Heliyon 7 (2021) e08367

Contents lists available at ScienceDirect

Heliyon

journal homepage: www.cell.com/heliyon

Research article

Rapid assessment of the civil registration and vital statistics performance of health facilities in the five districts of Zambia: A cross-sectional study

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ARTICLE INFO

Keywords:
CRVS
Death registration
Birth registration
Africa

ABSTRACT

Background: Civil registration and vital statistics (CRVS) are essential administrative tools for accurate statistical data on vital events. However, civil registration coverage is particularly poor in low- and middle-income countries. Currently, CRVS are attracting global attention, as their improvement is considered a priority. While health facility is one of the important actors involved in the management of quality CRVS, its function in CRVS remains unclear. Therefore, this work aims to investigate the CRVS performance of the health facility in Zambia, a low-income country, and identify the gaps for effective policy-making.

Methods: To assess the health facilities' CRVS performance, a questionnaire was developed based on existing assessment tools for the whole CRVS; this comprised 21 multiple-choice questions in 10 areas with four choices awarded between 0 and 3 points according to performance. These questionnaire-based interviews were conducted by information officers in all health facilities per first, secondary, and tertiary-level in five target districts of Zambia, selected via socioeconomic and geographic features. The average points were calculated in each area by each level of healthcare system and summarized in a single chart.

Results: The results indicated low scores in the following areas: staff compliance with standard reporting procedures, infrastructure, capacity of coding based on International Classification of Diseases among health personnel, documentation of the cause of death in medical records, and absence of a system to identify the cause of death of brought-in-dead cases.

Conclusion: The tool developed in this work to evaluate the CRVS performance of health facilities was useful for identifying the gaps that need to be overcome to ensure the quality of CRVS in Zambia. However, its validity should be further investigated in other areas in Zambia as well as in other countries.

1. Introduction

By maintaining a record of the occurrence and characteristics of major events within a population, civil registration and vital statistics (CRVSs) are indispensable administrative tools for obtaining vital statistical data [1]. A key advantage of the CRVS system is that it provides the foundation for the development of a national population register. This enables governments to create and update their administrative databases [2]. These systems also serve individuals, providing the documentation required to establish legal identity and family relationships, claim nationality, access public services, exercise civil and political rights, and participate in various aspects of modern life [3, 4]. CRVS serves as a significant instrument through which fundamental human rights are demonstrated in legal ways [2].

Nonetheless, the average global coverage of civil registration remains low. In 2017, only 68 % of the countries, territories, and areas reported that at least 90 % of births occurred. For death registration, only 55 % of the countries, territories, and areas have at least 90 % coverage [5]. Large regional disparities are also noted. In Africa, which is home to several low- and middle-income countries (LMICs), the percentages of countries with less than 50 % coverage of birth and death registration are approximately 40 % and 60 %, respectively [4]. In contrast, most

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https://doi.org/10.1016/j.heliyon.2021.e08367
Received 23 May 2021; Received in revised form 26 August 2021; Accepted 8 November 2021

countries in Europe and North America, where several high-income countries are found, have birth and death registration rates exceeding 90 %. Accordingly, various multilateral organizations and initiatives consider a weak CRVS in lower-income countries a global priority issue for development. In addition, the Sustainable Development Goals (SDGs) of the United Nations highlight the importance of CRVS for the accurate assessment of health-related indicators. Target 16.9 of the SDGs aims to boost the birth registration rate in order to provide universal basic legal identification and access to justice and to foster peaceful and inclusive societies for sustainable development.

Mikkelsen et al. suggest that the low civil registration rates of LMIC can be attributed to several factors [6]. First, despite existing legal framework in these countries, the law is either inefficiently framed and needs revision or inadequately enforced. Second, due to a lacking interministerial cooperation and a confusing division of roles, the legal and statistical position of CRVS remains ambiguous, making it difficult for each ministry and agency to work together to bolster the system. Third, non-state actors such as religion-based nongovernmental agencies may sometimes manage civil registration, thus raising the possibility of double registration, unless all stakeholders coordinate to ensure proper data integration. Fourth, people may be unable to access the registration office due to physical and socioeconomic barriers, even when the need for civil registration is understood. Finally, people may have little knowledge on the reason, need, and medium- and long-term benefits of registration and, thus, have little to no motivation to participate in the registration process.

