# **Map and Match**: Primary Health Care Operational Data Barriers and Innovations

## ACKNOWLEDGMENTS

**PATH**

**Gates Foundation**

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## CONTENTS

This report builds on two foundational resources: the Landscape Report, which documented critical gaps in how primary health care (PHC) operational data is extracted and transmitted in four African countries (Burkina Faso, Ethiopia, Kenya, Nigeria), and the Innovative Approaches Brief, which cataloged promising technological and non-technological solutions with potential to address these barriers. While those resources identified problems and potential solutions independently, this report connects the two by mapping which innovations could address which gaps to improve PHC operational dataflows.

## Our Approach

We developed a "map and match" visualization—a user-friendly matrix that crosswalks the innovative approaches identified with the specific PHC operational data gaps documented in focus countries. We created three versions of this visualization: a cross-country matrix highlighting common barriers across all four countries, and dedicated country-specific matrices for Ethiopia and Burkina Faso, where primary data collection and validation was conducted. We created a complementary visualization to illustrate which PHC pillars the innovations were designed or deployed to improve, and highlighted opportunities to adapt the innovations for other PHC pillars. This tool enables strategic identification of which solutions could address which barriers in different contexts. To support understanding of how each innovation functions and its potential to address identified barriers, we included a glossary of innovation descriptions. To validate both the identified gaps and the appropriateness of potential solutions, we conducted stakeholder consultations in Burkina Faso and Ethiopia.

The map and match tables show how different innovations can help address specific PHC operational data barriers.

- **Rows list the barriers**. The barriers are organized by categories: tools, infrastructure, processes, people, and governance and policy (see box).

- **Columns list the innovations**. The innovations are organized by steps in the data value chain (see box).

- **Each cell shows whether and how an innovation responds to a particular barrier**. An innovation can address a barrier by reducing it, or bypass the barrier by avoiding it altogether.

To use the table, start by identifying a barrier on the left side. Then read across the row to see which innovations offer solutions. Or, if you want to understand what a specific innovation addresses, start at the top of a column and read down. This allows you to see opportunities and gaps across barriers and innovations.

## Categories of barriers

**TOOLS:** Includes the design, usability, and function of digital and non-digital tools used to extract and transmit PHC operational data.

**INFRASTRUCTURE:** Includes physical infrastructure (e.g., electricity, internet connectivity, solar power), facility infrastructure (e.g., adequate space, quality of space), and essential supplies and equipment (e.g., digital tools, hardware, paper forms).

**PROCESSES:** Includes workflow practices, SOPs, supervision processes, and data quality and validation checks related to PHC data extraction and transmission.

**PEOPLE:** Includes the responsibilities, bandwidth, competing priorities, motivation, training, and capacity of health system actors involved in PHC operational data extraction, transmission, and use.

**GOVERNANCE & POLICY:** Includes national and/or subnational regulatory requirements, accountability structures, budget allocation procedures, and coordination mechanisms governing PHC operational data.

## Categories of innovations

- **Data extraction:** Innovations that support frontline workers to collect data directly from sources and organize and/or structure the data to prepare for transmission.

- **Data transmission:** Innovations that support securely sending data to central systems for analysis.

- **Enablers:** Innovations that are not specific to data extraction or transmission but provide cross-cutting support across the data value chain.

# CROSS-COUNTRY MAP AND MATCH

**INNOVATIONS**

Legend:
- ● The innovation directly or indirectly **addresses** (reduces) the barrier.
- ○ The innovation partially or completely **bypasses** the barrier.

