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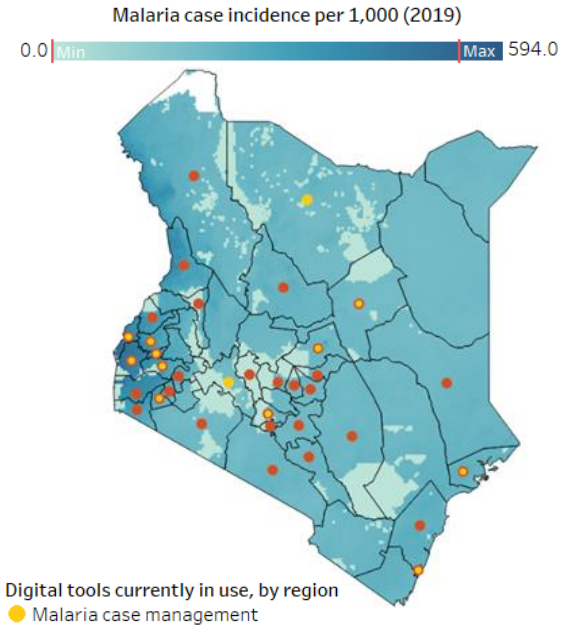
Role of Digital Tools in Fighting Malaria at the Community Level

KENYA

Executive Summary

In Kenya, 75 percent of the 51 million people in the country are at risk of malaria.[1] In the past decade, Kenya has increased coverage of malaria prevention interventions, resulting in significant declines in morbidity and mortality.[2] Kenya has prioritized scaling up case management at the community level in targeted areas, focusing on the lake endemic region, which has the greatest burden of malaria (19 percent prevalence in children six months to 14 years).[3] The two community health worker cadres, community health volunteers and community health assistants, both provide community case management of malaria in accordance with Level 1 services in the Kenya Essential Package for Health (KEPH).

Kenya has been an early adopter of digital health in East Africa, through institutionalization of new technologies, as well as supportive policies and laws to govern digital health. The Community Health Digitalization Strategy launched in March 2021 will support continued digitalization of community health and scaling up of the electronic Community Health Information System (eCHIS) across Kenya while implementing interoperability with the Kenya Health Information System and the Digital Health Platform (DHP).[4] Current recommendations involve enhancing implementation of eCHIS and strengthening sustainability efforts for digital community health initiatives.



MALARIA

Incidence per 1,000 people in 2018[8]

70.8

PEOPLE

Community Health Worker (CHW)

92,920 CHWs[5]

19 per 10,000 people

GOVERNANCE

National Digital Health Strategy[6]

YES

SYSTEMS

Digital Health Index[7]

SCORE: 3

digital square

Recommended Actions

PEOPLE

Community health workers and other decision-makers

Refine the national eCHIS training curriculum for CHWs

Support reviewing and updating the national eCHIS training curriculum for CHWs. Implement a series of trainings across all eCHIS stakeholders, including training of community health assistants (CHAs) and community health volunteers (CHVs) as well as sensitization with county, sub-county, facility teams, and community health committees.

Identify and engage partners and government for post-pilot planning

Ensure appropriate post-pilot plans for eCHIS include on-the-job training for users, mentorship, regular software upgrades and system maintenance, and hardware repair and replacement for long-term sustainability of eCHIS.

Strengthen development of a community-level data scorecard or dashboard

Improve access and analysis of community-level data by strengthening and supporting dissemination of cross-indicator community scorecard or dashboard with actionable activities to be shared at community dialogue and action day.

GOVERNANCE

Strategies and policies

Support coordination mechanism for eCHIS implementation at national and county levels

Support operationalization of the Technical Working Group (TWG) to guide community digitalization and eCHIS. Ensure the Division of Community Health Services is on the National Health Information System Interagency Coordination Committee (ICC) and Health Informatics TWG (Hi-TWG).

Develop policies and guidelines to guide community health digitization activities

Develop a work plan for current digitization efforts and data-use initiatives including guidance for digital community health tools to adhere to the national guidelines. Institute framework for minimum functionalities to guide selection and enhancement of digital platforms. Support the use of development and implementation standards and guidelines for eCHIS software interoperability.

Support advocacy and resource mobilization plans to transition eCHIS support from partner to national and county government

Ensure Ministry of Health (MOH) budget planning and resource mobilization within the expenditure bills includes committed spending for community digitalization.

SYSTEMS

Processes and digital tools

Develop a costed strategy for all the requirements in a digital community health implementation

Support development of a long-term financing plan to support sustainable provision of digital hardware and software for CHWs.

Formulate a monitoring and evaluation framework and conduct an evaluation to support scale-up and maintenance of eCHIS

Evaluate eCHIS implementation to assess success factors and stakeholder involvement. Conduct a detailed eCHIS systems/software evaluation, including a review of source code and documentation, end user interviews, and gathering evidence from the field.

Support development and expansion of features within eCHIS

Support eCHIS software enhancement to include human resources for health. This may include supporting functional module to identify, track, and monitor CHW capabilities and training; developing supportive supervision module in eCHIS; enabling linkage of eCHIS and DHP to support referrals between the community and facilities; and additional features as needed.

Methodology

The country-level document was compiled using a mixed-methods assessment which involved primary and secondary data collection. The assessment is based upon a survey, focus group discussions, and key informant interviews with relevant stakeholders. The combined approach of these methods was able to fill gaps in data collection that resulted in input from all the primary actors involved in digital health at the community level in Kenya. Findings from these activities were validated during a workshop and used to develop the recommendations.