Several of these issues can be addressed through effective cooperation between the health sector and civil registration offices. Healthcare institutions can act as entry points for the civil registration process and for filing notifications [1]. For example, the birth registration rate in South Africa significantly improved after childbirth registration offices were formed within healthcare facilities and mobile registration services were provided in remote areas [7]. In addition, the health sector is deemed vital in bolstering the data on death certificates by identifying the cause of death (CoD), which is crucial for successful, optimal, and inclusive policy management. The collection of correct CoD information can be difficult in several LMIC. For example, Burger et al. determined that the causes were either ill-defined or unknown in approximately 24 % of deaths in South Africa, which led to suboptimal and biased data for planning purposes [8]. Therefore, more accurate and reliable information may be obtained by boosting the ability of health sectors and clinicians to create a standard death certificate [9] and produce quality medical records.

Additionally, the health sector can use data from CRVS to develop, implement, and monitor policies for public services to meet citizens' needs. Phillips et al. [10] describe that a functional CRVS can improve people's health by providing the legal foundations to ensure human rights and access to social services by enabling the timely collection of accurate vital and mortality data. These data can then be used by governments, either local or national, to formulate, implement, and track health policies in an effective, efficient, and strategic way. Therefore, health sector can play a crucial role in improving CRVS by acting as an entry point and collecting accurate vital data and by using CRVS information to improve health outcomes and formulate policy. The role of health sector in CRVS is summarized in the study of Yokobori et al [10].

Currently, a number of governments, international organizations, and academics worldwide are adopting various measures to bolster CRVS. To improve these efforts, a situational analysis of the entire CRVS was performed via a rapid survey of the Asia-Pacific region [6] after which the African region was assessed [11, 12]. However, the roles played by public sectors, including health, finance, and law, in the implementation of the CRVS remain unclear, nor have their current circumstances and possible interventions. Notably, the health sector can help strengthen the CRVS in lower-income countries. Accordingly, this work investigates the CRVS performance of the health sector through hospitals in the five representative districts in Zambia, a low-income country, aiming to translate the global political momentum into concrete actions to improve the CRVS.

2. Methods

2.1. Research design

This cross-sectional study was conducted to evaluate the CRVS performance of health facilities in the Republic of Zambia.

2.2. Target site, population, and research period

This research ran from April to May 2016. Five target districts were randomly selected, based on socioeconomic and geographical features: Lusaka District in the capital city, Livingstone District in the regional city, Chongwe District in the suburban area next to Lusaka, Choma District at the center of the provincial level, and Kalomo District in rural area. Given that there were three healthcare levels (from first to tertiary), all hospitals at the beginning of 2016 in the target districts were chosen. The target hospitals at each level were the University Teaching Hospital (UTH) and Livingstone Central Hospital (LCH) as the tertiary-level hospitals, Levy Mwanawasa General Hospital (LMGH) and Choma General Hospital (CGH) as the secondary-level hospitals, and Chongwe District Hospital (CDH) and Kalomo District Hospital (KDH) as the first-level hospitals (as shown in Table 1). Regarding health system in Zambia, there are mainly three levels of administrative system, that is, national, provincial, and district levels, and the health offices are set up at each level. The Ministry of Health (MoH) and provincial health offices supervise the tertiary and secondary hospitals, respectively. District health offices (DHOs) manage the first-level hospitals, health centers, and health posts. The expected functions of hospitals at each level are as follows: First-level hospitals serve a population of between 80,000 and 200,000 and provide medical, surgical, obstetric, and diagnostic services. Secondary-level hospitals serve a catchment area of between 200,000 and 800,000, with services in internal medicine, general surgery, pediatrics, obstetrics, gynecology, psychiatry, and intensive care. Tertiary-level hospitals serve a catchment population of approximately 800,000 or higher, providing subspecializations, training, and research. Vital events in health facilities are usually documented in medical records by physicians or clinical officers, and these are reported by information officers to local health authorities.

