Redesigning vaccines CCE temperature monitoring data use and decision making using Human-Centered Design in Kenya and Tanzania

October 2020 - April 2021



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Acronyms

CCE - Cold Chain Equipment **DIVO** - District Immunization and Vaccines Officer

EPI - Expanded Program on Immunization

HCD - Human-Centered Design

HF - Health Facility

IMPACT - Information Mobilized for

Performance Analysis and Continuous Transformation

IVD - Immunizations and Vaccines

Development Program

JSI - John Snow Inc.

SCMET - Sub County Medical Engineer Technician

SCPHN - Sub County Public Health Nurse **CEPI** - County Expanded Program on Immunization **MoHCDGEC** - Ministry of Health, Community Development, Gender, Elderly and Children **MoH** - Ministry of Health **MET** - Medical Equipment Technician **NVIP** - National Vaccines and Immunization Program **PORALG** - Office of the President of the Regional Administration and Local Government **RIVO** - Regional Immunization and Vaccines Officer **RTM** - Remote Temperature Monitoring **RTMD** - Remote Temperature Monitoring Device(s)



Executive Summary

This report is a summary of insights and findings from the Human-Centered Design (HCD) approach and usability study conducted on national, regional, county, sub-county and health facility levels as well as partners working on vaccines cold chain management at all levels of the healthcare system in both **Kenya and Tanzania**.

Kenya - 3 Counties / 25 Sub Counties / 3 Facilities / 76 participants

Tanzania - 3 Regions / 11 Districts / 7 Facilities / 43 participants



Executive Summary

HCD was chosen due to its unique ability to place the user at the center of the design process and the involvement of various stakeholders in the development of solutions. This ensures that the solutions take into account the nuances and context of the setting.

Usability testing is an essential aspect of the human centered approach that tests the functionality of products on users during the development process.

In **Kenya**, the usability test was conducted to understand the health workers experience with cold chain temperature monitoring devices, gauge their understanding of Cold Chain Equipment (CCE) indicators, study the CCE data use and decision making and ultimately, redesign the CCE indicator visuals.

In **Tanzania**, the usability test was conducted to assess accessibility and usability of key CCE indicator visualizations in existing information management systems and highlight any shortcomings to allow for improvements. This way, the immunization managers can easily support improvement of CCE performance in their regions, councils and health facilities.



About Our Work

To ensure potency of vaccines in immunization supply chains, the Bill & Melinda Gates Foundation (BMGF) funded inSupply Health to undertake an HCD approach to understand users' preferences and the current challenges with using vaccines CCE temperature monitoring data for decision-making in immunization programs across all levels. This work covered both Kenya and Tanzania.





About Our Work

By investigating the understanding of vaccine CCE temperature monitoring indicators, testing the experiences with CCE monitoring devices, as well as understanding the level of CCE data use and decision making, we gained grounded, specific insights into the challenges experienced in vaccines CCE temperature monitoring data use and decision making. This formed the basis on how to redesign the CCE indicator visuals.



Thematic Areas

Our study is focused around four thematic areas:

Capture experiences with cold chain temperature monitoring devices

We aim to capture the wider background in which the immunization work relates with vaccine cold chain temperature monitoring data. We aim to understand the various devices currently being used and, note experiences, obstacles and challenges based on their interactions with the data and devices.

CCE data use and decision-making

The focus is to gain a better understanding of CCE data use in day-to-day decision making (both extrinsic and intrinsic) at all levels in the system. In addition to exploring what factors influence decision making, our focus is on understanding what information (both reported data as well as other, less formal information sources) is currently being used to make immunization decisions, what information might be currently inaccessible, not available at the right time or missing entirely, what information is currently being collected but not being used, and what other data would be useful to track.

Determine the level of understanding of CCE indicators

We would like to obtain a greater understanding of participants' comprehension of vaccine CCE temperature monitoring indicators. In particular, we will explore if there is any overlap between indicator definitions and whether the level of understanding is adequate to fully utilize the information for decision making.

Redesign the CCE indicator visuals

The goal is to capture insights from different levels of decision making on the key CCE indicators that were identified in collaboration with NVIP and partners. Ultimately, this will assist in the redesign of the visuals based on the recommendations given by immunization professionals to streamline data analysis and interpretation at all levels.



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Kenya Project Background

The Kenya Ministry of Health (MoH), through Gavi Cold Chain Equipment Optimization Platform (CCEOP) and the World Bank procured Cold Chain Equipment (CCE) and stocked 85% of Kenya's health facilities (HF) nationwide. Several measures were then implemented by MoH in collaboration with its partners to monitor the vaccines CCE temperature through innovative devices to ensure vaccine potency.

However, a variety of vaccines CCE temperature monitoring devices are being used at different levels of decision making. These devices track similar indicators but are visualized differently as each device has its own dashboard, prompting managers to log in to at least 3-4 dashboards in order to review overall CCE performance. As a result, it is difficult to review performance across the country and to triangulate between different immunization data streams to understand the link between CCE performance, utilization, and coverage.

In order to bridge these gaps, inSupply Health in partnership with New Horizons collaborated with the MoH to implement VARO applications and PogoDV dashboard and establish a CCE data use using a structured problem solving approach (IMPACT Teams) in 3 Counties; Mombasa, Turkana and Nairobi.



