

Identifying barriers to the production and use of routine health information in Western Province, Zambia

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Abstract

Recent decades of improvements to routine health information systems in low- and middle-income countries (LMICs) have increased the volume of health data collected. However, countries continue to face several challenges with quality production and use of information for decision-making at sub-national levels, limiting the value of health information for policy, planning and research. Improving the quality of data production and information use is thus a priority in many LMICs to improve decision-making and health outcomes. This qualitative study identified the challenges of producing and using routine health information in Western Province, Zambia. We analysed the interview responses from 37 health and social sector professionals at the national, provincial, district and facility levels to understand the barriers to using data from the Zambian health management information system (HMIS). Respondents raised several challenges that we categorized into four themes: governance and health system organization, geographic barriers, technical and procedural barriers, and challenges with human resource capacity and staff training. Staff at the facility and district levels were arguably the most impacted by these barriers as they are responsible for much of the labour to collect and report routine data. However, facility and district staff had the least authority and ability to mitigate the barriers to data production and information use. Expectations for information use should therefore be clearly outlined for each level of the health system. Further research is needed to understand to what extent the available HMIS data address the needs and purposes of the staff at facilities and districts.

Keywords: Health information system, health systems, health systems research, decision-making

Key messages

- Zambia has seen great improvements in health data production with the implementation and improvement of a national HMIS in recent decades. However, several challenges remain regarding quality data production and information use for decision-making.
- Health systems staff at national, provincial, district and facility levels involved in data production and information use identified several complex barriers to using HMIS data within the context of Western Province.
- While staff at facility and district levels disproportionately bear the labour required to overcome these challenges to complete monthly submissions of routine data, they have the least authority or ability to contribute to solutions to mitigate the challenges.
- Expectations and standards for adequate information use must be outlined for each level of the health system. Further research is required to understand how HMIS data can be used or improved to meet the information needs of each level of the system, especially for the facilities and districts.

Introduction

Reliable health information is foundational for decision-making within health systems, and necessary to support ongoing functions, such as policy development and implementation, governance, research, education and financing (World Health Organization (WHO), 2010). Tremendous progress has been made in low- and middle-income countries (LMICs) to improve the routine health information systems (RHISs) that produce relevant, timely, complete and accurate data to enable informed health system decision-making processes. However, while improvements have led to increases in the volumes and quality of data that is produced, significant technical, behavioural and organizational challenges continue to persist with RHIS functioning (Hoxha *et al.*, 2020).

This is the case in Zambia, where despite vast improvements to the national RHIS since its establishment in 1996, the country has continued to deal with challenges such as: multiple incongruent or unintegrated data sources, insufficient staff training, poor internet connectivity and inadequate availability of registers and tools (Zambia Ministry of Health, 2007; 2023; USAID DELIVER PROJECT 2012; Chisha *et al.*, 2015; MEASURE Evaluation 2018). These challenges have also been

widely reported in other sub-Saharan African countries, such as Kenya, Malawi, Ethiopia and Nigeria, among others (Edet *et al.*, 2017; Hoxha *et al.*, 2020; Kebede *et al.*, 2020; Regeru *et al.*, 2020).

Whether in Zambia or elsewhere, these barriers affect the entire data use cycle, consisting of both the production of quality data (reporting of indicators into the system) and the use of information (analysing, interpreting and reviewing data for decision-making) (Nutley and Reynolds, 2013; PATH, 2016). For example, inaccurate or untimely data production leads to loss of trust and confidence in the data, and thus low use of RHIS information by health workers and decision-makers (Nutley and Reynolds, 2013; Wagenaar *et al.*, 2015; Dagnew *et al.*, 2018; Regeru *et al.*, 2020). Furthermore, challenges such as data duplication or poor staff training for data analysis often cause data to be left raw and un-synthesized, rendering them uninterpretable or unhelpful for decision-makers (Health Metrics Network & World Health Organization, 2012; Nutley and Reynolds, 2013; Mbondji *et al.*, 2014; Ngusie *et al.*, 2022). Thus, despite the potential for RHIS data to improve planning, policy and research, utilization is still reported to be low in clinical and decision-making settings (Abajebel *et al.*, 2011; Wagenaar *et al.*, 2015; Asemahagn and Lee, 2017; Shiferaw *et al.*, 2017; Hung *et al.*, 2020; Odei-Lartey *et al.*, 2020).

As Zambia continues to tackle pervasive health issues with limited resources, increasing the value of RHIS data is a priority of decision-makers seeking to improve health outcomes (Zambia Ministry of Health, 2023). Some studies from within Zambia indicate that there is room for improvement to strengthen the information system and the use of information for priority health areas—namely HIV (Moonga, 2016), tuberculosis (Lungu *et al.*, 2022), malaria (Chisha *et al.*, 2015) and maternal and child health (MCH) (Banda, 2015; Kamanga *et al.*, 2022). The gaps in routine data for other growing health concerns outside the priority areas, such as cancer and other non-communicable diseases may have more inconsistencies in data quality and completeness, and receive less attention in literature (Brugha *et al.*, 2010; Cabanes *et al.*, 2019).

Despite the gaps in data quality, health workers at sub-national levels are continually expected to carry out data production and decision-making activities to improve health services for the population. Health workers at facility and district-level positions are often tasked with increasing data collection and reporting workloads, while also using information to make good clinical and service-related decisions. This often results in an overburdened workforce with insufficient training or guidance on how to analyse and synthesize data (Boerma, 2013; O'Neil *et al.*, 2021) or how to use the RHIS information for decision-making (Hotchkiss *et al.*, 2012).