2.3. Data collection and tool

For data collection, the research team directly interviewed the information officers at each target hospital, based on the structured questionnaire, to assess the expected functions of health facilities in terms of CRVS. There was more than one information officer in hospitals. However, there is only one chief information officer and served as a director responsible for information management. Therefore, the interview was conducted with the chief information officer. The results were reviewed and then confirmed by the directors of hospitals and chief nursing officer. Regarding the questionnaire for interviews, there were no existing tools to assess the

Table 1. Summary of the target districts and hospitals.

Target District	Area	Target Hospital	Level*
Lusaka	Capital City	University Teaching Hospital	Tertiary
		Levy Mwanawasa General Hospital	Secondary
Livingstone	Regional City	Livingstone Central Hospital	Tertiary
Chongwe	Sub-urban Area	Chongwe District Hospital	Secondary
Choma	Provincial Center	Choma General Hospital	First
Kalomo	Rural Area	Kalomo District Hsopital	First

* Levels of hospital are at the time of survey in 2016.

Table 2. Questionnaire concerning the CRVS performance of health facilities (Summary).

A. Regulations Concerning the Recording of Vital Events	
1	Presence of regulations governing the reporting of vital events
2	Presence of regulations governing the certification of causes of death (CoDs)
B. Infrastructure and Resources	
3	Presence of adequate equipment in information offices for CRVS
C. Data Transmission	
4	Use of electronic data transmission to a higher information office
5	Compliance with data reporting
D. Practices Affecting the Quality of the CoD Data	
6	Training for physicians concerning CoD certification
7	Training for registrars concerning ICD-10 coding
8	Availability of ICD-10 code books
E. ICD Coding Practices	
9	ICD-10 coding practice for death cases
F. Data Quality and Plausibility Checks	
10	Quality assurance procedures for CoD coding
11	Consistency and plausibility checks for CoD data
G. Medical Records	
12	CoD recording according to international standards
13	Verification of CoD using information from medical records
H. Brought in Dead (BiD)	
14	BiD cases as a percentage of total deaths
15	Status of the implementation of a verbal autopsy for BiD cases to identify CoD
16	Reporting of BiD information to a higher information office
I. Data Access, Feedback, and Use	
17	Generation of CoD statistics
18	Receipt of feedback from a higher health information office
19	Use of data on vital events for policy and program purposes
J. Encouragement of Birth/Death Registration	
20	Collaboration with other agencies for CRVS
21	Encouragement of parents or relatives to undertake registration

performance of health facilities in functional CRVS. Therefore, the questionnaire was developed based on a literature review that included the "rapid assessment of vital statistics system" introduced by Mikkelsen et al. [6], which aimed at the comprehensive assessment of the overall CRVS system in a nation. As per our aim, we removed some questions to investigate the overall CRVS system such as "organization and functioning of the vital statistic system" and "data completion of birth and death registration" and added some questions to scrutinize the factors influencing the quality of mortality information at the hospital level, including medical records and brought-in-dead (BiD) cases. Afterward, the research team reviewed the questionnaire with the staff in the MoH and conducted a pretest in LMGH. Based on the results, the research team made any necessary revisions and finalized the tool to evaluate the health facilities as regards their roles in CRVS. This allows the tool to be able to use along with the local contexts. The final version of the questionnaire comprised two parts: the general vital statistics in each facility and an assessment of hospital performance as regards CRVS function. The latter part comprised 21 multiple-choice questions in 10 areas with 4 choices awarded between 0 and 3 points according to performance (0 as the lowest and 3 the highest). The 10 areas were as follows: (A) regulations concerning the recording of vital events; (B) infrastructure and resources; (C) data transmission; (D) practices affecting the quality of CoD data; (E) International Classification of Diseases (ICD) coding practices; (F) data quality and plausibility checks; (G) medical records; (H) BiD; (I) data access, feedback, and use; and (J) encouragement of birth/death registration. Regarding (G) medical records, 10 medical records at each hospital were randomly selected, and 3 medical doctors in the research team checked the information written in these records. If the results were conflicting, the average scores were adopted. For other questions, one in the research team made interviews and recorded the responses. If there were any observers who had any different views on the questions, the research team sorted out the discrepancies via consensus. Regarding question area (H) BiD, while complete autopsy should be the most accurate way to identify CoDs of any death, this practice could not be applied to all BiD cases in Zambia because of the limited resources. Therefore, the researchers consulted with the MoH and agreed that verbal autopsy should be included as a practical and feasible alternative approach to investigate BiD cases for this research. Before starting the surveys, the method of interviews, and interpretation of responses were standardized within the research team. The questions are detailed in Table 2 and Additional File 1.

