JOURNAL OF COMMUNITY SYSTEMS FOR HEALTH
2026, VOL. 3
https://doi.org/10.36368/jcsh.v3i1.1250

ORIGINAL RESEARCH

Integrating community health management information system into the community and district health system in Mpongwe, Zambia

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Received 2 July 2025 ; Accepted 6 January 2026 ; Published 3 February 2026

ABSTRACT

Introduction: Considerable attention has been directed towards implementing and strengthening community health management information systems (c-HMIS) in low-and middle-income countries. In 2012, the Zambian Ministry of Health with the support from the Clinton Health Access Initiative developed a c-HMIS. Guided by the by Atun's framework for integrating interventions in health systems, we explored the acceptability and adoption of the c-HMIS in the community and district health system in Mpongwe District, Zambia.

Methods: A qualitative case-study design was used to examine the integration process of the c-HMIS. Data were collected through phone-based in-depth interviews with 66 purposively selected participants from the community, facility, district, provincial, and national levels (including Neighborhood Health Committees leaders, community-based volunteers, community health assistants (CHAs), CHA supervisors, and Ministry of Health officials). Data were analyzed using thematic analysis.

Results: The nature of the problem, which included the persistent issue of data quality deficiency motivated the Ministry of Health and stakeholders to adopt the c-HMIS. The attributes of the c-HMIS intervention such as the provision of data collection tools, training stakeholders in using these tools and the perceived simplicity of the c-HMIS facilitated the adoption process. Further, health system characteristics such as timely availability of data and improved health information feedback processes; as well as the broader adopting context such as community participation promoted community ownership of the c-HMIS. The c-HMIS implementation barriers included challenges with data collection tools and digital platforms.

Conclusion: Overall, our findings indicate that while the c-HMIS has substantial potential to strengthen health information management systems, its sustained integration within the community and district health systems depends on leveraging some of the identified enablers and carefully addressing systemic, health system, and contextual barriers.

Keywords: Community, management, information, participation, health system.

Abstract in Español at the end of the article

INTRODUCTION

Sound and reliable information is the foundation for decision-making across all health systems [1]. Health information systems are important as they improve the availability, quality and use of the data to inform health sector reviews, planning and monitoring of the health system's performance [2]. They provide a mechanism for data collection, storage and analysis to support the

management of health care delivery systems at all levels including the community [3,4]. At lower levels, community health management information systems (c-HMISs) are designed to link all stakeholders, healthcare providers, consumers, providers, purchasers, payers, and researchers in the community health system [3,4]. As such, c-HMISs are a crucial tool in the optimal functioning of a community health system [5,6]; defined as "*the set of local actors, relationships, and processes engaged in producing, advocating for, and supporting health in communities and households outside of, but existing in relationship to, formal health structures*" [7]. Collecting routine health information enables timely access to accurate, reliable data on the health of communities, which supports the provision of appropriate services [8–10].

The implementation of c-HMISs in a well-coordinated manner across different sectors at community level is crucial for attainment of better health outcomes [11]. The nature and pattern of c-HMIS have changed over time whereby some low resource settings are migrating from utilizing paper to digitalized information systems [11–13]. Overall, acceptance and use of the c-HMIS have not been optimal, and not many studies have interrogated why this is the case [3,4]. Studies mainly conducted on the formal health system have shown that implementation of c-HMIS is affected by several barriers. First, there are various forms of c-HMIS mobile data collection applications that seek to replace pen and paper [3]. Additionally, there are technical barriers such as weak ICT infrastructure and inadequate human capacity including limited digital literacy among health workers [3,4]. Organizational and policy barriers such as limited finances, lack of clear national e-health policies, leadership also hinder the implementation process of c-HMIS [3]. Finally, data quality concerns as well as broad sociocultural barriers such as privacy concerns within communities also affect the implementation of c-HMIS [3,4].

In 2012, the Zambia Ministry of Health (MoH) recognized a huge gap in c-HMIS and therefore, developed and implemented the c-HMIS in the same year, with the support from the Clinton Health Access Initiative (CHAI) and the Department of International Development (DFID). The c-HMIS was used by community health assistants (CHAs) and community-based volunteers (CBVs) – individuals that support health facility staff with the provision of basic health services in the community [14]. CBVs are coordinated by Neighborhood Health Committees (NHCs) – community-based non-partisan health management structures composed of residents in a defined catchment area that act as a link between the community and their nearest Health Centre/Health Post (HC/HP). The NHC is the lowest community structure in the health care system [15]. The NHC is divided into smaller sections called zones [16]. The CHA is a cadre that is formally trained to bridge the gap between facility and community by providing basic health services in the community [17]. The CHA also supports facility staff with the provision of basic health services at the facility level [17]. CHAs move door-to-door providing health services and record the data of the services they provide using household and patient registers [18]. CBVs and CHAs collect, aggregate and enter community health service delivery data. The CHAs use the Health Information Aggregate forms known as HIA4a while CBVs use the HIA4b forms. HIA4a covers disease and service delivery data by the CHAs for the entire catchment area of a health post (aggregating community data across all zones of the health facility) while HIA4b covers disease and service delivery data by CBVs in their respective zones. The data collected by the CBVs is submitted to the NHC secretary who compiles and enters the information on the HIA4b booklet.