DESK REVIEW	SURVEY	INTERVIEWS	WORKSHOP	ANALYSIS
In **AUGUTS and SEPTEMBER 2020**, **29** documents were reviewed to establish a foundation of knowledge on the malaria strategy, community health program(s), governance, data systems and architecture, role of data in decision-making, and infrastructure. See Appendix A.	In **OCTOBER 2020**, a survey was sent to **76** stakeholders at all levels of the health system, policymakers, funders, and private-sector partners. The survey was open for **4** weeks and had a received **8** responses. Due to a low response rate, data were validated through the desk review, interviews, and workshop.	Interviews were conducted with **5** individuals from the **World Health Organization**, the **Division of National Malaria Program (DNMP**), the **Division of Community Health, Living Goods**, and **ScanForm** between **NOVEMBER 2020** and **JANUARY 2021**.	A workshop was conducted with **36** participants in **JULY 2021.** The workshop aimed to fill any remaining gaps from the survey and interviews and identify opportunities for digital tools to increase impact. Participants included the **MOH, PMI, Living Goods,** and others involved in digital health.	Following the workshop, Kenya country and technical staff from Digital Square reviewed outputs from each step and developed a country profile highlighting recommendations developed in consultation with **PMI**. Final data were collated on **25 OCTOBER 2021**.

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 maturity model and adapted to incorporate malaria-specific content.[9] 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 who 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

92,920 **Community health workers in country[4]**	**Compensation policy:** **VOLUNTEER**
8,500 **Providing malaria community case management[10] (as of 2021)**	**Compensation policy:** **VOLUNTEER**

In Kenya, there are two main cadres of CHWs, which include 89,670 CHVs and 3,250 CHAs.[5] CHVs are permanent residents of their communities who receive a basic ten-day training to provide the KEPH, including maternal and child health; family planning; and infectious diseases, at the household level. Additionally, CHVs are trained in technical modules such as community case management for malaria (CCMm), based on local needs and funding. While CHW trainings are not currently tracked comprehensively, the MOH is interested in tools to track trainings completed by CHVs, such as CCMm. While CHVs' work is voluntary, they may receive stipends from county governments or implementing partners as well as nonfinancial incentives, such as transportation or opportunities for career advancement.[11] CHAs must have a certificate in community health, psychology, social work, or community development and undergo a mandatory two-year training, with refresher courses as needed. CHAs are primarily based at health facilities, provide the KEPH, and serve as a link between households and health facilities. CHAs are formal employees of the county government, but remuneration is applied inconsistently and depends on various factors, including the source of funding.[12] Relative to CHVs, CHAs serve a larger population, work directly within health facilities, and train and supervise CHVs. CHAs also compile reports from CHV data and manage the community-based health information system.

In malaria-endemic regions, CCMm is supposed to be conducted by CHWs through diagnosis and treatment of positive cases (test and treat) based on the national-level framework.[11] For facilities using a test and treat approach, and when commodities are available, CHWs receive a supply kit of long-lasting insecticide treated nets (LLINs), rapid diagnostic tests, artemisinin-based combination therapy, and paracetamol from health facilities. However, due to a 2019 ruling barring non-laboratory staff from conducting diagnostic tests, in practice, test and treat by CHWs is prevented until the case is resolved. Recent estimates suggest CCMm is being implemented in ten malaria endemic counties and covers 31% of Community Health Units (CHU) in those counties.[13] For malaria in pregnancy, CHWs provide health education and encourage antenatal care seeking at facilities. In Kenya's decentralized health system, CHW programs are implemented at the county level and the services provided can vary depending on the partners and funding.[14] All CHWs operate out of a CHU, which is governed by a Community Health Committee (CHC). As of 2020, there are 9,150 out of a target of 9,513 CHUs. Each CHU is supported by 1 CHA and 10 CHVs for a recommended number of 9,513 CHAs and 95,130 CHVs based on the 2019 national census.[15]

Community health worker digital readiness

Kenya faces a shortage of human resources for digital health and health information systems (HIS). Formal digital health career paths do not exist within the public sector and less than 25 percent of health workers receive training in digital health.[16] While digital health training exists for some health workers, CHWs do not receive formal digital health training. Some CHWs may receive initial training for specific digital health tools from the DNMP with support from partners, but they still face challenges due to lack of computer literacy and mentorship. In addition, hardware procurement, replacement of digital tools, regular system maintenance, and purchasing of internet bundles are infrequently supported by counties or implementing partners. More support for digital tools post implementation is key to address digital readiness challenges among CHWs in Kenya.[17]

Data-driven decisions at each level of health system

The DNMP is housed within the Department of Preventive and Promotive Health in the Kenyan MOH. DNMP oversees national malaria surveillance and is tasked with developing policies and guidelines, strengthening the reporting of malaria data, standardizing information collection, and conducting regular stratification for targeting approaches and interventions using routine data.[1] However, due to Kenya's devolved structure, implementation is a county-level responsibility with national-level oversight. Epidemiological and entomological data are used to stratify and target interventions and resources within different epidemiological zones, which comprise multiple counties.[3] One of the key strategic objectives of the *Kenya Malaria Strategy* (KMS) is to strengthen malaria surveillance and use of information to improve decision-making. However, lack of quality and reliable data, access to information, and delayed reporting of events are frequently cited issues with reporting in community health digital systems.[18]