2.4. Data analysis

In terms of general vital statistics, the numbers of births, deaths, and BiD cases are summarized in Table by facility. BiD was defined as a death that occurred before the individual arrived at the health facility. The estimated coverage of birth and death numbers collected in each target hospital over the totals in the respective district was also estimated from the district population in 2010 Census projection [13]. Since the 2015 projection of these numbers by district was not available in 2010 Census, the estimated number of deaths in each district was obtained as follows: the total number of projected deaths (in year 2015) given in the 2010 Census multiplied by the population ratio of the district [13].

Regarding the questions used to assess the CRVS performance of each health facility, the average points were calculated in each area by each level of healthcare system and summarized in a single chart. In addition, the average CRVS performance was disaggregated by geographical area: urban and rural. The hospitals in the capital city, UTH and LMGH, were categorized into urban and, otherwise, rural hospitals.

For statistical analysis, the generation of graph to describe the number of deaths and births at each health facility and the calculation of the average score of CRVS performance were processed using Microsoft Excel 2013 (Microsoft, Redmond, WA). Statistical test was not performed due to the small sample sizes.

2.5. Ethical considerations

Ethical approval was obtained from the University of Zambia's Biomedical Research Ethics Committee (ref.: 006-03-16) and the Ethics Committee of the National Center for Global Health and Medicine in Japan (ref.: NCGM-G-001890-01). The researchers provided sufficient information about the research for the interviewees of information officers in each target hospital and obtained written consent before each interview.

3. Results

3.1. Birth and death numbers in target hospitals

The numbers of deaths in the target hospitals are shown in Table 3. The BiD cases for CGH were not in the information office at the time of

Table 3. Number of deaths registered in 2015, rate of brought in death (BiD) in target hospitals, and the estimated coverage rate in respective district.

	Target Hospital	Total Number	BiD Number	BiD %	Estimated deaths in the district*	Estimated Coverage %**
Urban	UTH	9104	3194	35.1%	16301	55.8%
	LMGH	1032	435	42.2%	16301	6.3%
Rural	LCH	647	143	22.1%	2813	23.0%
	CGH	150	NA	NA	4743	3.2%
	CDH	455	265	58.2%	1669	27.3%
	KDH	101	74	73.2%	5513	1.8%
Total		11489	4111	35.8%	31039	37.0%
Estimated National Total Death Number**					202198	

*Estimation from the 2015 provincial total in 2010 Census projection [13], weighted by the district populations. The estimate number of deaths in each district was obtained as follows – the total number of projected deaths (in year 2015) given in the 2010 Census multiplied by the population ratio of the district.
** Estimated Coverage: Total number of registered deaths in each hospital was divided by the estimate deaths in the district.

Table 4. Number of births registered in 2015 in target hospitals, and the estimated coverage rate in respective district.