In 2019, the MoH, with support from CHAI, decided to pilot the c-HMIS in Mpongwe District, Copperbelt Province. To pilot the c-HMIS, meetings focused on building the capacity of provincial and district health managers to plan, implement and monitor performance of c-HMIS, as well as training workshops for CHAs, NHCs, CBVs and health workers in c-HMIS were conducted. Additional activities were providing user rights for health workers to enter c-HMIS data in DHIS2 at facility level. Further, quarterly health center committee (HCC) meetings to use c-HMIS data to make decisions including the development and use of community action plans were conducted. The HCC is a group of people elected from among the executive committee members of all the NHCs from all zones under a catchment area of a health center/health post.

Research conducted in Zambia and other low- and middle-income countries (LMICs) has largely concentrated on the generation, flow, and utilization of community-based health information system data, emphasizing data pathways, accessibility, feasibility, and real-time access [3,19–21]. In Zambia, most studies on community health systems have examined incentive structures, management practices, and the evolving role of the CHAs in primary health care delivery, alongside broader implementation challenges [5,22]. However, limited attention has been paid to the socio-technical and institutional mechanisms shaping the acceptability, adoption, and integration of the c-HMIS within local health systems [23]. Addressing this gap is essential to understanding how c-HIMS can be institutionalized within Zambia and other similar settings [5–8]. This study aimed to address this gap by exploring the factors that shaped the acceptability and adoption of the c-HMIS in the community and district health system in Mpongwe District, Zambia. This study is significant as it has the potential to inform the MoH and all community health stakeholders about the necessary processes to effectively implement a successful c-HMIS. Further, understanding integration of health interventions is crucial to promoting efficient utilization of resources in health systems [24].

Study conceptual framework

A conceptual framework on the integration of health innovations into health systems by Atun et al, guided data collection and analysis [25]. This conceptual framework was selected because it recognizes that integrating c-HMIS into a given context is both relational and complex [25]. Integration occurs within plural provider environments shaped by diverse norms and values, as well as informal, horizontal mechanisms that influence coordination and accountability across communities and contexts [25]. Further, the conceptual framework has been used to study the integration of similar interventions in community and district health systems in Zambia [17,24]. According to this framework, examining the integration process requires exploring the nature of the problem being addressed by the intervention to be integrated such as the lack of comprehensive data for decision making in this case. The framework also underscores the adoption system, which involves actors at community, health facility and district levels as well as the supportive infrastructure. Finally, it explores health system characteristics, including financing, medical supplies, and tools, as well as the broader socio-cultural factors that shape c-HMIS implementation (Figure 1).

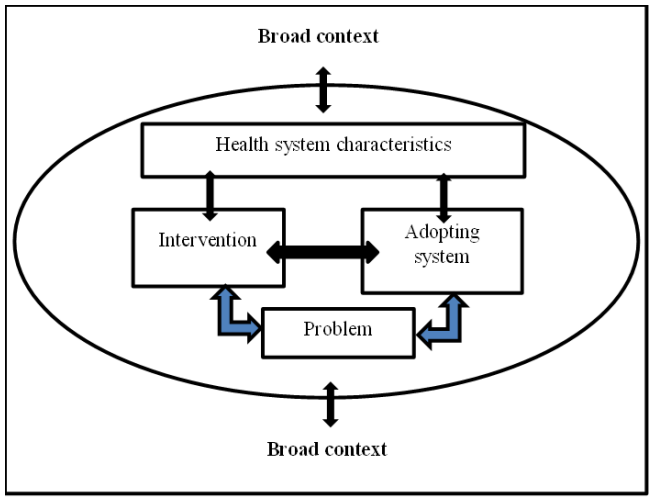

Figure 1. Conceptual framework for analyzing integration process (adopted from Atun et al. 2010).

METHODS

Study setting

The study was conducted in a rural setting in Mpongwe District in Copperbelt Province, Zambia. The district has a population of 135,486 according to the 2022 Census. The health system is led by the Mpongwe District Health Office which coordinates planning, supervision, procurement, and reporting across facilities and community structures. Mpongwe Hospital is a key facility serving a largely rural catchment area and providing outreach services. The c-HMIS is used by CHAs and CBVs who support basic community services; CBVs are coordinated by NHCs–the lowest community health structure linking communities to nearby health centers/posts.