| Category | BARRIERS | Collect only essential data | Color-coded stock cards | Data clerks | Marble Jar | Peer review of data entry | Pictorial paper forms | SPARS program | Biometric attendance systems | IoT cold chain sensors | Smart Paper Technology | Photo to Digital - ODK Scan | Physical data courier | Remote photo-based reporting | Signalytic | SnapForm AI-OCR | WhatsApp for coordination | Wifi Direct | Clear role definition | Solarization of facilities | WhatsApp for peer learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Extraction | | | | | | | Extraction + Transmission | | | Transmission | | | | | | | Enablers | | |
| TOOLS | Fragmented and overlapping reporting tools | ● | | | | | | | | | | | | | | | | | | | |
| INFRASTRUCTURE | Weak/unstable internet, electricity | | ○ | | ○ | | ○ | | | ● | ○ | ○ | | ● | | | | ○ | | ● | |
| INFRASTRUCTURE | Limited availability of devices | | ○ | | ○ | | ○ | | | | ○ | | | ● | | | | | | | |
| INFRASTRUCTURE | Lack of maintenance for devices | | ○ | | ○ | | ○ | | | | ○ | | | ● | | | | | | | |
| INFRASTRUCTURE | Inadequate transport for submitting paper reporting forms | | | | | | | | | | ○ | ○ | ● | ○ | ○ | ○ | ○ | ○ | | | |
| PROCESSES | Manual processes that are time-consuming and error prone | ○ | ● | | | | ● | | ● | ● | ● | ● | | | ● | | | ○ | | | |
| PROCESSES | Inconsistent SOPs or limited awareness of SOPs | | | | | | ● | | | | | | | | | | | | ● | | |
| PROCESSES | Weakly implemented feedback and data validation mechanisms | | | | | ● | | ● | | | | | | | | | ● | | | | ● |
| PEOPLE | Overburdened health care workers | ● | ● | ● | ● | | ● | | ● | ● | ● | ● | | | ● | ● | | | | ● | ● |
| PEOPLE | Lack of data support staff | ○ | | ● | | | | | | | ○ | ○ | | ○ | ○ | | | | | | |
| PEOPLE | Limited staff capacity / digital literacy and inconsistent training | | ○ | ○ | ○ | | ○ | ● | | | | | | | | | | | | | ● |
| PEOPLE | Women have more data responsibilities given their overrepresentation in frontline roles | ○ | | | ● | | | | | | | | | | | | | | | | |
| PEOPLE | Limited use of data at community/facility levels; low perceived value of data | | ● | | | | ● | | | ● | | | | | | | | | | | ● |

**Abbreviations:** AI-OCR: Artificial Intelligence - Optical Character Recognition; IoT: internet of things; ODK: Open Data Kit; SOPs: standard operating procedures; SPARS: Supervision, Performance Assessment and Recognition Strategy.

## INNOVATIONS

Legend:
- ● The innovation directly or indirectly **addresses** (reduces) the barrier.
- ○ The innovation partially or completely **bypasses** the barrier.

| BARRIERS | Extraction | | | | | | | Extraction + Transmission | | | Transmission | | | | | | | Enablers | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Collect only essential data | Color-coded stock cards | Data clerks | Marble Jar | Peer review of data entry | Pictorial paper forms | SPARS program | Biometric attendance systems | IoT cold chain sensors | Smart Paper Technology | Photo to Digital - ODK Scan | Physical data courier | Remote photo-based reporting | Signalytic | SnapForm AI-OCR | WhatsApp for coordination | Wifi Direct | Clear role definition | Solarization of facilities | WhatsApp for peer learning |
| **TOOLS** — Fragmented and overlapping reporting tools (140 digital tools, applications, and platforms identified) | ● | | | | | | | | | | | | | | | | | | | |
| **TOOLS** — Expectation that ASBCs use both paper-based and digital systems where eSanteCom has been piloted, which is duplicative and time-consuming | ● | | | | | | | | | | | | | | | | | | | |
| **INFRASTRUCTURE** — Connectivity challenges that delay synchronization of mobile tools at community level | | ○ | | ○ | | ○ | | | | | | ● | ● | | | ● | ● | | ● | |
| **INFRASTRUCTURE** — Connectivity gaps and an unstable network (RESINA), which slow data transmission at facility and district levels, particularly in rural districts | | ○ | | ○ | | ○ | | | | ○ | | ● | ● | | | ● | ● | | ● | |
| **INFRASTRUCTURE** — Hardware (smartphone, tablet, computer) shortages, poor quality of devices, and lack of maintenance | | ○ | | ○ | | ○ | | | | | ○ | ● | | | | | | | | |
| **PROCESSES** — Limited awareness and use of existing SOPs, and weak enforcement of them | | | | | | | ● | | | | | | | | | ● | | ● | | ○ |
| **PROCESSES** — Inadequate quality of supervision | | | | | | | ● | | | | | | | | | | | | | ● |
| **PEOPLE** — Heavy workloads that force staff to work overtime to complete data reporting | ● | | ● | ● | | ● | | | | | ● | ● | | | ● | ● | | | | |
| **PEOPLE** — Tendency of monthly reporting to mobilize most of the facility's health workers, disrupting the workflow | ● | | ● | ● | | | | | | | ● | ● | | | ● | | | ● | | |
| **PEOPLE** — Limited capacity and insufficient training of ASBCs; uneven literacy / digital literacy | | ○ | | ○ | ● | ○ | ● | | | | | | | | | | | | | ● |
| **POLICY** — Weak enforcement of data governance policies and poor staff awareness | | | | | | | | | | | | | | | | ● | | | | ● |

