Cold chain equipment inventory guidelines

Improving the quality and accuracy of national cold chain equipment inventory data

An actionable guide to processes and standards for cold chain stakeholders
Background

Accurate and up-to-date cold chain equipment inventories (CCEIs) are essential to effectively managing cold chain assets within a health system. Updated CCEI data enable governments to make informed decisions on vaccine distribution and storage, equipment maintenance and repair, routine and campaign immunization planning and procurement. This document provides guidance and rationale for key stakeholders throughout the cold chain on why and how to maintain accurate cold chain inventories.

CCEI data are widely used for the following purposes:

- **Asset management:** Data on cold chain equipment (CCE) location, make/model, age/installation date, functional status, temperature alarms, time to repair, warranty claims, and spare part consumption are illustrative indicators that inform asset and performance tracking, maintenance and repair services, and budget decisions.

- **Vaccine introductions and campaigns:** Data on CCE functional status, performance level (i.e., uptime), and storage capacity provide essential information for national Expanded Programme on Immunization (EPI) managers during vaccine introduction and campaign planning and implementation.

Challenges

Developing and maintaining an updated CCEI is resource and labor intensive. Ensuring the accuracy of CCEI requires standardized indicators and consistent reporting systems. The following section provides more detail on these challenges. These include:

- **Inconsistent CCEI data and data standards:** The lack of standardized indicators can lead to differing metrics and inconsistent data quality. Even when standards are clear, simple CCE information—such as serial numbers—can be challenging to find on devices. Without high-quality data, CCE managers are limited in their ability to effectively monitor performance metrics of CCE equipment. This lack of data also leads to challenges in managing maintenance and repair services, spare part inventories and purchasing decisions, and decommissioning processes.

- **Varied CCE reporting systems:** The use of multiple and unique CCEI inventory reporting systems with differing data further exacerbates the varying challenges of inconsistent inventory data CCEI inventory data that EPI managers must review and interpret. In some cases, neighboring regional districts have distinct systems and indicators, which again, complicates effective management and reporting.

- **Constrained resources for CCEI inventory data collection:** Developing or refreshing national CCEIs inventories requires a significant investment in labor, coordination, and supervision. Many countries conduct ad hoc, nation-wide campaigns as part of their cold chain equipment CCE optimization platform application; however, without continually refreshing this CCEI data, these CCEIs quickly become outdated. National cold chain budgets typically do not include annual resources to support routine data collection activities.

- **Unclear ownership of CCE and/or inventory maintenance:** The resources, protocols, and personnel who contribute to maintaining CCEIs are often dispersed across various Ministries and Departments within governments (e.g., Expanded Programme for Immunization, Finance, Procurement, Biomedical engineering, etc.). The dispersed accountability can lead to confusion and unclear ownership of CCE and/or inventory processes.

These challenges affect actors and processes from the national level down to the individual health care facility. The impact of these challenges is arguably greatest in the lowest health administrative levels.

Addressing CCEI data gaps at the lowest health administration level offers the greatest opportunity to catalyze change within this data system. Up-to-date CCE inventories improve the delivery of critical vaccines and management of cold chain equipment within a country. Equally as important is establishing clear standard operating procedures and roles and responsibilities for managing the generation and maintenance of CCEI data.
CCEI data generation

Various individuals interact with CCEIs in distinct ways. Existing guidelines describe the flow of CCE and data through the health system; however, there is a lack of clear and consistent guidance for district and health care facility staff on processes and requirements for regularly collecting CCEI data. This guide uses personas of four key actors to capture the roles, responsibilities, and challenges in CCEI data collection and reporting. These four actors are outlined below and are described in further detail in the following sections. Simple data collection templates used by these actors can be found in Appendices A-E.

**National/regional EPI manager**

The EPI manager oversees the immunization program and flow of vaccine stock through the cold chain. This person uses aggregated and analyzed CCEI data—such as the Dashboard for Immunization Supply Chain (DISC)—for forecasting, budgeting, and procuring appropriate CCE.

