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Role of Digital Tools in Fighting Malaria at the Community Level

ZAMBIA

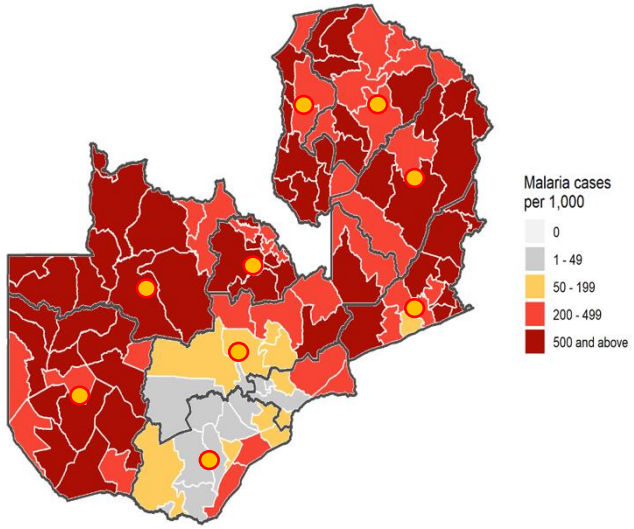
Executive Summary

Malaria is highly endemic in Zambia, with the entire population considered to be at risk of contracting the disease. The risk is highest in the wetter, rural provinces of Luapula, Northern, Muchinga, North-Western, and Western, and is lowest in Lusaka and Southern Provinces.[1] Zambia employs a stratified malaria elimination strategy with five different intervention packages depending on the number of cases per 1,000 population.[2] Zambia has made significant but slow progress in malaria control in partnership with PMI, the Global Fund, and the Bill & Melinda Gates Foundation, recording reductions in overall malaria mortality with fluctuations in malaria incidence and prevalence in the last decade.[1]

Malaria services at the community level are provided by two forms of health workers: community based volunteers (CBVs) and community health assistants (CHAs).[3] Their mandate is to test for and treat malaria, collect and report malaria data, support vector control campaigns, and educate and sensitize communities on malaria. In this report, the term community health worker (CHW) refers to both CBVs and CHAs.

Zambia has made significant investments toward expanding coverage of community health workers utilizing the mobile phone–based Malaria Rapid Response (MRR) system for reporting of community data into the National Malaria Elimination Program (NMEP) DHIS2 system.

Key digital health recommendations in this profile include setting up an electronic registry of all community health workers and digitizing the whole malaria community case management process from client registration to hospital referral and client follow-up after treatment.



MALARIA

Incidence per 1,000 people in 2021[4]

340

PEOPLE

Community Based Volunteer (CBV)
Community Health Assistant (CHA)

19,853 CBVs/CHAs in 2022[16]

10.9 per 10,000 people[16]

GOVERNANCE

National Digital Health Strategy

YES

SYSTEMS

Digital Health Index[5]

SCORE: 2

digital square

Recommended Actions

PEOPLE

Community health workers and other decision-makers

Ensure timely submission of community-level data

Ensure provision of resources/enablers such as registers and mobile phones with talk time credit for timely submission of data by CHWs and health facility staff. This involves the introduction of an incentive for timely submission and recruitment of human resources based at the health facility dedicated to data collation and submission.

Support development of ICT skills among community health workers

Develop an information and communication technology (ICT) skills module to be added to the training curriculum for community health assistants. In addition, the training on digital community tools to be standardized at Ministry of Health (MOH) level for all community health worker cadres.

GOVERNANCE

Strategies and policies

Ensure new digital health strategy is inclusive of the needs at community health level

The Digital Health Technical Working Group to coordinate the introduction of community health component to the draft of the new Digital Health Strategy. Ensure inclusivity of the Digital Health Technical Working Group across vertical programs that implement digital tools, such as the National Malaria Elimination Program (NMEP), among others.

Involvement of community level in design of digital health tools

Conduct Collaborative Requirements Development Methodology workshops consistently across all digital community health interventions to develop comprehensive list of digital health system requirements, including enablers and skill set needs.

Secure funding for digital health tools used in community health programs

Include costs related to digital health tools used for community health in the preparation of budgets for health facilities where CHWs are supervised. This is to ensure there is funding for phone credit, mobile data, and device repair or replacement.

SYSTEMS

Processes and digital tools

Digital registry of all CHWs

Set up an electronic registry of all CBVs and CHAs in the country that is dynamic enough to track data on CHW deployment saturation targets and progress at district, provincial, and national levels. It should profile active and inactive CHWs in relation to the provision of services and reporting of data.

Stage-gate approach in digitization of malaria case management business processes at the community health level

Taking into account the challenges in the enabling environment, a gradual introduction of digital health tools to be used by CHWs in the delivery of malaria case management services is recommended. These tools will encompass processes such as client registration, clinical decision-making, referral to health facility, client follow-up, health education, and reporting, as well as tracking commodities and supplies.