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Kenya Project Background

NVIP in collaboration with inSupply Health, convened a vaccine CCE temperature monitoring design workshop to provide a platform to demonstrate Kenya's current vaccine CCE temperature monitoring data visibility, data access, and data use. The outcome of this workshop was visual prototypes of priority vaccines CCE temperature monitoring indicators that would be used for decision making.



Tanzania Project Background

The Tanzania Ministry of Health, Community Development, Gender, Elderly and Children (MoHCDGEC) through the Immunization and Vaccines Development (IVD) program and JSI have been working to improve CCE availability and effective use through a Remote Temperature Monitoring (RTM) system.

To enhance vaccine potency, inSupply Health complemented the ongoing RTM initiatives by identifying indicators and proposing visualizations to be implemented in existing information systems and discussed in various forums including data review meetings.

To enable these initiatives, inSupply Health worked with 8 district councils in Mwanza Region and 1 council in each Singida Region (Singida DC), Tabora Region (Sikonge DC) and Dar es Salaam region (Kigamboni Municipal Council). The process involved identifying key indicators for monitoring CCE performance, training on interpretation, pre-testing their use and addressing any challenges reported by users. This allowed for the CCE managers to continue observing and supporting monthly follow-up of CCE monitoring by regions and councils.

IVD in collaboration with the Office of the President of the Regional Administration and Local Government (PORALG) and inSupply Health also planned supportive supervision visits for discussing CCE performance and key indicators that were identified during the data review workshops to gather more insights.



Tanzania Project Background

In addition, inSupply Health also worked with the immunization vaccine officers to resolve any challenges that they are facing in the vaccines Information management system (VIMS).

The indicators and visualizations identified are documented in indicator reference sheets and standards to guide monitoring of CCE performances to ensure vaccine potency with the ultimate goal of ensuring immunity in the community.



Methodology

Human Centered Design allows for an empathetic perspective of the world, where people act as both the central source of direction and the key benchmark for the viability of a solution.

Usability Testing

This is a qualitative approach that evaluates the overall user experience by establishing the intuitiveness of the product/service and the relative ease with which end users can accomplish a set of tasks that a typical user of the product/service would need to accomplish.

In Kenya, we conducted usability tests on prototypes of vaccine CCE temperature monitoring data visuals generated by key stakeholders as a way to reveal the usability issues experienced with the current visuals and identify insights on how best to reconfigure visuals. We also tested CCE visibility, access, and use at the different levels and how well understood CCE indicators were at each level, given that data use is predicated on users accessing visuals that are easy to interpret and act on.

In Tanzania, usability testing focused on visuals associated with key CCE indicators used for performance monitoring and to address system challenges. The focus was to enhance the ability of CCE managers to observe and support monthly follow-up of CCE monitoring by regions and councils.



Methodology

Data Processing and Analysis

During the testing, observation, and interactive activities we collected data via voice/audio recording (given the participant's written or verbal consent), note taking, as well as through visual observation tools. This data was analyzed through a technique called "insight generation". This is a HCD approach to data analysis, bringing together observers and stakeholders to gain deeper meaning of the data. This analysis is an interactive process where the relevant team members consolidated the raw data into meaningful insights.



Methodology

	Usability Testing Locations	Total Participants	Roles Interview	Focus Group Discussions	
Kenya	3 Counties: Mombasa, Nairobi and Turkana, 25 Sub Counties 3 health facilities	31 participants	Cold Chain Technicians, Nexleaf partners, County METs, CEPI, EPI logistician, SCMETs, SCPHNs, SC Depot Managers, EPI nurses, County Medical Engineers, Biomedical engineers, Depot SCPHN and Immunizing nurses.	45 health workers participated in a focus group discussion to uncover a lot more information in a short time.	 Executive summary Study Background Key Takeaways Recommend ations Visuals Redesign Participant
Tanzania	3 regions: Singida, Tabora, Mwanza 11 districts 7 health facilities	43 participants	Regional RIVOs, Assistant RIVOs, DIVOs, Assistant DIVOs and Immunizing nurses.	NA	6 Analysis

Study Sites & Participants: We included decision makers, data collectors and data users, including health system leaders, managers and service providers linked to the national immunization program during the study.



Decision Making Process: Lack of direct and timely access of vaccine CCE temperature monitoring data for decision-making

Some of the users did not have direct access to the Vaccine CCE temperature monitoring data when they needed it. For the sub county level in Kenya, they had to wait to receive reports at the end of the month, which makes it difficult to quickly adapt and make decisions in a timely manner. While in Tanzania, participants did have access, it was limited to facilities with RTMS leaving those without RTMS to uptime data only.

"For coldtrace 5 the challenge is that I keep forgetting the credentials but I think if I login in on my computer it gives me the temperatures but I don't remember off the top of my head. I do not use the dashboard because of the credentials. I will start using it when I get the credentials." **Sub County Public Health Nurse, Nairobi** "...we have not been informed about nor given a right to access. Especially for Nexleaf where we expected to access the data from the dashboard that monitors temperatures. This has not been possible because we are reliant on the national level..." - Sub County Public Health Nurse, Mombasa

"What I would really like is a system where I can monitor the fridges I am manning. I do not need to rely on someone to bring me the report at the end of the month. I would like to access and see what is happening and give feedback and download and print and tell the facilities what they are doing or their cold chain performance at the end of the month." - Sub County Depot Manager, Nairobi "I wish I would have a platform where I could get access to the data on real time instead of the cumulative data without visiting the numerous facilities, with such I'll be able to take a quick action..." - Sub County Public Health Nurse, Mombasa