Study design

A qualitative case-study design was employed to conduct an in-depth exploration of the integration of the c-HMIS into the district health system in Mpongwe, Zambia. A case study involves an in-depth, contextual analysis of a case to understand a complex phenomenon within its real-life settings [26]. In this study, the case was the district, its context, actors, and systems that shaped the integration process (the phenomena) of the c-HIMS. This design was deemed suitable as integration of c-HIMS is a complex, context-dependent process involving multiple actors such as health workers, CHWs and community members.

Table 1. Participants characteristics.

Respondents Interviewed	No. of male	No. of female	Total
CHA Supervisors	6	5	11
CHAs	11	12	23
CBVs	12	2	14
NHC secretary	2	1	3
NHC chairman	3	1	4
NHC member	3	0	3
District / provincial staff	6	0	6
Ministry of Health - ICT Department, National level	1	1	2
TOTAL	44	22	66

Study population

The study population included stakeholders involved in the implementation and use of the c-HMIS at community, district/provincial, and national levels: CHA supervisors, CHAs, CBVs, NHC leaders and members (chairperson, secretary, and members), district/provincial health staff, and Ministry of Health ICT Department staff (national level).

Participants were eligible if they were ≥18 years, worked at community, district/provincial, or national level, and were directly involved in implementing, supervising, managing, or using c-HMIS. Participants had to be willing and able to provide informed consent. Those not involved in c-HMIS or unable/unwilling to consent were excluded.

Sample size and sampling technique

Data was collected in one district which was purposively selected because it was the only one where the c-HIMS was piloted. All the health facilities where the c-HIMS was piloted were included in the study. As shown

in Table 1, qualitative data was collected from 66 respondents. In these facilities, all CHAs and their supervisors were included in the sample. We included all the actors that were trained and involved in implementing c-HIMS at various levels of the health system. Data saturation, which, according to Guest, is the stage when no additional new information can be attained was reached during data collection [27]. This was discussed with the data collection team and validated during coding process by the coding team [28].

Data collection

Data were collected through phone-based in-depth interviews as physical interviews were not feasible due to COVID-19-related travel and meeting restrictions. An experienced team of data collectors, all holding at least a bachelor's degree and with over four years of data collection experience, conducted the interviews under the supervision of four senior researchers. Prior to data collection, the team completed a one-week intensive training on qualitative interviewing, use of interview guides, audio recording, and research ethics. Data collectors were guided by an interview guide developed by the authors and refined collaboratively with the team. The guide was structured around the main thematic components of Atun's framework for analyzing the integration process. A pilot study was conducted to pre-test and refine the tools and procedures, strengthening the reliability and validity of the data collection process.

We minimized potential power dynamics between us and CHWs through adopting various strategies. These included using local language, fostering respectful environment, appreciating their experiential knowledge of the context that shaped the implementation of c-HIMS, seeking informed consent and emphasizing confidentiality.

The interview guide examined stakeholders' experiences with the c-HIMS across key domains. Questions explored pre- c-HIMS data collection and use, data availability challenges, and effects on planning, service delivery, and community health. The guide assessed understanding of c-HIMS, when and how it was introduced, training and support activities, data collection roles, reporting tools, as well as communication and submission flows from community to facility and district levels. The interviews probed how c-HIMS data are used in decision-making, planning, and review meetings, and compared c-HIMS with previous information systems. Additional questions examined factors influencing adoption, alignment and compatibility with other health information systems, and perceived effects on accountability, governance, and resource allocation. Finally, participants discussed implementation challenges, feedback loops, and recommendations for improvement.

Data analysis

All audio recordings were transcribed verbatim and translated for analysis with all identifiers redacted from the interview transcripts before analysis. To ensure good data quality, each interview transcript was checked by the research team to ensure responses were in line with the objectives of the study and language translations were accurate.

The data was analyzed thematically [6]. Transcripts were read multiple times for data familiarization and identification of initial codes by the research team. A codebook was then developed through an iterative process of reviewing and discussing the preliminary codes and assigning them to the appropriate themes. NVivo 12 software was used to code, categorize, and manage the data. To enhance the credibility of findings, the data was coded by six members of the research team. The coders independently coded transcripts and compared the coding to establish inter-coder reliability.

Ethical consideration

Approval to undertake the study was obtained from CHAI's internal Scientific and Ethics Review Committee, the Excellence in Research Ethics and Sciences Institutional Review Board (IRB Ref No. 2020-Jul-004), and the National Health Research Authority. Oral informed consent was obtained and documented through recorded phone interviews conducted prior to data collection. Participation was voluntary, and participants were informed that they could decline to answer any question or withdraw at any time without penalty. To protect privacy and confidentiality, no personal identifiers were included in the transcripts or reports, while the recordings and study files were securely stored with access limited to the research team. The study was assessed as minimal risk, with no expected direct benefit to respondents; however, findings may help strengthen community health information systems and service delivery.