**Abbreviations:** AI-OCR: Artificial Intelligence - Optical Character Recognition; ASBC, *agent de santé à base communautaire* (community-based health worker); IoT: internet of things; ODK: Open Data Kit; SOPs: standard operating procedures; RESINA, *REseau Informatique National de l'Administration* (National Computer Network of the Administration); SPARS: Supervision, Performance Assessment and Recognition Strategy.

**INNOVATIONS**

Legend:
- ● The innovation directly or indirectly **addresses** (reduces) the barrier.
- ○ The innovation partially or completely **bypasses** the barrier.

| BARRIERS | Collect only essential data | Color-coded stock cards | Data clerks | Marble Jar | Peer review of data entry | Pictorial paper forms | SPARS program | Biometric attendance systems | IoT cold chain sensors | Smart Paper Technology | Photo to Digital - ODK Scan | Physical data courier | Remote photo-based reporting | Signalytic | SnapForm AI-OCR | WhatsApp for coordination | Wifi Direct | Clear role definition | Solarization of facilities | WhatsApp for peer learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Extraction** | | | | | | | **Extraction + Transmission** | | | **Transmission** | | | | | | | **Enablers** | | |
| **TOOLS** | | | | | | | | | | | | | | | | | | | | |
| Fragmented, duplicative tools and parallel reporting (e.g., paper-based and eCHIS). | ● | | | | | | | | | | | | | | | | | | | |
| Weak integration and standardization across information systems | ● | | | | | | | | | | | | | | | | | | | |
| **INFRASTRUCTURE** | | | | | | | | | | | | | | | | | | | | |
| Unreliable electricity and connectivity at community and facility levels, contributing to eCHIS synchronization failures | | ○ | | ○ | | ○ | | | ○ | ○ | | ○ | ● | | | | ● | | ● | |
| Limited financial support for transport, airtime, and device maintenance | | ○ | | ○ | | ○ | | | ○ | | ○ | ○ | ○ | ○ | ○ | | ○ | | | |
| Lack of local information technology / technical support; long travel for repairs | | ○ | | ○ | | ○ | | | | | | | ● | | | | | | | |
| Insufficient availability of electronic devices (desktops, laptops, tablets, smartphones, power banks) | | ○ | | ○ | | ○ | | | | | | ○ | ● | | | | | | | |
| **PROCESSES** | | | | | | | | | | | | | | | | | | | | |
| Lack of clear written roles and SOPs, particularly at community level | | | | | | | | | | | | | | | | | | ● | | |
| Paper-heavy, time-consuming processes with multiple registers. | ● | | | | | ● | | ● | ● | ● | ● | | ● | | ● | | ○ | | | |
| Poor data quality (incomplete, inconsistent, and/or delayed reporting), in part due to manual processes | ● | ● | ● | | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | | ● | ● | ● | ● |
| Inconsistent establishment of Performance Management Teams (PMT) per national standards, and where they exist, inadequate prioritization of facility data quality checks | | | | | | | ● | | | | | | | | | | | | | ○ |
| **PEOPLE** | | | | | | | | | | | | | | | | | | | | |
| Low prioritization of data recording and quality assurance; data fatigue due to the high volume of reports required | ● | | | | ● | | ● | | | | | | | | | | | | | |
| Staff shortages and heavy workloads (often over 500 households per HEW), contributing to delayed or inconsistent recording | ● | | ● | ● | | | | | | ● | ● | | | ● | ● | | | | | |
| Low digital literacy and analytical capacity among health workers | | ○ | ○ | | | ○ | ● | | | | | | | | | | | | | ● |
| Language barriers (some reporting formats are not translated into local languages, creating gaps in HEW understanding of the tools) | | ○ | | ○ | ○ | ● | | | | | | | | | | | | | | ● |
| Weak accountability for data tasks; unclear roles | | | ● | | | | ● | | | | | | | | | | | ● | | ● |
| Weak data use culture: inconsistent use of data for planning and performance monitoring; data are only for reporting purposes | | ● | | | | | ● | | | | | | | ● | | | | | | ● |