Disaggregation of community-level data

Collection of disaggregated data on CHW activity either through the extension of DHIS2 Tracker beyond health facility level to community health level or through a different application.

Digitize the ordering of commodities by CHWs

Draw lessons from an antiretroviral decentralization pilot and vaccination monitoring system in extending the LMIS beyond facility level to allow handling of commodities used by CHWs.

Methodology

A desk review and key informant interviews were conducted to develop this profile. Due to time constraints, a survey was replaced with additional interviews, which included questions on digital tools that were developed for the survey. Findings from these activities were validated during the workshop and used to develop the recommendations.

DESK REVIEW	SURVEY	INTERVIEWS	WORKSHOP	ANALYSIS
From **MAY** to **JUNE 2021**, 26 documents were reviewed to establish a foundation of knowledge on the malaria strategy, community health, governance, data systems and architecture, the role of data in decision-making, and infrastructure. See Appendix A.	Conducting a survey was deprioritized due to time constraints. Instead, additional interviews were conducted. The interview tool incorporated questions on digital tools, community health workers, and malaria case management.	Interviews were conducted with 38 individuals from various organizations (see Appendix C) from **JANUARY** to **FEBRUARY 2022**.	A workshop was conducted with 18 participants in **APRIL 2022**. The workshop aimed to validate results from previous steps and identify opportunities for digital tools to increase malaria program impact.	Following the workshop, the team reviewed outputs from each step and developed a country profile highlighting recommendations developed in consultation with **PMI** and the **Ministry of Health**. Data were last collated on **May 6, 2022**.

Information collected through the methods described above was categorized according to key components within three domains: people, governance, and systems. These domains and their underlying components were informed by an existing Living Goods maturity model and adapted to incorporate malaria-specific content. The components include personnel, training, and technical support ("People"); policies, strategies, and governance structures, and their implementation ("Governance"); and data flow, digital tool structures, functionalities, and use ("Systems"). Together, these components describe the *desired state* for CHW use of digital tools for malaria case management, a state in which community health programs can leverage digital tools to generate and use data that improve malaria programming with the ultimate aim to decrease the local malaria burden.

PEOPLE

People highlights the community health workers, supervisors, information technology support staff, and other decision-makers that contribute to effective use of digital tools and data in malaria community health programs.

GOVERNANCE

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

Systems describes the processes and digital tools that enable community health platforms to effectively use digital technology and data to strengthen malaria and other health programs.

People

UNDETERMINED **Total community health workers in country**	**Compensation policy:** **VOLUNTEER & PAID** **Paid by government and cooperating partners**
11,000+ **Providing malaria community case management**	**Compensation policy:** **VOLUNTEER & PAID** **Paid by government**

In Zambia, community health workers are composed of two main groups: community based volunteers (CBVs) and community health assistants (CHAs). CBVs constitute the larger proportion, and in practice they are commonly referred to as community health workers. To address this ambiguity, the Community Health Unit within the Ministry of Health aims to standardize the label for CBVs to community health volunteers in the future. CHWs are selected from their local communities for training through the Neighbourhood Health Committees. CHAs undergo formal standardized training for 12 months at three specialized training institutions. Following training, CHAs are registered with the Health Professionals Council of Zambia before being deployed to health posts. While CBV training has been standardized for some cadres, it is usually over shorter periods and varies significantly depending on the implementing partner, with a focus on specific disease verticals. CBVs tend to work directly with implementing partners, whereas CHAs are formally employed by the government. Both cadres of CHWs are trained to provide diagnostic services and administer malaria treatment in addition to collecting and reporting malaria data. However, CHAs are the only ones who have been trained to provide intermittent preventive treatment of malaria during pregnancy services. CHWs also provide services related to family planning, maternal health, newborn care, nutrition, HIV and tuberculosis, and water access, sanitation, and hygiene. There is a shortage of CHWs in the country, even though the exact number of CBVs is unknown, as there is currently no national database of CBVs across all disease areas. The malaria program maintains a registry of CHWs trained on iCCM plus, which lists more than 11,000 CHWs.[3] More than 3,000 CHAs have been trained, but fewer than 1,500 have been put on the government payroll due to financial constraints, forcing many to work as volunteers.[3] CBVs are not full-time workers, and the time spent volunteering is meant to be capped at a maximum of three days per week. Incentives such as starter kits (bicycles, T-shirts, hats, medication boxes), lunch allowances for meetings, and per diems during trainings are provided depending on resource availability. Retention of CHWs is difficult due to disparities in incentive distribution and inconsistent funding for salaries and program activities. CHAs often spend a significant portion of their time assisting at health facilities instead of being in the community due to a shortage of staff at health facilities. CHWs also travel to the health facility at least once a month to access the phone used for reporting data. CHWs are also affected by stockouts of commodities such as test kits, medicines, and tools for reporting. The COVID-19 pandemic disrupted the supply chain of key malaria commodities, especially rapid diagnostic tests, causing stockouts in many areas. Many CHWs then stopped providing malaria testing and treatment services as supplies were rationed at health facilities. Efforts to restart CHWs in malaria testing and treatment have been progressing.