RESULTS

The results have been structured around the main thematic areas of the Atun et al's integration framework including the nature of the problem, the intervention (the c-HMIS intervention), and health system characteristics. The broader context and the adoption system were merged into one theme, broader adopting context, as the findings were similar (Table 2).

1. NATURE OF THE PROBLEM

Gaps in health information management and uptake of c-HMIS

Weak data management systems

Poor quality of data was one of the issues which necessitated the development and implementation of the new health information management system. Prior to this system, respondents reported that the main method of reporting health information from health facility and across the health system was paper based. Respondents noted that relying only on paper-based reporting was problematic. In some cases, information would go missing due to some pages from the exercise books being torn apart.

> "*Before it became electronic, it was paper-based recording tools. They would then give the stakeholders at the health facility, then to district, to province until it was aggregated at national level. So, it was paper based throughout. And we were using books, forms were also used although not standard*" (IDI number 51, District staff)

Most respondents narrated that there was no standardized community health information system as the paper-based tools were not uniform across facilities. It was reported that there was no clearly defined structure and communication channel through which health information was reported.

> "*There was no standard template, people would report as they feel but with the c-HMIS, we have realized there's a standard way in which data must be.*" (50, IDI, CHA, Coordinator, District staff)

Table 2. Main themes and subthemes in the results.

Main theme	Subtheme	Categories
Nature of the problem	Gaps in health information management and uptake of c-HMIS	• Weak data management systems
The c-HMIS Intervention	The c-HMIS characteristics enabling implementation process	• Capacity building and support • System improvement and usability
	The c-HMIS characteristics inhibiting implementation process	• Limitations in data collection tools and infrastructure • Data quality and reporting challenges • Gender inclusive tool design
Health system characteristics	Health systems characteristics facilitating implementation of c-HMIS	• Strengthened health information management • Enhanced planning and decision-making • Strengthened service delivery and accountability
	Health systems characteristics limiting implementation of c-HMIS	• Human resources and motivation constraints
Broader adopting context	Contextual factors facilitating the c-HMIs implementation process	• Community participation and ownership • System usability and compatibility
	Contextual barriers to implementing c-HMIS	• Logistical and infrastructure barriers • Sociocultural and human capacity challenges • External and environmental disruptions

The participants at most of the facilities complained of delayed submissions of reports. Others stated that in certain cases, reports were not submitted altogether. Delays in reporting were partly due to the old data collection system that was not properly linked to other existing health information systems at the provincial level. As a result, they noted that data collected using the paper method was not routinely reported beyond the health facility.

> "*There was no formal reporting tool to channel that data upward. So, the data was just sitting at the health facility.*" "*Basically… at our level provincial office, that data wasn't trickling through*" (IDI number 48, Provincial staff)

2. THE INTERVENTION

The c-HMIS characteristics shaping implementation process

Capacity building and support

In the introduction of the c-HMIS and consequent implementation, identifying actors who would be involved in the implementation at the community level was the first cardinal activity. In each health facility, it was reported that an attempt was made to select people from respective zones. It was stated that various community health workers such as the CHAs, NHCs, and CBVs were trained to collect and report data.

> "*Or I can say now we are many, so the problems are now reducing. The challenges now are not too many because manpower is now increased*" (IDI number 23, CHA)

The follow up phase during the program implementation process was the distribution of standardized MoH approved tools. It was reported that the c-HMIS was easy to use because it had clear instructions on how CHWs could operate it, which information to collect and the types of health services they offered in the community.

> *"The new system is easier than the old one because it explains in detail, and it highlights. For example, when you go on environmental cases it explains and tackles everything and even when looking at malaria cases it tackles everything"* (IDI number 39, CHA)

System improvement and usability

Respondents reported that the c-HMIS system was easily accepted by the CHWs and staff at the district level because it easily availed critical health information. It was indicated that this information could inform decision making with respect to delivery of health services at different levels of the health system including community, facility and district levels.

> *"At the community level, what led to the acceptance of the system is that those at the facility, cannot manage to know the information from the community, they would not hear it quickly if there were no CBVs to collect the information as they are just found at the center and if they want to know the information of how people are living in the community they can now quickly know unlike if there wasn't this system"* (IDI number 12, CBV)

The c-HMIS characteristics inhibiting implementation process

Limitations in data collection tools and infrastructure

Health care providers at the facility indicated that one challenge faced in the reporting system was inadequate understanding of the tools as some health workers were not trained. Because of this, some facility staff and CHAs reported that they had difficulties validating the accuracy of the data collected.

