also, in the words of one of the informants "*it's not the mandate of the agency to replace the national system*." The Ugandan system should therefore strive to become more self-sufficient.

3.1.4. Lead times of emergency response are too long and unreliable

Descriptive: Orders take too long to be fulfilled for emergency response.

There is a lack of transparency of order status. Some waited more than one month without knowing their order status, and could not plan accordingly. The notifications which were given were not always accurate or dependable.

Shipment results were sometimes disappointing: not all items, not full quantities, or incorrect materials were shipped.

Standard Operating Procedures (SOPs) are not clear to all actors and can result in ad-hoc decisions.

Explanatory: As a consequence of past experience, trust in the order management is low. Low expectations for fulfilment resulted in gaming behavior (over-ordering or placing multiple orders for the same requirements).

Requirements/recommendations: Order management should be speedy in case of emergency, reliable, and transparent.

3.1.5. Training is needed on an ongoing basis

Descriptive: Many staff were trained in a one-off session which was not followed up. Almost all desire regular refresher trainings. A strong commitment to the proper functioning of the system was articulated.

Explanatory: Without training, compliance to Standard Operating Procedures (SOPs) is not possible.

Non-logisticians often work in logistics functions. There are high rates of turnover in staff. In certain cases, a single person takes on multiple roles.

Training as a response team would support team-based learning and problem-solving.

Training would drive use of the eELMIS system, which would create transparency and a single centralized version of the data, which is the basis of good monitoring and governance.

Requirements/recommendations: Staff need to be trained in logistics strategies, standard operating procedures, and technical use of the system.

Training should not be one-off but repeated at regular intervals to refresh skills and reflect the newest requirements and knowledge.

Not only health workers who are responding but all stakeholders in the system should be trained: local implementing partners and community-based organizations. Anyone who plays a role in the SOPs (like the DHOs who have to make approvals) should be included in the training.

3.2 Epidemic history, prediction, and planning

Every logistics preparedness system depends upon a reliable estimate of requirements which are fed into planning processes. To create a forecast for future epidemics, the project received records of epidemic occurrences for the past 20 years in Uganda. These records revealed that the historic outbreaks are known, but that they are too rare to allow for meaningful predictions.

Simultaneously, the researchers reviewed existing literature on infectious disease outbreaks to establish best practices and draw on existing solutions. Studies of early warning systems and caseload prediction after an outbreak (depending on several factors) exist. However, these systems are activated after the first case has been detected, and not capable of predicting possible outbreaks or their likelihood.

Several approaches and hypotheses were found which predict when outbreaks occur, but none of them are considered feasible in the case of Uganda, for example in-depth continuous genetic analysis/surveillance of wildlife pathogens. Those predictions which are made are too general to be

used for stock planning (i.e. "*There will almost certainly be a large outbreak of an infectious disease somewhere in Africa in the next 10-30 years*"). The feedback from the CDC in Atlanta and others confirms that prediction is not reliable. It is better to be prepared.

The ESUPS project funded by USAID and working with multiple NGOs consolidates data on national stock levels, and models only how these would perform in past outbreaks.

Finally, the team consulted international experts in search of a methodology for computation of disease development. They benchmarked the response management by International CDCs, the WHO, MSF, and USAID. The CDCs and the WHO use range scenarios (low, middle, high) of the caseload to plan the response.

The WHO informed the project that it has an MCM catalog for regular healthcare. There are, however, no globally standardized treatment plans with the needed MCMs and their consumption rate per treated person for epidemics. Additionally, collecting accurate information on the size, weight, and price of materials for logistics planning purposes is a challenge.

3.3 eELMIS data analysis

The eELMIS system was developed and implemented in Uganda at considerable expense and is recognized as an important enabler of emergency response. In particular, the IT functionality offers an alternative to manual order management, as well as a central repository and shared view of the data.

Measured over the period from September 2019 – to October 2020, the project examined various aspects of the eELMIS system: the adoption of the system by key users, how well emergency orders could be tracked through the fulfilment process, and the performance of the fulfilment process itself. The findings are summarized in this section.

3.3.1 System adoption of eELMIS

All districts currently use eELMIS, but the usage is irregular. Some districts use eELMIS only rarely (e.g., only 1 order entered into the system). Others use eELMIS frequently (e.g., Kalangala with 568 item orders in the system). Some regional referral hospitals use eELMIS.

The selected year of data revealed 902 Pending district approvals and 285 pending node approvals. This indicates a bottleneck in order processing due to the approval process.