	Target Hospital	Total Number	Estimated births in the district*	Estimated Coverage %**
Urban	UTH	20871	63936	32.6%
	LMGH	4773	63936	7.5%
Rural	LCH	2127	9775	21.8%
	CGH	1202	16478	7.3%
	CDH	1839	6548	28.1%
	KDH	1458	19154	7.6%
Total		32270	115890	27.9%
Estimated National Total Birth Number**			656428	

*Estimation from the 2015 provincial total in 2010 Census projection [13], weighted by the district populations. The estimate number of births in each district was obtained as follows – the total number of projected births (in year 2015) given in the 2010 Census multiplied by the population ratio of the district.
** Estimated Coverage: Total number of registered births in each hospital was divided by the estimate births in the district.

the interview because the personal computer (PC) was unable to store all of the data. UTH, LMGH, and CGH, which are located in or near the capital city, had higher number of deaths. Table 3 also includes data on BiD cases. BiD cases as a percentage of total deaths accounted for 35.8 % (4,111/11,489) on average and ranged from 20.1 % to 73.5 % by hospitals. Lower-level hospitals tended to have a higher rate of BiD cases. The numbers of births in the target hospitals are shown in Table 4. The hospitals in the capital city had more newborns than other hospitals in 2015. Regarding the coverages of the birth and death numbers in the districts, the average rates were 27.9 % for birth and 37.0 % for death, as shown in Tables 3 and 4. In the capital city, UTH and LMGH covered 40.1 % for birth and 62.1 % for death. These hospitals captured approximately 5.6 % of deaths in estimated national totals. On the other hand, in rural hospitals, the coverages were deemed lower. In CGH and KDH, the coverage rates were as low as 7.3 % and 7.6 % for death and 3.2 % and 1.8 % for birth, respectively. As regards LCH and CDH, which was located in the regional city and next to the capital city, the coverage was relatively high: 21.8 % and 28.1 % for death and 23.0 % and 27.3 % for birth, respectively.

3.2. CRVS performances of target hospitals

Figure 1 shows a matrix summarizing the average CRVS performances of the hospitals at each healthcare level for the 10 areas of the questionnaire. All hospitals at each level scored full marks regarding regulations concerning the recording of vital events. These regulations are associated to the procedures for reporting vital events and certifying CoD. For infrastructure and resources, the necessary equipment, such as PCs, printers, Internet services, and electricity, was better prepared in tertiary-level hospitals than in first- and secondary-level hospitals. The score of data transmission was from 1.0 to 2.0 at all levels. Some facilities

	Tertiary Level	Secondary Level	First Level	Overall
A. Regulations Concerning the Recording of Vital Events	3.0	3.0	3.0	3.0
B. Registration of Infrastructure and Resources	2.5	2.0	1.5	2.0
C. Data Transmission	1.8	1.5	1.5	1.6
D. Practices Affecting the Quality of Cause of Death Data	1.5	1.2	0.8	1.2
E. ICD Coding Practices	3.0	3.0	1.5	2.5
F. Data Quality and Plausibility Checks	1.3	1.0	0.8	1.0
G.Medical Records	1.3	1.3	1.3	1.3
H. Brought in Dead (BiD)	1.5	1.3	1.0	1.3
I. Data Access, Feedback, and Use	2.3	2.3	2.0	2.2
J. Encouragement of Birth/Death Registration	1.8	1.5	1.5	1.6

*Definition of score; 0 is the lowest and 3 is the highest.

2< <=3 1< <=2 0< <=1

Figure 1. Situation analysis of the death/birth information system at 6 hospitals in 5 districts in Zambia. *Definition of score; 0 is the lowest and 3 is the highest.

	Urban	Rural
A. Regulations Concerning the Recording of Vital Events	3.0	3.0
B. Registration of Infrastructure and Resources	2.5	1.8
C. Data Transmission	1.8	1.5
D. Practices Affecting the Quality of Cause of Death Data	1.5	1.0
E. ICD Coding Practices	3.0	2.3
F. Data Quality and Plausibility Checks	1.5	0.8
G.Medical Records	2.3	2.2
H. Brought in Dead (BiD)	1.3	1.3
I. Data Access, Feedback, and Use	1.5	1.2
J. Encouragement of Birth/Death Registration	1.8	1.5

*Definition of score; 0 is the lowest and 3 is the highest.

