Strengthening Digital Community Health

Lessons from designing and implementing digital tools for community health in four African countries

Contents

Abbreviations

CHW	community health worker
CRDM	Collaborative Requirements Development Methodology
DPGs	Digital Public Goods
DHIS2	District Health Information Software
EA	Enterprise Architecture
HIS	Health Information System
HL7 FHIR	Health level 7 Fast Healthcare Interoperability Resource
HMIS	Health Management Information System
iCCM	Integrated Community Case Management
ICT	Information and communication technology
LMIC	Low- and middle-income countries
MVP	Minimum viable product
NMP	National Malaria Program
NMEP	National Malaria Elimination Program
MOH	Ministry of Health
PMI	U.S. President's Malaria Initiative
TWG	Technical Working Group
USAID	United States Agency for International Development
ZDCHP	Zambia Digital Community Health Project

Acknowledgments

About Digital Square

Digital Square, funded under the United States Agency for International Development (USAID) Cooperative Agreement Number: AID-OAA-A-16-00084, is a global mechanism that coordinates investments into smart, scalable health technology solutions and creates an environment in which they can be sustained. A historic lack of coordination in digital health has resulted in an imbalanced, disorganized marketplace where available tools and investment mechanisms do not match the long-term needs of countries or communities. To accelerate health equity through the development, adoption, scale, and delivery of digital health innovations, Digital Square focuses on creating better alignment and coordination. Digital Square brings partners together to improve how the global community designs, uses, and pays for digital health tools and approaches. Digital Square works with innovators to advance adaptable, replicable tools that are designed to work together seamlessly. Digital Square works with governments and country-based technology experts to strengthen local capacity to implement and manage digital health programs. Digital Square works with donors to identify new ways to invest that ensure long-term success and align with each country's priorities. By strengthening the coordination among these partners, Digital Square reorients the market to better match tools and approaches to the needs of countries and communities. Digital Square brings technical, operational, and advocacy expertise to address well-recognized barriers to scaling digital health. These strong partnerships across the sector allow Digital Square to identify barriers faced in different areas of the marketplace and collectively design new approaches to overcome them. Our work is divided into three key areas: 1) alignment and co-investment, 2) global goods ecosystem, and 3) regional and country digital transformation systems.

About PMI DCHI

The U.S. President's Malaria Initiative (PMI), led by USAID and co-implemented with the U.S. Centers for Disease Control and Prevention (CDC), launched its Digital Community Health Initiative (DCHI) in 2020 with a vision to strengthen quality health delivery at the community level. This initiative aims to invest in the scale-up of digitally enabled community health platforms that equip frontline health workers with mobile tools to improve case management; improve access to near real-time, high-quality community

data; catalyze a cultural shift in the use of community data for decision-making; facilitate the integration of services at the community level; and integrate and empower community health workers (CHWs) as a valued aspect of national health systems. DCHI is implemented by PATH's Digital Square initiative and its sub awardees, including IntraHealth International, John Snow Inc., Last Mile Health, and Population Services International.

A group of agents de santé (ASCs) walk through m-s@ntécom app during a hands-on training in Tambacounda Region, Senegal.

PATH/Vick-Nathan Tchibinda Azizet

Executive summary

Community health workers (CHWs) are a critical part of the health system in many countries, delivering essential health services directly to communities. In malaria-endemic countries, CHW cadres play a crucial role by actively engaging in disease prevention, treatment, and health promotion. Digital tools can increase the effectiveness, efficiency, and quality of care that CHWs provide by streamlining data capture, providing clinical decision support, and tracking supplies.

In support of strengthening quality health delivery at the community level, The U.S. President's Malaria Initiative (PMI), led by USAID and co-implemented with the U.S. Centers for Disease Control and Prevention (CDC), launched its Digital Community Health Initiative (DCHI) in 2020. DCHI is implemented by PATH's Digital Square initiative and its sub awardees, including IntraHealth International, John Snow Inc., Last Mile Health, and Population Services International.

This white paper discusses ongoing DCHI work to strengthen digital community health systems in Burkina Faso, Rwanda, Senegal, and Zambia. In these four countries, Digital Square is partnering with the ministries of health, software developers, and other key actors to support the design and development of community-level digital tools. The objectives of this white paper are to:

1. Share insights and lessons learned from developing digital community health tools in Burkina Faso, Rwanda, Senegal, and Zambia.

2. Make recommendations based on the insights to inform country health leaders, policymakers, implementing partners, software developers, or other stakeholders who are supporting the design and development of digital community health tools in similar settings.

Insights and recommendations are categorized by the domains of governance, people, and systems outlined in the Digital Health for Community-Based Management of Febrile Illness framework.

"Governance" highlights the importance of strong country leadership and stakeholder alignment that enabled the ministries of health in Burkina Faso, Rwanda, Senegal, and Zambia to rapidly advance the digitalization of their community health programs. Country leaders were central to the DCHI approach and the ministry of health (MOH) in each country endorsed a primary digital tool for community health with a clear vision for national scale-up.

PATH

The Zambia Digital Community Health Project (ZDCHP) team engaged with CHWS and health facility staff during project activities focused on the scale-up and training of an electronic CHW registry.

"People" includes the CHWs, supervisors, information and communication technology support staff, and other decision-makers who contribute to the effective use of digital tools and data in community health programs. In each of the four countries the system design processes centered the end-user needs of CHWs to design contextually appropriate and effective digital tools. These processes included the Collaborative Requirements Development Methodology (CRDM), human-centered design, and user acceptance testing. Given that many CHW tasks are similar across countries, the PMI DCHI project developed editable workflows for common CHWs tasks that can be a resource for others identifying business processes and system requirements available in Appendix 3. CHW tasks span several health domains and in all four countries the MOH-endorsed digital tools are integrated across health areas. A single digital tool that supports CHW activities avoids burdening CHWs with competing data entry systems.

"Systems" were developed based on the user-centered design processes. Ministries of health identified functional requirements that outline what the digital system must do, with different requirements prioritized in each country. In all countries, the ministries of health selected digital tools that are open source and built on standards (like Health Level 7 Fast Healthcare Interoperability Resource) to enable interoperability. The ministries of health in Burkina Faso and Senegal are moving forward with m-s@ntécom, the MOH in Rwanda selected the Community Electronic Medical Record (EMR), and the MOH in Zambia selected the Community Health Integrated Platform (CHiP) based on the MEDplat system. Finally, all four countries used a health enterprise architecture approach to ensure the digital community health data, systems, processes, and technology could work together seamlessly with other systems in the country. Table 1 below summarizes the recommendations based on the insights from experiences in Burkina Faso, Rwanda, Senegal, and Zambia.

Table 1: Recommendations to strengthen digital community health.

DOMAIN	RECOMMENDATIONS
Governance	• Empower country leadership: Facilitate strong leadership from the MOH to spearhead and take ownership of the digitalization process and establish a clear digital health vision. This fosters country buy-in and ownership which is crucial for sustainability and scalability of digital health initiatives. • Foster stakeholder alignment: Ensure alignment among diverse stakeholders, including representatives from malaria control programs, digital health sectors, and community health initiatives. Donors and implementing partners should actively support the government's digital health vision. • Plan for national scale: Discuss national scale-up considerations from the initial stages of digitalization efforts, including the total cost of ownership. By envisioning and preparing for nationwide implementation from the outset, governments and partners can optimize resources and streamline processes for sustainable digital health transformation.
People	• Prioritize end-user needs: Ensure that the design of digital tools for community health is centered around the needs of CHWs and the communities they serve. Employ methodologies such as CRDM, human-centered design, or user acceptance testing to actively involve end-users in the development process, thereby enhancing usability and effectiveness. • Catalyze digital skill building: Actively integrate digital and data skills into relevant capacity strengthening activities at all levels of the health system. Where there are major gaps, identify partners to bring in new skills, especially from the private sector (e.g. technology developers, data hosting). Consider government officials and private sector leaders seewking out digital skills building programs, (e.g., Digital Health Applied Leadership Program), courses (e.g., Digital Health: Planning National Systems), and certifications (The Open Group Architecture Framework). This will ensure all stakeholders are able to be effective partners in jointly achieving the government's digital health vision. • Leverage existing resources: Encourage countries and partners engaged in the development of digital tools for community health to adapt and enhance existing resources such as the user personas, business processes, workflow diagrams, and functional requirements developed by the PMI DCHI project. This promotes efficiency and continuous improvement in digital health tool development across different contexts.

Systems	● Start with a minimum viable product: Begin digital tool development by focusing on a subset of essential functionalities, known as foundational requirements, to create a minimum viable product (MVP). Advanced functionalities can be incrementally incorporated into subsequent iterations. This phased approach allows for iterative improvements while ensuring the initial deployment meets critical user needs.
	● Use open standards for interoperability: Adopt open standards in the design and implementation of digital health tools to facilitate seamless exchange of information across different systems. Utilizing standards such as HL7 FHIR ensures compatibility and interoperability, enabling efficient data sharing and integration within the broader health ecosystem.
	● Leverage Digital Public Goods (DPGs) and Global Goods: Explore and utilize digital tools recognized as DPGs and global goods, which are open source and designed to address global health challenges. Leveraging these resources promotes adaptability, scalability, and collaboration while reducing dependency on proprietary solutions.
	● Utilize a health enterprise architecture approach: Adopt a health enterprise architecture approach to ensure seamless integration and interoperability of digital community health systems within the broader health infrastructure. By establishing a comprehensive framework for data management and exchange, countries can enhance the efficiency, security, and scalability of their digital health initiatives.