**Key challenges include:**

- Inability to effectively report and plan due to inaccurate CCEI data. This can lead to delays in campaign planning, CCE maintenance and repairs, purchasing of spare parts, and CCE uptime reporting.

**Cold chain equipment technician**

Subnational CCE technicians are responsible for ensuring CCE remain functional within their assigned geographies. Planned preventative maintenance, repairs, and installation are among their regular activities. Subnational CCE technicians regularly report inventory and repair needs to national technicians, who use aggregated CCEI data for planning and repair prioritization.

**Key challenges include:**

- Vague and insufficient descriptions of CCE faults make diagnosis challenging. These diagnoses are further complicated by a lack of technician bandwidth or technical capacity, lack of diagnostic tools or spare parts to test repair solutions, and unclear and nonstandardized CCE repair reporting processes.

**Cold chain equipment manager/ logisticiant/ vaccine store manager**

A cold chain equipment manager/ logisticiant/vaccine store manager oversees and manages vaccine stocks and distribution. This person ideally relies on CCEIs—specifically CCE functional status and available storage capacity—for planning purposes.

**Key challenges include:**

- Allocating vaccines to health facilities is challenging without data on CCE functional status and available vaccine compartment space. The lack of CCEI installation and functionality data also complicates exercising rights to equipment warranties for repair and replacement.

**Healthcare facility staff**

Frontline health care workers—such as health immunization workers—have many responsibilities outside of vaccinating children, including conducting planned preventative maintenance to clean or defrost CCE, recording CCE temperatures, and reporting equipment malfunctions.

**Key challenges include:**

- Limited technical capacity and time available to troubleshoot and diagnose CCE, which results in delays in reporting CCE faults.

An up-to-date CCEI will enable CCEI stakeholders across the cold chain to make data-informed decisions; plan for procurement, rehabilitation, and replacement of existing CCE; and effectively prioritize time and resources.
Improved CCEI

A robust, accurate, and up-to-date CCEI should include basic data fields. The consistency of indicators within a national CCEI ensures data are interoperable across different applications and users. There are several high-priority fields that need to be used and updated consistently by all. These include:

- Location and health facility name (pulled from national master health facility list).
- Cold chain asset ID (serial number or unique identifier).
- CCE make/model.
- CCE installation date.
- Equipment functional status (functional; functional, needs repair; nonfunctional).

Additional data fields can equip CCE managers with a richer picture of CCEIs and overall data to make decisions. Examples of additional data fields include: nature and date of prior repairs, spare parts installed, model and serial number of voltage stabilizers, number of cold boxes, number of vaccine carriers, etc.

CCEI tools and systems

Several types of CCEI data collection systems and tools exist, as outlined in the following.

Paper-based systems: Manually tallied CCEIs require a significant effort to maintain and are tedious to update. Data are typically received via hard-copy documentation. In many cases, the variability of reporting forms and lack of guidance on forms means significant investment of time into data cleaning is needed to ensure data are consistently reported.

Electronic systems: Electronic-based CCEIs can be simple Microsoft Excel spreadsheets or more complex applications [e.g., electronic Logistics Management Information System (eLMIS), Cold Chain Equipment Manager (CCEM), District Health Information Software 2 (DHIS2), Open Data Kit Tool Suite X (ODK-X) CCEIs; see Appendix A for more information] that analyze and forecast vaccine equipment needs. Inputs to these systems can be provided either through digital technologies (e.g., mobile phones and tablets) or manually entering paper-based data.

CCEI system choice

Countries should select and employ systems and tools that are appropriate for users’ capacity and those that support CCE management and decision-making.

The following personas present some key roles for actors in the immunization system who typically have responsibilities for CCE. In practice, individuals’ responsibilities may range over multiple roles. To ensure strong management of the equipment, all the key responsibilities should be assigned within one team.
Cold chain equipment inventory persona

HEALTH CARE WORKER

I play a key role in providing timely, accurate data to my cold chain technician on how the CCE is functioning in my health care facility.

CCE roles/responsibilities

- I store and retrieve vaccines from CCE and deliver safe and potent vaccinations to members of my community.
- I conduct basic monitoring (e.g., recording temperature on a paper log) and maintenance (e.g., wiping out vaccine compartment and cleaning CCE solar panels).
- When there are issues with the refrigerators, I call my cold chain technician and report the problem.