Strengthening the RHIS and increasing the use of information for decision-making is a priority for health officials of Zambia (Zambia Ministry of Health, 2023). However, there are limited recent studies examining the experiences of Zambian health system staff involved in routine data production and information use. To support local efforts and address this gap in literature, we designed a qualitative study exploring the challenges that health workers experience throughout the data use cycle at sub-national levels within Western Province (WP), Zambia. Through our findings and analysis, we offer a critical perspective on the production of RHIS data and

use of information for health systems decision-making in LMICs.

Methods

Study setting

WP is amongst the most economically challenged provinces in Zambia, with nearly three quarters of its population of over a million people living in extreme poverty (Zambia Central Statistical Office, 2016). The province has the second highest HIV prevalence rate (16%) in Zambia (Zambia Ministry of Health, 2019), some of the most adverse MCH care indicators, and low uptake of various childhood vaccinations (Zambia Central Statistics Office, Ministry of Health Zambia & ICF, 2019). Addressing these complex issues by identifying and mitigating barriers to healthcare access is thus a priority for provincial health leaders.

The province is divided into 16 districts, each of which contains an administrative district health office that manages all health services and activities in the district, including the collection and reporting of routine health data. Health facilities are organized into levels based on the range and complexity of services provided: rural health posts provide the most basic care, rural and urban health centres provide primary care and preventative services, and district and provincial hospitals act as referrals for health centres and provide more complicated services (Zambia Ministry of Health, 2012). Interviews were mainly conducted in WP, at provincial-level administrative offices and in district health offices and facilities in five of the total 16 districts. Additional interviews were conducted in Lusaka, the capital city of Zambia, where national government offices are located and the health information system is centrally managed.

Zambia's routine health information system

The Zambian RHIS, referred to as the Health Management Information System (HMIS), is managed by the central Ministry of Health (MoH) and collects continually reported data from all district-level health facilities within the country. The development of the Zambian HMIS is the result of decades of continual economic and health systems reforms. Following significant economic challenges in the mid-80s and a resulting decline in health infrastructure and outcomes, the responsibilities of the MoH were decentralized to provinces and districts in 1996 and its implementation activities were devolved to a newly established 'Central Board of Health' (CBoH) system (Kalumba *et al.*, 1994; Chansa *et al.*, 2020). Financing schemes were introduced to link health system financing to performance, requiring that a national HMIS be implemented to capture routine data on service delivery and management (Kalumba *et al.*, 1994; Bossert *et al.*, 2003; Chansa *et al.*, 2020).

However, CBoH reforms were short-lived and discontinued in 2006 due to high operational costs, lack of cohesion within the health sector, and failure to transfer MoH staff to the decentralized boards (Mudenda *et al.*, 2008; Chansa *et al.*, 2020). A subsequent process of restructuring returned all health systems' authority and responsibility to the central MoH (Chansa *et al.*, 2020). With re-centralization, the MoH oversaw the revamping of the HMIS with the introduction of the DHIS2 (District Health Information Software 2) platform and implementation of an electronic health record (EHR) system in select districts, improving the tools for data

reporting and analysis, and increasing the volume of collected data.

Today, the HMIS captures data on disease morbidity and mortality, MCH services, service delivery indicators (such as staff workload, health facilities utilization and availability of essential drugs) and financial services (Zambia Ministry of Health, 2007). The Integrated Disease Surveillance Response (IDSR) system operates alongside the HMIS to provide real-time reporting of infectious disease outbreaks to the Zambia National Public Health Institute (ZNPHI)—a separate statutory body under the MoH. Additional electronic health record systems and routine surveillance systems have also been added over time that focus specifically on HIV and malaria (e.g. the US Centers for Disease Control ‘Smart Card’ project to support continuity of care for HIV).

The operation of the Zambian HMIS is similar to those of other sub-Saharan African countries. Patient data are collected at point of care—most often on paper-based registers—in health facilities or during community health visits by volunteers. Each month, these data are aggregated at each facility onto paper-based reports and submitted to district health offices, where information officers then input the data from the reports into the DHIS2 platform. Within some larger health centres and hospitals, data are collected digitally through the EHR system when possible or collected on paper registers, and later electronically aggregated before submission to the district health office. Once submitted into the DHIS2 at the district level, the data are viewable by the provincial and national administrative departments of the MoH.

Study sample and design

We designed a qualitative study to understand the experiences of health workers involved in the production of HMIS data at the various sub-national levels in the Zambian health system. In May and June of 2019, we conducted in-depth, semi-structured interviews with a total of 37 health and social sector professionals across 14 different settings (Table 1). A purposive sampling strategy was used to select participants holding a broad range of positions across various levels of the health system. We interviewed staff at facility level ($n=9$), district level ($n=17$), provincial level ($n=2$) and national level ($n=9$). Respondents were selected to provide perspectives from various points within the data use cycle, including data collection, management, analysis, synthesis and/or information use. Settings and individuals were largely identified and recruited to the study through the recommendations of health sector stakeholders (e.g. MoH officers, provincial health officers and district health officers).

Interview questions were designed to assess the functioning of the HMIS at each level of the health system and the respondents’ roles in producing or using data. Interview data were analysed inductively and through an iterative thematic analysis process using QSR NVivo software.