This white paper aims to inform and empower country health leaders, policymakers, implementing partners, and software developers to accelerate digital transformation for community health across similar settings. By following these recommendations, governments and partners can take proactive steps to integrate digital solutions into community health programs, thereby advancing sustainable improvements in community health services and outcomes.

PATH/Daniel Ng'andu

The ZDCHP team participated in requirements gathering and refining activities with community health care workers and health facility staff.

Introduction

In malaria-endemic countries, community health worker (CHW) cadres play a crucial role by actively engaging in disease prevention, treatment, and health promotion. This level of the health system is particularly important as CHWs are often community members themselves and provide a level of familiarity and trust to bridge the gap between communities and healthcare services. The COVID-19 pandemic exposed many operational gaps in the health system, and CHWs received a renewed focus and importance to supporting healthy communities. As a result, many countries are developing or revising their CHW policies to enable CHWs to play a larger role in addressing health needs.

One way that CHWs can be supported to deliver on their role more effectively is through the use of digital tools. Digital tools can help CHWs streamline data entry to capture accurate, complete, and timely information about patients and service delivery. The tools can provide clinical decision support to CHWs to increase the quality of care delivered. And digital tools can track supplies of diagnostics or treatments to reduce stockouts. There is growing interest among ministries of health, implementing partners, donors, academics, and software vendors to identify and implement appropriate digital tools with robust functionalities at the community level.

In support of strengthening quality health delivery at the community level, The U.S. President's Malaria Initiative (PMI), led by USAID and co-implemented with the U.S. Centers for Disease Control and Prevention, launched its Digital Community Health Initiative (DCHI) in 2020. This initiative aims to invest in the scale-up of digitally enabled community health platforms that equip frontline health workers with mobile tools to improve case management; improve access to near real-time, high-quality community data; catalyze a cultural shift in the use of community data for decision-making; facilitate the integration of services at the community level; and integrate and empower CHWs as a valued aspect of national health systems.

This white paper discusses ongoing DCHI work to strengthen digital community health systems in Burkina Faso, Rwanda, Senegal, and Zambia. In these four countries, Digital Square is partnering with the ministries of health, software developers, and other key actors to support the development and

Defining community health workers
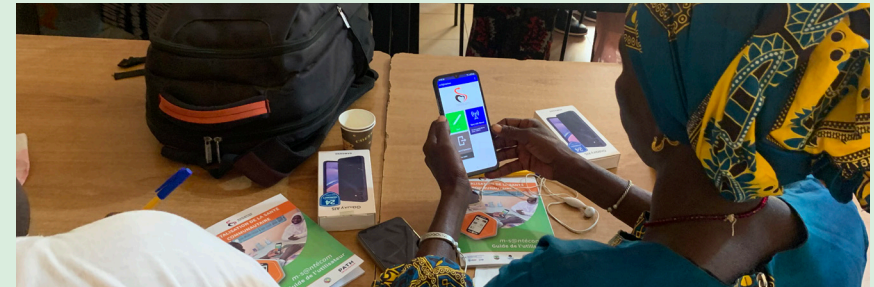
Community end users download m-s@ntécom onto their newly procured mobile phones.

CHWs go by many names. In different contexts, they can be known as accredited social health activists, community health extension workers, community health volunteers, or village health team members, to name a few.

There are often various cadres of CHWs within a country with different levels of education and training. The range of services CHWs provide can vary by cadre, with some limited to providing behavior change communication activities and others delivering packages of preventive and curative services. They can also vary in how and where they provide these services, with some CHWs operating out of community posts or health huts and others providing services through home care.

In this report, we use the term "CHW" to refer generally to all frontline health workers at the lowest administrative level who are dedicated to serving their local communities.[1]

For more information and resources on CHWs, please visit: https://joinchic.org/ and https://www.pmi.gov/what-we-do/community-health/.

deployment of community-level tools. Insights from these country experiences can inform global health leaders, policymakers, and implementers looking to replicate successful models in similar settings to better equip CHWs to deliver health services to the last mile.

Objectives

The objectives of this white paper are to:

1. Share insights and lessons learned from developing digital community health tools in Burkina Faso, Rwanda, Senegal, and Zambia; and

2. Make recommendations based on the insights to inform country health leaders, policymakers, implementing partners, software developers, or other stakeholders who are supporting the design and development of digital community health tools in similar settings.

Methods

Beginning in 2021, Digital Square implemented a phased approach as outlined in Figure 1 in all 27 PMI partner countries. In Phases 1 (Identify) and 2 (Prioritize), Digital Square and its partners engaged national malaria programs and other key stakeholders to understand the digital environments and define country-specific priorities for using digital technology in community health programs. The assessments were guided by the Digital Health for Community-Based Management of Febrile Illness framework which describes the desired state when people, governance, and systems work together to strengthen service delivery through the expanded use of digital technologies at the community level. Although the assessments focused on malaria, the findings helped to understand the broader digital ecosystems at the community level to support integrated service delivery.

In Phases 3 (Implement) and 4 (Amplify), Digital Square and its partners collaborated with ministries of health and relevant stakeholders to provide assistance to implement prioritized activities and enhance country capacity in digital health. The implemented activities tailored to each country included CHW assessments, strategy development for digital community health, and the implementation of digital tools to support community health.

PMI DCHI conducted malaria digital community health assessments in all 27 PMI partner countries, including the four countries highlighted in this white paper. The country profiles produced in the first two phases are published on the digital community health page of the Digital Square website.

In Burkina Faso, Rwanda, Senegal, and Zambia, the ministries of health prioritized designing, piloting, or scaling a community-level digital tool to support CHWs. Digital Square staff compared the processes and results of these activities across the four countries to highlight findings and recommendations that can inform others interested in digitalizing community health in similar settings.

The findings and recommendations are categorized by the domains of people, governance, and systems outlined in the Digital Health for Community-Based Management of Febrile Illness framework. "People" includes the CHWs, supervisors, ICT support staff, and other decision-makers who contribute to the effective use of digital tools and data in community health programs. "Governance" describes the national strategies and policies that provide the framework for community health programs' use of digital tools for malaria and their implementation. "Systems" refers to the processes and digital tools that enable community health platforms to effectively use digital technology and data to strengthen malaria and other health programs.

Figure 1: PMI DCHI's phased activity overview

PHASE 1 **Identity**	PHASE 2 **Prioritize**	PHASE 3 **Implement**	PHASE 4 **Amplify**
Rapid ecosystem assessment	Workshop or exercise to prioritize opportunities identified in Phase 1	Provision of implementation assistance for prioritized activities	Expansion of prioritized activities from previous phases
Desk review, survey, key informant interviews, focus groups		Enhancement of country-level capacity	

Settings

Table 2 provides an overview of each country with respect to digital health, community health, and malaria by providing a key data point to provide context. The World Health Organization (WHO) states that it is ideal to have at least 23 CHWs per 10,000 people; out of the four countries, only Rwanda has

a CHW density greater than this benchmark. The Global Digital Health Monitor is an interactive web-based resource that aims to track, monitor, and assess the enabling environment for digital health throughout the world. Countries self assess across 23 indicators; Table 2 below shows the average score across the 23 indicators for each of the four countries in the Global Digital Health Monitor indicating. The overall maturity of each country's digital health environment is 3 with 1 being the lowest and 5 being the highest score.

Table 2: Key data points across the four African countries implementing tools for community health.

	Burkina Faso	Rwanda	Senegal	Zambia
CHWs per 10,000 people	8.8	47	5.8 ASC/DSDOMs /matrones only.	10.9 CBVs/CHAs only.
Total CHWs	17,648 (2023)	58,286 (2021)	33,039 (2021)	19,853 (2022)
Malaria incidence per 1,000 people (PMI MOPS 2023)	568	76	31	428
Global Digital Health Monitor score (as of 2023)	3	3	3	3
Digital tools that support community health in country	**m-s@ntécom** (eSanteCom) - DHIS2 Aggregate - DHIS2 Tracker - Headwind MDM - SMSCallout - RapidPro - Zato	**Community Electronic Medical Record (EMR)** - RapidSMS - SIScom on DHIS2	**m-s@ntécom** - DHIS2 - DHIS2 Tracker - mInfoSanté - ODK Collect	**CHiP (based on Medplat system)** - C-HMIS (DHIS2) - MCI (on DHIS2 Tracker) - REVEAL

Findings

Governance

WITH STRONG COUNTRY LEADERSHIP AND STAKEHOLDER ALIGNMENT, MINISTRIES OF HEALTH IN BURKINA FASO, RWANDA, SENEGAL, AND ZAMBIA WERE ABLE TO ADVANCE THE DIGITALIZATION OF THEIR COMMUNITY HEALTH PROGRAMS TOWARD A VISION FOR NATIONAL SCALE.

The DCHI phased approach centered around country leaders from the beginning. The rapid ecosystem assessments in Phase 1 were conducted in partnership with and based on inputs from country stakeholders including national malaria programs (NMPs), information and communication technology units, and community health programs. Digital Square facilitated prioritization workshops in each country as an opportunity for country stakeholders to decide which opportunities would be most impactful in their country. This approach facilitated country ownership for the implementation and amplification phases that followed. It also brought together stakeholders from malaria, community health, and digital health programs to align on a shared vision for digital community health.