CCEI engagement

Every day, I make sure the temperature display on the CCE is within the correct range. I record this information on a paper temperature monitoring form next to the CCE.

<table>
<thead>
<tr>
<th>When my refrigerator is not working I...</th>
<th>so that...</th>
<th>...to maintain the availability, potency, and efficacy of vaccines at my facility.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consult my contingency protocol and relocate vaccines if temperatures go out of range</td>
<td>The vaccines remain safely stored</td>
<td></td>
</tr>
<tr>
<td>First follow the basic troubleshooting steps I was trained on</td>
<td>I can quickly fix the repair myself</td>
<td></td>
</tr>
<tr>
<td>Call my local technician if basic troubleshooting does not work</td>
<td>The technician can provide additional guidance or conduct an in-person visit to inspect or repair the CCE</td>
<td></td>
</tr>
</tbody>
</table>
Current challenges faced

- I did not receive or cannot remember all the steps I was trained on regarding which data to report and how to find those data.
- Sometimes, the data requested cannot be provided.
- I cannot report the temperature if the serial number of the CCE is scratched off or I do not know where it is located.
- The volume of patients I manage is very high. Taking the time each day to write down data on the CCE, in addition to the temperature data, is difficult, time consuming, and cumbersome. I am not sure what happens with these data.
- I am not here every day, so sometimes data are not captured.
- I was not trained on how to fix CCE problems and am not sure how to describe the problem (i.e., what information the technician wants).
- I have to use my own cellular phone data to call the district technician, who sometimes I cannot immediately reach.
- Long time passes from when I call the technician for repair to the time they are actually able to come to my health facility. They must be busy.

CCEI data

On an ongoing basis (monthly is preferred), I communicate the following data points, either on the phone or when the district technician comes to visit our facility (see Appendices A to C for sample tools):

- Health facility name and administrative information.
- Manufacturer, model, serial number, and functional status of all CCE assets.
- 30 day temperature recorder (DTR) or other temperature recording device.

Why collect CCEI data?

- Providing updated and accurate CCEI data helps my technician plan and quickly repair my CCE.
- Adhering to established inventory data standards improves the efficiency and effectiveness of the entire CCEI reporting system.
- I can be sure the vaccines I am giving children are safely stored and secured.

CCEI checklist for health care workers:

- Does the district technician have the most up-to-date data on the CCE for this facility?
- Have CCE monitoring and preventative maintenance steps been completed and reported to the technician this month/quarter?
- Have CCE problems/faults been reported to the district technician? Is it clear what problems I should report and how?

Note: It may not seem like taking these steps will help, but as data are generated with your help, a more reliable cold chain will be built!
COLD CHAIN EQUIPMENT TECHNICIAN

Inventories help me track CCE functionality, plan maintenance and repair visits, and provide data on spare parts needed.

CCE roles/responsibilities

- I am a trained CCE technician located in a district (or equivalent tier) EPI office or with a contracted maintenance company.
- I am responsible for monitoring the functionality of CCE in my district, repairing CCE either in health facilities or my workshop, and reporting data on a set timeline to the higher levels of the supply system.
- I distribute vaccines to health facilities within my district.
- I liaise and coordinate with other cold chain personnel (e.g., cold chain assistants and immunization focal points) in my district.

CCI engagement

In order to ensure CCE are properly functioning in my district and that accurate CCEI data are reported to regional and national offices, I constantly monitor the functional status of CCE in my district/region.