We reference the concept of the data use cycle developed by PATH (2016) in their framework for identifying points of action to accelerate data use culture. Much of our interviews were around barriers to data production, or more particularly, data reporting and collection. The framework posits that a data use culture can be accelerated by pushing levers to support the data use cycle (data production and information use). Some of the levers include changes to legislation

Table 1. Number of interview participants by setting and level of health system

Setting	Number of participants
Facility level	9
Rural health post (1)	1
District hospitals (2)	8
District level	8
District health offices (5)	8
Provincial level	2
Provincial health office (1)	1
Statistics office (1)	1
National level	5
Ministry of Health offices (2)	1
ZNPHI (1)	4

and policy, standards and interoperability and leadership and governance, among others.

This research was approved by the Office of Research Ethics at the authors’ institute and ERES Converge IRB, a private research ethics board in Zambia. Support and authorization were also received from the National Health Research Authority in Lusaka and the Provincial MoH office in WP. Participants provided informed consent prior to interviews.

Results

Barriers to data collection and information use were identified in discussions with respondents and are organized based on similarities and type of system challenges. Results were sorted into four main themes listed in Table 2.

Governance and health system organization Change to governance structure

Respondents at all levels spoke of the effects of centralization on HMIS information use at the districts. Under the CBoH, the decentralized governance structure had enabled a strong culture of information use at local levels. Districts were better equipped to conduct frequent trainings and hold meetings with facility staff, while facility staff were required to conduct quarterly self-assessments to review performance for service delivery and facility management against key indicators.

However, when the authority for decision-making moved upward upon re-centralization, frequent facility-level self-assessments were no longer required. Today, facility staff no longer have a formal mandate to regularly review their data, nor the enforced and guided responsibility to use information for planning. In the absence of a formal requirement, some districts encourage their facilities’ staff to conduct regular informal assessments and data reviews, although interest in such activities varies between facilities and districts.

As a consequence of these changes, respondents explained that facilities’ staff have become more reactive to problems as they arise, as opposed to being proactive in planning for services. In addition, with less frequent data review meetings between district and facility staff, there is less opportunity to incorporate needs or priorities identified at the community level. As such, decisions made at the district level may now be less representative of communities and less informed by data. One respondent described these changes in planning responsibilities:

Table 2. Identified challenges organized into themes and subthemes

Theme (description)	Subtheme	Findings
1. Governance & Health System Organization (factors pertaining to the organization and strategies of the overall health system.)	1.1 Change to governance structure	The change in the structure from a decentralized model of governance to a centralized MoH has resulted in less decision-making authority. Partner funding and global priorities have influenced the development of the HMIS tools, as well the type of data collected and how they're collected.
	1.2 Donor/partner influences	
2. Geographic Barriers (barriers related to the distance between health facilities and district administrative offices.)		The long distances between the facilities and the district health offices in WP cause challenges with submitting monthly paper-based reports, especially during flooding seasons. There is also a lack of cellular and internet network coverage over the vast area, making remote communication difficult.
3. Technical & Procedural Barriers (factors directly related to the technological tools and processes for collection, management and transfer of data and the dissemination of information between the levels of the health system.)	3.1 Clinical records	Much of the HMIS data are generated from patient records at facilities. As such, there may be errors in recording data accurately and interpreting the clinicians' notes.
	3.2 Difficulties with indicators and registers	The number and complexity of indicators and register books that are required to be collected and reported for the HMIS pose challenges for health facility staff whose primary objectives are in patient care and service delivery.
	3.3 Information technology infrastructure	Efforts to improve digital data collection, transfer and reporting, and analysis have been slow due to issues of inconsistent power, lack of internet, unavailability of computers at facilities and poor integration of available software.
	3.4 One-way movement of information	Raw data are collected and transmitted upward towards the health system on a regular basis, but communication regarding translated information is less frequently transmitted back down.
4. Human Resources Capacity & Training		Staff at all levels of the system reported being understaffed or undertrained to be able to ensure quality in collected data or the effective use of data. Regular meetings and more frequent training were identified as possible solutions to increase the appreciation for data among staff and build capacity for data use.

Planning and self-assessments were carried out by the facilities with neighbourhood health committees. The neighbourhood health committees were invited to the facilities, and they would do their planning [together] while factoring in community needs. After their plans were made at facility level, staff would come from the facility to the district and share their plans. So, we were factoring in their plans and the needs of the community and facility. Our role [at the district] was mainly to aggregate and come up with an overall plan, [while catering to the needs] of the community. Where we're at now, I think things have changed. Planning is no longer a down-up approach but is mainly top-down. (District-level respondent)

The negative effects of recentralization may have been more intensely felt in WP. One respondent described that WP was a leading province in the country for data collection and utilization during the decentralization period owing to strong support from bilateral partners (Heinfelaar, 2011).¹ Subsequent to system re-centralization, partner support for

health programs at sub-national levels were redirected to the central level or discontinued,² further contributing to a loss of decision-making responsibility and data ownership at the district level (Lake and Musumali, 1999; Mudenda *et al.*, 2008). Although it was not clear from our interviews how other provinces were affected, respondents in WP uniformly described a decline in respect for and use of information when the health system was recentralized.

Donor influence

Historically, the development and strengthening of much of Zambia's health system, including the HMIS, were largely driven by donor support. As such, the country's data collection systems are much more robust for program areas around which donor support is high—such as HIV, TB, malaria and MCH—than for other priorities.