"At our level we do not have any dashboards, we respond to calls from healthcare workers." -**SCMET, Turkana**

"Having access to CT5 data would be useful to know the behaviour of individual units....improve specificity of some units....I currently don't have access to the data...It would be useful for escalation." - **Biomed Engineer**, **Mombasa**



Decision Making Process: Multiple systems and login credentials limit CCE data accessibility and use at national & subnational levels

A number of the respondents cited their concern over not being able to access the RTM dashboard used to monitor temperature levels. Some of the respondents lost track of the passwords provided to them during on-boarding and have not followed up on getting them from the administrator. Respondents from Turkana mentioned that

comment on it.

have access to the dashboard find it difficult to follow up on alarms and performance because they have to refer to multiple dashboards. Furthermore, the visuals in these dashboards are not easy to read and understand so it is challenging to infer meaning from them. One respondent they had no experience mentioned the need with the RTM dashboard to share the and therefore could not information and the inability to do so.

The respondents in

the national level who

One of the respondents noted that it took a lot of effort to log in to the dashboards and noted that they had to use their own data bundles. This prevents them from frequent use of the dashboard

"I have a phone and I have a laptop.... By the way I displaced my diary that had my credentials....I do not use the dashboard because of the credentials....Lack of data bundles would also prevent us from logging in " - Sub County Public Health Nurse, Kasarani Nairobi

"I would appreciate alarms being sent to my phone rather than having to access it on the dashboard...A National dashboard would be easier to look at rather than having to multiple dashboards...I'm not able to share the data with anyone else in an understandable format...I cannot make inferences from the dashboards since the data is presented as a table, the visuals are not clear." - National Cold Chain Technician



Data Culture and Value: Basic CCE indicator knowledge is lacking

It was apparent that the majority of the issues that were being experienced by the users was due to lack of adequate training on the indicators. Some of the users could not correctly define the indicators and therefore could not correctly interpret the indicator visuals. This contributes to the attitude they have towards daily monitoring and recording of CCE data since they do not understand the purpose for it. When staff transfer occur. there is no clear plan for ensuring the incoming staff is given adequate training to take over the role and its responsibilities, creating gaps in knowledge.

"I don't understand the indicator. So I don't know if it works." - **EPI Nurse, Turkana**

"I really need to refresh my mind on the dashboard tools." - **Sub County Public Health Nurse, Nairobi**

"We need training on cold chain equipment and vaccine management and mentorship." -Kenya Registered Community Health Nurse, Mombasa County

"Key problems? Network problems, and sometimes lack of knowledge in reading the dashboard indicators." -**DIVO, Kigamboni** In response to the question, "What do you understand by the term effective holdover?" "Maybe I can guess but I'm not familiar with the terms." - Sub County Public Health Nurse, Mombasa

"I have experience with the fridge tag but most of at the facility have a knowledge deficit. We need training to be updated on new trends." - Sub County EPI Nurse, Turkana

"And again another thing is there is inadequate training. Not everyone is versed with the indicators so knowledge gap. When you talk about ITT or cold chain it is like greek to some people." - **Sub County Public Health Nurse, Nairobi**



Data Culture and Value: CCE temperature data is for daily decision-making

A large number of the respondents would prefer to receive data daily in order to be able to keep track of the vaccine potency to avoid wastage and take action where needed in a timely manner.

It is important to also know which facilities are experiencing electricity challenges in case the vaccines need to be temporarily moved to neighbouring institutions. The indicator visuals could be used during support supervision. "That data we also use as a training model or sample to show the faulty fridges and even during in-charge meetings we display to gauge the in-charge meetings data interpretation on whether they can tell the fridge is functioning or not using the data." - **Sub County Public Health Nurse, Nairobi**

"I would use the data on a daily basis to document and at the monthly basis I would use it to present to the county assembly" - Kenya Registered Community Health Nurse, Nairobi

"Change in colour gives me information about CCE temperature earlier before severe problem occurs." -**DIVO Mwanza** "We liaise with the neighbouring facilities for vaccine storage when there's closure of hospital or power outages. Also forward to the Sub County Nurse indicating the number and state of the VVM." - Kenya Registered Community Health Nurse (KRCHN), Nairobi

"...For county it is real time data that I monitor on a daily basis to assist me as a Program Officer to take action. For the facility I use fridge tag data during supervision to display recording for the 60 days. I would like to be provided with the analysed data on real time at the sub county and facility level as it would reduce the cases of vaccines that are not potent." -**Sub County Public Health Nurse, Mombasa**

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Data Culture and Value: Data discrepancies in temperature reports

Respondents resonated with having timely and accurate data. Many noted that there is a gap in data discrepancies between the temperature charts which are submitted in reports and what is on data loggers themselves.