3.3.2 Tracking orders through the fulfilment process

In this analysis, order number and item name were used as identifiers. When trying to follow orders through the process of Order-to-goods-issues-and-Receipt was not always transparent. Not all orders could be followed through the order cycle.

3.3.4 Order fulfilment performance

Service levels appear to be less than optimal since the amount received rarely coincided with amount ordered. The order fulfilment rate was either too high (more than 100%) or too low (less than 50%). Furthermore, some items were received that were not ordered.

There is a need to reduce the order fulfilment cycle time, which averages 26 days at present. This is too long for an emergency response.

Certain order create dates coincided with the order dates. A possible explanation for this is that the orders from the Emergency Treatment Units were collected by the district before entering them into the system as a batch.

Some order create dates of different orders were the same. A possible explanation for this is the requirement for a District Health Officer to approve orders prior to entry into the system, which were then probably done in a batch.

Quantity 0 indicates a stockout in the system. A total of 569 line items could not be fulfilled due to stockouts. In 2019 (prior to COVID-19, after the system went live), 17 line items could not be fulfilled due to stockouts. This suggests a need to improve stock availability.

At the time, Arua was the only Node entering inventory data into in the system.

The order volume in the system began to rise after March 2020 following the Covid-19 outbreak. The system was clearly being used to respond to this new epidemic. 424 different item types (some are just different sizes) were ordered. PPE, Drugs and Medical consumables and Disinfection seem to be the most important needs. System data supported transparency of orders throughout the fulfilment process, showing that these items were frequently ordered, issued and received.

4. Next Steps: Solution Search

4.1 Summary of the Baseline Assessment results

The Baseline Measurement is a structured interpretation of the sources of data listed in the previous sections: key informant interviews, eELMIS order data, international benchmarks of disease management processes, and internal documents of the Ministry.

Process mapping and network modeling are ongoing project activities which address the opportunities and issues identified in the other analyses. For example, process maps reveal the root causes of the long order lead times, which were identified by the key informant interviews as well as the eELMIS analyses.

The researchers recommend viewing the logistics system which supports the response to infectious disease outbreaks in Uganda as a *supply chain*. According to theory, the performance of this supply chain is determined by 7 key functions known as "drivers": Information, Human resources, Inventory, Facilities, Transportation, Finance, and Sourcing. Together, they contribute to how well the entire system achieves its declared purpose, see figure 2.

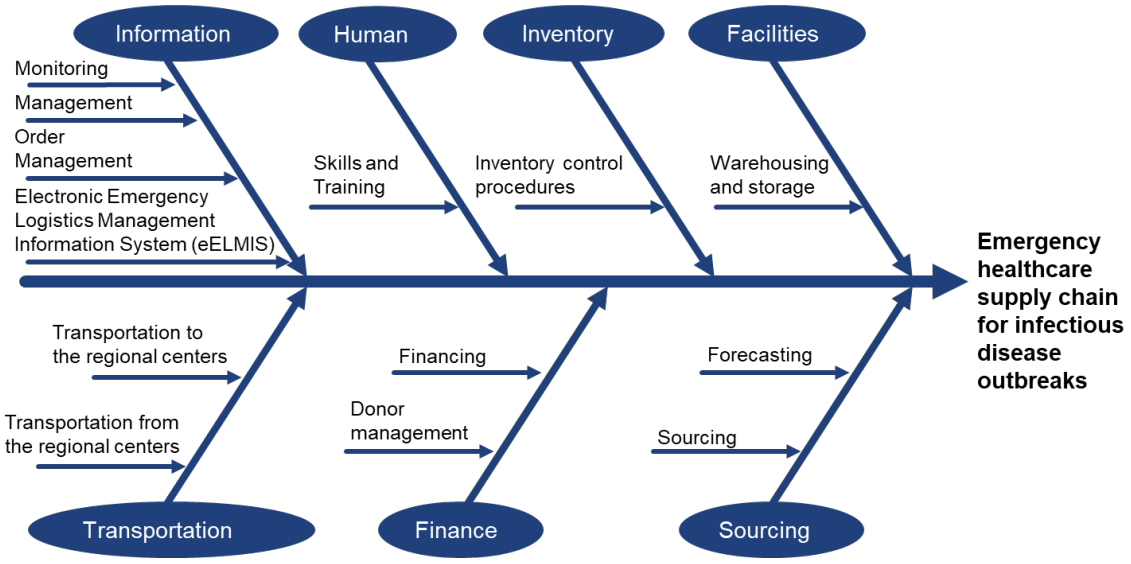

Figure 2: Supply chain performance drivers broken down for the current state analysis

If one or more of the drivers are not working optimally, the performance of the entire system is reduced. When the results of the data analyses (described in the previous sections), were combined and consolidated, the Baseline Assessment of Logistics Preparedness for Infectious Disease Outbreaks arrived at a list of 10 performance gaps, each of which is categorized by a supply chain performance driver, see table 2.