For example, the World Bank introduced a results-based financing (RBF) project to select districts in 2008³ to improve MCH services by incentivizing performance against select MCH targets (Friedman *et al.*, 2016). While the project ended

in 2014, the World Bank and other donors have continued to use RBF schemes in MCH programming in some facilities and districts (Bergman *et al.*, 2021), reinforcing a culture of more careful collection and analysis of data for MCH over other health areas:

Now what we're seeing is that this [RBF] program focuses on a very limited number of [MCH] indicators. As part of the program, the facility is supposed to be doing data reviews on a regular basis [but] what we see is that they concentrate on reviewing data on only those incentivized areas. Then they forget environmental health, malaria, etc. We had a meeting 3 weeks ago where we talked about having a review program in place so that effort is applied across all program areas [and not just the incentivized areas]. (Provincial-level respondent)

Partners and donors can also influence data generation activities by requiring extra data collection for the programs they oversee and implement. Some partners employ their own staff to collect additional data, as changing or adding new indicators to the national system can be costly and slow. Although these data are usually shared with district offices to reconcile any errors and differences from HMIS data, there have been instances when partners collected health data but delayed sharing or have not shared at all with government health sector offices. This can result in loss of ownership in data, duplicate or inconsistent data sets, and difficulty integrating partner-run programs with the overall health system.

At times, there are certain programs that even the Ministry... we don't have access to this data and they don't want to give it to us even though they're using our facilities. So, at times they'll have diff stats than country stats. I don't know how far the MoH has [made progress in this regard], but we're working on data management policies. We want to work with partners that have already been established. (National-level respondent)

Geographic barriers

The remoteness of some facilities poses a significant challenge for data reporting. Some of the district offices we visited oversee facilities across the seasonally flooded Zambezi floodplain that may be as far as 170 km away from the district administrative centre. The geographic characteristics and difficult terrain prevent timely submission of monthly paper-based aggregate reports. During certain months of the year, staff from some facilities must take long journeys to make their submissions at district offices by motorbikes, dugout canoes, ox carts or a combination of transportation means.

The geographic barriers for many outlying health posts and centres are further compounded by the lack of cellular and internet network coverage. In these areas, regular communication with the district offices is unfeasible as staff must walk several kilometres to be within range of cellular connection. Weekly surveillance reports are therefore delayed as submission can only occur biweekly when motorbikes are deployed for HIV sample collection activities, or monthly with submission of other HMIS reports.

The inaccessibility of many facilities also creates challenges for quality assurance activities, as district office staff cannot hold meetings with facilities for data validation, consistent

staff training or monitoring and evaluation. Data uploaded to the DHIS2 are locked (cannot be edited or changed) after 3 months; in some cases, district staff are unable to communicate or travel to follow-up with more distant facilities for up to 6 months, and erroneous data entries cannot be amended within this 3-month timeframe.

Facilities that have reported low levels of a particular condition would suddenly show increases [in incidence/prevalence] of 400% even though the population number hasn't changed. This means you have to go back to the data source [to validate the data]. Just to visit one facility, the furthest one, you need 120 litres of diesel and another 4 hours of [canoe] paddling. So quality monitoring becomes a challenge. That's why we can only conduct validation activities quarterly [rather than monthly]. But by the time we're able to validate and fix the data, the community partners and provincial and national offices have already seen the [incorrect] data, and the corrected data no longer has value because it's being analyzed the way it is. (District-level respondent)

Technical and procedural barriers

Clinical records

Data collection procedures for the HMIS are complicated by the realities of clinical practice and the methods of recording clinical data. For example, data quality is sometimes difficult to ensure due to the possibility of human errors when recording patient data on paper-based registers. In larger hospitals with dedicated data clerks, clinical record notes written by practitioners may be difficult to read or misinterpreted by the data clerks who complete the HMIS registers. In other instances, clinical records may indicate diagnoses of certain diseases in patients without accurate laboratory case confirmation, as in the case for some sexually transmitted infections, which may impact the accuracy of data reported to the DHIS2.

For health workers in smaller facilities, recording data into the HMIS registers is an added task on top of clinical duties. During a clinical visit, patient data must often be recorded twice; comprehensive patient history and details of diagnoses are recorded in paper-based health 'passports' and immunization cards carried by the patient, while key indicators for the HMIS are recorded in the registers housed at the facility. Although the registers are categorized by service areas, data for one patient can encompass several registers in one visit. When a health worker's priority is to provide care for the patient, and when there are many patients anxiously awaiting to be seen, completing the registers is cumbersome and the accuracy and completeness of data may be compromised.

Difficulties with indicators and registers

The introduction of the DHIS2 software has allowed the collection of more data for the HMIS, resulting in an overwhelming number of reportable indicators in the paper-based registers. Staff responsible for recording and aggregating data must manage several different registers (up to 21 in smaller facilities and 25 in some district hospitals and the provincial hospital at the time of interviews), contributing to the time and effort required for complete and accurate recording. Respondents conveyed that many of the indicators are

difficult to interpret and manage, some of which may be less relevant to clinical care delivery.