In Rwanda and Zambia, there were several digital tools in use in some subnational areas to support community health but discussions around national scale-up of digital tools for community health were nascent. With support from the DCHI, country stakeholders in each country selected and endorsed a primary digital tool for community health. In Rwanda, the MOH has selected Community Electronic Medical Record (cEMR) as the digital tool to support community health. cEMR underwent piloting 2023 and MOH endorsed the tool for national scale-up. The Zambia MOH selected the Community Health Integrated Platform (CHiP), which is based on the MEDplat system which was developed leveraging feedback from CHWs. CHiP started piloting in 2024 in Ndola, Mpongwe, Kazungula and Katete Districts.

In Burkina Faso and Senegal, CommCare was already in use in some subnational areas to support community health. The ministries of health in Burkina Faso and Senegal have endorsed CommCare as their primary digital tool for community health and are planning for national scale-up.

In Burkina Faso, CommCare has been adopted as a data collection tool on Android at the community level. It is being piloted by CHWs in 17% of the country's health districts (12/70). The application assists CHWs in carrying out and reporting their activities. Administration and usage guides have been developed, and all actors at the pilot sites have been trained (District Medical Officer, Prevention Officers, Head Nurses, Community Health Workers). A national deployment plan was developed by the Information Systems Department in 2024.

In Senegal, Commcare is used to support integrated community case management (iCCM) in two health districts (of 79 the country). CommCare is deployed with iCCM and malaria case management, integrated home visits, community level IPT, stock monitoring, and CHW management. The application will serve as a decision aid tool that provides CHWs a system that uses an intelligent diagnostic algorithm to help them make informed clinical decisions. CommCare has an automated system that gives appropriate treatment or refers the patient to higher-level health services if necessary. CHWs can track stock levels and make supply requests to avoid stock-outs and will empower CHWs by facilitating and accelerating information sharing with head nurses and health districts. The application integrates directly with the government's national health information system (DHIS2), creating an automatic end-to-end data pipeline, from data collection and aggregation to monitoring and reporting on key indicators at national level. The Senegal government values high engagement, enterprise architecture, and sustainable actions for long-term, national use of CommCare.

Senegal's leadership positioned sustainability and long-term use at the center of all activities related to CommCare. A key challenge for digital solutions long-term longevity is a strong partnership between governments and telecommunication companies who offer affordable communication products (e.g., phones and SMS bundles), Internet, and cloud computing storage. DCHI, at the direction of the MOH, engaged telecommunication companies in the CRDM process. Sonatel, an internationally accredited Senegalese telecommunications company, participated in DCHI's CRDM workshops and was identified as a strong private sector partner for local hosting capacity.

In each of the four countries, the ministries of health' endorsement of a single tool and clear vision for national scale has enabled partners like PMI and Digital Square to support the ministries of health in their digital transformation.

Considerations to craft a vision statement for digital health.

- What documents are available to determine needs and environment?
- How complex is the digital environment in the country? Think of existing tools (any phase), stakeholders, telecommunication and technology developers, health care personnel, and more.
- Who needs to be in the room to draft a vision statement?
- What are the gaps that digital tools could support?
- How does each health level interface with digital tools?

GOVERNANCE RECOMMENDATIONS

- **Empower country leadership**: Facilitate strong leadership from the MOH to spearhead and take ownership of the digitalization process and establish a clear digital health vision. This fosters country buy-in and ownership, which is crucial for sustainability and scalability of digital health initiatives.
- **Foster stakeholder alignment**: Ensure alignment among diverse stakeholders, including representatives from malaria control programs, digital health sectors, and community health initiatives. Donors and implementing partners should actively support the government's digital health vision.
- **Plan for national scale**: Discuss national scale-up considerations from the initial stages of digitalization efforts, including the total cost of ownership. By envisioning and preparing for nationwide implementation from the outset, governments and partners can optimize resources and streamline processes for sustainable digital health transformation.

People

THE SYSTEM DESIGN PROCESSES CENTERED THE END-USER NEEDS OF CHWS AND THE COMMUNITIES THEY SERVE TO DESIGN CONTEXTUALLY APPROPRIATE AND EFFECTIVE DIGITAL TOOLS.

The ministries of health in each country collaborated with PMI and Digital Square to design (or re-design) the digital tools selected for use. The design processes aimed to ensure that the digital tools included the necessary functionalities to support CHW tasks and data workflows in alignment with national policies and standards.

All four countries used the following approaches to design and test the digital tools:

1. **Collaborative Requirements Development Methodology (CRDM)**: CRDM is a process for documenting public health workflows and defining functional requirements for information systems that support those workflows.[1]
2. **Human-centered design (HCD) approach**: HCD is a tool to create better outcomes by understanding people. It is an inclusive approach that engages and centers end users from the project conceptualization through completion. [4]
3. **User acceptance testing**: User acceptance testing (also referred to as beta testing or end-user testing) is a phase of software development in which the software is tested in the "real world" by the intended audience or business representative.[6]

These approaches are complementary and sometimes overlapping. They all share the common aim of engaging end users in the solution design and development. Placing the needs, behaviors, and preferences of the users at the center of the design process ensures that the design of these systems are tailored to the local context and user needs. Ultimately, by embracing HCD and similar approaches, digital community health systems can enhance accessibility, engagement, and effectiveness, fostering a healthier and more connected society.

Case study: Using HCD in Zambia

In Zambia, Digital Square conducted a review of current systems to assess the status of community service delivery areas and progress in digitalizing community health services. The assessment revealed issues with the cHMIS, including reporting burdens (e.g., duplication of reporting) and breakdown at the district level. PMI DCHI used an HCD approach to address these challenges by bringing together stakeholders (e.g., district and facility health officers, CHWs, other local partners) in workshops to gather requirements and optimize workflows. The MOH's technical validation led to significant changes in workflows, such as incorporating COVID-19, gender-based violence, elimination of mother-to-child transmission of HIV, under-five vaccination monitoring, and integrated management of childhood illnesses into the cHMIS.

Digital Square supported a CRDM process in each country to document CHW workflows and define associated functional requirements for the community health digital tools. The CRDM focuses on four core components as outlined in Table 3. The process to develop these components emphasizes active involvement and open communication among stakeholders, including end users, developers, and health domain experts, fostering a shared understanding of project goals and constraints. Digital Square facilitated

Table 3: Components of the CRDM process.

Core component	Key question and description
User personas	**Who are we doing this for?** User personas describe the demographics, environment, and key challenges for the various country stakeholders that would be using aspects of the system. These personas are a method for enhancing engagement with stakeholders and build context for prototyping and implementation efforts.
Business process matrix and workflow diagrams	**What are they doing today?** Through ongoing country consultation, a set of common processes is identified for a system using the CRDM, and a visual representation of the business process in terms of tasks and decision points is created in a logical workflow to enhance communication and collaboration among users, stakeholders, and engineers.
Process design	**How could information system products improve data quality and use?** Looking at the current user and organizational paint points we begin to redesign the system and tell a story about how the user's lives will be changed and are able to reach their respective goals.
Common requirements	**What must the information system products do?** As a final part of the CRDM, the functional requirements are defined for the information system. This helps ensure solutions will be able to meet the needs of the various stakeholders.

stakeholder workshops to review and validate the user personas, draft the business processes and workflows, and develop functional requirements. There were multiple working sessions in each country to validate, analyze, and refine the process flows. At various stages the CRDM outputs were disseminated to gather feedback and make revisions before moving to the system design and development stage. Through this iterative, user-centered approach, the CRDM encourages collaborative problem-solving, enabling the identification of comprehensive and accurate requirements early in the development lifecycle.

GIVEN THE SIMILARITIES IN CHW TASKS ACROSS COUNTRIES, THE PMI DCHI PROJECT DEVELOPED BUSINESS PROCESS WORKFLOWS AS A REUSABLE RESOURCE FOR THE GLOBAL DIGITAL HEALTH COMMUNITY.

Figure 2 is a diagram that shows four "swim lanes" and how patients, CHWs, data, and national/regional level decision-makers interact across the business domain of community health. Looking from left to right, Figure 2 depicts how the CHW supports the patient to access and enroll in health services so that the patient can be evaluated, diagnosed, and then referred to proper treatment. Looking from top to bottom, the diagram shows interactions representing how digital tools can support national/regional decision-makers to manage health at the community level and how there are data flows across the different "swim lanes". For example, digital tools can support stock management. CHWs log data about supply chain commodities in real-time that is routed to decision-makers to monitor malaria drug stock levels at community level and to help them make decisions to reorder supplies as needed to prevent stockouts.

Each country developed its own CHW workflow diagrams to illustrate the business processes in terms of tasks and decision points. Stakeholders mapped 22 business processes in Burkina Faso, 13 in Rwanda, and 10 in Senegal. (See Table 5 for a complete list of business processes mapped.) Many of these business processes overlapped; for example, all countries mapped processes related to case supervision and drug distribution during campaigns.

Given that many CHW tasks are similar across countries, the PMI DCHI project developed editable workflows for common CHWs tasks that can be a resource for the global digital health community to learn from, re-use, or adapt. Appendix 3 includes seven editable workflows developed by PMI DCHI for passive case detection, treatment, treatment management, CHW supervision, human resource management, inputs and commodities, and proactive case detection.

ACROSS COUNTRIES, THE MOH-ENDORSED DIGITAL TOOLS ARE DESIGNED TO SUPPORT MOST CHW TASKS ACROSS HEALTH DOMAINS.