NATIONAL LEVEL	At the national level, the Kenya Health Information System (KHIS) and electronic Integrated Disease Surveillance and Response (eIDSR) system are managed by the Department of Monitoring & Evaluation, Health Research Development & Health Informatics, which oversees the reporting processes and generates standard reports. The DNMP accesses the data for further analysis and generates malaria surveillance bulletins for dissemination across malaria stakeholders at the subnational level. In addition, the Disease Surveillance and Response Unit uses the data from the eIDSR for prompt response to reported outbreaks and for producing a weekly surveillance bulletin. The MOH Division of Community Health uses data from all health facilities and CHUs to track program progress and to create an annual health-sector performance report.[18] Every year, data are consolidated for county-specific health review reports to agree on priorities.[19]
COUNTY LEVEL	County Health Management Teams (CHMTs) are led by a county community health officer/coordinator and include county malaria control coordinators. CHMTs provide coordination and leadership for the overall health management in the county. CHMTs support planning, procurement, resource mobilization and allocation, monitoring and evaluation, supervision and quality control over community health data and services, and linkage to the executive committee of county government and at the national level.[15] County malaria TWGs also include county malaria control coordinators and provide platforms for joint planning, performance review and accountability, and tracking malaria data quality indicators, including data flow and reporting.[2]
SUB-COUNTY LEVEL	At the sub-county level, sub-county health management teams include sub-county health records information officers and sub-county malaria control coordinators. Sub-county health records information officers are responsible for monthly data validation and input into KHIS. These officers review data from facilities and CHUs and flag data quality issues for feedback to lower levels. Sub-county malaria control coordinators use the KHIS dashboard for data quality reporting for malaria monitoring and evaluation activities. The coordinators provide leadership for the development of annual work plans and integrated development plans, including county TWG meetings to ensure malaria programming remains a priority area of investment for their county governments.[2]
HEALTH FACILITY LEVEL	In general, data analysis and use at the facility level is governed by county health-sector plans and frameworks. Some county-level plans identify specific roles tasked with managing the use and quality of KHIS data. In some facilities, CHAs analyze KHIS data and share with the CHVs to facilitate workload discussions, monitor utilization of health interventions, inform health promotion communication, and plan for dialogue days with the wider community.[20] At the health-facility level, data inform consumption planning for supplies and commodities and guide decisions related to the CHV activities.[15]
COMMUNITY LEVEL	According to the *Community Health Policy*, all CHUs should be registered in the Master Community Health Unit List (MCHUL), assigned an MCHUL number, and CHAs should ensure that the CHU is visible in KHIS. The MCHUL is an integrated module of the Kenya Master Health Facility List. CHWs are tasked with collecting and maintaining records and uploading data into the KHIS. Quarterly monitoring and dissemination of community-level data are used for planning and discussion at community dialogue and action days organized by CHCs. These community dialogues are an opportunity for information sharing, and to coordinate upcoming activities with CHWs and community members. CHCs provide leadership, oversight, and coordination of community services. CHCs focus on broad management of community health, such as developing annual plans, facilitating resource mobilization, and liaising with other stakeholders.[21]

Governance

	DIGITAL	COMMUNITY HEALTH	MALARIA
Name	*Kenya National eHealth Policy*	*Kenya Community Health Strategy*	*Kenya Malaria Strategy*
Current strategy dates	2016–2030	2020–2025	2019–2023
Coordinating body	National Health Informatics Technical Working Group	MOH Division of Community Health Services	MOH Division of National Malaria Control Program
Funding strategy	No	Yes	Yes

The MOH is tasked with policy formulation around digital tools and makes decisions around the development of digital health platforms at the community level.[22] The *Kenya National eHealth Policy 2016–2030* is the guiding national strategy for digital health. The policy does not mention malaria or other disease areas specifically. The policy does outline the functions of the CHCs, which include building the capacity of CHVs to access technologies.[6] The *National Community Health Digitization Strategy* was launched in 2020 in collaboration with the MOH, Living Goods, Amref, and other partners. The strategy recognizes the critical role community health can play in achieving universal health coverage through information and communications technology (ICT)–supported service delivery and data management. The strategy provides a framework for the development, deployment, and sustainability of digital interventions for community health. Key to the strategy is the development of eCHIS, which will become part of the DHP currently under development by the MOH. While malaria is not referenced specifically, stakeholders representing malaria programs were a part of the strategy development, including Amref and Save the Children.[4] This coordinated approach to digitalization of community health is intended to support all aspects of service delivery and data management, including for malaria.

The recently updated *Kenya Community Health Strategy (KCHS) 2020–2025* seeks to increase health service coverage of CHWs, improve use and quality of data, ensure availability and distribution of commodities, and facilitate the coordination of community health governance, training, and sustainable financing. One of the key KCHS strategic objectives is to support a harmonized digital eCHIS, which includes developing the Community Health Digitization Roadmap. The Community Health Digitization Strategy was launched in March 2021. A key focus of the strategy moving forward is prototyping, testing, and piloting eCHIS.[5] Effective eCHIS implementation will require establishing guidelines for digitization activities and coordination mechanisms for eCHIS, including linking these efforts with the National Health Information System ICC and the Hi-TWG. As part of the strategy, training activities would include implementing online-learning platforms for CHWs and supervisors. In addition, the *Kenya Community Health Policy 2020–2030* prescribes the selection criteria, responsibilities, and tasks of CHWs, including testing and treating malaria. The policy outlines the governance of the CHW program, whereby CHVs are selected by CHAs and CHCs and supervised by CHAs. CHAs report to the facility in-charge, are accountable to the CHCs, and are directly supervised by the sub-county community health coordinator and sub-county MOH.