**Abbreviations:** AI-OCR: Artificial Intelligence - Optical Character Recognition; eCHIS: electronic community health information system; HEW: health extension worker; HMIS: health management information system; IoT: internet of things; LMIS: logistics management information system; ODK: Open Data Kit; SOPs: standard operating procedures; SPARS: Supervision, Performance Assessment and Recognition Strategy.

## How to read this table:

This table shows how the innovations can address data gaps across health system pillars for PHC operational data that are related to equipment, facilities and infrastructure, finances, human resources for health, service coverage, and supplies.

- **Rows list the PHC pillars.**
- **Columns list the innovations.**
- **Each cell shows whether the innovation was designed or could be adapted for data related to the specific PHC pillar.**

To use the table, start by identifying a PHC pillar on the left side. Then read across the row to see which innovations offer solutions. Or, if you want to understand what PHC pillars a specific innovation could address, start at the top of a column and read down. This allows you to see opportunities to apply and adapt innovations across the PHC pillars.

**INNOVATIONS**

► **Innovation** designed or deployed for data related to this PHC pillar

▷ **Opportunities** to adapt innovations for data related to other PHC pillars

| PHC PILLARS | Extraction | | | | | | | Extraction + Transmission | | | Transmission | | | | | | | Enablers | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Collect only essential data | Color-coded stock cards | Data clerks | Marble Jar | Peer review of data entry | Pictorial paper forms | SPARS program | Biometric attendance systems | IoT cold chain sensors | Smart Paper Technology | Photo to Digital - ODK Scan | Physical data courier | Remote photo-based reporting | Signalytic | SnapForm AI-OCR | WhatsApp for coordination | Wifi Direct | Clear role definition | Solarization of facilities | WhatsApp for peer learning |
| Equipment | ▷ | | ▷ | | ▷ | ► | ▷ | | ► | ▷ | ► | ▷ | ► | ▷ | ▷ | ▷ | ▷ | ▷ | ► | ▷ |
| Facilities and infrastructure | ▷ | | ▷ | | ▷ | ► | ▷ | | | ▷ | ► | ▷ | ► | ▷ | ▷ | ▷ | ▷ | ▷ | ► | ▷ |
| Finances | ▷ | | ▷ | | ▷ | ► | ▷ | | | ▷ | ► | ► | | ▷ | ▷ | ► | ▷ | ▷ | ► | ▷ |
| Human resources for health | ▷ | | ▷ | ► | ▷ | ► | ▷ | ► | | ▷ | ► | ▷ | | ▷ | ▷ | ► | ► | ▷ | ► | ▷ |
| Service coverage | ► | | ► | | ► | ► | ▷ | | | ► | ► | ► | | ▷ | ► | ► | ► | ► | ► | ► |
| Supplies | ► | ► | ▷ | | ▷ | ► | ► | | ► | ► | ► | ▷ | | ► | ▷ | ► | ► | ▷ | ► | ▷ |

**Abbreviations:** AI-OCR: Artificial Intelligence - Optical Character Recognition; IoT: internet of things; ODK: Open Data Kit; SPARS: Supervision, Performance Assessment and Recognition Strategy.