CHWs undertake similar tasks in Burkina Faso, Senegal, Rwanda, and Zambia. In all four countries CHWs perform community level outreach, engagement, and education. They utilize the Integrated Community Case Management (ICCM) approach to address malaria, pneumonia, and diarrhea. In Burkina Faso, Senegal, Rwanda, and Zambia, CHWs are trained to perform diagnosis and treatment of uncomplicated malaria at the community level. CHWs refer severe malaria cases to the health facility in each country.

All countries' primary-endorsed MOH tools to support community health are integrated across several health domains. In all countries, the MOH-endorsed digital tools support CHWs with tasks related to curative services for febrile illness and health promotion activities for malaria and maternal, newborn, and child health. For CHWs, having one digital tool that is cross-cutting to deliver essential services is beneficial for ease of use and streamlined data capture. A digital tool that supports CHW activities across health domains avoids burdening CHWs with competing data entry systems.

Table 4 displays common CHW tasks by country and indicates whether the MOH-endorsed digital tools for community health support CHWs in performing that task. The CHW tasks were formulated by a previous Digital Square project that analyzed digital systems in a number of East African countries. The digital tools support nearly all CHW tasks with a few exceptions across countries. Senegal is not yet using a digital tool to support the health domains of family planning and HIV at the community health level although CHWs perform these tasks using paper-based tools. CHWs in all four countries perform WASH work, although digital tools support the work only in two countries (i.e., Rwanda and Senegal) but not the others (i.e., Burkina Faso, Zambia). In Rwanda, family planning tasks are not currently supported by cEMR but are planned to be added.

Figure 2: Functionalities and use cases for CHW digitalization in a business domain diagram.

This graphic attempts to depict how digital functionalities can be embedded across all levels of the health system and the continuum of care to strengthen digital community health services.

CHW: community health worker, HF: health facility, HMIS: Health Management Information System

- ■ Opportunity to fully automate workflow with digital tool
- ┈┈ Types of digital data collected or actions taken by health actor(s)
- → Process path
- ┈►Automated information and data flow with digital tool
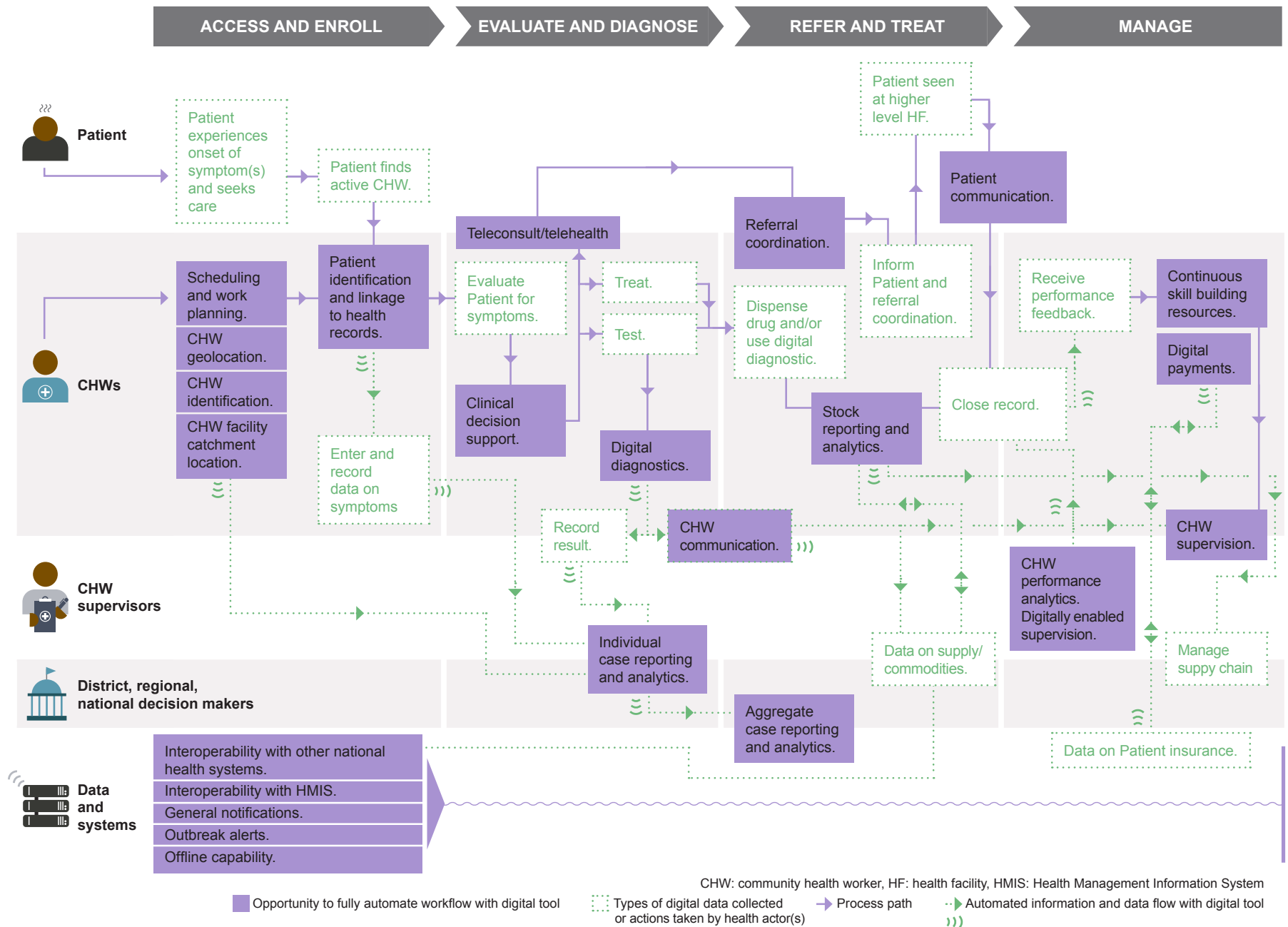
Table 4: Comparison of high-level CHW tasks mapped to whether digital tools support them to perform tasks across four countries.

High-level CHW tasks	Burkina Faso		Rwanda		Senegal		Zambia	
	CHW task?	Digitally supported?	CHW task?	Digitally supported?	CHW task?	Digitally supported?	CHW task?	Digitally supported?
Curative services for febrile illness								
Distribution of supply chain commodities	✓	✓ eSanteCom	✓	✓ cEMR	✓	✓ m-s@ntécom	✓	✓ CHiP
Rapid Diagnostic Tests (RDT)	✓	✓ eSanteCom	✓	✓ cEMR	✓	✓ m-s@ntécom	✓	✓ CHiP
Referral of severe cases	✓	✓ eSanteCom	✓	✓ cEMR RapidSMS	✓	✓ m-s@ntécom	✓	✓ CHiP
Temperature checks	✓	✓ eSanteCom	✓	✓ cEMR	✗	✗	✓	✓ CHiP
Treatment of uncomplicated malaria	✓	✓ eSanteCom	✓	✓ cEMR	✓	✓ m-s@ntécom	✓	✓ CHiP
Health promotion								
Family planning	✓	✓ eSanteCom	O	O cEMR	✓	✗	✓	✓ CHiP
HIV	✓	✓ eSanteCom	✗	✗	✓	✗	✓	✓ CHiP

continued on the next page

Condition								
Malaria	✓	✓ eSanteCom	✓	✓ cEMR	✓	✓ m-s@ntécom	✓	✓ CHiP
Maternal, Newborn and Child Health	✓	✓ eSanteCom	✓	✓ cEMR RapidSMS	✓	✓ m-s@ntécom	✓	✓ CHiP
Nutrition	✓	✓ eSanteCom	✓	✓ cEMR	✓	✓ m-s@ntécom	✓	✗
Tuberculosis	✓	✓ eSanteCom	✓	✓ cEMR	✓	✓ m-s@ntécom	✓	✗
Water, Sanitation and Hygiene	✓	✗	✓	✓ cEMR	✓	✓ m-s@ntécom	✓	✗
Immunization	✓	✓ eSanteCom	✗	✗	✓	✓ m-s@ntécom	✓	✓ CHiP

✓ Yes ⃒ O Not yet, but planned ⃒ ✗ No, not planned or not applicable

PEOPLE RECOMMENDATIONS

- **Prioritize end-user needs**: Ensure that the design of digital tools for community health is centered around the needs of CHWs and the communities they serve. Employ methodologies such as CRDM, HCD, or UAT to actively involve end-users in the development process, thereby enhancing usability and effectiveness.

- **Catalyze digital skill building**: Actively integrate digital and data skills into relevant capacity strengthening activities at all levels of the health system. Where there are major gaps, identify partners to bring in new skills, especially from the private sector (e.g. technology developers, data hosting). Consider government officials and private sector leaders seeking out digital skills building programs, (e.g., Digital Health Applied Leadership Program), courses (e.g., Digital Health: Planning National Systems), and certifications (The Open Group Architecture Framework). This will ensure all stakeholders are able to be effective partners in jointly achieving the government's digital health vision.

- **Leverage existing resources**: Encourage countries and partners engaged in the development of digital tools for community health to adapt and enhance existing resources such as the user personas, business processes, workflow diagrams, and functional requirements developed by the PMI DCHI project. This promotes efficiency and continuous improvement in digital health tool development across different contexts.

Systems

RESOURCES (TIME, COSTS, AND MORE) ARE KEY CONSIDERATIONS WHEN DESIGNING AND DEVELOPING A DIGITAL TOOL.