[The previous] HMIS [had a smaller] number of indicators. It made people work hard to achieve targets. But now, the indicator definitions—some of the facility staff that we've seen can't fluently explain or define those indicators. When we're talking about fully immunized, what does it mean? What does it take for a child to be fully immunized? During the CBoH, those [kinds of explanations] were covered under HMIS manuals. But this time, it's really difficult. When you look at the DHIS2 manual, it's quite a big document and you can't expect that the facility staff can go through that big of a document. (District-level respondent)

Furthermore, the speed at which indicators are changed or added to the HMIS is often greater than what staff at facilities and districts can respond or adapt to. When new programs are introduced, there is a delay before the indicators to monitor the programs are added to the DHIS2, and often an even further delay before the paper registers and monthly aggregate forms at facilities reflect these new changes. One respondent describes the difficulty in training staff to keep up with the continual changes:

Last year we were supported by the Global Fund to re-train the staff on the new tools that came. Most of these tools, they just came last year. [But many more indicators have changed since then]. In the HIV/AIDS component, it's changing so fast. Right now, there are a lot of new data elements that are no longer matching with the system. Beginning in July, we are going to revise the registers again because of the new data elements that have come on board. So, we have to go back and re-train staff. (District-level respondent)

Information technology infrastructure

Challenges with the development of information and communications technology infrastructure have slowed the transition to an electronic system for health records at many health centres. For example, the MoH has been implementing SmartCare, an EHR system that allows patients to carry a digitized health passport and enables facilities to electronically submit monthly data to the HMIS. Although SmartCare was introduced over 10 years ago, most facilities within WP have not been able to switch from the paper-based system due to lack of computers, consistent power and internet and funds to implement and maintain the SmartCare software and hardware.

Even where digital data entry of patient records is possible, transferring the data between different computers or software remains a challenge. At the facility level, staff have difficulty transferring data into Microsoft Excel for simple analysis or between wards in a hospital when power outages prevent intranet connections. At some district offices, information officers must manually extract data from the SmartCare system before inputting into the DHIS2 platform. These challenges may be partly attributed to the fact that the various software were developed separately by different external actors and thus more complicated to bridge together (Gumede-Moyo *et al.*, 2019; DHIS2, n.d.).⁴

In addition, at the national level, routine HMIS data (housed on the DHIS2), surveillance data (reported through

the IDSR system), and other data are unintegrated and held in different databases. This sometimes leads to duplicate data or discrepancies between the various datasets, and ultimately, inaccurate analyses. Staff at the national level reported that conversations were beginning around the idea of a national harmonized data repository to improve analysis and effective input into health program planning and evaluation.

We don't have one [repository] where this data sits. HMIS on DHIS2 on its own, IDSR data, other data from other programs all with their own systems. It's important to have that data integrated to have a more holistic picture. We lack that. The idea for the repository was to have as much data from different places coming to one place. The systems can remain singular, but they need to come together for analysis. (National-level respondent)

One-way movement of information

While data continue to be reported upward from facility to district and beyond, less information was said to be communicated back down to the facilities. Channels exist at the national-level ZNPHI to disseminate disease surveillance information to the general public through online bulletins and reports, as well as to the district offices for the purposes of data validation (to correct errors) and staff training. However, it was less clear from our interviews whether consistent channels exist at the national MoH offices to relay information and maintain communication with the districts and facilities regarding routine HMIS activities.⁵ When facility or district staff communicated up the chain regarding some of the challenges in data reporting, it was reported that staff did not receive communication back down. When staff receive little feedback regarding reported data, they are less motivated to ensure good information use practices.

Q: Do you receive feedback on what you've reported?

A: [Not normally], but there are some special programs where we get feedback. For instance, we report national malaria data using mobile phones. For that, sometimes they will make some follow-ups, where they say, 'How about this? What happened? What have you done?' But [for data that goes] to the ministry [through the DHIS2], we don't normally get feedback. But where we misreport, the district information officer will always call and ask to check on the indicator. (Facility-level respondent)

Human resources capacity and training

Respondents spoke of inadequate technical training for staff at facilities and district offices, as well as a lack of consistent and certified programming to build managerial and leadership capacity. Even when staff training is provided, it is difficult to sustain the knowledge due to continually changing indicators, staff turnover, and the transient nature of volunteers who aid with documentation in some facilities.

The workload of local facility staff may also leave little time for careful data collection and analysis. Some facilities may have data clerks funded by US-CDC/PEPFAR programs, but in facilities that are not included in such programs data collection and submission are done by clinicians with several other duties or junior staff lacking adequate training. To submit monthly reports to the district offices, staff at some smaller facilities must spend the first few days of each month after

work hours to aggregate data from registers. Under current legislation, smaller facilities are unable to hire information officers to take on data-related roles until such a position is authorized at the national level.

We also don't have infrastructure capacity to handle data at facilities. [...] At the provincial level, we have officers dedicated for that, and even at district level. To some extent at the hospital level, there are only a few where they don't have that position. But at the [local] health centers, people are not employed specifically for data or information management. If there are two health workers at the facility, a physician or health officer and a nurse, one of them is in charge of information in addition to their regular responsibilities. We can't react to it until the establishment at the Ministry create a position for this. Right now, it's an ad hoc arrangement. (Provincial-level respondent)

Discussion

Our study assessed challenges to collecting and using HMIS data in WP, Zambia, as identified by health system employees at the facility, district, provincial and national levels. Challenges were present at all stages of the data use cycle including data collection, synthesis and use for decision-making. Most of these challenges identified in our setting—such as complicated indicators, challenges associated with paper-based registers, frequent power outages and lack of training—are consistent with challenges that have been reported across LMICs, including other sub-Saharan African countries (Dagnew *et al.*, 2018; Li *et al.*, 2018; Hoxha *et al.*, 2020).