The *KMS 2019–2023*, lays out several strategies for employing CHWs to combat malaria. Amidst setbacks from the 2019 court ruling barring non-laboratory staff from conducting diagnostic tests and challenges accessing commodities, counties are still attempting to implement community case management of malaria by trained CHVs guided by the KCHS to promote the use of malaria interventions at the household level. A key facet of the KMS is ensuring implementation of community-level reporting through HIS and enhancing the surveillance systems to detect malaria and conduct case investigations.[1] Apart from strengthening routine HIS and use of data for surveillance and program performance, digital health is not mentioned in the KMS.

GOVERNANCE Policies define digital health and health data governance roles, responsibilities, and structures.	The MOH oversees the implementation of the *Kenya National eHealth Policy 2016–2030* including related roles and responsibilities for governance and implementation of eHealth policy areas and programs. Included in the eHealth policy guidance is the management of policy interpretations and implementation by the Hi-TWG. Hi-TWG is a collaboration of MOH, Ministry of ICT, health professionals, ICT industry partners, county governments, academia, and other partners. At the county level, the County Executive Committees in charge of health and ICTs are responsible for legislation relating to implementation and use of eHealth applications and services.[6] At the community level, the Community Health Digitization Strategy outlines the governance of eCHIS headed by a Steering Committee, TWG, and Secretariat.[5]
DATA MANAGEMENT Policies provide specifications for data access, privacy, security, and confidentiality and outline stipulations for data sharing.	A series of policies govern data management in Kenya. The *Health Information System Policy 2010–2030* was established to enforce security mechanisms for collection, storage, and dissemination of health data. The MOH has Health Sector ICT Standards and Guidelines that address collection and use of personal health information, disclosure of personal health information, and protection of privacy.[6] The Data Protection Bill, passed in November 2019, established the Office of the Data Protection Commissioner and official processes for data registration and personal data protection.[23]
STANDARDS AND INTEROPERABILITY Policies describe an enterprise architecture, normative standards—such as health information standards—and digital identity.	The MOH has launched a number of standards and guidelines including the Standards and Guidelines Electronic Medical Record Systems in Kenya 2010, the Kenya Health Enterprise Architecture (KHEA) 2015, and Kenya Standards for E-Health Systems Interoperability 2015. Guidelines are typically updated every ten years, and guidance is provided through memos and circulars as new information becomes available between document updates. According to the eHealth policy, an Interoperability Framework for eHealth systems and services is needed and the KHEA needs to be operationalized and implemented throughout the country. The Hi-TWG will be key for monitoring the KHEA. Due to lack of understanding and experience implementing local standards and the high resource cost to convert legacy systems, there is also a need for more robust standards and guidelines that are localized to the context of use in Kenya.[6] In addition, a Health Information Exchange (HIE) is operable and provides core functions, including authentication, translation, storage, and warehousing.[16] As of 2020, all HIS systems must comply with MOH HIE capabilities requirements outlined in the Kenya Health Inf*ormation Systems Interoperability Framework*.[24]
INFRASTRUCTURE Policies define data hosting and storage (e.g., local or cloud), mobile device management, and telecommunications access.	According to the eHealth policy, the Ministry of ICT is in charge of monitoring compliance with standards and guidelines for eHealth infrastructure, device specifications, and software.[6] The *Kenya Standards and Guidelines for mHealth Systems 2017* provides guidance for establishing and maintaining current and future mobile health information systems and ICT infrastructure that facilitate data and information sharing across multiple systems.[25] Kenya has been working on a Certification Framework to govern deployment of any digital health tool in the country.[22]
WORKFORCE Policies describe workforce job structures and descriptions, plans for training, digital literacy expectations, and incentives for digital adoption.	The eHealth policy recognizes the need for a trained workforce to implement, operate, and effectively use eHealth technologies. The policy tasks the MOH with developing strategies and partnerships to facilitate basic digital literacy through integration in existing education and training curricula, continuous education, and ongoing workshops and seminars to increase capacity for the adoption and utilization of digital services.[6]