2< <=3 1< <=2 0< <=1

Figure 2. Situation analysis of the death/birth information system in urban and rural hospitals in Zambia. *Definition of score; 0 is the lowest and 3 is the highest.

reported that data were not transferred electronically or that data reporting was delayed up to or even beyond the reporting deadline. In terms of ICD coding, although ICD codes were used to record CoD in almost all hospitals, practices to guarantee its quality, such as coding training and ICD code book availability, were not in place. The scores of proper CoD information in medical records were lower than 1.0 at all levels. The assessment of the medical records was completely agreed among three surveyors. In addition, the average scores related to data plausibility checks were also found to be lower than 1.0 at all levels. Regarding data access, feedback, and use, the scores ranged from 2.0 to 2.3. Feedback from higher offices and data use were better than 2.0, although some facilities complained about late feedback. The scores related to BiD data management ranged from 1.0 to 2.0. Almost all facilities recorded and reported information on BiD cases. However, they did not have the system to regularly identify CoD by using a verbal autopsy. Finally, whereas most facilities reported that health staff encouraged relatives to register vital events at the civil registration office, there were no interagency committees to discuss bottlenecks in the CRVS. These findings were more applicable to lower levels. Figure 2 describes the CRVS performance by geographical areas. Compared with urban hospitals, the average scores were lower in rural hospitals for all areas in the questionnaire.

4. Discussion

This study was designed to examine the performance of health facilities in CRVS in LMIC. As per previous publications [10], the health sector plays a critical role in CRVS, as it acts as an entry point for registration and collects accurate vital data used for effective health policy formulation. The results suggest several weaknesses in the requirements for the expected roles in CRVS.

First, several hospitals had insufficient staff compliance with the standard procedures for data transmission. The low compliance may be attributed to insufficient infrastructures and resources as described in question area (B) infrastructure and resources. Many of the interviewees indicated that the troubles of PCs, printers, and Internet services were some of the reasons for delayed reporting. Reinforcement of the necessary infrastructure should be imperative for quality CRVS data management. In addition, the lack of knowledge, and skills for electronic reporting to higher level may affect the adherence to the standard procedure. Since information officers periodically changed in hospitals, the refreshment training or reorientation session should be considered to update the capacity for data reporting in the annual action plan of hospital management. As AbouZahr et al. reported, for health sector to contribute toward strengthening the CRVS, health officials should be delegated to notify these vital events to the civil registrar, capturing and transmitting information using agreed protocols in a systematic and standardized way [14].

Second, whereas ICD coding was applied to identify CoD in almost all hospitals, the quality remained insufficient due to lacking health personnel related to ICD coding and inadequate documentation of death information on medical records. It is imperative to strengthen the ICD coding capacity of health staff involved in death registration. The following steps can be taken to achieve a sufficient quality of ICD coding: an accurate diagnosis according to the ICD, its proper recording in the medical records, and completion of the death certification in line with standards. Because these steps fall under the jurisdiction of physicians and clinical officers in Zambia, their capacity to appropriately comply with this process should be augmented by the provision of training, quality assurance through supervision, and improved availability of the ICD code book. Tolabing et al. reported how educational intervention improved the completeness and acceptability of the CoD statement in death certificates in the Philippines [15]. Moreover, information officers are vital to strengthen the CRVS performance of health facilities. Because of their roles in data management, supervision of data plausibility, and provision of feedback indispensable to ensure the quality of ICD coding, the capacity building of information officers should also be considered.

Third, most hospitals lacked a system for identifying the CoD in BiD cases. Although most hospitals stated that they recorded and reported the information on BiD cases to local health authorities, the CoD quality was limited due to the considerable incompleteness of the data. One of the main reasons is that there was only minimal information available in the medical records of BiD cases and lack of complete autopsy. As stated earlier, since autopsy was not feasible for all BiD cases, verbal autopsy could potentially be a good alternative to obtain better statistics of CoDs among BiD cases. Therefore, to strengthen the data management in BiD cases, it is useful to establish a system to routinely conduct verbal autopsy for BiD cases by asking relatives several key questions related to the death. Recently, the WHO recommended the use of verbal autopsy to capture the CoD and strengthen the vital statistics regarding deaths [16]. Although several countries [17, 18, 19] have incorporated verbal autopsy into their official health information system, a physician-based verbal autopsy for all BiD cases may not be feasible due to workload and costs. Therefore, an automated verbal autopsy is being developed to enable non-physician healthcare staff to make a reliable diagnosis of CoD in BiD cases. The automated verbal autopsy could be considered as an option to identify the CoD of BiD cases in resource-limited settings.