> *"So, in terms of the education of some people, there are some gaps (low levels of literacy). Some people don't know why they are filling the report and because of the lack of appreciation of the system, people may also not appreciate the authenticity or the value of it"* (IDI number 50, District Staff)

Due to the large number of zones in the district, it was stated that, at times, the data collection tools run out and CHWs had to improvise by using paper-based ones, which would sometimes go missing.

> *"And then two of course is to make the tools available all the time. Because sometimes you find that the registers have run out and people have to improvise, and when they are improvising certain elements are not captured. So, there is a need for the continuous supply of the tools for collecting the information"* (IDI number 52, Provincial staff)

Data quality and reporting challenges

Another aspect which needed to be addressed was the possibility of reporting using digital platforms. Respondents recommended the need to be equipped with digital platforms including smart phones installed with social media platforms such as WhatsApp and others so that they could easily submit data without having to physically take reports to the health facilities.

> *"The system can be improved especially in our place, if they can allow us to use the WhatsApp. Because WhatsApp can reach faster than these copies. You send via WhatsApp and then later you send also the copies. If they can also buy for us these big, big phones for reporting information only"* (IDI number 46, CHA)

Gender inclusive tool design

The participants indicated that the health information collected in the c-HMIS mainly captured data on women and children's wellbeing. However, data on men's health and other health and gender indicators were hardly included. Therefore, it was suggested that the system be revised to include health data that is gender inclusive.

> *"Ok for the women and the children they are there. Now for the men they are not there. For example, STIs we would like this to be added"* (IDI number 31, CHA)

3. HEALTH SYSTEM CHARACTERISTICS

Health systems characteristics facilitating implementation of c-HMIS

Strengthened health information management

Some respondents indicated that feedback process in c-HMIS was quicker and done immediately after submitting the report. The feedback focused on issues raised in the report–data completeness, accuracy, interpretation, decision-making, and availability of c-HMIS materials such as bicycles and tools.

> *"For this time the feedback is good because in the past there was nothing like when you go in the community and write the challenge and you take at the Centre, they did not make an effort to go and see the community"* (IDI number 22, NHC)

In addition, it was suggested that the c-HMIS had promoted timely submission of reports because the actors had specific dates when they were supposed to report.

> *"The system is time-bound. You have to report timely. If you miss the period, the information is kind of distorted"* (IDI number 53, District staff)

Furthermore, respondents noted that the new system had ensured data was uniform across communities and facilities. The standardised tools enabled CBVs and facilities without CHAs to access standardised information.

> *"The other thing is that even for facilities that don't have CHAs but only CBVs, they are able to have the standard information with those facilities which have CHAs so that gap is not even seen"* (IDI number 47, CHA)

Enhanced planning and decision-making

Respondents indicated that the data was fundamental to decision-making, evidence-based planning, and resource allocation across all departments of the health system. They noted that data from the c-HMIS had informed the development of activities such as the construction of sanitation facilities as well as the promotion of maternal and child health, for example.

> *"The data is used for planning, making decisions, resource allocation and reporting programs that they are conducting. For example, ODF (open defecation facilities) programs or activities may rely on this information to see how many communities have such facilities. Mother and child health programs can also get information from the c-HMIS to implement their programs"* (IDI number 54, District staff)

The data was reportedly also used for mapping key health issues in communities including diseases and their causes, as well as pregnant women in the zones who needed to attend antenatal programs.

> *"It is also useful in that we are able to know the number of pregnant women in the zone who need to attend antenatal programs and also the number of households following the sanitation programs of having pit latrines and hand washing basins"* (IDI number 56, District Staff)

The c-HMIS was viewed as vital as it helped in tracking changes over time during the implementation process. It was reported that the system had indicators which stakeholders can use to assess progress or lack of it overtime. It was further stated that the community would use the data to identify areas that needed attention and develop appropriate health activities.

> *"With this information we are able to know the trend in terms of community challenges between months for example we are able to know if the problem is growing or reducing; and if we compare this month and the past month and then solve those problems going forward"* (IDI number 30, CBV)

The respondents further observed that the c-HMIS had promoted human resource governance through enhancing supervision and monitoring of CHWs performance. This improvement was possible through collecting monthly data on the activities conducted in the community by the CHAs and CHWs.

> *"What I would say is that this system has helped to monitor the data collected and to supervise CBVs and NHCs. The system is also helping to make sure that each actor works and does what they are supposed to do every month to make sure that the data gets to the facility and then the facility to the district. If you are not doing your part it will show"* (IDI number 47, CHA)

Strengthened service delivery and accountability

It was reported that c-HMIS had contributed to increased referrals from the community to the facility and the documentation of these referrals because it was a prerequisite (in the c-HMIS) for stakeholders to report any referrals they did. Further as people collected data, they could easily identify the health challenges and encourage the affected people to go to the health facility.