<table>
<thead>
<tr>
<th>When CCE is not working I learn via...</th>
<th>so that I can...</th>
<th>...to maintain the availability, potency, and efficacy of vaccines at my facility.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A call from the health care worker and/or visits to health care facilities</td>
<td>Identify and locate the CCE&lt;br&gt;Review the maintenance record of the device*&lt;br&gt;Understand the nature of the problem with the unit and what has been tried to fix the issue&lt;br&gt;Plan for a site visit with the appropriate parts and tools&lt;br&gt;Repair the device and update the repair job card (date of repair, parts replaced, reasons for failure if known)</td>
<td></td>
</tr>
</tbody>
</table>

*Note: If the device is under warranty, the health facility typically calls the warranty provider directly. If possible, I accompany the warranty provider to observe the repair.
Current challenges faced

- Descriptions of faults by facilities are unclear and not standardized—making it challenging for me to determine what repair is needed.
- Quality of CCEI data is not consistent or data are simply absent. Focal person/nurse is hard to reach and constant shuffling of staff to new facilities leads to unknown contacts with unknown technical knowledge.
- Not enough time, resources, or correct/enough spare parts and tools.
- I am currently expected to use my own phone airtime to collect and collate CCEI data, which is a burden.
- Large number of facilities need support.
- Paper manuals exist but they are outdated, cumbersome, and not readily accessible to help me address the CCE faults.
- No clear method/form for tracking repairs/parts. I am not sure what the regional/national team does with these data.
- Little or no guidance available on how to decommission/dispose of equipment.

CCEI data

I communicate and/or visit health care facilities to collect and report the following data points (see Appendices B to E for sample tools):

- Facility name and administrative information (e.g., catchment area).
- Manufacturer, model, serial number, and functional status of all CCE assets.
- Equipment maintenance logs (if available and which note date of failure/date of repair) and warranty status.
- Fridge-tag data and freeze alarm reports.
- Model and serial number of voltage stabilizers for grid-powered CCE.
- Number of vaccine carriers in the district.
- Number of cold boxes.
- Maintenance job cards (reported fault, services provided, spare parts used, repair dates), if available.

Why collect CCEI data?

- Having consistent and accurate CCEI data collected through a systematic approach helps me plan for the week/month and secure the resources I need to be successful.
- Tracking spare part use systematically would allow me to more effectively order and manage spare parts needed for the equipment in my district.
- By updating the CCEI, I can be sure that the vaccines I distribute are properly stored in the 2°C to 8°C temperature range.

CCEI checklist for CCE technicians:

- Have you collected and verified the most updated data on the CCE in your district this quarter?
- Have you sent the accurate dataset to regional/national staff this quarter?
- Have you sent a maintenance job report to regional/national staff this quarter?
- Have you been able to complete all the requested repairs and/or triaged faulty CCE this quarter? If not, have you requested additional repair manuals and/or reached out to support networks for advice?
COLD CHAIN EQUIPMENT MANAGER/LOGISTICIAN/VACCINE STORE MANAGER

CCEIs help me monitor and manage CCE technicians and vaccine and equipment procurement planning.

CCE roles/responsibilities

- I manage the overall planning, monitoring, and repair oversight of CCE in districts and health care facilities. This includes resource and spare part management to ensure functional CCE.
- I conduct field supervision visits, which include monitoring of CCE and technicians.
- I maintain and ensure the accuracy of the CCEI in my region.
- I collate and submit inventory/maintenance reports to national EPI stakeholders.
- I coordinate with regional and national vaccine supply actors to plan for and distribute vaccines within my region.
- I participate in trainings with other cold chain personnel (e.g., cold chain assistants and immunization focal points) in my region.

CCEI engagement

I need to know the functionality and status of all equipment as well as spare part consumption in my assigned region.

<table>
<thead>
<tr>
<th>To stay updated on the functionality and status of CCE in my region, I...</th>
<th>so that I can...</th>
<th>...to maintain the availability, potency, and efficacy of vaccines at my facility.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Review performance and status indicators in the CCEI</td>
<td>Know which equipment is where and the functional status to direct maintenance and repairs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Monitor performance of CCE and know when to contact the warranty provider*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ensure the EPI program has proper storage space available for vaccines</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Plan for campaigns, new vaccine introductions, or other activities that will impact the cold chain</td>
<td></td>
</tr>
</tbody>
</table>

*Note: See Module VMH-E5-01.1: How to Develop a Repair and Maintenance System for Cold Chain Equipment for more information.
Current challenges faced

- There is no reliable CCEI system that allows me to quickly assess the number and location of functional and nonfunctional equipment in health facilities.
- Quality of CCEI data is not consistent or data are simply absent. Cleaning data for a large number of districts and facilities is cumbersome. Without high-quality data, forecasting and planning are based on inaccurate data.
- There is no simple way of assessing faults, maintenance tasks, and spare parts usage rates. The descriptions of faults by facilities are unclear and not standardized—making it challenging for me to determine what fix is needed.