Fourth, regarding the low coverage of civil registration as Tables 3 and 4 presents, while there could be sector-wide interventions to be considered, including legislations to protect human rights, incentives for registration by public services and facilitating access to registration offices [2], it is also critical to leverage health sectors as an entry point for registration to capture vital events which occur in health facilities [10]. However, the results suggest the weaknesses of this functions in the target hospitals. For the registration process of birth and death, health facilities could issue the notification required for the civil registrations. In

this study, while information officers issued the notification for all births and deaths that occurred in the hospitals, a few of them did not explain the procedure of registration to push the parents or relatives to visit to the registration office, and few inter-sector collaborations for better CRVS were not reported. According to the UNICEF, one of the obstacles for birth registration is the missing linkage between the place of event occurrence and registration; thus, a recommended approach is to integrate registration more closely with health services [20]. More collaboration with activities by health facilities could improve low civil registrations suggested in Tables 3 and 4. Fagernäs et al. reported that an increase in birth registration in Ghana has been attributed to a package of interventions, including leveraging child health campaigns and training community health workers to register births [21].

Lastly, regarding the function to utilize vital statistical data for health policy, most of the interviewees indicated few feedbacks that were received from a higher level on a regular basis, and the vital statistical data was rarely used for health policy and program purpose. Following health information management system in the MoH [22], information officers in hospitals need to monthly report all vital statistical data to higher level authorities such as DHOs. Then, DHOs aggregate the data to report to the provincial level and feedback to health facilities in the district. Feedback of statistical information to those involved in data collection and field level can help improve quality and fuel a virtuous cycle, from data collection and compilation to analysis and interpretation, and enhanced data use for policy and planning [23].

All these weaknesses were more distinct in rural hospitals than in urban hospitals. One of the factors to explain this discrepancy could be the lacking political incentives to maintain the quality of CRVS since the number of births and deaths at health facilities in rural area was smaller than in the communities. Therefore, the awareness of meaning and significance of CRVS among the staff in hospitals tended to be lower in the rural area than in the urban area.

Considering the weaknesses identified from the results as mentioned earlier, the research team proposed three policy implications for the MoH to improve the CRVS performance of health facilities: implementation of interventions to improve staff compliance with standard procedures, augmentation of the ICD coding capacity, strengthening of the data management of BiD cases, improvement of infrastructure and resources for registration, enhancement of inter-sector collaboration, and reinforcement of data feedback from a higher level. In response, the Ministry provided ICD coding training for physicians, clinical officers, and information officers in the research target sites. In addition, an automated verbal autopsy system was introduced to identify the CoD in BiD cases in UTH [24], which successfully determined the distributions of CoD. Given this success, the MoH currently plans to embed the automated verbal autopsy into Zambia's health information system. Likewise, the assessment tool developed in this research to evaluate health facility performances in terms of CRVS function can visualize the actual state of several components of the roles played and extract tangible policy implications to lead to prompt implementation. One of the reasons that these recommendations were immediately realized may be that this investigation focused on health facilities and that the ministry responsible for addressing them was clear, despite the involvement of multiple sectors in the CRVS.