> *"Where these SMAGs are working and reporting in the HIA4B, you find that there is that part where they have to refer, we refer and maybe see the patient and then we send them feedback, so even in the report they will indicate that this month maybe this and that person was referred and feedback came"* (IDI number 07, Facility staff)

Health systems characteristics limiting implementation of c-HMIS

Human resources and motivation constraints

At the district level, it was stated that few personnel were dedicated to data entry to produce the final reports. This was a challenge as reports (HMIS) from the district were not produced on time thereby affecting planning and decision making at the district level.

> *"Right now, there is one information officer based at the district health office. The same person has got 31 health facilities and each of these facilities produces three reports. So, we're seeing this person in a month trying to enter about 500 reports, which is a huge task. So, we see the reports entered very late…. Otherwise, the delays negatively affect the utilization of these reports and decision making"* (IDI number 48, District staff)

Another widely reported challenge was the inadequate incentives for CHWs. The lack of incentives, particularly monetary ones, was disadvantageous, as most CHWs either declined to help collect data or submitted reports late. CHWs also complained that they were not incentivised for the services they provided to the facility.

> *"The bad thing is on the people involved in the system, (CBVs) they can work but not effective because it is voluntary and they are not paid"* (IDI number 57, CHA)

4. BROAD ADOPTING CONTEXT

Contextual factors facilitating the implementation process

Community participation and ownership

The implementation of the c-HMIS reportedly encouraged community engagement and promoted community ownership and responsibility. It was noted that now more than before, the community was engaged in action planning including coming up with solutions to health problems in the community.

> *"During action planning we sit with the community and allow them to mention the diseases that are common in their area. Then we discuss what we can do to prevent or cure the diseases affecting the community and find the solution together with the community"* (IDI number 32, CHA, Mushipashi health post)

Respondents observed that community engagement, ownership and responsibility had resulted in health interventions or services addressing the felt or experienced needs in the community. They indicated that this was possible because the new c-HMIS had allowed the community to plan based on the data collected in each area. A good example of community ownership and responsibility came from Chisanga health post in Mpongwe District where the chief provided land for use by the health facility to build a maternity wing that would reduce the problem of home deliveries.

> *"The system helps planning for a particular community according to their needs not like what we used to do in the past where you could just plan on information because that is what you collected in one area. But then you find that when implementing maybe another area has more and bigger problems than the area where you collected data"* (IDI number 47, CHA)

System usability and compatibility

District level stakeholders revealed that the c-HMIS was readily accepted because health workers were already familiar with the system, having previously used it at both the facility and district levels; the only modification involved extending data collection to the community level.

> *"We already had this system at the facility and district level. So, it was just a plus for us to have it at the community level because it is just an addition. It is not different from what we already have. But it is covering up with what was missing at the community level"* (IDI number 49, District staff)

It was further reported that the new system was compatible with other existing systems in the health facility which made it easy to use because staff were already familiar. For example, the c-HMIS was linked with other reporting tools such as the DHIS2, making it easy to link information from the community and the health facility.

> *"It linked to other systems in a way that we look at the same places, as in, at the district level we look at the cases they received, the cases they had, and these other systems look at how it is affecting the community at large, and it is collected directly from the community. The other system looks at the prevention and how to end it and the other one looks at relative levels"* (IDI number 39, CHA)

Contextual barriers to implementing c-HMIS

Logistical and infrastructure barriers

One of the biggest challenges that was reported was the lack of transportation. The considerable distance between the health facility and the various community zones made monthly reporting difficult, resulting in delayed reporting of information.

> *"Sometimes we have a lot of challenges when sending the reports to the facilities which are at the district. It's far and we have transport challenges. So, sometimes the report will be late for two days"* (IDI number 45, CHA)

Electricity shortage or power outage was also mentioned as one major challenge faced by both CHWs and staff at the district level. Lack of electricity made it difficult for health workers to access and send information to the next level.

> *"And then sometimes the faulty tools like computers and now the challenge of the power outages; maybe you don't have power for three, four days and that affects the program"* (IDI number 52, Provincial staff)

Poor phone network was indicated as a hindrance to communication between the facility staff and CHWs. It was reported that most times the CHWs were unreachable when they were queries with the data.

> *"In terms of communication since they don't have mobile phones and here where we are our network is poor. We are having a poor network system"* (IDI number 46, CHA)

Sociocultural and human capacity challenges

Respondents also revealed that there were low literacy levels among CHWs and thus some did not understand and appreciate the system altogether. These low literacy levels sometimes led to the collection of incorrect information.

> "*Then also, CBVs and SMAGs are not trained in specialized fields such as maternal health. Sometimes they don't know what to write on the report, so you have to teach them again*" (IDI number 47, CHA)

External and environmental disruptions

The respondents stated that during the rainy season, collecting data in the community became difficult because of poor road networks and lack of protective materials such as raincoats.