Based on the business processes, countries developed functional requirements that outline what the digital system must do. Functional requirements can be categorized as 'foundational' which are the minimum requirements or 'advanced' which can be considered in later digital tool iterations. Foundational and advanced functionalities can vary by setting depending on the digital environment, digital literacy, and infrastructure access to smartphones,

tablets, and the internet. For example, offline capability may be a foundational requirement in settings with limited internet connectivity as this functionality is required for the system to work for users. Something like geolocation can be considered a more advanced functionality that could be added to a future version of the tool to improve the users' capacity to identify and manage cases. The starting point of all digital environments varies; foundational functionalities are always needed for a digital tool at the community level.

Digital Square distilled 24 key functionalities from its implementation experiences to consider in digital health tools for community level use to support CHW tasks. Table 5 shows functionalities prioritized by the ministries of health in Burkina Faso, Rwanda, Senegal, and Zambia. Functionalities were prioritized based on value add and addressing gaps in country contexts.

Table 5: Functionalities commonly prioritized for digital tools designed for CHWs use.

Functionality[2]	Description	Burkina Faso	Rwanda	Senegal	Zambia
Foundational functionalities					
Aggregate case reporting and analytics	Tool collects aggregate case data and has data analytic functions in the tool or online.	✓	✓	✓	O
Case geolocation	Tool allows collection or use of geospatial data for individual cases.	✗	✓	✗	O
CHW communication	Tool allows two-way communication between peer groups, associated health facility staff, and/or supervisors.	✓	✗	✗	O
CHW facility catchment location	Tool provides uniquely identified CHWs and associated links to the health system.	✗	✓	O	O
CHW identification	Tool uniquely identifies CHWs.	✓	✓	✓	O

CHW performance analytics	Tool has analytic functions (data validation, graphs, charts) that support data quality, quality of care, or other performance areas.	✓	O	O	O
Clinical decision support	Tool provides algorithms or checklists to guide CHW service provision.	✓	✓	✓	✓
Individual case reporting and analytics	Tool collects individual case data and has data analytic functions in the tool or online.	✓	✓	O	✓
Interoperability with Health Management Information System (HMIS)	Tool sends information to the official national health management information system.	O	✓	✓	✓
Offline capability	Tool functions, at least partially, off-line.	✓	✓	✓	✓
Outbreak alerts	Tool sends and receives outbreak-related notifications.	✗	O	O	✗
Referral coordination	Tool allows client referral and tracking between CHWs and local health facilities.	✓	✓	✓	✓
Stock reporting and analytics	Tool collects stock data and has analytic functions in the tool or online.	✓	✓	✓	✓
Advanced functionalities					
CHW geolocation	Tool allows collection or use of CHW geolocation data for monitoring and planning distribution.	✓	✓	✓	O
Client communication	Tool allows two-way communication between CHWs and clients regarding health messages.	✗	O	✗	✗
Client identification and linkage to health records	Tool allows CHWs to uniquely identify each client, connect to health records at other health facilities, and track and coordinate care over time.	✓	✓	✗	O
Continuous skill-building resources	Tool provides access to training materials, policies, or other useful reference documents.	✓	✓	✓	✓

Digital diagnostics	Tool connects to diagnostics to read and/or share diagnostic information.	✗	✓	O	✗
Digital payments	Tool facilitates payment of salary, stipends, and/or performance incentives to CHWs.	✓	O	✗	✓
Digitally enabled supervision	Tool can be used by supervisors to assess CHW skills and capacity.	O	✓	O	✓
General notifications	Tool sends and receives notifications.	O	✓	O	✓
Interoperability with other national health systems	Interoperability is the ability of systems, applications, and devices to communicate and share data with each other like the national health management information system.[2]	O	✓	O	✓
Scheduling and work planning	Tool allows CHWs to plan and schedule key activities in the community.	✓	O	✗	O
Teleconsults/telehealth	Tool connects skilled health providers in real time to CHWs and community members.	✗	✗	✗	✗
Total existing operational functionalities ✓		13/24	17/24	9/24	11/24
Total planned functionalities O		5/24	5/24	8/24	9/24
Total functionalities, not operational nor planned ✗		6/24	2/24	7/24	4/24

✓ Yes │ O Not yet, but planned │ ✗ No, not planned

*Digital Square cross-referenced the Community-Based Management of Febrile Illness to show which functionalities are foundational versus more advanced.

SEVERAL DIGITAL TOOLS ARE AVAILABLE TO SUPPORT COMMUNITY HEALTH. MINISTRIES OF HEALTH HAVE PRIORITIZED TOOLS THAT ARE OPEN SOURCE AND BUILT ON STANDARDS TO ENABLE INTEROPERABILITY.

The ecosystem assessments conducted in Phase 1 identified several digital tools in use at the community level in each country named in Table 5. As noted earlier, the MOH in each country has endorsed a single tool to scale nationwide in support of community health. The ministries of health in Burkina Faso and Senegal are moving forward with CommCare, the MOH in Rwanda selected the Community EMR, and the MOH in Zambia selected CHiP.

Other digital tools listed that are not the primary digital community health tool used across comprehensive domains often serve to complement the primary digital community health tool. For example, ODK Collect is an open source tool used in Senegal to support community health. It gives users the ability to develop offline forms to collect the data digitally and upload and aggregate responses.

To mitigate the risk of having multiple digital tools with overlapping functions, Digital Square recommends using an enterprise architecture (EA), which is a holistic approach that helps to structure the digital health ecosystem and plan for a more connected health system, from its processes and operations to its information technology and its people. Think of it as a dynamic blueprint—describing how the elements of a digital health system fit together, interact, and ultimately align with the goals of the system. Burkina Faso and Senegal both prioritized EA as part of their PMI DCHI implementations.

Selecting a digital tool based on interoperability standards was an important consideration in each country. Aligning to standards means that the tool captures information in a standardized way so that it can seamlessly exchange information with other systems. The ability to exchange information across various systems is known as interoperability. For example, CommCare uses Health Level 7 Fast Healthcare Interoperability Resources (HL7 FHIR) standard, which enables fast and interoperable exchange of healthcare information. Zambia's CHiP uses FHIR release 4. Interoperability of health information systems can enable new data insights, avoid duplication, reduce costs for data capture and management, and improve the quality and continuity of care for people accessing care at multiple points of service across the health system.

Table 6: Digital tools that support community health in Burkina Faso, Rwanda, Senegal, and Zambia.

Burkina Faso	Rwanda	Senegal	Zambia
CommCare^ (eSanteCom)	Community Electronic Medical Record (EMR) ^	m-s@ntécom ^	CHiP (based on Medplat system) ^
DHIS2	RapidSMS	DHIS2	C-HMIS (DHIS2)
RapidPro	SIScom on DHIS2	DHIS2 Tracker	MCI (on DHIS2 Tracker)
Zato		mInfoSanté	REVEAL
		ODK Collect	

^ denotes the MOH-selected digital tool to support community health. CHiP: Community Health Integrated Platform: DHIS2 - District Health Information Software 2, EMR - Electronic Medical Records, C-HMIS - Community health management information system, MCI - Malaria Case Investigation, eLMIS - Electronic Logistic Management Information System, ZHAP - Zambia Health Analytics Platform

CommCare, EMR, and CHiP are all open source software, meaning the source code is available and modifiable. This allows developers to adapt the software to the local context, apply it across health areas, and to learn from or collaborate with others who have used the software. Open source software also reduces the risk of vendor lock-in (i.e., when a government becomes dependent on a vendor for digital products or services and is unable to switch to another vendor without significant costs or inconvenience) since any developers can access the source code. It also means that the cost of ongoing software maintenance or new feature development can be shared across several implementers and supporters.

CommCare and MEDPlat (the system CHiP is based on) are registered DPGs. DPGs are open source software, open data, open artificial intelligence

(AI) models, open standards, and open content that adhere to privacy and other applicable laws and best practices, do no harm by design, and help attain the Sustainable Development Goals[3]. CommCare is also a Digital Square global good. Global goods are health-focused DPGs that are impactful, scalable, and adaptable to different countries and contexts. Global goods are open source, standards-based, and designed to be interoperable as part of a larger ecosystem. Mature digital health software global goods have a clear governance structure, funding from multiple sources, proven effectiveness, and demonstrated deployment at scale[4]. Table six lists the seven Global Goods classified as community-based information systems according to the WHO's Classification of digital interventions, services and applications in health.

ALL FOUR COUNTRIES USED A HEALTH ENTERPRISE ARCHITECTURE APPROACH TO STRENGTHEN DIGITAL COMMUNITY HEALTH.

A health enterprise architecture approach is a process to ensure all data, systems, processes, and technologies in a country work together seamlessly and securely according to a national vision, policy, or blueprint[5]. The enterprise architecture provides a holistic framework for how various systems should store, manage, share, and use data. As part of the DCHI project, a health enterprise architecture approach was used in Burkina Faso, Rwanda, Senegal, and Zambia to map the data flows between the community health system and other health information systems in the country.

For example, the Zambia enterprise architecture framework outlines how the CHiP will connect to an interoperability layer that can access a shared health record, a health facility list, a provider registry, and a client registry. Existing digital tool systems will also be integrated and flow into DHIS2. Zambia is taking an additional step by including health finance and insurance providers' data and allowing CHWs basic access to aggregated data.The Zambia MOH is currently working to finalize the interoperability framework into policy guidelines.