Systems

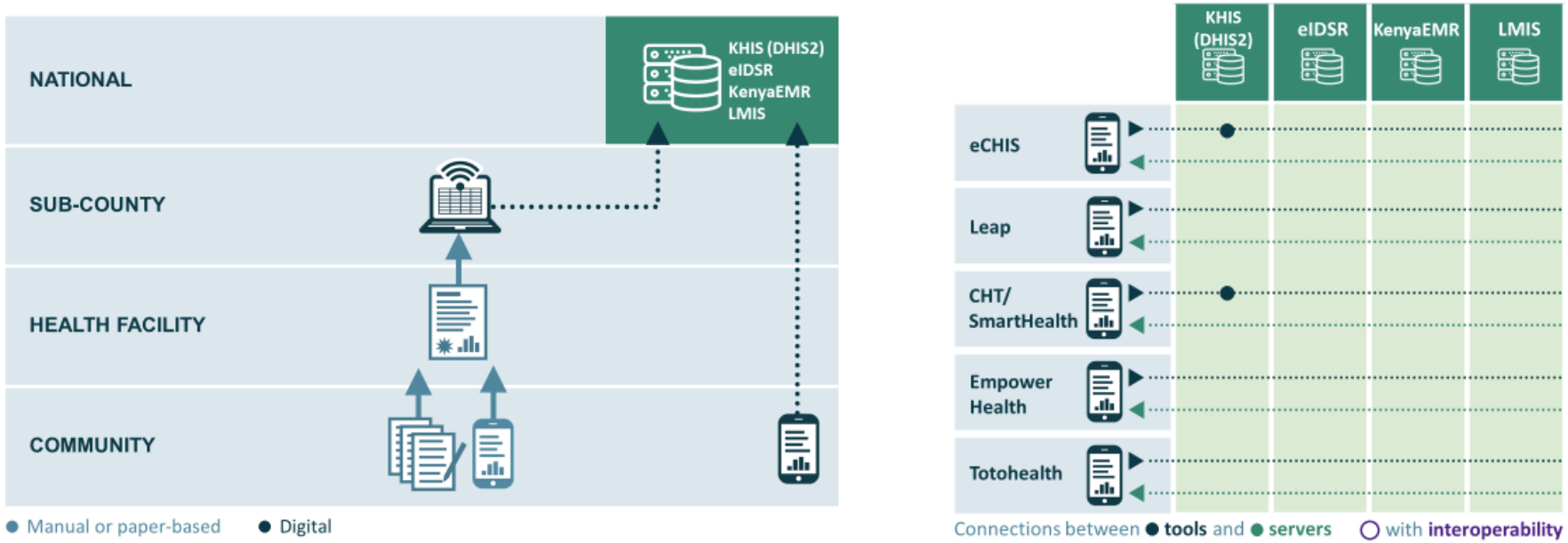
Data flow

In Kenya, most of the data collected at the community level are reported through paper-based systems. CHVs collect data on basic household information, health status, household health promotion practices, births, deaths, and the health services and activities provided by CHVs. Data are compiled using a household register and CHV logbook, which CHVs present to their supervising CHA at the end of every month, except as this relates to disease outbreaks. According to the national disease surveillance and response guidelines, CHVs should notify their supervising CHA (via mobile phone or other communication route available) of any disease encountered within their areas of work for reporting to the National Integrated Disease Surveillance & Response Unit.[21] For CHVs performing CCMm, data is compiled in a daily activity register (MOH 648) and CHAs also compile a summary of CCMm cases managed by CHVs in a monthly summary reporting form (MOH 748). For routine data uploads, CHAs compile the data from all of the CHVs in their community unit into a summary form (MoH 515), which they submit to the sub-county for entry in into the KHIS national reporting platform.[26] Currently, the Division of Community Health within the MOH has developed the Community Health Digitization Strategy with a roadmap for enabling community data collection and reporting digitally using the eCHIS.[5] eCHIS is currently being piloted in Isiolo, Kisumu, and Migori Counties with plans for national scale-up across all 47 counties in 2022.[5]

Reporting of community-based malaria case management is done through KHIS. In most of the country, data from facilities are collected and summarized in hard-copy MOH reporting tools before reporting to the sub-county level on the fifth of every month, where the data are entered into the KHIS system for county and national review. Some high-volume public facilities and private facilities are reporting directly into KHIS. The process is managed by health records officers or special focal health workers. At the sub-county district level, county health records information officers are responsible for monthly validation and input into KHIS for the entire sub-county, reviewing data from facilities, and flagging data quality issues for feedback. *The Health Information Systems Policy 2010–2030* proposes to enforce mandatory reporting by all health care providers, but there is no enforcement of this to date. The *Kenya Malaria Monitoring and Evaluation Plan 2019–2023* includes targets and baseline estimates of surveillance system evaluation metrics including completeness, timeliness, and use of data for decision-making at a health facility level. NMCP receives this data monthly except for malaria threshold data, which are reported weekly in targeted sub-counties. Baseline estimates of this surveillance data in 2017 suggest 80 percent of expected health facility reports are completed and received and 60 percent are received on time. Only 31 percent of targeted sub-counties were reporting malaria threshold data weekly in 2017.[27]

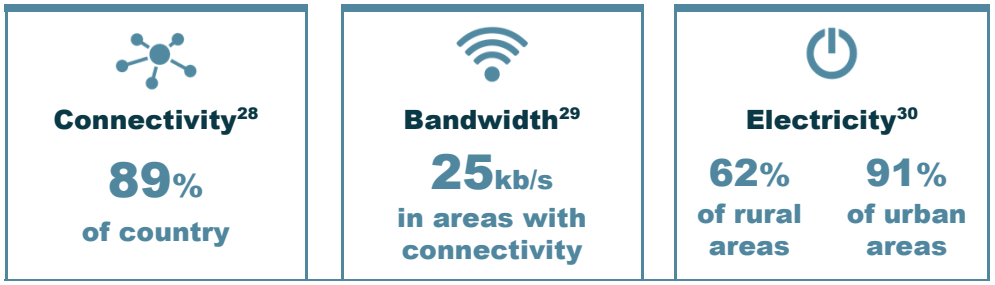
In Kenya, various national-level HIS exist. Since 2010, the KHIS operates on District Health Information Software 2 (DHIS2) as the national reporting platform. The eIDSR system was developed from a short message service (SMS) tool in 2007 to the web-based eIDSR in 2011. The mobile SMS-based disease outbreak alert system (mSOS) was integrated with the eIDSR system in 2015 for faster and more efficient outbreak notification but has limited rollout. The eIDSR was integrated into KHIS in 2016. KHIS also includes malaria commodity reporting since 2012 and community malaria management since 2015.[18] Other key systems deployed in Kenya include an Electronic Medical Record System (EMR), Laboratory Information System, Logistics Management Information System, Kenya Master Health Facility List, and the Integrated Human Resource Information System (IHRIS). The IHRIS implementation was supported by IntraHealth, and there is ongoing work to develop and extend this system to include the management and tracking of CHWs, including a workforce registry and service area deployment.