> "*The other challenge is that during the rainy season or we had a problem of raincoats, rain boots, and some others t*" (IDI number 18, CHA)

Further, the respondents cited the COVID-19 pandemic as another environmental challenge that hindered holding of physical meetings, a situation worsened by the network connectivity challenges that also limited virtue meetings.

> "*Here it is every month, but for now it is difficult to meet the community due to Covid 19. So, we have not met for two months now*" (IDI number 62, NHC)

DISCUSSION

The study aimed at exploring the acceptability and adoption of the c-HMIS in Mpongwe District, Zambia. Our study revealed several factors that facilitate the uptake of c-HMIS, including formal health system factors such as improved human resource capacity to manage c-HMIS. This improved capacity resulted from training on data collection, which reportedly enhanced the adoption of c-HMIS as health workers became more familiar with the system. This finding is consistent with studies conducted in Ethiopia and Brazil [4,29,30]. Our study found training to be crucial as it potentially improved stakeholders' capacity to report and use data for decision making. Similar studies conducted in Ethiopia Kenya, Malawi, Mozambique have underscored the value of c-HMISs in enhancing decision making and how this facilitates their integration into local health systems [29,31].

The respondents acknowledged that one of the facilitators to acceptability and adoption of c-HMISs was their capacity to enhance health service delivery, a finding that aligns with a similar study on the utility of c-HIMS in Kenya [11]. Compared to the studies in Kenya, Ethiopia, Malawi and Mozambique [31], our study provides additional evidence on implementation of c-HMIS, underscoring that their integration in local health systems could possibly be enhanced by promoting community ownership. We noted that community participation enhanced acceptability and adoption of c-HMIS by promoting shared communication, learning responsibilities and providing an opportunity to accommodate diverse actors, interests, and expressions of power that characterize the CHS [32–36]. Community engagement is vital as it has the potential for reducing mistrust in health systems by minimizing room for doubts because the actors are known and respected in the communities [15,31,33,37]. Further, community engagement facilitates understanding of contextual implementation realities which is essential because communities are sites of transformation whose expertise, capacities and ownership, coupled with external support shape the implementation process of health interventions such as the c-HIMS [6,36,38,39].

An additional contribution of this study to the existing body of knowledge is the finding that community participation in the c-HMIS implementation process facilitated the uptake of the new system through engaging community members in the formulation of action plans. It was reported that now more than before, the community was engaged in developing action plans that reflected the problems or disease burdens in the community as well as development of health interventions or services addressing community needs. We note that community-engaged implementation processes of health programs such as the c-HMIS can also improve acceptability and adoption by facilitating co-production and co-designing among various implementing partners as the case of the development of local plans [15,32–35]. We further observe these locally coordinated actions in the CHS are vital as they are often the ultimate triggers of sustainability of new health interventions because they build on local resources [7,12,40–42].

However, health systems and socioeconomic barriers affected the acceptability and adoption of the c-HMIS. These barriers included transportation challenges, electricity shortage or power outage, poor phone network and low literacy levels among CHWs. These challenges which could be linked to structural determinants of health systems have been reported in several systematic reviews in LMICs [3,19–21]. An additional barrier which was reported in this study was the lack of gender inclusiveness in the data collection tools. We note this gap could be linked to global debates on health equity in information systems, thus requiring further attention.

Several implications, lessons and reflections for scaling up digital c-HMIS nationally and other similar settings were drawn. First, to reduce resistance from district staff and health workers and ensure context appropriate c-HMIS, it is important to engage these stakeholders early in the design and implementation of c-HMIS. Second, it is important to invest in offline-first systems and solar/hybrid charging options to deal with infrastructure related challenges such as lack of electricity which affect data quality and availability. Third, we noted that conducting one off or just a few training courses might not be adequate for long-term skill retention and system adoption of c-HMIS. For sustained capacity building, it is important to consider building cascade training and mentorship models as well as integrating digital skills in the curricula for CHAs and health workers. Finally, to

ensure sustained financing for digital health, it is important to consider integrating implementation costs into government budgets at national level.

Study limitations

The main limitation of this study was that all the interviews were done through phone due to the COVID-19 travel restrictions. This made it difficult to effectively record some of the interviews because of poor phone network. To mitigate this limitation, we conducted more interviews than the minimum purposive sample. Further, key documents including the CHA timesheets, HIA4a and b forms and health facility data were not reviewed. The inability to review this data denied the study the opportunity to validate some of the information that was provided in the interviews relating to the quality of the reports. Despite these limitations, conducting interviews with different stakeholders at various levels of the health systems provided useful information to facilitate a comprehensive understanding of the acceptability and adoption of the c-HMIS. We also aimed to strengthen transferability by providing a rich description of the context in which the c-HMIS is implemented, the procedures of data analysis, and by providing quotations in the text representing a variety of informants [17,43].