The effects of these challenges were most strongly felt by the staff at the lower levels of the system (facilities and districts), where much of the data collection and reporting activities take place and are thus more labour-intensive. In addition to the burden of labour, lower-level staff also have little authority to address the barriers that impede or increase their work, and little ownership over the HMIS data and information outputs. For example, when new indicators are added into the HMIS at the national level, facility and district staff must work to keep up with the changing data elements in addition to meeting existing expectations for data collection. However, staff at facilities and districts often lack the authority to hire more staff or volunteers to assist with data collection and have few other avenues to voice their concerns to higher (provincial and national) levels.

This unequal distribution of labour, authority and autonomy can be partly attributed to the centralized structure of the health system, in which major funding and decision-making responsibilities flow down from the national MoH to the district health offices. As a result, the HMIS information seem to be more useful for the decision-making activities of the higher levels of the system than for the facilities where the data generation mostly takes place. It is worth noting that since this study was carried out, the Zambian government has announced plans for decentralization of the health system over the 2022–2026 period (Zambia Ministry of Health, 2023). However, it is not clear to what extent the districts will be given decision-making power over finance and resource allocation under these plans.

Nevertheless, issues of disproportionate decision-making power and HMIS workload at district level persists in several sub-Saharan African countries regardless of whether the health system is centralized or decentralized (Boerma, 2013). What results from these dynamics is a reinforcing of a culture within the health sector in which lower-level staff may be less empowered to act on available HMIS information to improve health services (PATH, 2016). Moreover, at district levels to a certain extent, and especially within facilities, aggregate HMIS data are less useful for staff responsibilities and staff have less ownership and authority over the HMIS data. Given the labour and time required to collect, record, and submit the data in addition to performing other clinical duties, there is less motivation and capacity to ensure data quality or to synthesize and use data for purposes beyond what is absolutely required. If the data contained in the DHIS2 are not designed to mainly serve the purposes and functions of the facility, or if it is unclear as to how the facilities should best use the information, it should be questioned why they must take the brunt of the labour to produce the data.

Despite the labour carried out by facility and district staff, there were still some perceptions at the top that not enough work was being done for either data production or information use at the lower levels. We suggest that this is not because staff at facilities or districts are not doing enough work, but because the expectations for data use are unclear and vary between the levels of the health system. This highlights a larger gap within the general HMIS-related literature that the meaning of adequate 'data utilization' is often not clearly defined for the users responsible for the generation of data—that is, the facility staff—as it is difficult to determine exactly how, and to what extent, data should inform decision-making processes (Hotchkiss *et al.*, 2012). It is useful to question how and whether the information is currently used, and by whom and to what ends, in order to advance locally identified health priorities.

The first solution we suggest in response to these issues is to identify the health priorities and information needs at each level of the system and also provide clear expectations and procedures for information use. Second, the Ministry's decentralization plans over the next few years should be guided by a clear outline for the roles and responsibilities regarding the various stages of the data use cycle to enable the collection, storage and analysis of data and the use of information in ways that are more equitable and useful for those that bear the burden of generating such data. Finally, re-implementation of mandatory self-assessments that were commonplace prior to centralization could provide opportunities for strengthening an information use culture. As Braa *et al.* (2012) have found, such self-assessments and quality checks at facility and district level can have a significant impact on the quality of data reported into the HMIS.

Our study has some limitations, including the small sample of informants at hospitals and health posts, and the lack of respondents at urban and rural health centres. Given that the bulk of routine health data collection takes place in clinical settings, spending more time with staff in these facilities would have provided a deeper understanding of their various needs and challenges with data production and information use. Similarly, we were not able to visit the districts furthest from the provincial capital, where staff may have different experiences, particularly with monthly data reporting. Additionally,

our study focused on HMIS information use solely within the public health system, which excludes use by the private sector, academics, NGOs and other stakeholders who may be producing important work to inform government public policies and strategies. Thus, our study may not capture an exhaustive list of barriers, nor the full breadth of the complexity of data collection and information use in this region.

Making the HMIS more equitable may be challenging in a centralized model of governance, such as in Zambia where staff at the lower levels of the health system have little autonomy or avenues to influence change. However, in a setting where financial and human resources are scarce, it may be more useful to re-think how the HMIS can better serve the purposes of the sub-national levels of the health system rather than to attempt to address all of the individual technical and infrastructural challenges. It is our hope that our study has provided insight into some of the practical challenges that exist in the Zambian context and a more critical analysis of the overall challenges to sub-national information use that we believe may be more useful for decision-makers in low-resource contexts.

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Author contributions

N.L. was involved in data collection, analysis and interpretation and drafting of the manuscript. D.S. was involved in data collection and provided expert consultation on context and subject matter. C.R.J. was involved in study design, data collection and critical revision of the manuscript. K.A.G. was involved in study design and critical manuscript revision. J.A.L. was involved in study design, data collection and critical manuscript revision. All contributing authors have read and approved the manuscript prior to submission.

Reflexivity statement

This study was conducted by doctoral students and faculty researchers from the University of Waterloo in Canada in partnership with health officials and researchers from the Ministry of Health in Zambia. This research attempts to understand the challenges and barriers to information use from the perspectives of employees within the health system directly involved in data activities. Analysis of the qualitative data was conducted by the authors who have varying degrees of experience and knowledge of the health information system within Western Province. D.S. is both an employee within the Zambian health sector and doctoral student at the University of Waterloo. All other authors have been educated in North America,

with previous research experience within Zambia or other LMICs.

Ethical approval. The study was approved by the University of Waterloo's Office of Research Ethics (ref #41126) in Canada and ERES Converge IRB, a private research ethics board in Lusaka, Zambia (IRB 00005948). Support and authorization were also received from the National Health Research Authority in Lusaka and the Provincial Ministry of Health office in Western Province.