Kenya has numerous policies and guidelines to support interoperability. Ensuring interoperability across HIS will break down data siloes, facilitate data flow across systems and levels of the health system, and encourage data use and data-driven decision-making. The KHEA is the blueprint of implementation of health information systems in the country. However, in the wake of devolved governance, there are challenges in institutionalizing these policies evenly from the national to county level.[16] Currently, the only CHW tools that send data into the national HIS are eCHIS and the Community Health Toolkit (CHT)/SmartHealth app. The eCHIS is also currently linked to the DHP, a HIS intended to link patient information across the health network such that a patient can get health services in any of the connected facilities. There is interest from the MOH in expanding the features of eCHIS to enable two-way referral between the community and health facilities. The DHP is being piloted in a few health facilities in Nairobi and Kisumu. The *National Community Health Digitization Strategy* notes the requirement for government-wide integration and interoperability of the eCHIS as it is being developed and deployed.[4] Currently eCHIS does not yet have interoperability with other HIS, but the standards for eHealth interoperability are in draft form and are intended to provide guidance on how eCHIS will be linked to other HIS platforms once the piloting phase is complete. The eCHIS is expected to integrate with the following systems: the National Integrated Identity Management System for client identity resolution, the KenyaEMR systems for client referral coordination, the Shared Health Record system for deidentified patient-level data, the HMIS for aggregating health service statistics, and the MCHUL for managing data on CHUs.[4] Effective implementation of eCHIS should include enhancing software and reporting specifications for emerging needs (including community-based surveillance and commodity management), establishing a monitoring and evaluation (M&E) framework to support scale-up and maintenance, and conducting an evaluation with system implementers to review source code and documentation.



Abbreviations: CHT, Community Health Toolkit; DHIS2, District Health Information Software 2; eCHIS, electronic Community Health Information System; eIDSR, electronic Integrated Disease Surveillance and Response; KHIS, Kenya Health Information System; LMIS, Logistics Management Information System.

Digitally enabling infrastructure



Kenya is a leader in mobile telecommunication access, and mobile penetration has been rising. According to the 2019 census, 20.7 million Kenyans over 3 years of age (~47 percent) owned a mobile phone, with slightly more women than men owning a mobile device.[31] About 39 percent of adults in Kenya are using mobile internet. People with a secondary education or more and those under 30 are more likely to own a mobile phone and use mobile internet.[32] Mobile broadband is relatively affordable and available in many parts of the country, but bandwidth is limited. Kenya also has the second-fastest internet speed in Africa.[33] Approximately 85 percent of Kenyans are covered by a 3G or higher signal. Fixed broadband can offer greater bandwidth and higher returns but is not widely adopted due to high costs and limited deployment. The country also has a strong and competitive global connectivity infrastructure, which has enabled higher speeds and lower pricing for retail customers. However, rural areas face constraints in service reliability with mainly government-owned single-fiber providers.[33] The ICT sector in Kenya has seen an average annual growth rate of 10.8 percent, and the rise in innovative digital startup enterprises has earned the country the reputation as the "Silicon Savannah." Early startup success stories have attracted potential investors in this space and inspired new generations of entrepreneurs. Large multinational technology firms such as Vodafone and Airtel have also gravitated to Kenya as an entry point for the East African market, establishing regional corporate hubs and creating positive spillover effects. The entrepreneurship ecosystem could be further strengthened by growth-focused financing and creating a more robust digital talent pipeline. While the country has made efforts to encourage digital skill development within the education sector, gaps exist in access to training, digital content, and digital devices and connectivity.[33]

The Ministry of ICT has implemented the construction of the Konza National Data Center, which is planned for completion in 2021.The first phase was completed in June 2020, and the second phase of the project is ongoing.[34] All 290 sub-counties are now connected to enable data transfer to the centralized government data center. The MOH has supported digital health infrastructure including equipment, computers, tablets, phones, software, and devices. However, provision of this infrastructure is limited and inconsistent: less than 25 percent of the necessary digital health infrastructure is estimated to be available and in use in Kenya.[16] As part of the Community Digitization Strategy and eCHIS rollout, the MOH has analyzed the investment cost of eCHIS implementation per CHU and county, including the provision of ICT hardware at the CHU level.[5]

Digital health tools in use and functionality

Community health digital interventions in Kenya are heavily influenced by partner-supported initiatives. More than 59 digital community health tools have been identified as active in Kenya, with 79 percent supported by partners outside of country and national government.[5] Data from these initiatives are often disconnected from national systems and data are stored on partner-supported servers. The digital solutions for CHWs in Kenya have been developed, deployed, and supported in an ad hoc manner with little coordination. While these tools cover a broad range of system functionalities, no solution provides a comprehensive set of features and functionalities. The most common functions supported by CHW digital health tools are data reporting, patient management, and diagnostics.[17] eCHIS is intended to cover the continuum of community health services and increase availability, quality, and utilization of data at the community level. The MOH has identified current areas of focus for the eCHIS, including tracking commodities and supplies, monitoring capacity building and deployment of CHVs, and supporting supervision. The commodity management system is intended to be based on the cStock tool implemented by InSupply Health. The following digital tools were assessed based on their current or potential use in managing malaria and other febrile illnesses to strengthen service delivery and generate and use data that improve community health programming.

USE CASE(S)	eCHIS	Leap	CHT / SmartHealth	Empower Health	Totohealth
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 routine LLIN distribution during ANC or EPI visits	□	□	■	□	□

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

Abbreviations: ANC, antenatal care; CHT, Community Health Toolkit; CHW, community health worker; eCHIS, electronic Community Health Information System; EPI, Expanded Program on Immunization; LLIN, long-lasting insecticide treated net.