In Senegal, there was no enterprise architecture at the outset of the DCHI project so this was an opportunity to create a framework starting with community health. Figure 3 shows Senegal's enterprise architecture, which includes an interoperability layer to seamlessly and securely connect all the digital systems according to the vision outlined in the national policy.

SYSTEMS RECOMMENDATIONS

- *Start with a minimum viable product*: Begin digital tool development by focusing on a subset of essential functionalities, known as foundational requirements, to create a minimum viable product (MVP). Advanced functionalities can be incrementally incorporated into subsequent iterations. This phased approach allows for iterative improvements while ensuring the initial deployment meets critical user needs.

- *Use open standards for interoperability*: Adopt open standards in the design and implementation of digital health tools to facilitate seamless exchange of information across different systems. Utilizing standards such as HL7 FHIR ensures compatibility and interoperability, enabling efficient data sharing and integration within the broader health ecosystem.

Table 7: Community-based information systems (WHO Classifications) as listed in the Digital Square Global Goods Guidebook.

Community-based information systems			
Community Health Toolkit	OpenFn	RapidPro	Tupaia
DHIS2	OpenSRP	Reveal	

"In Senegal, the digital transformation started with community health.. We want to extend it to the whole health system. For this we need strong leadership, commitment, and good governance. We'll do our utmost to support the development of the enterprise architecture."

Cheikh Tidiane Gueye, Technical Advisor in Charge of Partnership, Ministry of Health and Social Action

Figure 3: Senegal's enterprise architecture framework
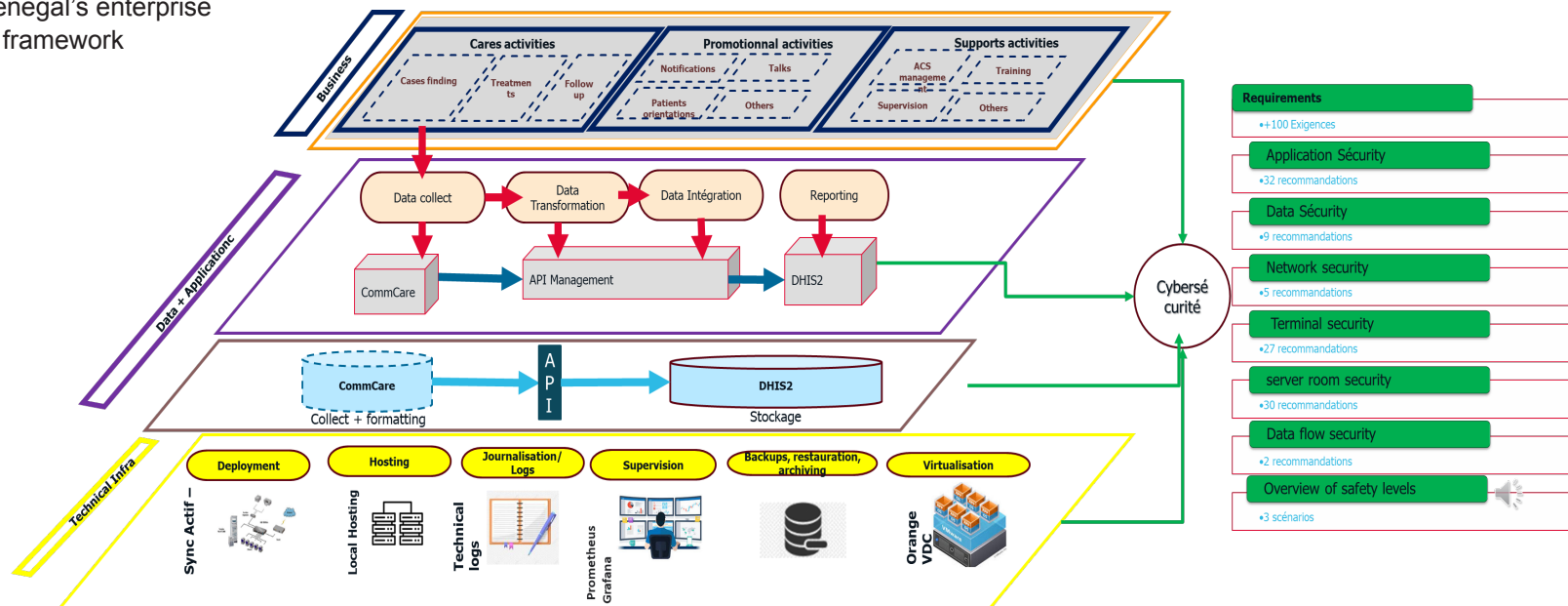
- **Leverage DPGs and global goods**: Explore and utilize digital tools recognized as DPGs and global goods, which are open source and designed to address global health challenges. Leveraging these resources promotes adaptability, scalability, and collaboration while reducing dependency on proprietary solutions.

- **Utilize a health enterprise architecture approach**: Adopt a health enterprise architecture approach to ensure seamless integration and interoperability of digital community health systems within the broader health infrastructure. By establishing a comprehensive framework for data management and exchange, countries can enhance the efficiency, security, and scalability of their digital health initiatives.

Conclusion

The governments in Burkina Faso, Rwanda, Senegal, and Zambia have accelerated progress on digital transformation of community health with support from the PMI DCHI. Comparing the experiences across countries provides insights on the factors - country leadership, stakeholder alignment, human-centered design, standards and interoperability, and enterprise architecture - that enable successful digital transformation. The recommendations put forth in the domains of governance, people, and systems provide a comprehensive framework to inform and empower country health leaders, policymakers, implementing partners, and software developers to accelerate digital transformation for community health across similar settings. By following these recommendations, governments and partners can take proactive steps to integrate digital solutions into community health programs, thereby advancing sustainable improvements in community health services and outcomes.

A group photo of Group 1 ASCs at three-day capacity strengthening training on m-s@ntécom in Senegal.

The PMI DCHI project supported ministries of health to employ key strategies and resources to design its digital tools for CHW use including leveraging the 1) Collaborative Requirements Development Methodology (CRDM); 2) Digital Health for Community-based Management of Febrile Illness Framework; 3) the health enterprise architecture approach; 4) human-centered design approach, and 5) user acceptance testing. Many of these approaches and resources overlap. The table below shows which approaches were used across the four countries. Appendix 1 also offers a brief overview of each approach.

Table A1: Comparison of strategies and resources used to strengthen digital tools at the community level.

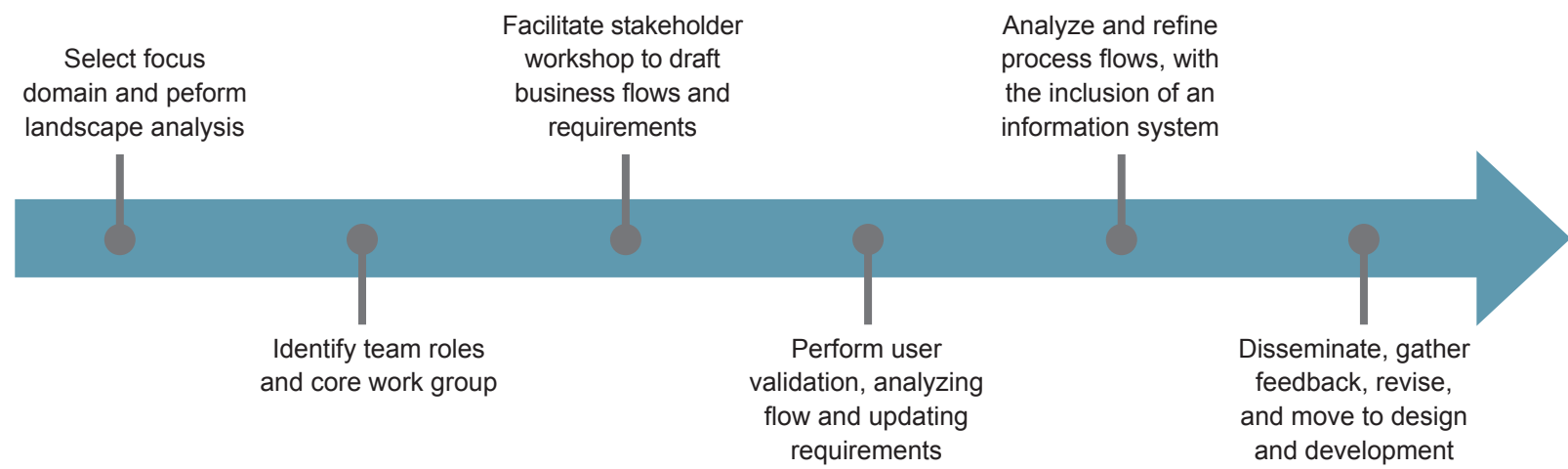| Country	Collaborative Requirements Development Methodology	Digital Health for Community-Based Management of Febrile Illness Framework	Health enterprise architecture approach	Human-centered design approach	User acceptance testing
Rwanda	✓	✓	✓	✓	✓
Senegal	✓	✓	✓	✓	✓
Burkina Faso	✓	✓	✓	✓	✓
Zambia	✓		✓	✓	✓

CRDM

WHAT IS THE CRDM?

The CRDM emphasizes active involvement and open communication among stakeholders, including end users, developers, and health domain experts, fostering a shared understanding of project goals and constraints. Through facilitated workshops, brainstorming sessions, and interactive tools, the CRDM encourages collaborative problem-solving, enabling the identification of comprehensive and accurate requirements early in the development lifecycle. Table A2 describes the CRDM's four key components and Figure 1 illustrates how the approach is intended to support the development, in these cases, of digital community health systems through the life cycle of the technology.