	Performance Gap	Supply Chain Drivers
1	SOPs are not regularly applied across the system	Inventory, Information
2	There is little visibility of stock levels in the periphery.	Inventory, Information
3	Poor demand-supply matching leads to stockouts or overstocks in various locations in the system	Inventory
4	A quantification process/methodology does not exist, or is unsystematic	Information, Sourcing
5	Network design is possibly sub-optimal leading to poor performance of operations.	Facilities
6	Emergency order fulfilment times are too slow, especially because of approvals.	Information
7	Transport to the districts and then in the last mile is inadequately planned, and not always available.	Transportation
8	LSC becomes a bottleneck when fulfilling incoming orders from 136 districts.	Information
9	Emergency budget does not cover all requirements.	Finance
10	Staff must be developed and regularly trained in both SOPs and use of IT system.	Human, Information

Table 2: Performance gaps categorized by supply chain drivers

4.2. Solution Search

To make the most of limited resources, the solution search will begin by addressing the most important problem areas. In the next step of the project, the 10 performance gaps and improvement opportunities identified in the baseline will be prioritized.

The solution search will then invite experts and stakeholders to participate in focus groups. It will also identify so-called “low-hanging fruits”, or problems which can be solved with little effort and cost, to create the necessary momentum for change.

In the course of the solution search, the project emphasizes that existing strengths and opportunities should be capitalized. These include leadership in the Ministry, which recognizes the role of logistics as an enabler of better public health outcomes. Sponsorship, communication, and the support of adaptive change by the Ministry will be key to successful solution development and adoption.

Uganda also possesses significant experience in dealing with infectious disease outbreaks, from which other countries can learn. The collective intelligence of the emergency response team is a resource which could establish the Ministry of Health as a knowledge broker for others.

The project team also recommends that valuable infrastructure like eELMIS and the Prepositioning Centres, as well as Lean expertise in other government offices be leveraged to full effect. Partners are also potential sources of support which should be engaged in the solution search. This would also avert the tendency of organizations planning independently in an uncoordinated manner, thereby working at cross-purpose.

5. Glossary

CDC	Centre for Disease Control
DPNM	Department of Pharmaceuticals and Natural Medicines
eELMIS	electronic Emergency Logistics Management System
ESUPS	Emergency Supply Prepositioning Strategy Project, see www.esups.org
ETH	Eidgenössische Technische Hochschule / Swiss Federal Institute of Technology
JEE	the Joint External Evaluation
JMS	Joint Medical Store
LSC	Logistics Sub-Committee
MOH	Ministry of Health
NMS	National Medical Store
NTF	National Task Force
PHEOC	Public Health Emergency Operations Centre
PHE	Public Health Emergency
RRH	Regional Referral Hospital
SOP	Standard Operating Procedure
UNHCR	The United Nations' Refugee Agency
UPDF	Uganda People's Defense Force
WFP	World Food Program
WHO	World Health Organization

DETAILS OF THE PROJECT TEAM

Name	Position	Organization	Contact
Ms. Harriet Akello	Senior Pharmacist/Ug Team lead	MOH -DPNM	harakelo@gmail.com
Mr. Thomas Obua Ocwa	Senior Pharmacist/Ass. Team lead	MOH-DPNM	obthoc@gmail.com
Mrs. Neville Oteba	Commissioner	MOH-DPNM	
Ms. Juliet Namugga Kasule	Project team	MOH-PHEOC	hmo6@cdc.gov
Mr. Milton Makoba Wetaka	Project team	MOH-PHEOC	mmwetaka2@gmail.com
Prof. Dr. Stephan Wagner	Faculty Director HumOSCM Lab/ ETH team lead	ETH Zurich, Chair of Logistics Management	stwagner@ethz.ch
Dr. Bublu Thakur-Weigold	Associate Director, HumOSCM Lab	ETH Zurich, Chair of Logistics Management	sthakur@ethz.ch
Ms. Laura Heuser	Doctoral Researcher	ETH Zurich, Chair of Logistics Management	lheuser@ethz.ch
Ms. Eliane Müller	MAS student	ETH Zurich, Chair of Logistics Management	
Mr. John-Hans Wasswa	Technical Advisor	MOH-PHE	waswahans@gmail.com jhwasswa@msh.org