CASE MANAGEMENT FUNCTIONALITIES	eCHIS	Leap	CHT / SmartHealth	Empower Health	Totohealth
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	■	□	■	□	□
Interoperability with HMIS Tool sends information to the official national health information system	■	□	■	□	□
Offline capability Tool functions, at least partially, offline	■	□	■	□	□

MANAGEMENT & SUPERVISION FUNCTIONALITIES	eCHIS	Leap	CHT / SmartHealth	Empower Health	Totohealth
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; eCHIS, electronic Community Health Information System; HMIS, Health Management Information System.

Appendices

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For more information: digitalsquare@path.org

APPENDIX A

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APPENDIX B

Abbreviations

AAI	ActionAid International
AMPATH	Academic Model Providing Access to Healthcare
ANC	antenatal care
CCMm	community case management of malaria
CHA	Community Health Assistant
CHC	Community Health Committee
CHMT	County Health Management Team
CHT	Community Health Toolkit
CHU	Community Health Unit
CHV	community health volunteer
CHW	community health worker
DHIS2	District Health Information Software 2
DHP	Digital Health Platform
DNMP	Division of National Malaria Program
eCHIS	electronic Community Health Information System
eIDSR	electronic Integrated Disease Surveillance and Response
EPI	Expanded Program on Immunization
HIS	Health Information System
Hi-TWG	National Health Informatics Technical Working Group
HMIS	Health Management Information System
HNQIS	Health Network Quality Improvement System
HTT	Household Tracking Tool

ICC	Interagency Coordination Committee
ICT	information and communications technology
IHRIS	Integrated Human Resources Information System
IPTp	intermittent preventive treatment
I-TECH	International Training and Education Center for Health
KCHS	Kenya Community Health Strategy
KEMRI	Kenya Medical Research Institute
KEPH	Kenya Essential Package for Health
KHEA	Kenya Health Enterprise Architecture
KHIS	Kenya Health Information System
KMS	Kenya Malaria Strategy
LLIN	long-lasting insecticide treated net
LMIS	Logistics Management Information System
MCHUL	Master Community Health Unit List
MOH	Ministry of Health
NASCOP	National AIDS and STIs Control Program
ODK	Open Data Kit
PIC4C	Primary Integrated Care for 4 Chronic Diseases
PMI	U.S. President’s Malaria Initiative
PSI	Population Services International
TWG	Technical Working Group
UNICEF	United Nations Children’s Fund
USAID	United States Agency for International Development
WHO	World Health Organization

APPENDIX C

Contributors

Informant Name	Organization
Paulete Aketch	MOH
Howard Akimala	Living Goods
Sarah-Blythe Ballard	PMI
Collins Chimuti	Living Goods
Amos Chweya	InSupply Health
Leonard Cosmas	WHO
Anna Drabko	QED
Lesley Githingi	Living Goods
George Githuka	MOH – DNMP
Ali Hassan	MOH – DNMP
Salim Hussein	MOH – Division of Primary Health Care
Caroline K. Kathia	MOH
James Kiarie	MOH – DNMP
Maureen Kiman	MOH - Division of Community Health
Charles Kimani	Global Development Incubator
Dickson Kirathe	MOH – Division of National Tuberculosis, Leprosy and Lung Disease Program
Gidion Kigen	DHP
Jane Koech	MOH
Joyline Korir	MOH
Francis Mutia	DHP
Julius Mbeye	Lwala Community Alliance
Priscilla Mithamo	MOH
Jeremiah Mumo	MOH – Division of Health Informatics Monitoring and Evaluation
Stanley Muthee	JimCab
Purity Mwangi	DHP
Samuel Mwangi	Kenya Medical Training College
Eric Nderitu	MOH
Teresia Njeri	MOH – Division of Community Health
Mercy Njeru	Centers for Disease Control and Prevention
Mourice Odera	Novartis
Chris Odero	PATH
Felix Odhiambo	Digital Health Platform
Kenneth Ogendo	Living Goods
Wesley Oghera	MOH
John Okari	DHP
Linet Okoth	LVCT Health
David Oluoch	Living Goods
Elizabeth Otieno	MOH
Elvis Oyugi	MOH – DNMP
Mildred Shieshia	PMI
Joseph Sitienei	MOH – National Strategic Programs
James Soki	PATH

Yusuf Suraw	MOH – DNMP (focal person for community health)
John Toweett	MOH
Faith Wamaitha	PATH
Rachael Wanjini	Living Goods
John Wanyungu	MOH - Division of Community Health
Tabitha Wawery	MOH - Division of Community Health
William Wu	QED

Abbreviations: DHP, Digital Health Platform; DNMP, Division of National Malaria Program; MOH, Ministry of Health; PMI, U.S. President's Malaria Initiative; WHO, World Health Organization.