Data accuracy is subject to uncontrollable external factors such as power outages. Quality is mostly affected by MoH staff being unable to read the data during weekends and holidays. "Data discrepancies between reported alarms in monthly IVD forms, temperature monitoring charts and the fridge tags." - **Iramba DC Tanzania**

"The data filled in IVD monthly form is not actual in some HF reports as it differs when I visit HFs during SS and distribution" - **Ikungi DC Tanzania**

"We have noticed of late there is a lot of forgery especially when you are not strict on the PDF printout." -Sub County Biomedical Engineer, Nairobi

"I sit with the depot manager and the facility-in-charge as we go through the PDF report." - **Sub County Biomedical engineer, Nairobi** "We complete temperature monitoring charts and that is the data that is used to supply vaccines to the facilities if the facilities don't report their temperature monitoring data we do not consider them." - **EPI Nurse, Turkana**

"There is a knowledge gap of users with reading FT2 & CT5...The FT2 training was last year and there was no follow up since then." - **Sub County Public Health Nurse, Mombasa**

"Over the weekend there is no data coming in. If we can capture data on weekends/national holidays. If the machine can print out to show the days when there is no data being recorded. A print out for the last 7 days"- **Sub County Biomedical Engineer, Mombasa**



"Reporting issues with how its recorded. Bad handwriting which you can't read the values properly. Sometimes the values recorded are different from PDF reports" - **Sub County Biomedical Engineer**, 23 **Mombasa**

Motivation: CCE Actions depend on pre-allocated resources

Due to risks associated with CCE breakdown. users need pre-allocated resources ready to support action e.g. back-up generators, fuel, phone calls, transport, and spare parts. The staff have to purchase data bundles to access the dashboards to view the CCE data. Many of the users have to use their own mobile phones and laptops as there are no desktops provided at their institution.

The respondents also expressed the desire to visit the health facilities for inspections and trainings which may need to frequently occur due to high staff turnover.

"I would need airtime because it would be consuming airtime. Some phones are not compliant with the gadget, for example Huawei. I suggest a tablet for monitoring CCE temperature." - **Sub County Public Health Nurse, Mombasa** "I think we have had enough training on the VARO but we will need support on the access and some facilitation for moving up and down. For example, I am based at the sub county, unless the facility calls you or brings you the PDF and there is a problem we are not able to make those impromptu visits to support the facilities unless we are supported once in a while. If we can have a computer at the depot that will also help." - **Biomedical Engineer, County Level, Nairobi**

"We need some gadgets. Sometimes it becomes hard to access the dashboards because of the phones we use or the memory is full so I see it better when doing some things. It is good you use some specific gadget not used for many operations. Sometimes it is a challenge, we need some transport allowance to go to some facilities where we need to conduct training because we move from one facility to another and they are not very close to each other." - **MET**, **Nairobi**

"We are going to use their phones, even though it doesn't use a lot of data bundles, sometimes they ask." - **Sub County Public Health Nurse, Nairobi**



EPI nurse,

Turkana

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Motivation: Slow response time to escalated issues demotivates staff

Majority of the FT2E temperature 30DTR loggers in the field have expired. Some of the institutions have been waiting for several months for device replacements. Private health institutions especially are overlooked in favour of public health institutions. New facilities have to wait for a long time to acquire new equipment.

In addition, many of the staff members could not access the dashboard due to forgotten passwords and login credentials. Some of them have never received access. Furthermore, the staff members require the RTM experts to make any repair and maintenance services to the RTM devices as they are not adequately trained to do it themselves. These services are not done in a timely matter, which prevents the staff from fully utilising the devices for temperature monitoring.

"For the RTM (Coldtrace 5) at the sub county level, we have not been able to access data for the past 7 months until last week when they were replaced." - **Biomedical Engineer, Nairobi** "NexLeaf at the Sub County depot which was introduced by the program uses power and is connected to all the fridges. It is intended to be connected to our gadgets however this is not yet done." - Sub County Public Health Nurse, Nairobi

"I have had issues accessing the RTM dashboard since October 2019..... I have to contact the RTM staff to move the sensors, since I cannot move equipment myself...... You find that for example I was transferred from Dagoretti to Starehe and I was getting alerts from Dagoretti while I am still in Starehe...." - **Biomedical Engineer, Nairobi**

"At our level we

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from healthcare

workers. We just

charts and MoH

reports to make

decisions.." - EPI

nurse, Turkana

use the

temperature



Day-to-Day Experiences: Shift from periodic descriptive reporting to real time proactive data use

The HCD process allowed us to identify new indicators that can be used in day-to-day operations to support proactivity and platforms that can be used to share insights with users. For CCE performance to improve, data use should go beyond monthly or quarterly meetings. It requires real time root cause analysis.

Category	Description	Indicators	Tool/Platform
Performance goal Indicators	Indicators that can be reviewed monthly/quarterly to show achievement or failure to take acton for recording, reviewing, reporting etc.	 Uptime Alarm rates Functional Status Stock outs 	 VIMS Coldtrace Dashboard
Action Indicators	Needs daily review for preventing, predicting and promoting action	 Cool (When temperature lowers) Hot (When temp starts to rise, visualized as red color, SMS alert) Under Stocked (running low of stock) 	 Mobile Solutions e.g. TImR, RTM SMS alerts Whatsapp Phone calls

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Executive Summary

Study Background

Key Takeaways

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Recommendations

Day-to-Day Experiences: Need for Robust Temperature Monitoring Devices

The most common cold chain temperature monitoring device currently in use is the FT2E. Other devices mentioned include VVM and FT2s. The respondents noted the user friendliness of the devices and the ability to access data remotely as being an advantage of RTMs as compared to analog 30DTR loggers (FT2).

However, there are some challenges being experienced. Some of the FT2 devices in the health facilities are faulty or expired and require fixing or replacement. Also, there is a discrepancy with the temperature monitoring, where FT2E and the RTMs may register different temperatures by +2°C or +3°C since the RTMs can be placed within the freezers while the FT2E cannot.