Community health worker digital readiness

The main challenges to community digital systems are the lack of reliable electricity supply and mobile network accessibility. Thus, the design of digital community health solutions should take the infrastructure limitations into consideration for implementation to be successful. These challenges are compounded by the high cost of mobile data and a shortage of devices, including at the health facility level. The capacity to operate digital tools by CHWs is limited, as there is no ICT skills training included in the pre-service training for CHAs, implying that the usability of the community digital health solutions should be designed to be simple and conducive to self-learning. In some areas, CHWs are provided with mobile devices or data, but this is inconsistent

and depends on project funding. However, mobile phone–based solutions such as the Malaria Rapid Reporting tool have been successfully deployed to good effect.

Data-driven decisions at each level of the health system

Zambia has developed its own high-quality dashboards to facilitate data use and data-informed decision-making. To foster the growth of data usage culture at all levels, the National Malaria Elimination Centre (NMEC), Tableau Foundation, and PATH Malaria Control and Elimination Partnership in Africa (MACEPA) introduced the Tableau data visualization tool.[1] The tool enhances Malaria Rapid Reporting (MRR) and community malaria data analysis through dashboards that are emailed monthly to malaria program stakeholders. The Tableau visualization tool is available nationwide, but its utilization has been limited by the lack of computer devices at health facilities. Zenysis also supports the Ministry of Health with data integration and visualization through the Zenysis platform for malaria commodities.[6] There are challenges with data timeliness and data accuracy limiting the usefulness of data in the Health Management Information System (HMIS) and electronic Logistics Management Information System (eLMIS) for decision-making. At the community and facility levels, challenges such as stockouts of paper-based registers and the shortage of mobile devices contribute to poor data timeliness. In some areas, there are Data CHWs who are CHW cadres that are given a phone and trained to collect data from about four or five other CHWs and communicate it directly via the Malaria Rapid Reporting (MRR) system. Challenges with the consistent provision of phone credit and device repairs are raised and known to affect the program. Steps to promote consistency across partners' support are being made, albeit slowly with some partners. The MRR system can issue performance-based incentives in an automated manner by depositing phone credit directly to the CHWs mobile number to encourage timely submission of data.

NATIONAL	National malaria data are used to develop national strategy documents and applications for resources from donors and partners. The country has developed high-quality dashboards to facilitate data use and data-informed decision-making. The tracking of malaria elimination progress involves routine analysis of malaria data reported in the HMIS and National Malaria Elimination Centre (NMEC) DHIS2 instance by the CHWs on a monthly basis. PMI, Global Fund, Rotary, and other partners supported malaria data review meetings and the development of electronic work planning tools linked to performance monitoring dashboards, which have been taken up for regular use at provincial and national levels.
PROVINCIAL	Provincial Integrated Data Review meetings are held. DHIS2 data submitted by districts is checked for completeness and timeliness at the provincial level, where malaria staff watch for outliers and identify any errors. Staff monitor malaria transmission and report any unexpected increases in transmission to the NMEC vector control team to monitor the need for insecticide treated bed nets and indoor residual spraying (IRS). Case management data is used to anticipate stockouts of commodities. Weekly data quality assessments are also conducted by provincial malaria staff.
DISTRICT	The District Health Information Officer (DHIO) validates data and enters it into DHIS2. The DHIO reviews and validates the data in DHIS2 and provides feedback to the health facilities. Facilities with access to the Malaria Rapid Reporting (MRR) system can report directly to DHIS2. Monthly meetings are held to discuss malaria data to monitor trends and enable planning for resources. Weekly monitoring of malaria cases is done in areas where MRR has been implemented.
HEALTH FACILITY	Access to the Tableau Reader starts at the health facility level. Data is used to monitor trends and set targets using disease thresholds. Supervising health facility staff review the data to monitor potential outbreaks, as well as assess how CHWs are managing malaria cases and discuss any areas for improvement. There are monthly Neighborhood Health Committee and Health Center Committee meetings held with health facility staff and CHWs in a catchment to discuss trends in malaria cases and discuss feedback on how to manage any changes in malaria cases. Due to funding constraints, these meetings have not been held regularly.