APPENDIX D

Community digital health tools*

Name of Tool	Type of Digital Health Intervention†	Implementer (Funder)	Scale	Malaria Use Case
Amref Leap	**2.5** Healthcare provider communication **2.8** Healthcare provider training **3.1** Human resource management	Amref (Accenture)	13 counties	Training of HWs
eCHIS	**2.1** Client identification and registration **2.2** Client health records **2.6** Referral coordination **2.8** Healthcare provider training **3.2** Supply chain management **4.1** Data collection, management & use	MOH	Pilots in 3 counties (Isiolo, Kisumu, and Migori); plans for national scale	Case detection Case management Screening w/ referral Communication/messaging IPTp Routine LLIN distribution Training of HWs
CommCare	**2.1** Client identification and registration **2.2** Client health records **2.3** Healthcare provider decision support **4.1** Data collection, management & use	Lwala Community Alliance	1 county (Migori)	Case management Screening w/ referral
CHT / SmartHealth	**2.1** Client identification and registration **2.2** Client health records **2.3** Healthcare provider decision support **2.6** Referral coordination **2.8** Healthcare provider training **3.1** Human resource management **3.2** Supply chain management **3.4** Civil registration and vital statistics **4.1** Data collection, management & use	MOH, Living Goods, University of Nairobi, Medic Mobile (Living Goods)	13 counties (Busia, Kisii, Kakamega, Nakuru, Kiambu, Isiolo, Kisumu, Siaya, Vihiga, Lamu, Marsabit, Meru, Mombasa)	Case detection Case management Screening w/ referral Communication/messaging IPTp Routine LLIN distribution Training of HWs
Community support supervision checklist		DNMP, Amref, county governments	Lake endemic, coastal endemic, and epidemic prone	Case detection Case management Screening w/ referral Communication/messaging IPTp Routine LLIN distribution
cStock	**3.1** Human resource management **3.2** Supply chain management	InSupply/JSI (USAID)	5 counties	N/A
DHIS2 Tracker		4Kenya	1 county	

Name of Tool	Type of Digital Health Intervention†	Implementer (Funder)	Scale	Malaria Use Case
E Boresha	**2.1** Client identification and registration **2.2** Client health records **4.1** Data collection, management & use **4.3** Location mapping	Save the Children, MOH	2 counties (Busia, Bungoma)	
Empower Health	**1.4** Personal health tracking **2.1** Client identification and registration **2.2** Client health records **2.3** Healthcare provider decision support **2.6** Referral coordination	Medtronic LABS (Novartis)	6 counties (Makueni, Meru, Nyeri, Kakamega, Nairobi, Kisumu)	N/A
HNQIS	**3.1** Human resource management	PSI	327 facilities	N/A
HTT	**2.2** Client health records **4.1** Data collection, management & use **4.3** Location mapping	Local government (UNICEF)	1 county (Vihiga)	N/A
Kenya Electronic Medical Record	**2.1** Client identification and registration **2.2** Client health records **2.5** Healthcare provider communication **2.6** Referral coordination **2.7** Health worker activity planning and scheduling **2.9** Prescription and medication management **3.4** Civil registration and vital statistics **4.1** Data collection, management & use	Palladium, NASCOP, I-TECH (USAID)	National	N/A
mDharura	**3.3** Public Health event notification **4.1** Data collection, management & use	Medic Mobile	5 counties (Nakuru, Marsabit, Meru, Mombasa, Siaya)	Case detection
Medic Mobile	**1.1** Targeted client communication **1.2** Untargeted client communication **2.1** Client identification and registration **2.2** Client health records **2.3** Healthcare provider decision support **2.6** Referral coordination **4.1** Data collection, management & use	MOH, Medic Mobile	1 county (Siaya)	Screening w/ referral Communication/messaging
M-TIBA	**1.7** Client financial transactions **2.1** Client identification and registration **3.5** Health financing	PharmAccess, CarePay, Safaricom	National	N/A
ODK	**4.1** Data collection, management & use	County government		

Name of Tool	Type of Digital Health Intervention†	Implementer (Funder)	Scale	Malaria Use Case
PIC4C	**1.1** Targeted client communication **2.1** Client identification and registration **2.2** Client health records **2.3** Healthcare provider decision support **2.6** Referral coordination **2.9** Prescription and medication management **4.1** Data collection, management & use	MOH, AMPATH, AAI, World Bank	2 counties (Busia, Trans Nzoia)	N/A
REDCap	**2.2** Client health records **4.1** Data collection, management & use			?
ScanForm	**4.1** Data collection, management & use	QED	7 counties (Siaya, Homa Bay, Migori, Nakuru, Mombasa, Busia, Kisumu)	Case detection Case management (dx/tx) Routine LLIN distribution
SurveyCTO	**1.1** Targeted client communication **1.2** Untargeted client communication **2.2** Client health records **4.3** Location mapping	PAMCA, PSI, KEMRI (USAID)	2 counties (Busia, Kwale)	Routine LLIN distribution
Totohealth	**1.1** Targeted client communication **1.2** Untargeted client communication **2.6** Referral coordination	Grand Challenges Canada		N/A
Verbal Autopsy	**3.4** Civil registration and vital statistics	Government of Kenya		N/A

*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: AAI, ActionAid International; AMPATH, Academic Model Providing Access to Healthcare; DHIS2, District Health Information Software 2; eCHIS, electronic Community Health Information System; HNQIS, Health Network Quality Improvement System; HTT, Household Tracking Tool; HWs: health workers; IPTp, Intermittent preventive treatment; I-TECH, International Training and Education Center for Health; KEMRI, Kenya Medical Research Institute; LLIN, long-lasting insecticide treated nets; MOH, Ministry of Health; NASCOP, National AIDS and STIs Control Program; ODK, Open Data Kit; PAMCA, Pan-African Mosquito Control Association; PIC4C, Primary Integrated Care for 4 Chronic Diseases; PSI, Population Services International; UNICEF, United Nations Children's Fund; USAID, United States Agency for International Development.

APPENDIX E

Next-generation digital health tool functionalities for malaria case management

CASE MANAGEMENT FUNCTIONALITIES	eCHIS	Leap	CHT / SmartHealth	Empower Health	Totohealth
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	eCHIS	Leap	CHT / SmartHealth	Empower Health	Totohealth
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; eCHIS, electronic Community Health Information System; iHRIS, Human Resources Information System; LMIS, Logistics Management Information System.