"For FT2E this has been the best gadget so far as it registers the temperature for a longer time and gives readings up to 60 days via laptop or tablet. However, the temp alarm mark X gives alarm without reaching the minimum temperature exposure -high or low temperature exposure." -Sub County Public Health Nurse, Nairobi "FT2E is a good device because it helps us monitor temperature of the refrigerator 24/7 even during weekends you can see if there was a problem over the weekend. The only problem that it tends to fail." -Sub County Public Health Nurse, Embakasi East and South

"Most of FT2E have expired and need replacement. RTM is not yet installed in my region. The ones that can be repaired we repair at our level." - **RIVO**, **Tanzania**

"We mostly use FT2Es. Most of them are not functioning properly. We need support for the facilities that don't have. **- EPI nurse, Turkana** "Sensors for Coldtrace RTMs get broken a lot and need replacements. We need support for the facilities that don't have." - **DIVO, Mwanza**

Day-to-Day Experiences: Unreliable electricity supply

Various parts of the country experience frequent power blackouts that interrupt the normal working of the temperature monitoring devices. Solar fridges are preferred to overcome this hurdle.

"RTM got introduced recently. It's working well. The only issue with it is power issues with the national grid. Despite the national grid being in Lokichar electricity comes and goes especially on Friday & Saturday." -Sub County Public Health Nurse, Turkana

"There is unreliable power. Electricity is not stable especially on Friday and Saturday compromising vaccine potency....Gas and electric fridges are unreliable at times. I propose solar fridges." - **Public Health Nurse, Turkana**

"Power issues and electricity not being reliable. We have now a generator that helps with this." - **EPI nurse, Turkana** "Proposal to have solar given that the gas and electric types are unreliable at times.." - Kenya Registered Community Health Nurse, Nairobi

"The RTM is a higher level device and sends messages. The challenge is that if somebody unplugs the refrigerator, or there is no electricity, it reads "no data". It needs to be somewhere where there is constant electricity." - **Sub County Public Health Nurse, Nairobi**

"Sometimes, when there are weather changes or power cuts, the refrigerators produce multiple alarms. Some facilities use both solar (during the day) gas (during the night) as a source of power." -**DIVO, Mwanza**



Usability Test Observations

The researchers recorded the participants' feedback using audio and written notes. For this report, the visuals and other issues have been divided into major categories for ease of digesting the findings.

Each of the issues have the **type of error** and the **level of impact**. The types of errors are divided into two categories, **severe** and **non-severe issues**.

- Severe issues prevent the user from completing the intended goal of a task.
- **Non-severe issues** are those that cause some discomfort to the user when they are trying to complete a task. They might be able to complete the task but solving these non-severe issues will make it easier and more efficient.

The other category is the level of impact. This is divided into High, Moderate or Low.

- A high score means the user cannot complete the intended goal of a task.
- A **moderate score** means the user experiences some difficulty when trying to complete a task but is able to complete the task.
- A low score means the problem does not significantly affect the completion of tasks for the user.

Note: Severe issues have high scores while non-severe issues have either moderate or low scores.



Usability Test Observations - Kenya

Visuals	Issues	Type of Error	Score	
Refrigerator/ Fridge Uptime	 Lacks the key that explain the axis The users were not able to specify the time period of when the vaccines were exposed to high or low temperatures 	Severe	High	 Executive Summary Study Background Key
Freeze/Heat Excursion Time	 The percentage time represented was not well understood by users The users were not able to tell when the temperatures were normal 	Severe	High	Takeaways (4) Recommendations (5) Visuals Redesign (6) Participant
Effective Holdover/Autonomy for Solar	- This visual was not widely understood - Users could not understand what the different colours represented or the time period due to lack of a key	Severe	High	Analysis
Frequency of Heat/Freeze Alarm	 The users were unable to tell which alarm occurred the most The users were unable to tell how many times an alarm occurred 	Severe	High	30

Usability Test Observations - Tanzania

Visuals	Issues	Type of Error	Score	
Functional Status of Cold Chain	Updates are not automatic.	Non-severe	Moderate	 Executive Summary Study Background
	spare parts or maintenance	Severe	High	3 Key Takeaways
	Lack of clarity on how to handle obsolete CCE	Non-severe	Moderate	(4) Recommendations
	DIVOs could not update some very old equipment with no serial numbers in VIMS	Non-severe	Moderate	5 Visuals Redesign 6 Participant
Temperature	Malfunctioning RTMs cause multiple alarms	Severe	High	Analysis
Alarms Rate (Heat and Freeze Alarms)	Users are not able to correctly use the thermostat to regulate temperature causing multiple alarms	Severe	High	

Usability Test Observations - Tanzania

Visuals	Issues	Type of Error	Score	
Cold Chain Equipment Uptime	Some of the users had not undergone training and therefore did not understand the indicator	Severe	High	1 Executive Summary 2 Study
Completeness of CCE data and %	Receipt of data is affected by network connectivity	Severe	High	Background 3 Key Takeaways
Time RTM devices are sending or not sending data	Poor usage practices such as removing the RTM chargers to charge phones affecting percentage of time RTM devices are sending data	Severe	High	 (4) Recommendations (5) Visuals Redesign (6) Retrigient
Stock Status	Stock distribution interruption: the distribution schedule may be interrupted due to the facilities lack of resources such as vehicles for transportation	Severe	High	Analysis
	DIVOs are not using the VIMS feature for stock forecasting because they lack knowledge on how to use it	Severe	High	
	Vaccines are distributed manually and then updated on the system which is contrary to what should be done.	Non-severe	Moderate	30