COMMUNITY	CHWs submit monthly activity reports to supervising health staff at local health facilities, which are used to report on key indicators and number of visits conducted, restock health commodity supplies, and review activities to prioritize tasks for the following month. They also supply data that is used to inform deployment of IRS services in the community. Through the Outreach Training and Supportive Supervision program, Global Fund and PMI support district and provincial officials to systematically provide support and supervision to CHWs and health facilities using malaria case management data.[7]

Governance

	DIGITAL	COMMUNITY HEALTH	MALARIA
Name	National eHealth Strategy	National Community Health Strategy (NCHS)	National Malaria Elimination Strategic Plan (NMESP)
Current strategy dates	2017–2021	2019–2021	2017–2021
Coordinating body	Digital Health Technical Working Group	Community Health Unit	National Malaria Elimination Centre
Funding strategy	Yes	Yes	Yes

The current National eHealth Strategy was developed in 2016. A new national digital health strategy was recently drafted and is undergoing the final stages of approval before it is published. This will formalize the Digital Health Technical Working Group as the governance organ responsible for providing oversight and direction for digital health systems under the Ministry of Health as it reports to the National eHealth Coordinator. The current and incoming strategies do not set specific plans for digital tools used by community health workers. The National eHealth Strategy presented a detailed budget with a budget deficit of 40%.[8] Budget for digital tools for CHWs is available through short-term once-off funding for small-scale implementation, mainly covering the cost of the technology (system, devices, and air time). Significant investments have been made in expanding coverage of community health workers who test and treat for malaria across the country utilizing the mobile phone–based Malaria Rapid Response system for reporting of community data into HMIS/DHIS2. This is supported through a range of partners and funders, including PMI, Global Fund, CHAZ, the Bill & Melinda Gates Foundation, Isdell-Flowers Foundation, World Vision, and Rotary/Rotary Foundation.[1]

The Zambian government is committed to achieving universal coverage through an integrated community and primary health care approach. Thus, it established a dedicated Community Health Unit within the department of Public Health mandated to coordinate and provide oversight on community health services in the country. The Community Health Unit is working to ensure timely availability of community health data for evidence-based decision-making through improved data reporting systems. The Community Health Strategy embraces the role of new innovations and technology in helping transform community health service provision. The Community Health Unit thus coordinates the piloting and scale-up of high potential innovations for community health in partnership with local, regional, and international partners.[3]

The National Malaria Elimination Program plans to strengthen the malaria surveillance system at all levels to provide timely and sound evidence to guide the implementation and policymaking process for malaria control and elimination in Zambia.[9] The strategy prioritizes synchronization of the National Malaria Elimination DHIS2 instance with the national HMIS platform and supporting data visualization platforms such as Tableau and Zenysis to visualize malaria data at health facilities and in communities in real time. In addition, it prioritizes monthly analysis of malaria data reported by CHWs and weekly monitoring of cases in areas where MRR has been implemented. The Ministry of Health also intended to roll out a Community Health Workers Logistics System in the 2020–2021 period, but this is yet to kick off. The NMESP has a detailed budget and stresses the need for increased domestic investment to help bolster ongoing donor support for the achievement of malaria elimination targets.

GOVERNANCE Policies define digital health and health data governance roles, responsibilities, and structures.	The National eHealth Strategy 2017–2021 set a governance framework that established an eHealth Technical Work Group (TWG) as the overall coordinating body for eHealth implementation. The eHealth TWG was mandated to function as a clearing house for all proposed technology-based solutions and innovations in the health sector responsible for developing guidelines, standards, and implementation plans.[8] The eHealth TWG was inherited by the Digital Health TWG ahead of the new digital health strategy that is being finalized.[4]
DATA MANAGEMENT Policies provide specifications for data access, privacy, security, and confidentiality and outline stipulations for data sharing.	The parliament of Zambia enacted the Data Protection Act in March 2021. The Act provides a system for the use and protection of personal data by regulating the collection, use, transmission, storage, and otherwise processing of personal data. In addition, the Act established the Office of the Data Protection Commissioner and set out the duties of data controllers and data processors, and the rights of data subjects.[10]
STANDARDS AND INTEROPERABILITY Policies describe an enterprise architecture, normative standards—such as health information standards—and digital identity.	The National eHealth Strategy 2017–2021 set a course for the establishment of a national enterprise architecture and development of a Health Information Exchange with an interoperability layer. Under the coordination of the eHealth TWG, the country seeks to implement international standards for integration and interoperability, such as HL7 and nomenclature (ICD10, ICD0, ICPC2, SNOMED, LOINC) in conjunction with local standards set by the Zambia Information and Communications Technology Authority. Once set in place, the Ministry seeks to enforce the application of these interoperability and integration standards through annual system assessments and certification of systems.
INFRASTRUCTURE Policies define data hosting and storage (e.g., local or cloud), mobile device management, and telecommunications access.	Zambia mandates local hosting of all health data in the National Data Centre at the Monitoring and Evaluation department of the Ministry of ICT. PEPFAR Zambia supported the development of a National Data Warehouse that aggregates data from disparate systems such as the SmartCare EHR, LIS, eLMIS, and HRIS presenting visualization of program data.[11] Plans for digital tools for CHWs have been implemented that address poor connectivity, low bandwidth, and access to electricity for device charging. There is also the need to adapt existing plans to meet the needs of the CHW program, including a centralized, coordinated provision of hardware, talk time, and data for CHW tools and systems.
WORKFORCE Policies describe workforce job structures and descriptions, plans for training, digital literacy expectations, and incentives for digital adoption.	The National eHealth Strategy 2017–2021 calls for a coordinated focus on the growing workforce capacity and adoption of eHealth through national awareness campaigns, financial incentive programs, and care provider accreditation. The strategy also set out to implement changes to vocational and tertiary training programs to increase the number of skilled, nationally available eHealth practitioners.[8]