Conflict of interest statement. None declared.

Notes

1. One respondent attributed this support to the Dutch government, which was particularly active in providing development assistance to the poorest areas of Zambia including Western Province. It is not clear exactly how this support contributed to a strong data collection culture, other than that decision-making and planning—and thus, data-use—were conducted at the district level with direct support from donors.
2. In the 90s through to 2009, partner and government funding were pooled into a 'basket' whereby districts were funded directly under a common set of procedures. When the CBoH was dissolved, some bilateral partners contributing to the basket reportedly redirected their funds to other sectors.
3. The results-based financing scheme was introduced as a pilot program by the World Bank and is used by the Zambian MoH to contract-in health facilities by incentivizing performance for select MCH-related outputs. While the pilot program ended in 2014, the RBF scheme continues to be used in various MCH funding packages by the World Bank and other bilateral and multilateral donors. At the time of our study, some facilities in WP were participants in an RBF program.
4. SmartCare was developed by the Zambian MoH in partnership with the US Centre for Disease Control and Prevention (CDC), whereas the DHIS2, used in several LMICs, is an open-source platform developed and managed by researchers at the University of Oslo.
5. The ZNPPI deals mainly with disease surveillance data while the MoH oversees the entirety of the HMIS, including other routinely collected, non-surveillance data. All of these data are uploaded to the DHIS2 platform.

References

- Abajebel S, Jira C, Beyene W. 2011. Utilization of health information system at district level in Jimma Zone Oromia regional state, south west Ethiopia. *Ethiopian Journal of Health Sciences* 21: 65–76.
- Asemahagn MA, Lee A. 2017. Determinants of routine health information utilization at primary healthcare facilities in western Amhara, Ethiopia. *Cogent Medicine* 4: 1387971.
- Banda PC. 2015. Status of maternal mortality in Zambia: use of routine data. *African Population Studies* 29: 1820–30.
- Bergman R, Forsberg BC, Sundewall J. 2021. Results-based financing for health: a case study of knowledge and perceptions among stakeholders in a donor-funded program in Zambia. *Global Health: Science and Practice* 9: 936–47.
- Boerma T. 2013. Public health information needs in districts. *BMC Health Services Research* 13: S12.
- Bossert T, Chitah MB, Bowser D. 2003. Decentralization in Zambia: resource allocation and district performance. *Health Policy and Planning* 18: 357–69.