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Recommendations and action items

The following are the observations and subsequent recommendations made by the users. We have used the score scale with 1 being the highest and 4 being the lowest score. This is further outlined below:

- Score 1 High severity problems that often prevent a user from correctly completing a task. They occur in varying frequency and are characteristic of calls to the Help Desk. Reward for resolution is typically exhibited in fewer Help Desk calls and reduced redevelopment costs.
- Score 2 Moderate to high frequency problems with moderate to low severity are typical of erroneous actions that the participant recognizes needs to be remedied. Reward for resolution is typically exhibited in reduced time on task and decreased training costs.
- Score 3 Either moderate problems with low frequency or low problems with moderate frequency; these are minor annoyance problems faced by a number of participants. Reward for resolution is typically exhibited in reduced time on task and increased data integrity.
- **Score 4** Low severity problems faced by few participants; there is low risk to not resolving these problems. Reward for resolution is typically exhibited in increased user satisfaction.

This should assist in prioritisation of issues to fix. A high severity score requires urgent attention because it affects the correct completion of tasks by the user. A low severity score does not mean that it is inconsequential. It would be good to solve these issues as it would increase user satisfaction but it would not necessarily hamper the completion of tasks.



Kenya

Visuals	Recommendation	Score	
Refrigerator/ Fridge Uptime	 Provide an option or prompt to view another indicator like alarms when problem solving, to assist the user to know what to do next 	2	 Executive Summary Study Background Key
	 Add the location and the number of equipment that are performing at an optimal or suboptimal level in order to know where to make an intervention 	2	Recommendations
	- Add data labels	1	(5) Visuals Redesign (6) Participant Analysis
	 Have a drill down functionality in the dashboard to select time period of choice: Date Filter feature 	2	
	 Add a generate report feature on the dashboard that provides a detailed analysis of the indicator and what it means 	2	

Kenya

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Visuals	Recommendation	Score	1 Executive Summary
Effective	- Add a key to explain what the visuals mean	1	2 Study Background
Solar	- Add the definition of the indicator	1	(3) Key Takeaways
	- Define what is normal and what is abnormal to help	1	4 Recommendation
	users know what to expect		5 Visuals Redesign
			6 Participant Analysis

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Kenya

Visuals	Recommendation	Score	
Freeze/Heat Excursion Time	 Provide a quick introduction on the various features on the excursion indicator for the user to be aware of what they can learn from the indicator 	1	(1) Executive Summary (2) Study Background (3) Key Takeaways
	 Arrange the bars from the highest to the lowest excursion for the different fridge models 	3	4 Recommendations
	 Specify the time period that the graph represents. Instead of percentage, give total hours 	1	5 Visuals Redesign 6 Participant Analysis
	- Display the percentage of time when the fridge was operating at normal temperature	2	
	- Label the bars with the numbers to make visual interpretation easier	1	

Kenya

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Visuals	Recommendation	Score	Executive Summary
Frequency of	- Add time period filter in dashboard	2	2 Study Background
Heat/Freeze Alarm	- Consider arranging the bars from highest to lowest	3	3 Key Takeaways
	- Have a summary of heat and freeze alarms across models	3	4 Recommendations
	- Label the axes and bars or consider unstacking the bars	1	5 Visuals Redesign
	- Consider a different color coding to distinguish the indicator	4	6 Participant Analysis
	 Have a bar graph showing the comparison between the alarms and different fridge models 	2	

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Sections	Recommendation	Score	1 Executive Summary
Functional Status of Cold Chain Equipment	 Updating the CCE status in the monthly reports should also update the status in the CCE inventory 	2	 Study Background Key Takeaways
	- Ensure RTM devices can update inventory status	2	4 Recommendations
	 There should be standards on how to handle functional and non-functional CCE available to the users 	3	5 Visuals Redesign 6 Participant
	 Phone calls to HF staff can help in Root Cause Analysis in case of device malfunction 	2	Analysis
	 Labeling CCE with the RTM sensor number makes it easier to reconnect when they get disconnected 	2	

Sections	Recommendation	Score	
Functional Status of Cold Chain Equipment	- Most users preferred the first visual (vertical) for functionality status with a drill down feature. It was easy for them to interpret	1	 ① ① Executive Summary ② Study Background
	CCE FUnctional Status- District X		3 Key Takeaways 4 Recommendations
			 (5) Visuals Redesign (6) Participant Analysis
	Functional Drill down		
	Functional and Installed32Waiting For repair3Functional Not Installed2Obsolete2Total Functional CCE34Total Non Functional CCE5		40

Sections	Recommendation	Score	
Temperature Alarms Rate (Heat and Freeze	 HCWs need training and written instructions on how to regulate temperature for different refrigerator types 	2	 Executive Summary Study Background
Alarms)	 DIVOs need training on proactively using the daily visualization dashboard to prevent alarms 	2	 Key Takeaways Recommendations
	- Provide access to indicator reference sheets	2	5 Visuals Redesign Participant Analysis
	 Develop a learning package where they can easily access and be reminded 	2	
	- On-the-job training for old staff as a refresher and for new staff	2	

Visuals	Recommendation	Score		Frecutive
Cold Chain Equipment Uptime	There needs to be training on how to use CCE uptime, due to lack of knowledge	2	① ② ③	Sudy Background Key Takeaways
Completeness of CCE data and % Time RTM devices are sending or not sending data	When RTM device sensors fail, replacements or repairs on the sensor can be done faster to avoid delays	1	(4) (5) (6)	Recommendation Visuals Redesign Participant
	There can be communication with the Telecommunication companies to improve the quality of internet connectivity service	3		Анадул

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Visuals	Recommendation	Score	Executive Summary
Stock Status	DIVOs needed to be trained to access and interpret stock status dashboards and reports. After training the DIVO will be able to understand and appreciate decisions that could be made through the visuals. Videos/learning packages that can be accessed by DIVOs to orient them on how to use the system effectively with real case scenarios	2 2	 2 Study Background 3 Key Takeaways 4 Recommendation 5 Visuals Redesign 6 Participant Analysis

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Kenya

The following section displays the redesigns of the visuals based on the recommendations from the health workers at various levels in Kenya.