Systems

Data flow

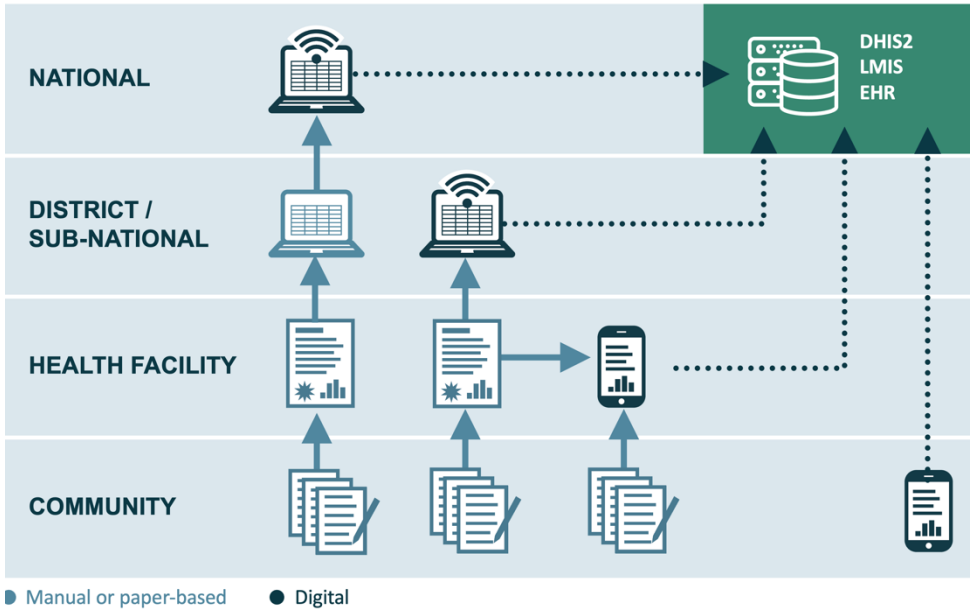
Health Management Information System (HMIS)
The DHIS2 platform is used for the national repository for health data in Zambia, which is managed by the Monitoring and Evaluation (M&E) Directorate in the Ministry of Health. There are separate DHIS2 instances used for aggregate health service delivery and for malaria data. To support improved facility and community malaria surveillance and more detailed malaria intervention monitoring, an additional DHIS instance was established at the NMEC, which currently houses aggregate monthly and weekly malaria data for analysis, dissemination, and use. This began in 2012 and was scaled up more intensively from 2017 to 2019 countrywide to enable quick access and response to surveillance data by decision-makers.[1] CHWs maintain paper-based registers that track key health indicators. They submit weekly and monthly data. CHAs and various CBVs are responsible for submitting community-level data—including activity reports, stock sheets, and registers of the number of clients they serve—to their supervisors at health posts and health centers. In some areas, CHWs have been empowered with mobile phones to use the Malaria Rapid Reporting (MRR) system as an electronic means of reporting. Health facilities predominately use manual and paper-based data collection systems where health personnel collect data at the point of service delivery. Data are collated, validated, and added to relevant health impact assessment (HIA) forms. Health Centre In-Charge sends HIA reports to the District Health Information Officer (DHIO) by the seventh day of the following month for data capture and processing by DHIO. Monthly by the 21st of the second month, DHIO validates data and enters them into the Integrated National HMIS DHIS2 Instance (iNHMIS)[4]. DHIO reviews and validates the data in DHIS2 and provides feedback to the health facilities. The malaria surveillance efforts have been shown to improve the quality of iNHMIS aggregate reports and standard data quality audits have been developed to support alignment of iNHMIS and MRR systems. Due to the stratified approach to malaria elimination in Zambia, districts in low malaria transmission areas have a higher reporting frequency, as there is more emphasis on surveillance. In select districts, the MRR system was also deployed at health facility level, allowing health facilities to report weekly malaria data directly into the NMEP DHIS2 instance. Due to staff shortages in some areas, CHWs come to the health facility to support health facility staff with malaria data collation and reporting.
Additional data systems that support community health and malaria program data include:

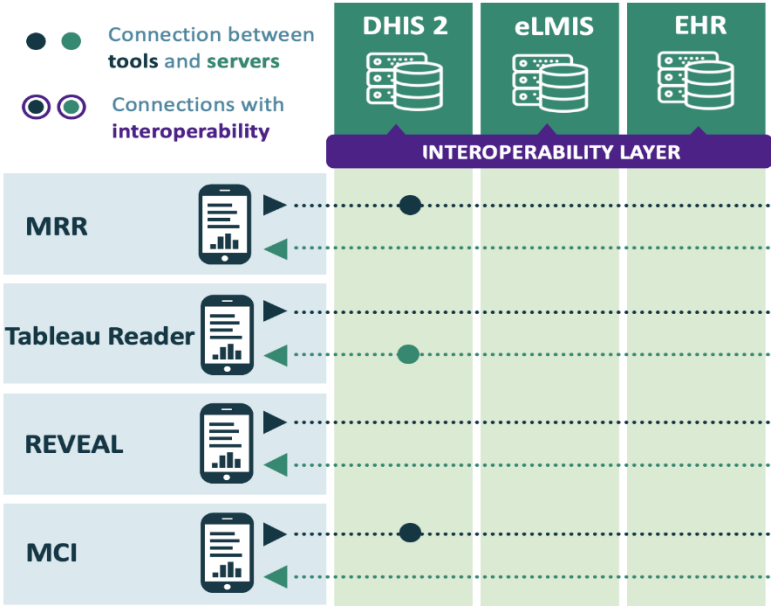
- Malaria Case Investigation (MCI): This a DHIS2 Tracker solution for malaria case-based surveillance that reports to its own DHIS instance separate from the NMEP and iNHMIS instances as it records patient-level data. It has been piloted in two districts in very low transmission areas. It is hosted at the National Data Centre.
- Electronic Logistic Management Information System (eLMIS): A USAID-funded digital health intervention implemented by John Snow Health that manages inventory and distribution of health commodities and notifies on stock levels of health commodities. At each health facility implementation, it works on their local area network (LAN) to enable multiple user access to the same application. It supports offline access to it from within the LAN, without having to use internet, since it is a local installation within the facility. The eLMIS enables order processing and stock visibility at the facility level. eLMIS is also integrated with the Ministry of Health HMIS. PMI invested in building MOH staff capacity in usage of the eLMIS through integrated pre-service and in-service training. The trainings have helped to ensure proper reporting and ordering of malaria commodities through eLMIS, promoting commodity security and mitigating instances of stockout or understock.
- Zambia Health Analytics Platform (ZHAP): Implemented by Zenysis working with the MOH, NMEC, and Medical Stores Limited. ZHAP monitors malaria burden trends; guides logistics decisions to reduce risks of overstock, waste, and stockout; and monitors the impact and effectiveness of malaria intervention packages.

- REVEAL: A decision-support and management tool developed and deployed by Akros for household-level interventions, specifically intervention campaigns such as mass drug administration or indoor residual spraying. Spray operator teams use the geospatial, tablet-based tool to guide their teams in finding and capturing data on houses as they are sprayed. Data are available daily on dashboards for managers to review progress and adjust team planning as necessary. This data-informed approach has been shown to reduce malaria cases and is in pilot phases for other malaria interventions. Since 2014 it has been implemented in Luapula, Eastern, Southern, and Western Provinces.[6]
- SmartCare**:** This is an electronic health record system (EHR) that was developed and deployed by the Zambia Ministry of Health in collaboration with the Centers for Disease Control and Prevention and many other implementing partners. It is an initiated nationally scalable electronic health record system designed specifically for low-resource, disconnected settings. SmartCare is a fully integrated electronic health record system to provide continuity of care and a clinical management information system largely focusing on HIV treatment and care at the facility and district level.[8] SmartCare has a community component that has not yet been deployed at scale.[4]

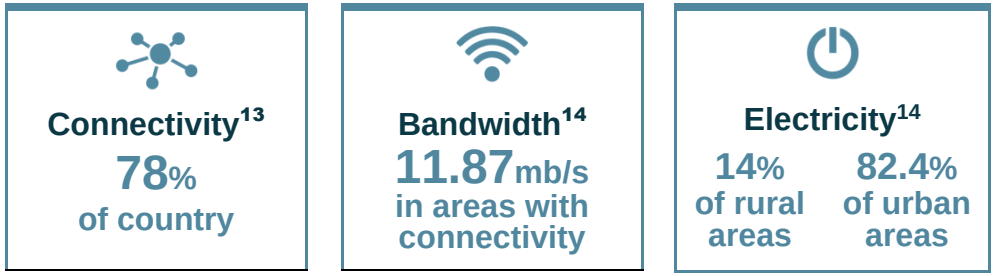
Enterprise architecture and interoperability

The MOH is in the process of developing an interoperability framework with the goal of achieving a high-level health information system enterprise architecture (EA). Key components of the central EA database will include a shared health record, a health facility list, a provider registry, and a client registry. Through the interoperability layer, point of service systems such as SmartCare EHR and eLMIS will integrate with DHIS2, and the data from the systems will be aggregated by the National Data Warehouse. The EA will integrate data from external providers such as health finance and insurance providers and incorporate data analytics applications. The Health Information Exchange is operational but undergoing improvements. The M&E department within the Ministry of ICT manages the National Data Centre currently being used to host the macro database linking the SmartCare EHR and DHIS2.