# GLOSSARY OF INNOVATIONS

| | |
|---|---|
| **Biometric attendance systems** | Using fingerprint scanners, mobile apps, or kiosks, the system captures staff presence at health facilities or service sites, enabling workforce monitoring and accountability through automated time-and-attendance tracking. |
| **Clear role definition and accountability** | Formal roles and responsibilities for data management staff are publicly displayed on facility information boards, supporting role clarity and accountability for assigned tasks. |
| **Collect only essential data** | Streamlined data collection using a reduced list of essential indicators to minimize errors, eliminate duplicate entry, and focus facility reporting on priority information that will be used for decision-making. |
| **Color-coded stock cards** | A visual inventory management system using color-coded kanban cards (green, yellow, red) that allows health workers to quickly assess stock levels and trigger reorders without calculations or digital tools. |
| **Data clerks** | Dedicated data clerk positions at facility and district levels relieve clinical staff of data entry burdens, and enable supervisory models that promote data-driven decision-making. |
| **IoT cold chain sensors** | Solar-powered Internet of Things (IoT) sensors paired with Nexleaf's ColdTrace platform continuously monitor temperature and conditions in vaccine refrigerators, cold rooms, and transport vehicles, using cellular or Bluetooth connectivity with battery backup to maintain data collection even during power outages or connectivity gaps in off-grid settings. |
| **Marble jar** | A participatory visual monitoring method where staff or community members use marbles, beads, or tokens to represent and track work tasks, time allocation, or responsibilities, enabling teams to quickly identify workload imbalances and discuss solutions without requiring literacy or lengthy surveys. |
| **Peer review of data entry** | Peer review is built into the data workflow, with colleagues checking each other's data before entry or submission, typically during group meetings or end-of-day reviews, to catch and correct errors early. |
| **Photo to Digital - ODK Scan** | Photo capture solution of paper registers, forms, and checklists to convert them to digital data through optical character recognition (OCR), computer vision, or manual transcription, enabling digital data use while preserving familiar paper-based workflows at the point of care. |
| **Physical data courier** | District staff collect paper registers from facilities on a set schedule and perform centralized data entry while maintaining chain-of-custody protocols to prevent loss and ensure timely reporting. |
| **Pictorial paper forms** | Low-tech visual tools using icons, pictograms, and stamps that enable staff and community members with limited literacy to reliably perform operational tasks like equipment maintenance, inventory management, and financial transactions without relying on text-based instructions. |

| | |
|---|---|
| **Remote photo-based reporting** | Facilities or staff send photos or SMS reports of equipment damage via WhatsApp* to a central triage team that maps the locations of repairs and prioritizes and schedules repairs, enabling rapid response to maintenance needs. |
| **Signalytic** | A solar-powered system that can operate with intermittent network connectivity by generating its own wifi network, and uses distributed ledger technology rather than a central server model, enabling digital data entry and reporting. |
| **Smart Paper Technology** | A hybrid health information system that uses specially redesigned paper forms completed at point of care and later digitized at scanning centers, enabling high-quality data capture for immunization, maternal and child health, primary care, and supply chain management without requiring digital tools during service delivery. |
| **SnapForm AI-OCR** | Mobile photo capture of paper forms combined with AI-powered data extraction automatically reads and enters values into the correct DHIS2 fields, eliminating manual data entry while preserving paper-based workflows. |
| **Solarization of facilities** | Solar systems with battery storage installed at health facilities ensure continuous power for cold chain equipment, computers, routers, and information systems during outages, improving data entry continuity, reporting timeliness, and commodity availability. |
| **SPARS program** | Supervision, Performance Assessment and Recognition Strategy (SPARS) is a national medicines management program in Uganda combining regular supportive supervision, standardized performance assessments across 25+ indicators, and recognition incentives to improve facility-level stock management, storage, ordering, and reporting practices. |
| **WhatsApp for coordination** | Health providers and managers use WhatsApp* informally to communicate and coordinate when formal digital systems are unavailable, slow, or not interoperable, enabling faster referrals, real-time bed availability updates, logistics coordination, and routine administrative tasks. |
| **WhatsApp for peer learning** | WhatsApp* groups connecting facility or community staff enable peer-to-peer knowledge sharing, mentoring, real-time troubleshooting of data issues, and collaborative problem-solving across facilities or districts. |
| **Wifi Direct** | CommCare's Wi-Fi Direct feature enables offline data collection in areas without internet by allowing field workers to transfer forms from their devices to a host tablet, which is later synced to the server when connectivity is available. |

* WhatsApp is a free, internet-based messaging application.

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