Key additions to the designs include:

- Definitions of the vaccine CCE temperature monitoring indicators
- Response to alarms and detailed actions to be taken
- A report feature that allows the health workers to download the detailed analysis of the indicators
- A clear depiction of the number of refrigerators that are performing at an optimal or suboptimal level and where they are located to guide intervention efforts
- Addition of labels and descriptive keys for easier identification of data on the visuals

The prototype visuals are included with a breakdown of the changes made for comparative purposes.

Note: Not all recommendations were implemented. The team prioritised changes that would have the most impact in the understanding and use of the vaccine CCE temperature monitoring indicators. It was also clear that some of the issues would be addressed when we implemented the prioritised recommendations. Therefore, there was no need.



Prototype visual 1 : Freeze/Heat Alarm

Recommendations implemented

- Adding a time period filter that allowed the users to view the specific date the refrigerator models had alarms
- Including a summary of heat and freeze alarms across the different fridge models
- Labelling the axes

Recommendations not implemented

- Consider arranging the bars from highest to lowest
- Consider unstacking the bars
- Consider a different color coding to distinguish the indicator





Frequency of freeze/heat alarm : Hover over the bar to highlight and view number of alarms and actions to be taken



Frequency of freeze/heat alarm: Click the action button to view supported responses to the issue.



Frequency of Freeze/Heat alarm: Actions to be taken are listed in the red ACTION box.

Prototype visual 2: Freeze/Heat Excursion Time

Recommendations implemented

- Provided a quick introduction on the various features on the excursion indicator for the user to be aware of what they can learn from the indicator
- Specified the time period that the graph represents instead of percentage, give total hours
- Labelled the bars with the numbers to make visual interpretation easier

Recommendations not implemented

- Arrange the bars from the highest to the lowest excursion for the different fridge models
- Display the percentage of time when the fridge was operating at normal temperature





Freeze/Heat excursion time: Hover over the bars to highlight and view the excursion time period.



Freeze/Heat Excursion time: Click on the action button to view the supported responses to the issue.



Freeze/Heat excursion time: Actions to be taken are listed in the red ACTION box.

Prototype visual 3: Effective holdover/autonomy for solar

Recommendations implemented

- A key was added to explain what the visuals mean
- A definition of the indicator was added
- The definition of the indicator was added to define what was normal and what was not

Effective holdover/ autonomy for solar



Days (Occurrence Date)

Note

Y –axis: Runs from 0° C to 10° C



Effective Holdover/ Autonomy for Solar: Sub county view - Click on the specific facility option listed to view the devices contributing to Holdover totals then once the facility is in focus, hover over the bars to view the holdover time period for that specific location. Click to view further details.



Effective holdover/Autonomy for solar: Facility view - From the previous bar graph we have clicked, we can now view further details. Hover over the power availability section to view the holdover time period.



Effective Holdover/Autonomy for solar: To view the list of fridge types, click on the drop-down arrow.



Effective holdover/ Autonomy for solar: View the list of fridges and toggle through.

Prototype visual 4: Refrigerator/Fridge uptime

Recommendations implemented

- Added location and the number of equipment that are performing at an optimal or suboptimal level in order to know where to make an intervention
- Added data labels
- Have a drill down functionality in the dashboard to select time period of choice : Date Filter feature
- Added a generate report feature on the dashboard that provides a detailed analysis of the indicator and what it means

Recommendations not implemented

 Provide an option or prompt to view another indicator like alarms when problem solving, to assist the user to know what to do next





Refrigerator/Fridge uptime: County & Sub county view - Click on the facility to see the devices contributing to uptime performances.



Refrigerator/Fridge uptime: Facility view - Scroll through to view the other devices that are contributing to the uptime.

The following section displays the redesigns of the Functional CCE status and CCE model performance visuals based on the recommendations from the health workers at various levels in Tanzania .

The prototype visuals state which option was preferred by the users and a brief breakdown of the changes made for comparative purposes.



Prototype visual: CCE Functional Status



VISUAL_2: Functional Status- Bar Chart

Respondents preferred **Option 1** over Option 2 citing ease of interpretation.



Vaccine Information Management System (VIMS)

TANZANIA 🔰 MWANZA REGION



CCE Functional and Non-Functional status in numbers: Displays the total number of functional CCE devices that are functional and installed and those that are functional but yet to be installed in a specific region.

Recommendations implemented

The visual was simplified to only have two reasons for non-functional CCE which are:

- Waiting for repair, and
- Obsolete.

Reasons

The bar graph was replaced with a circle graph specific to the region or council being viewed.

Also, the total number of devices is displayed next to the *Waiting for repair* and *Obsolete* options.