Digitally enabling infrastructure



Airtel, MTN, and Zamtel are the main mobile operators in Zambia, capturing nearly 99% of active mobile subscribers. MTN Zambia is the dominant operator, with 45.3% of the market share.[12] At the end of 2020, the total number of active mobile telephone subscriptions in Zambia was reported as 19.1 million, translating to a mobile penetration rate of 106.8%.[12] An increased demand for mobile voice and internet services was attributed to the COVID-19 pandemic, as households and businesses adopted various coping strategies to sustain their operations. The largest proportion of telecommunication installations were 2G sites, accounting for 41.1%, followed by 3G sites at 32.9%. Only 26% of the telecommunication sites were 4G/LTE sites. The proportion of 4G/LTE sites is expected to continue to increase as operators invest more in the technology to provide high-speed internet services and extend coverage of such services.[12] Health facilities in the remote and outlying border areas especially have poor internet access, causing reporting backlogs.[4]

Electricity coverage in rural areas, where 55% of the population resides,[14] is a significant problem in Zambia. Through the Rural Electrification Authority, Zambia developed a Rural Electrification Master Plan to mobilize funds from within and outside the country to achieve 51% rural electrification by the year 2030.[15] PEPFAR has supported the MOH in setting up solar power at health facilities. Priority was given to facilities with higher volumes of patient traffic. The rollout of the SmartCare EHR also saw installation of UPS backup power at select health facilities.[4]

PMI, the Global Fund, Rotary, PATH MACEPA, and other partners have funded the acquisition of tablets and smartphones for health facilities and CHWs in some provinces. COVAX supplied 500 mobile devices, and the NMEC plans to procure more devices for malaria monitoring. In other areas, CHWs and heath facility staff use personal devices to receive communication and report electronic data. Rolling power outages, sometimes lasting several days, affect the utilization of electronic devices. The availability of charging for mobile devices is another barrier to CHWs use of digital tools. Solar charging systems have been noted to damage the battery life of mobile devices, affecting the timely submission of data through mobile reporting tools.[4]

Digital health tools in use and functionality

There is an intention to increase the use of digital tools at the community level. The national community health strategy plans to enhance the timely collection and reporting of data collected within community health efforts through increased utilization of mobile/electronic data–capturing systems.[3] The NMEC outlined intentions to increase the number of CHWs and health facilities using mobile phones in the malaria surveillance system.[2] CHWs have stated an interest in the data collection registers they use to be electronic or digitized. There is also a desire to have the malaria case management process digitized at the community level to facilitate health education, clinical decision-making, and tracking of referrals.[4] However, no comprehensive digital tool(s) exist for CHWs in Zambia. Most tools are for specific functions or health areas, and many have not been scaled broadly. SMS is widely

available on all types of phones and the platform does not require an active internet connection, making it a feasible approach in areas of limited internet coverage in Zambia. Key challenges for digital tools for CHWs have been the maintenance of mobile devices, lack of funding for mobile data or talk time, electricity supply, and network coverage. While these systemic challenges will not be addressed in the near future, as they require massive cross-sectorial investments in digital infrastructure within the country, technology allows us to design tools and solutions that work in such extreme environments and are able to deliver efficiencies and effectiveness in health care delivery. With standardized training, CHWs have shown a capacity to implement digital tools well.

USE CASE(S)	MRR	MCI	Tableau	eLMIS	SmartCare EHR	REVEAL
Providing malaria community case management	■	■	□	□	■	□
Tracking malaria proactive and reactive case detection	■	■	□	□	□	□
Tracking malaria screening with referral	□	□	□	□	■	□
Transmitting messages to community on malaria	■	□	□	□	□	□
Training health workers	■	□	■	□	□	□
Tracking LLIN distribution during intervention campaigns	■	■	□	■	□	■

■= Current use ■= Possible, but not currently in use □= Does not meet use case

Abbreviations: EHR, electronic health record; eLMIS, electronic Logistics Management Information System; LLIN, long-lasting insecticide-treated net; MCI, Malaria Case Investigation; MRR, Malaria Rapid Reporting system.

CASE MANAGEMENT FUNCTIONALITIES	MRR	MCI	Tableau	eLMIS	SmartCare EHR	REVEAL
Aggregate case reporting and analytics Tool collects aggregate case data and has data analytic functions in tool or online	■	■	■	■	□	□
Individual case entry and analytics (*important in low-burden or elimination settings*) Tool collects individual case data and has data analytic functions in tool or online	□	■	□	□	■	□
Case geolocation (*important in low-burden or elimination settings*) Tool allows collection or use of geospatial data for individual cases	■	■	□	□	■	■

CASE MANAGEMENT FUNCTIONALITIES	MRR	MCI	Tableau	eLMIS	SmartCare EHR	REVEAL
Interoperability with HMIS Tool sends information to the official national health information system	■	■	□	■	■	■
Offline capability Tool functions, at least partially, offline	■	■	□	■	■	■

Abbreviations: EHR, electronic health record; eLMIS, electronic Logistics Management Information System; HMIS, Health Management Information System; MCI, Malaria Case Investigation; MRR, Malaria Rapid Reporting System.