- Braa J, Heywood A, Sahay S. 2012. Improving quality and use of data through data-use workshops: Zanzibar, United Republic of Tanzania. *Bulletin of the World Health Organization* 90: 379–84.
- Brugha R, Simbaya J, Walsh A, Dicker P, Ndubani P. 2010. How HIV/AIDS scale-up has impacted on non-HIV priority services in Zambia. *BMC Public Health* 10: 540.
- Cabanes A, Kapambwe S, Citonje-Msadabwe S *et al.* 2019. Challenges, opportunities, and priorities for advancing breast cancer control in Zambia: a consultative meeting on breast cancer control. *Journal of Global Oncology* 5: 1–7.
- Chansa C, Mukanu MM, Chama-Chiliba CM *et al.* 2020. Looking at the bigger picture: effect of performance-based contracting of district health services on equity of access to maternal health services in Zambia. *Health Policy and Planning* 35: 36–46.
- Chisha Z, Larsen DA, Burns M *et al.* 2015. Enhanced surveillance and data feedback loop associated with improved malaria data in Lusaka, Zambia. *Malaria Journal* 14: 222.
- Dagnew E, Woreta SA, Shiferaw AM. 2018. Routine health information utilization and associated factors among health care professionals working at public health institution in north Gondar, northwest Ethiopia. *BMC Health Services Research* 18: 685.
- DHIS2. n.d. *About dhis2*. <https://www.dhis2.org/about>, accessed 12 January 2022.
- Edet C, Whyte M, Ogu R, Obomanu G, Harry AM. 2017. Use of technology to manage health data in rivers state, Nigeria: a qualitative study on family planning and routine health information systems. Chapel Hill, NC: MEASURE Evaluation.
- Friedman J, Qamruddin J, Chansa C, Das AK. 2016. Impact evaluation of Zambia's health results-based financing pilot project. Washington, DC: The World Bank.
- Gumede-Moyo S, Todd J, Bond V, Mee P, Filteau S. 2019. A qualitative inquiry into implementing an electronic health record system (smart-care) for prevention of mother-to-child transmission data in Zambia: a retrospective study. *BMJ Open* 9: e030428.
- Health Metrics Network & World Health Organization. 2012. *Framework and Standards for Country Health Information Systems*, 2nd edn. Geneva, Switzerland: World Health Organization.
- Heinfelaar M. 2011. A history of SNV from a Zambian perspective 1965–2005. *ASC Working Paper 95/2011*. Leiden, The Netherlands: African Studies Centre.
- Hotchkiss DR, Diana ML, Fleischman Foreit KG. 2012. How can routine health information systems improve health systems functioning in low- and middle-income countries? Assessing the evidence base. *Health Information Technology in the International Context* 12: 25–58.
- Hoxha K, Hung YW, Irwin BR, Grepin KA. 2020. Understanding the challenges associated with the use of data from routine health information systems in low- and middle-income countries: a systematic review. *Health Information Management: Journal of the Health Information Management Association of Australia* 51: 135–48.
- Hung YW, Hoxha K, Irwin BR, Law MR, Grépin KA. 2020. Using routine health information data for research in low- and middle-income countries: a systematic review. *BMC Health Services Research* 20: 790–790.
- Kalumba K, Nangawe E, Muuka-Kalumba LM, Musowe V. 1994. Looking forward: Zambia's health system reform agenda into the next century. In: Kasonde JM, Martin JD (eds). *Experiences with Primary Health Care in Zambia*. Geneva, Switzerland: World Health Organization, 96–115.
- Kamanga A, Ngosa L, Aladesanmi O *et al.* 2022. Reducing maternal and neonatal mortality through integrated and sustainability-focused programming in Zambia. *PLOS Global Public Health* 2: e0001162.
- Kebede M, Adebaba E, Chego M. 2020. Evaluation of quality and use of health management information system in primary health care units of East Wollega Zone, Oromia regional state, Ethiopia. *BMC Medical Informatics and Decision Making* 20: 107.
- Lake S, Musumali C. 1999. Zambia: the role of aid management in sustaining visionary reform. *Health Policy and Planning* 14: 254–63.
- Li M, Brodsky I, Greers E. 2018. Barriers to the use of health data in low- and middle-income countries: a review of the literature. North Carolina, USA: MEASURE Evaluation.
- Lungu PS, Kabaso ME, Mihova R *et al.* 2022. Undernotification and underreporting of tuberculosis in Zambia: a national data quality assessment. *BMC Health Services Research* 22: 1074.
- Mbondji PE, Kebede D, Soumbeiy-Alley EW *et al.* 2014. Health information systems in Africa: descriptive analysis of data sources, information products and health statistics. *Journal of the Royal Society of Medicine* 107: 34–45.
- MEASURE Evaluation. 2018. Improving the quality of Zambia's clinical care data—findings from expedited audits of data quality in 93 health facilities in October 2017. Chapel Hill, NC: MEASURE Evaluation.
- Moonga AM. 2016. Prevention of mother to child transmission of HIV: data quality assessment in selected health facilities of the southern region of Zambia. Lusaka: Master's thesis, University of Zambia.
- Mudenda D, Mapoma C, Chita B, Chompolola A, Wake W. 2008. Provider purchasing and contracting for health services: the case of Zambia. Washington DC: Results for Development Institute.
- Ngusie HS, Ahmed MH, Kasaye MD, Kanfe SG. 2022. Utilisation of health management information and its determinant factors among health professionals working at public health facilities in North Wollo Zone, Northeast Ethiopia: a cross-sectional study. *BMJ Open* 12: e052479.
- Nutley T, Reynolds HW. 2013. Improving the use of health data for health system strengthening. *Global Health Action* 6: 20001.
- Odei-Lartey EO, Prah RKD, Anane EA *et al.* 2020. Utilization of the national cluster of district health information system for health service decision-making at the district, sub-district and community levels in selected districts of the Brong Ahafo Region in Ghana. *BMC Health Services Research* 20: 514.
- O'Neil S, Taylor S, Sivasankaran A. 2021. Data equity to advance health and health equity in low- and middle-income countries: a scoping review. *Digit Health* 7: 20552076211061922.
- PATH. 2016. Data use partnership: theory of change. Seattle: PATH, Vital Wave.
- Regeru RN, Chikaphupha K, Bruce Kumar M, Otiso L, Taegtmeyer M. 2020. 'Do you trust those data?'—a mixed-methods study assessing the quality of data reported by community health workers in Kenya and Malawi. *Health Policy and Planning* 35: 334–45.
- Shiferaw AM, Zegeye DT, Assefa S, Yenit MK. 2017. Routine health information system utilization and factors associated thereof among health workers at government health institutions in East Gojjam Zone, Northwest Ethiopia. *BMC Medical Informatics and Decision Making* 17: 116–116.
- USAID | DELIVER PROJECT. 2012. Digging into malaria data: comparing HMIS and LMIS data to improve program management in Zambia. Arlington, VA: USAID DELIVER PROJECT, Task Order 3.
- Wagenaar BH, Sherr K, Fernandes Q, Wagenaar AC. 2015. Using routine health information systems for well-designed health evaluations in low- and middle-income countries. *Health Policy and Planning* 31: 129–35.
- World Health Organization (WHO). 2010. *Monitoring the Building Blocks of Health Systems: A Handbook of Indicators and Their Measurement Strategies*. Geneva, Switzerland: World Health Organization.
- Zambia Central Statistical Office. 2016. 2015 living conditions monitoring survey: key findings. Lusaka, Zambia: Central Statistical Office.
- Zambia Central Statistics Office, Ministry of Health Zambia & ICF. 2019. Zambia demographic and health survey 2018: key indicators. Lusaka, Zambia: Central Statistics Office, Ministry of Health, ICF.

- Zambia Ministry of Health. 2007. Assessment of the health information system in Zambia. *Department of Planning & Development, M. E. U. (ed.)*. Lusaka, Zambia: Republic of Zambia Ministry of Health.
- Zambia Ministry of Health. 2012. The 2012 list of health facilities in Zambia: preliminary report (version no. 15). *Directorate of Policy & Planning, M. E. U. (ed.)*. Lusaka, Zambia: Ministry of Health.
- Zambia Ministry of Health. 2019. Zambia population-based HIV impact assessment (Zamphia) 2016: final report. Lusaka, Zambia: Zambia Ministry of Health.
- Zambia Ministry of Health. 2023. 2022–2026 national health strategic plan. Lusaka, Zambia: Ministry of Health.