CONCLUSION

The findings indicate that integration of the c-HMIS into community and district health systems was enabled by system characteristics such as targeted capacity building, user familiarity with digital platforms, and improvements in system usability, which enhanced acceptability and adoption. The c-HMIS contributed to strengthened health information management, improved planning and decision-making, and enhanced service delivery accountability within the health system. Community participation, perceived system compatibility with existing workflows, and local ownership further facilitated integration. However, the integration was constrained by limitations in data collection tools and infrastructure, persistent data quality and reporting challenges, gaps in gender-inclusive tool design, and human resource constraints. Overall, our findings suggest that while the c-HMIS has substantial potential to strengthen health information management systems, its sustained integration within the community and district health systems depends on leveraging some of the identified enablers and carefully addressing systemic, health system, and contextual barriers.

DECLARATIONS

AI utilization

The authors acknowledge the use of an AI-based language tool to improve grammar and readability in portions of the manuscript. All edits were reviewed by the authors, who take full responsibility for the final text.

Competing interests

The authors declare that they have no competing interests.

Funding

We acknowledge the financial support from the United States Agency for International Development (USAID) through Clinton Health Access Initiative (CHAI). USAID was not involved in the design of the study and collection, analysis, and interpretation of data and in writing the manuscript.

Author contributions

O A, J M Z, H S, C M, N B, E K, S C, and N L contributed towards the design of the study including the data collection tools. O A, J M Z, C M, N B, E K, and N L participated in collecting data. O A, J M Z, H S, C M, N B, E K, S C, A.S and N L participated in analyzing the results of the study. All the authors contributed towards the revision of analysis of the results, the draft manuscript, and approved the final manuscript.

Data availability

The datasets during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Acknowledgements

The technical support provided by CHAI throughout the study process is appreciated. We are also grateful to the Ministry of Health and community leaders in the study sites for the technical and logistical support provided during the study process. Furthermore, we would like to extend our sincere gratitude to the study participants for their time and valuable insight/input during the interviews. Special thanks to the data collection team who not only effectively managed the data collection process but also participated in transcribing and coding the data. Finally, the input during the data analysis and writing from Mr. Tulani Matenga, Mr. Chileshe Mpandamabula, Ms. Florence Tembo, Mr. Jaockim Msoni, Ms Deborah Chiti and Mr. Malizgani Paul Chavula are also appreciated.

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ABSTRACT IN SPANISH

Integración del sistema comunitario de información para la gestión en salud en los sistemas de salud comunitario y distrital en Mpongwe, Zambia

Introducción: Se ha prestado una atención considerable a la implementación y el fortalecimiento de los sistemas comunitarios de información para la gestión en salud (c-HMIS, por sus siglas en inglés) en países de ingresos bajos y medianos. En 2012, el Ministerio de Salud de Zambia, con el apoyo de la Clinton Health Access Initiative, desarrolló un c-HMIS. Guiados por el marco de Atun para la integración de intervenciones en los sistemas de salud, exploramos la aceptabilidad y adopción del c-HMIS en la comunidad y en el sistema de salud distrital del distrito de Mpongwe, Zambia.

Métodos: Se utilizó un diseño cualitativo de estudio de caso para examinar el proceso de integración del c-HMIS. Los datos se recopilaron mediante entrevistas en profundidad realizadas por teléfono a 66 participantes seleccionados de forma intencional a nivel comunitario, de establecimientos de salud, distrital, provincial y nacional (incluyendo líderes de los Comités de Salud Vecinales, voluntariado comunitario, asistentes comunitarios de salud (ACS), supervisores de ACS y personal del Ministerio de Salud). Los datos se analizaron mediante análisis temático.

Resultados: La naturaleza del problema, que incluía la persistente deficiencia en la calidad de los datos, motivó al Ministerio de Salud y a otros actores a adoptar el c-HMIS. Las características de la intervención, como la provisión de herramientas para la recolección de datos, la capacitación de los actores en su uso y la simplicidad percibida del c-HMIS, facilitaron el proceso de adopción. Asimismo, características del sistema de salud, como la disponibilidad oportuna de datos y la mejora en los procesos de retroalimentación de la información en salud, así como el contexto más amplio de adopción —incluida la participación comunitaria— promovieron el sentido de apropiación comunitaria del c-HMIS. Las barreras para la implementación incluyeron desafíos relacionados con las herramientas de recolección de datos y las plataformas digitales.

Conclusión: En conjunto, los hallazgos indican que, si bien el c-HMIS tiene un potencial considerable para fortalecer los sistemas de gestión de información en salud, su integración sostenida en los sistemas de salud comunitarios y distritales depende de aprovechar los facilitadores identificados y de abordar cuidadosamente las barreras sistémicas, del sistema de salud y del contexto.

Palabras clave: Comunidad, gestión, información, participación, sistema de salud.

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