MANAGEMENT & SUPERVISION FUNCTIONALITIES	MRR	MCI	Tableau	eLMIS	SmartCare EHR	REVEAL
CHW identification Tool uniquely identifies CHWs	■	■	□	■	■	■
CHW catchment location Tool identifies CHW associated position in org unit hierarchy/link to health facility/system	■	■	□	■	■	■
CHW performance analytics Tool has analytic functions (data validation, graphs, charts) that support data quality, quality of care, or other performance issues	■	■	■	□	□	■
Communication Tool allows two-way communication between peer groups, associated health facilities, or supervisors	□	□	□	□	□	■

■= Current functionality ■= Possible, but functionality not currently in use □= Does not have functionality

Abbreviations: CHW, community health worker; EHR, electronic health record; eLMIS, electronic Logistics Management Information System; MCI, Malaria Case Investigation; MRR, Malaria Rapid Reporting System.

Appendices

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APPENDIX A

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APPENDIX B

Abbreviations

CBV	community based volunteer
CHA	community health assistant
CHW	community health worker
COVID-19	coronavirus disease 2019
DHIO	District Health Information Officer
DHIS2	District Health Information Software 2
EA	enterprise architecture
EHR	electronic health records
eLMIS	electronic Logistics Management Information System
HIA	health impact assessment
HMIS	Health Management Information System
iCCM	Integrated Community Case Management
ICT	information and communication technology
IRS	indoor residual spraying
LLIN	long-lasting insecticidal net
LMIS	Logistics Management Information System
MACEPA	Malaria Control and Elimination Partnership in Africa
M&E	monitoring and evaluation
MCI	Malaria Case Investigation
MOH	Ministry of Health
MRR	Malaria Rapid Reporting System
NCHS	National Community Health Strategy
NMEC	National Malaria Elimination Centre
NMEP	National Malaria Elimination Program
NMESP	National Malaria Elimination Strategic Plan

PEPFAR	U.S. President's Emergency Plan for AIDS Relief
PMI	U.S. President’s Malaria Initiative
TWG	Technical Working Group
USAID	United States Agency for International Development
WHO	World Health Organization
ZHAP	Zambia Health Analytics Platform

APPENDIX C

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APPENDIX D

Community digital health tools*

Name of Tool	Type of Digital Health Intervention†	Implementer (Funder)	Scale	Malaria Use Case
MRR	**4.1** Data collection, management, and use	NMEC, Global Fund, PMI, PATH MACEPA	National	Data collection and reporting
MCI	**4.1** Data collection, management, and use	NMEC, Global Fund, PATH MACEPA	Subnational	Malaria case-based surveillance and investigations for low-burden areas
REVEAL	**4.1** Data collection, management, and use	PMI, PATH MACEPA	Subnational	Vector control

*Data that come from the survey have not been independently validated aside from tools featured within the profile.

†See Classification of digital health interventions v1.0, World Health Organization, 2018.

Abbreviations: MCI, Malaria Case Investigation; MRR, Malaria Rapid Reporting System; NMEC, National Malaria Elimination Centre, PATH MACEPA, Malaria Control and Elimination Partnership in Africa; PMI, U.S. President's Malaria Initiative.

APPENDIX E

Next-generation digital health tool functionalities for malaria case management

CASE MANAGEMENT FUNCTIONALITIES	MRR	MCI	Tableau	eLMIS	SmartCare EHR	REVEAL
Notifications Tool sends and receives notifications	■	■	■	■	■	■
Stock reporting & analytics Tool collects stock data and has analytic functions to support stock and logistics data analysis and decision-making	☐	☐	■	■	☐	■
Interoperability with other national health systems Tool sends information to other national systems (iHRIS, LMIS, etc.)	■	■	■	■	■	■
Referral coordination Tool allows CHW to notify local health facility of referrals and track them	☐	☐	☐	☐	■	☐
Scheduling & work planning Tool allows CHW to plan and schedule key activities in the community	☐	☐	☐	☐	☐	■

MANAGEMENT & SUPERVISION FUNCTIONALITIES	MRR	MCI	Tableau Reader	eLMIS	SmartCare EHR	mSpray
Decision support Tool provides algorithms or checklists to guide CHW service provision	☐	☐	☐	☐	☐	☐
Training materials & resources Tool provides access to training materials, policies, or other useful reference documents	☐	☐	☐	☐	☐	☐

CHW geolocation Tool allows collection or use of CHW geolocation data for monitoring and planning distribution	☐	☐	☐	☐	☐	■
Supervision Tool can be used by supervisors to assess CHW skills and capacity	☐	☐	☐	☐	☐	☐

■= Current functionality ■= Possible, but functionality currently not in use ☐= Does not have functionality

Abbreviations: CHW, community health worker; EHR, electronic health record; eLMIS, electronic Logistics Management Information System; MCI, Malaria Case Investigation; MRR, Malaria Rapid Reporting System.