Vaccine Information Management System (VIMS)

TANZANIA 🕻 MWANZA REGION



CCE Functional and Non-Functional status in numbers: Displays the total number difference as well as the number of non-functional CCE waiting for repair or replacement due to being obsolete in a specific region.



Vaccine Information Management System (VIMS)

TANZANIA > MWANZA REGION > UKEREWE



CCE Functional and Non-Functional status in numbers: This is for a location within the Mwanza region. One can drill down to find out which specific districts within the region are contributing to the functional and non-functional CCE status

Prototype visual: CCE Model Performance



Recommendations implemented: Instead of percentages, the bar graph will display actual number of devices



Vaccine Information Management System (VIMS)

TANZANIA 🗲 MWANZA REGION



CCE model performance: Displays each model and the number of functional or non-functional devices from that specific model in a comparative bar graph. Hover on the bars to view specific numbers.



Key Actors: National

CHALLENGES

Systems may give alerts but there are delays in taking actions.

Not all devices or systems are sending data.

It becomes costly when there are many alarms or broken sensors despite budgeting.

Systems/tools that require someone to be there physically and login to monitor the data. It cannot be accessed remotely.

Remote temperature monitoring systems are costly to maintain and support e.g. *Beyond Wireless* has annual subscriptions fees to access the dashboards.

Multiple siloed interventions

RECOMMENDATIONS

Present a cost friendly solution to viewing CCE related data at the national level.

Adopt CCE dashboards that are flexible and can be cascaded to the lower levels.

Provide access to CCE data on multiple platforms sourcing RTMDs.

"I have a good understanding of the CCE vaccine temperature monitoring indicators. I need to know CCE inventory and performance in the field currently and get historical data. I usually make calls to people to request for this information but it usually takes time. I have access and am able to use data but its in multiple platforms." "The only limitation I see is the multi-log. It is a computer based program without data bundles then I am not able to benefit from it when there are alarms." - **Kenya, Cold Chain Technician**

"The multi-log that does not give me alerts it uses SMS based data. We buy monthly. The more alarms the more the data and when you don't engage it is over then you find you do no have any alerts." - **Kenya, Cold Chain Technician**

"The visualization is also there but it is only on the computer that it is only installed on." - **Kenya, Cold Chain Technician**

"CCE needing thermostat adjustment is a recurring problem and nurses are not well trained." - **IVD Program** officer- Logistics



(3) Key Takeaways



(5) Visuals Redesign



Participant Analysis

Key Actors: County/Regional

CHALLENGES

Fridge tags sometimes expire and can not be used any more

No experience with using RTM

Internet and Network problems

Replacement of spare parts, sensors and devices is delayed by availability from National level

RTM devices could be connected wrongly in the CCE and resulting in false reports

Devices not sending data or systems not updated

Delays for sub county and facility staff to take actions

RECOMMENDATIONS

A dashboard that could help me analyse the data coming from the facilities.

There needs to be consideration of power outages and internet availability when making cold-chain decisions.

Introduction of the CCE indicators to maintain refrigerators with alarms seen on fridge tags.

Use VIMS system to produce reports on CCE functional status.

A good pipeline of spare parts.

"I have some experience interacting with CCE vaccine temperature monitoring indicators and occasionally access data from dashboards. I am responsible to help district or sub county managers use data to troubleshoot CCE issues, budget and plan for preventive maintenance in their sub county/district. I am responsible in mobilizing for spare parts in my county/region." "The positives is that it helps the user to know whether the fridge is within the optimal temperature" -**Kenya, Turkana County**

"I have no experience with any dashboard." - Kenya, Mombasa County

"I have experience with fridge tags...not so much experience with RTMS" - **Kenya, Turkana County**

"At our level we do not access the dashboard. Of late we have been receiving reports from the national level when our devices are not working and we take action by sending the biomed engineers to resolve the issue" - Kenya, Turkana County

"The system provides very useful information but DIVOs are not taking actions, I sometimes end up calling facility staff myself." - **RIVO Singida in Regional Data review Meeting**

"Updating CCE inventory should be automated when charting in VIMS monthly forms and when adding new CCEs" - **Mwanza RIVO in Regional Data review Meeting**



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Key Actors: Sub county/District

CHALLENGES

Fridge tags sometimes fail and cannot be used any more

Little experience with a temperature monitoring indicators

Mismatch of CCE data in paper forms, charts and electronic data from health facilities

Knowledge gap for health facilities to troubleshoot CCE issues

Lack of financial resources and spare parts

Power cuts

RECOMMENDATIONS

Conduct training to Health workers on the CCE vaccine temperature monitoring indicators

On Job Training to Health workers on how to interpret the CCE vaccine temperature monitoring visuals and the colours used

Provide access to analysed data in real time at the sub county and facility level would reduce the cases of vaccines that are not potent. "At our level we do not have any dashboards, we respond to calls from healthcare workers." - Sub County Biomedical Engineer, Turkana

"Some health workers forge temperature charts if they are unable to read them." -**Turkana South EPI nurse**

"Sub county depot needs a thermostat" -Turkana South EPI nurse

"Some data completeness challenges is due to power source" - DIVO Kigamboni

"I have very little to no experience interacting with some CCE vaccine temperature monitoring indicators and I get data from paper forms monthly and periodically access electronic CCE vaccine temperature monitoring data from dashboards but its very new to me."

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Executive

Summary

Background

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Visuals

Redesig**n**

Participant

Analysis

Recommendations

Study

Key