CCEI data

On a quarterly basis, I receive, verify, and collate the following data points (see Appendices B to D for sample tools):

- Facility name and administrative information (e.g., catchment area).
- Manufacturer, model, serial number, and functional status of all CCE assets.
- Equipment maintenance logs (if available, which note date of failure/date of repair) and warranty status.
- Temperature recording device (30DTR) and temperature excursion reports.
- Model and serial number of voltage stabilizers for grid-powered CCE.
- Number of vaccine carriers in the district.
- Number of cold boxes.
- Maintenance job cards (reported fault, services provided, spare parts used, repair dates).

On a predetermined basis, I generate a report on existing CCEI and the related data points noted above and submit it to the EPI.

Why collect CCEI data?

- This would help me to track functional status of CCE in my district/region and plan accordingly—for example,

CCEI checklist for CCE manager/logistician/vaccine store manager:

- Have you reviewed and verified the CCEI data in your region this quarter (e.g., functionality change, new/spare CCE, etc.)?
- Have you reviewed CCE maintenance and repair job reports this quarter?
- Have you reviewed and verified the CCE spare part inventory/use data in your region this quarter?
CCEI engagement

NATIONAL/REGIONAL EPI MANAGERS

CCEIs enable me to effectively plan and make evidence-based decisions.

CCE roles/responsibilities

- I review inventory reports to track high-level changes in installation, functional status, location, warranty, etc.
- I forecast future CCE and spare part needs.
- I make data/evidence-based decisions on equipment selection.

To manage the national CCEI in my region/country, I... so that I can... ...to maintain the availability, potency, and efficacy of vaccines at my facility.

<table>
<thead>
<tr>
<th>To manage the national CCEI in my region/country, I...</th>
<th>so that I can...</th>
<th>...to maintain the availability, potency, and efficacy of vaccines at my facility.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Need to know how different CCE makes and models are performing</td>
<td>Make accurate and informed CCE procurement decisions</td>
<td></td>
</tr>
<tr>
<td>Need to know the location of CCE within the country and trends on fault frequencies and types</td>
<td>Develop effective vaccine distribution plans before sending vaccines for routine or campaign needs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Report on CCE uptime</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Report and budget for investments such as CCE optimization platform, spare part inventories, resource requests</td>
<td></td>
</tr>
</tbody>
</table>
Current challenges faced

- The current CCEI data are not up to date and hard to rely on for decision-making.
- Conducting one-time inventories is time consuming and very expensive.

CCEI data

I regularly monitor and use the following data for making CCE-related program decisions:

- CCE functional status and aggregate performance data to understand CCE performance by type/model for future procurement plans.
- Review total uptime and any warranty claims.
- Storage capacities across facilities in near real time for stock distribution or capacity planning.
- Aggregate spare part consumption to better plan and budget for procurement and distribution of spare parts.
- Share updates with the performance quality safety and the postmarket monitoring team to help improve CCE performance.

Why collect CCEI data?

- Good inventories are the foundation for planning, budgeting, and reporting of CCE to ministry of health leaders and global stakeholders.

Why collect CCEI data?

- Using data to make informed forecasts and procurement decisions will help our program goals and provide better value for money.
- Accurate, real-time data from accurate inventories allow us to plan and strategically allocate resources to sustain a strong immunization supply chain in the country.

CCEI checklist for national/regional EPI managers:

- Have you reviewed aggregate CCEI data in your region/country this quarter (e.g., functionality change, trends with models/manufacturers, warranty claims, new/spare CCE, etc.)?
- Have you reviewed aggregate CCE spare part usage and warranty claim data this quarter?
- Have you reviewed aggregate CCE maintenance and repair job reports this quarter?