Table A2: Components of the CRDM process.

Core component	Key question and description
User personas	**Who are we doing this for?** User personas describe the demographics, environment, and key challenges for the various country stakeholders that would be using aspects of the system. These personas are a method for enhancing engagement with stakeholders and build context for prototyping and implementation efforts.
Business process matrix and workflow diagrams	**What are they doing today?** Through ongoing country consultation, a set of common processes is identified for a system using the CRDM, and a visual representation of the business process in terms of tasks and decision points is created in a logical workflow to enhance communication and collaboration among users, stakeholders, and engineers.
Process design	**How could information system products improve data quality and use?** Looking at the current user and organizational paint points we begin to redesign the system and tell a story about how the user's lives will be changed and are able to reach their respective goals.
Common requirements	**What must the information system products do?** As a final part of the CRDM, the functional requirements are defined for the information system. This helps ensure solutions will be able to meet the needs of the various stakeholders.

Figure A1: Collaborative requirements development and the information technology life cycle.

Select focus domain and peform landscape analysis

Facilitate stakeholder workshop to draft business flows and requirements

Analyze and refine process flows, with the inclusion of an information system

Identify team roles and core work group

Perform user validation, analyzing flow and updating requirements

Disseminate, gather feedback, revise, and move to design and development

HOW DID THE PMI DCHI PROJECT EMPLOY THE CRDM TO DIGITIZE COMMUNITY HEALTH?

Table A3: CHW persona developed in Senegal using the CRDM.

Overall	Roles and responsibilities	Motivation	Digital literacy	Challenges
• Is typically a man or woman between 22-55 years of age. • Speaks the language of their area of intervention. • Attains primary education level and trained on the management of patients for certain diseases and the promotion of health. • Volunteers for the community. • Maintains flexible working hours.	• Provides consultation, screening, treatment, follow up (malaria, diarrhea, malnutrition, etc.), screening for malnutrition, vaccination follow up of children under five years of age. • Collaborates with the Assistant to the Head Nurse. • Conducts home visits, health talks, and other tasks as assigned. • Completes data collection and activity reports.	• Feels a sense of pride and personal satisfaction. • Holds trust with the community.	• Uses basic telephones to make calls and send Short Message Service. • Uses social media for communication purposes in work (photos of reports) and personal.	• Separates personal and community activities. • Identifies community actors (badges, outfits, identification documents). • Engages in limited travels during the rainy season. • Manages heavy workloads. • Understands when cases need to be escalated.

Table A4 summarizes how three countries (i.e., Burkina Faso, Rwanda, Senegal) identified a set of business processes using the CRDM as part of the PMI DCHI process. Importantly, the CRDM brought together many departments across the ministries of health since digitizing community health involves both technology and health domains coming together. All three countries had the NMP or its equivalent as well as the digital health departments participating from the ministries. Two of three countries also had their community health and maternal child departments participate.

Table A4: Summary comparison of CRDM process.

Country	# of business processes identified	Departments of the MOH involved	Years CRDM process completed
Burkina Faso	25	Digital Health, National Malaria Control Program	2021-2022
Rwanda	7	Digital Health; Malaria & Other Parasitic Diseases Division/ RBC; Maternal, Child & Community Health Division/RBC and MOH Clinical services	2022-2023
Senegal	18	Digital Health; National Malaria Control Program; Maternal and Childcare; Community Health	2021-2022

Table A5 compares the business processes across Burkina Faso, Rwanda, and Senegal. All three countries created seven business processes for the following: diarrhea management; people registration; malaria; CHW supervision; malnutrition, drug distribution during campaigns, case reference. The hope is that the global digital health community who is interested in developing business processes for their country contexts can learn from and use the examples from these countries as a starting point and/or to learn more about the work already achieved as each country moved forward in its journey to digitize community health.

Table A5: Summary of business processes mapped during PMI DCHI.

Business processes mapped during PMI DCHI CRDM	Burkina Faso	Rwanda	Senegal	Total
Acute kidney failure			✓	1
CHW administrative management	✓		✓	2
CHW reference	✓	✓	✓	3
Case supervision	✓	✓	✓	3
CHW training and retraining			✓	1
Culinary demonstration	✓			1
Diarrhea management	✓	✓	✓	3
Drug distribution during campaigns	✓	✓	✓	3
Drug and input management	✓	✓		2
Long Lasting Insecticide Nets (distribution & tracking)	✓	✓		2

Malaria	✓	✓	✓	3
Malnutrition	✓	✓	✓	3
Management of non-infected wounds	✓			1
Newborn care at home	✓	✓		2
Notification of life events (birth/death)	✓			1
Notification of unusual events	✓			1
Possible serious bacterial infection (PSBI) follow-up	✓			1
Pneumonia (cough)	✓	✓		2
People registration	✓	✓	✓	3
Search for Acute flaccid paralysis cases, Guinea worms, chronic cough	✓			1
Supply of contraceptive methods	✓	✓		2
Training & refresher courses	✓	✓		2
Vitamin A Deficiency	✓			1
Washing elephantiasis	✓			1
Total in each country	**22**	**13**	**10**	

Once the countries defined the business processes, they depicted those in workflow diagrams to illustrate tasks and decision points logically ordered to facilitate collaboration among users, stakeholders, and engineers to design the digital tools with all these perspectives. Figure 2 below provides an example from Senegal on passive malaria case detection and treatments. The diagram outlines the interactions a CHW needs to take when supporting a client to determine whether they have malaria. Logic can be built into a digital tool to support the CHW to capture the data elements associated with the workflow and to guide the CHW to take appropriate action (e.g., referral or treatment) in the proper sequencing of steps. Appendix 3 links to an editable PowerPoint slide deck that offers additional examples of workflow diagrams produced by PMI DCHI as a resource for the global digital health community to learn from and potentially adapt.

Passive case detection

This diagram illustrates the interactions between the CHWs and clients outlining all the tasks that the CHWs must do when conducting passive case detection in the community. M-s@ntécom can be used to record RDT results and update the patient consultation workbook.

ARI – acute respiratory infection
RDT – rapid diagnostic test
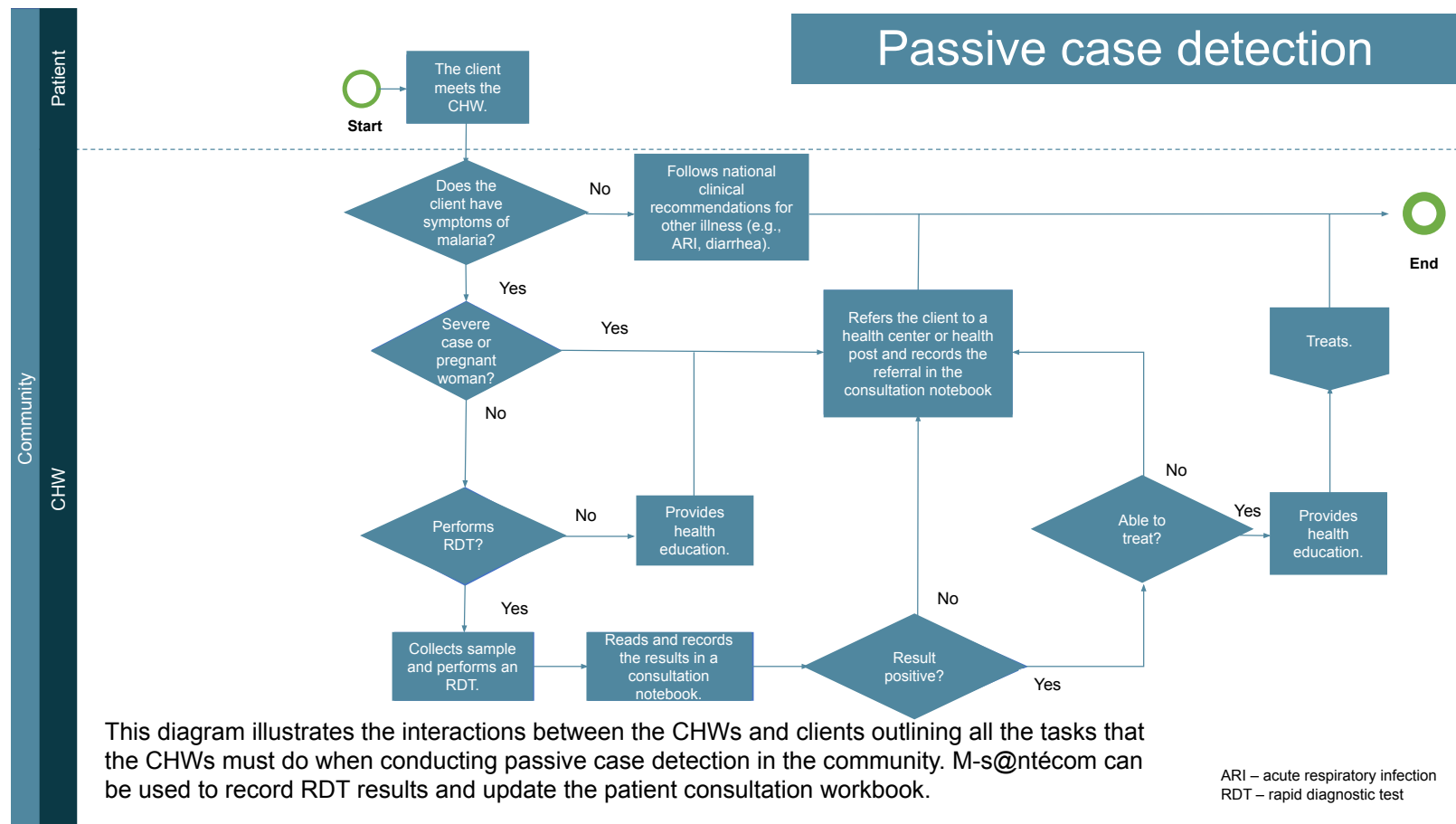
Human-centered design

The PMI DCHI project also used human-centered design (HCD). This is a powerful approach used to support the creation of digital community health systems by placing the needs, behaviors, and preferences of the users at the forefront of the design process. By engaging community members, healthcare professionals, and stakeholders, HCD ensures that the design of these systems resonates with the unique context and challenges of the community. Ultimately, by embracing HCD, digital community health systems can enhance accessibility, engagement, and effectiveness, fostering a healthier and more connected society.