There are several limitations to this work. The first limitation is the number of targeted districts. While we selected the districts considering diverse socioeconomic and geographic features, limited human and financial resources for this research restricted the target selection to only five districts. Therefore, the results may not be fully generalizable to health facilities in the rest of Zambia. Additional investigations should be considered, especially for other rural districts. In addition, although all hospitals at target districts were included in this research, some health facilities were upgraded after our survey. Therefore, the results may not describe the current situations at the target districts. Further investigations are thus needed to update the performance of these health facilities. Second, the coverage of the birth and death numbers collected in this research over total in the district where the hospital was located was estimated in this research. This data could be imprecise. One reason was the reliability of the denominators. Since the birth and death numbers by district level were estimated from provincial level projection in 2010 Census, they may not reflect actual situations. Another reason was that this data could not necessarily represent the coverage of the catchment area that the hospitals were supposed to cover since a higher level of hospitals should cover broader areas beyond the district. These weaknesses in the reliability of the data need to be considered for interpretation. The third limitation is the validity of the questionnaire developed in this work. The assessment tool mainly covers the components for data management of vital statistical data such as CoDs, but fewer for data use and entry point for registration. There could be room to add some questions to investigate the requirements to accomplish desirable performance for these functions, such as knowledge of staff about the benefits from civil registration and their capacity to interpret vital statistics for data use. In addition, we did not investigate the functions of a health administration agency to centrally manage the data. Their roles in CRVSs must be different from those of health facilities in that they should compile the data and contribute to policy formulation. The tool should be improved to enable the comprehensive assessment of performance in the entire health sector, including health authorities. Furthermore, the applicability of the tool to different administrative systems, political situations, and cultures should be explored. Similar research in other countries should be considered. With the challenges listed earlier, further validation should be necessary with more variety of stakeholders. Fourth, the effect of bias related with interviews needed to be taken into account. We selected a chief information officer at the target hospital as an interviewee; therefore, the response could be affected by the biases related to standpoint, knowledge, and recall. In addition, since the research team members directly collected the data, it should be considered if the interviewer bias could make the scores better than actual situations. While all results were reviewed and confirmed by the directors of hospitals and chief nursing officer after interviews, as Mikkelsen et al. suggested, rapid assessment has little value if it is the opinion of just one individual [6]. More involvement of different stakeholders should be considered in future studies. Finally, this assessment tool was unable to guide the prioritization of the identified problems. Although the results led to several policy implications, the steps to address these recommendations were not clearly presented. A recent research by Muñoz et al. suggested that process mapping should be conducted to illustrate the benefits of solution and target intervention identification [25]. Such mapping of the gaps identified by the assessment of the entire CRVSs would be extremely useful during the consideration of the action steps. In addition, qualitative analysis should be useful to scrutinize the backgrounds of findings in this study and identify the bottlenecks of problems to be addressed. This point of view should be incorporated into future research.

5. Conclusion

CRVSs are significant instruments for governments to obtain accurate and up to date demographic statistics for the management of their policies and for individual citizens to establish their legal identities and family relationships. Because the health sector is one of the important actors in CRVS improvements, the functions in relation to CRVS need to be evaluated for the development of policies that effectively strengthen the system. The tool developed in this work to evaluate the CRVS performance of health facilities was useful for identifying the gaps that need to be overcome to ensure the quality of CRVS in Zambia. However, because this assessment was conducted in limited districts of Zambia, the validity of this tool should be further investigated in other areas in Zambia as well as in other countries.

Declarations

Author contribution statement

Yuta Yokobori: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Wrote the paper.

Jun Matsuura: Performed the experiments; Analyzed and interpreted the data.

Hiromi Obara, Yasuo Sugiura, Tomomi Kitamura, Motoyuki Yuasa: Analyzed and interpreted the data; Wrote the paper.

Crispin Moyo, Chomba Mwango: Contributed reagents, materials, analysis tools or data.

Funding statement

This work was supported by NCGM Intramural research Fund, Japan (19A03).

Data availability statement

Data will be made available on request.

Declaration of interests statement

The authors declare no conflict of interest.

Additional information

Supplementary content related to this article has been published online at https://doi.org/10.1016/j.heliyon.2021.e08367.

Acknowledgements

The authors thank the Ministry of Health in Zambia, Dr. Jabbin L. Mulwanda, and JICA staffs related with Strengthening Basic Health Care Services Management for Universal Health Coverage Project in Republic of Zambia including, Mr. Hiroyuki Noda, Eiichi Shimizu and Takanori Hirayama for the support of all logistics for this research.

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