In Zambia, Digital Square conducted a review of current systems to assess the status of community service delivery areas and progress in digitalizing community health services. The assessment revealed issues with the cHMIS, including reporting burdens (e.g., duplication of reporting) and breakdown at the district level. PMI DCHI used a HCD approach to address these challenges by bringing together stakeholders (e.g., xxxx) in workshops to gather requirements and optimize workflows. The MOH's technical validation led to significant changes in workflows, such as incorporating COVID-19, gender-based violence, elimination of mother-to-child transmission of HIV, under-five vaccination monitoring, and integrated management of childhood illnesses into the cHMIS.

Digital Health for Community-Based Management of Febrile Illness

Senegal and Burkina Faso developed and used the Digital Health for Community-Based Management of Febrile Illness framework to help determine the functionalities needed for their digital community tools to help CHWs and their supervisors perform their routine tasks more effectively and efficiently. This resource is a framework that describes the desired state for CHW use of digital tools for managing malaria and other febrile illnesses—a state in which community health programs leverage digital health tools to strengthen service delivery and generate and use data that improve community health programming, with the goal of decreasing malaria morbidity and mortality and the burden of other febrile illnesses. Senegal and Burkina Faso used recommendations found in the nine boxes in Figure A2 (right)

Figure A2: Desired state for CHW use of digital tools for managing malaria and other febrile illnesses.

People	Governance	Systems
CHWs and supervisors have the necessary skills and are appropriately equipped and renumerated to provide high-quality care for febrile illness management, where needed.	National CHW policy and guidance exist, include on febrile illness management, and are costed, funded, and implemented.	There are clear data flows between CHW source data and national data warehouse.
Guidance, training, and ongoing technical support are available for digital tools and data use, and tools make CHWs' job easier.	National digital health strategy policies and guidance exist and are costed, funded, and implemented.	Implemented digital health tools are sustainable, adaptable, and aligned to national interoperability standards.
Data generated by CHWs are used by CHWs and facility, regional, and national decision-makers to reduce the burden of febrile illnesses.	National digital health and community health strategies and policies are aligned and support each other.	Digital health tools are contextualized for individual country adoption, have functionalities for CHW febrile illness management, and are used where needed.

across the three domains of people, governance, and systems to partner with the governments to prioritize the most high-impact activities to digitize community health. For example, the framework describes the ideal state is one where "CHWs and supervisors are appropriately skilled, equipped, and paid and are delivering febrile illness management where needed" and one illustrative recommendation was to "develop/fund/implement costed roadmap to scale CHW program." Senegal and Burkina Faso followed this recommendation over the life cycle of the PMI DCHI project by supporting the ministries of health to develop and implement costed roadmaps to digitize community health.

Appendix 2: Glossary

Terminology	Description
advanced functionalities	Are tool functions that add or enhance basic requirements for the end user. These can be considered in later digital tool iterations (e.g., geolocation).
aggregate data entry	Is combined data to be reported all at once and does not contain identifying information.
capacity strengthening	Is the process by which individuals and organizations acquire and retain the skills, knowledge, tools, or other resources needed to do a job completely or to a greater degree.
CDC	Centers for Disease Control and Prevention.
cEMR	Community electronic medical records.
CHiP	Zambia's Community Health Integrated Platform.
C-HMIS	Community health management information system.
CHWs	Is a frontline public health worker who is a trusted member of a community or who has a particularly good understanding of the community served. A CHW serves as a liaison between health and social services and the community to facilitate access to services and to improve the quality and cultural competence of service delivery.

Collaborative Requirements Development Methodology (CRDM)	Is a project participant tool and process for documenting public health workflows and defines functional requirements for information systems that support those workflows.[1]
connectivity issues	Are challenges accessing data/internet - could be lack of coverage, device, available airtime/credits for connectivity.
costed roadmap	Is the process of detailing the policy, human resources, training, infrastructure, and all other cost considerations when launching a digital ecosystem or a single digital tool.
data capture	Is the process of recording data (paper or digital) during house visits.
data management	Is the question of how collected data is organized, stored, and shared.
DCHI	Digital Community Health Initiative.
decision making or action	Are the process of using data to inform any decision making or actions.
digital functionality	Are a digital system that supports CHW tasks.
Digital Health for Community-based Management of Febrile Illness Framework	Is the desired state for CHW use of digital tools for managing malaria and other febrile illnesses – a state in which community health programs leverage digital tools to strengthen service delivery and generate and use data that improve community health programing, with the goal of decreasing malaria morbidity and mortality and the burden of other febrile illnesses.
Digital Public Goods	Is defined by UN Secretary-General as 'Open source software, open data, open AI models, open standards and open content that adhere to privacy and other applicable laws and best practices, do no harm, and help attain the Sustainable Development Goals.'[2]
electronic data entry	Is entering data into digital tools (non-paper-based records).
eLMIS	Electronic logistics management information system.
EMR	Electronic medical records.
environment	Is the ecosystem such as the available infrastructure, policies, digital literacy, size of the healthcare personnel, existing digital tools and mobile phones, and other factors.
foundational functionalities	Are the users' minimum requirements for using a digital tool (e.g., offline capability).

Global Goods	Is defined by Digital Square as 'digital health tools that are adaptable to different countries and contexts.'[3]
HCD	is a problem-solving technique that puts real people at the center of the development process, enabling you to create products and services that resonate and are tailored to your audience's needs.[4]
health enterprise architecture	Is a process to ensure all digital systems in a country work together seamlessly and securely according to the vision outlined in the national policy.
HL-7 FHIR	Health Level 7 Fast Healthcare Interoperability Resources.
iCCM	Integrated Community Case Management is a "strategy to train, support, and supply community health workers to provide diagnostic, treatment, and referral services for three common, treatable, and curable childhood illnesses: malaria, pneumonia, and diarrhea."[5]
interoperability	Is a function of a system that can transfer data securely among digital health systems.
MCI	malaria case investigation.
NTDs	neglected tropical diseases.
PSBI	Possible serious bacterial infection.
PMI	U.S. President's Malaria Initiative.
RDT	rapid diagnostic tests.
SOPs	Standard operating procedures are guidance documents for activities.
Systems for data collection and reporting	Are digital tools such as CommCare, DHIS2, ODK, RapidPro, Reveal, or other digital tools.
transmit/sync data	Is the process to send data to central servers or the next location for processing (if paper records).
UAT	Is a phase of software development in which the software is tested in the "real world" by the intended audience or business representative. (alternative names include beta testing or end-user testing).[6]
USAID	U.S. Agency for International Development.

WASH	Water, Sanitation, and Hygiene.
workflows	Are the steps a health worker takes to complete a task (ex. treatment of malaria) visually represented. This is also known as business processes.
ZHAP	Zambia Health Analytics Platform.

These are the sources that informed some of the definitions in this glossary.

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[3] Digital Square. "Global Goods for Health." https://digitalsquare.org/digital-health-global-goods. Accessed January 30, 2024.

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The digital ecosystem is rapidly evolving, and the U.S. PMI DCHI supported the mapping of CHWs, their tasks and responsibilities, digital literacy, and contributed to several countries' digital futures. This PowerPoint presentation aims to add to the global discourse through:

- Sharing editable resources available to the global digital health community that can be leveraged, adapted, and applied in other contexts.

- Providing user workflows and user personas examples from Senegal and Tanzania which can be adapted to other country contexts or improved upon in the current country context. These workflows were developed based on the CRDM and follow: passive case detection, treatment, treatment management, CHW supervision, human resource management, inputs and commodities, and proactive case detection.

Appendix 4: References

1. Digital Square. PMI Digital Community Health Initiative Cross-Country Landscape Report. PATH, 2022. Accessed August 13, 2024. https://static1.squarespace.com/static/59bc3457ccc5c5890fe7cacd/t/620be09ed784a362a9e421ce/1644945569802/PMI_DCHI_Global_Report.pdf.

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4. Digital Square. Global Goods Guidebook Version 4.0. PATH, May 25, 2023. Accessed August 13, 2024. https://digitalsquare.org/resourcesrepository/2023/5/25/global-goods-guidebook-version-40.

5. Digital Health and Innovation and Sexual and Reproductive Health and Research teams. Digital Implementation Investment Guide (DIIG): Integrating Digital Interventions into Health Programmes. Geneva: World Health Organization, September 15, 2020.