Chapter 11

Complexities of recording and reporting perinatal data: A Case Study from Namibia

Beatrix Callard

Abstract

Stillbirth and neonatal deaths, though largely preventable, are often underreported. This study, conducted in Namibia, mapped the processes and stakeholders involved in reporting perinatal mortality from facility to district level. It assessed the reporting burden and piloted an intervention using a simple, interoperable dashboard for stillbirths. The intervention led to higher data quality, with more complete records and fewer duplicates or missing entries. Automated calculations further enabled insights from the data. The study found that low-cost, simple interventions significantly improved data recording standards and accuracy. Key interventions included daily event verification to catch omissions or errors, using a standardized name-date format ("Surname, First name, yyyy/mm/dd"), applying Z-lines to prevent duplicate entries across pages, and entering each stillbirth or neonatal death as a standalone event with its ICD-10 code for integration into DHIS2. The most impactful was daily verification, a task suited to clerical staff to ease the burden on midwives. The study emphasizes the need to simplify existing systems to reduce duplicate reporting. Minimal changes can enhance data trustworthiness and encourage local data use, aligned with FAIR data principles. This study finds that it is imperative that facility data is owned by and remains in the domain of the facilities to enable them to meet the service needs of the communities they serve. Counting every stillbirth and newborn death is essential for the analysis of underlying causes of death, contributing factors and informing appropriate responses to maternal and child health care needs.

Keywords: Health Information System, Stillbirths, Namibia,

Introduction

It is estimated that two million stillbirths occur annually (Hug et al., 2021). These estimates are derived from Demographic Health Surveys, as facility or Ministerial records of these deaths do not exist or are of poor quality (Haider et al., 2021) Furthermore, approximately 6 million stillbirths and neonatal deaths are not recorded into Civil registration documents, which translates to them being uncounted. Sub-Saharan Africa and other low middle income countries (LMICs) experience the highest number, 99%, of these perinatal deaths. Yet these countries have limited data of reliable quality (Lawn et al., 2005).

The Millennium Development Goals (MDG), followed by the Sustainable Development Goals (SDG) included targets to reduce neonatal deaths [SDG3.2.2]. They also included targets to increase birth and death registration [SDG17.19.1, SDG17.19.2] (World Health Organisation (WHO), 2018).

International efforts were expanded to strengthen health management information systems (HMIS) and civil registration and vital statistics (CRVS) as it was understood that improved quality data was essential to directing policy and decision makers to inform service provision and access to care in order to reduce neonatal deaths and thus meet SDG targets and track health outcomes for mothers and their babies (Setel, 2020; Setel et al., 2007). While Akuze et al. (2021) reported an improvement in quality of neonatal data, de Bernis et al. (2016) highlighted the oversight of not including stillbirth targets in the SDG. Therefore, a similar improvement in reduction is not evident (Hug et al., 2021). Nevertheless, previously operating in parallel systems, the last decade has seen a convergence of efforts directed towards strengthening healthcare delivery, HMIS, CRVS and improving data quality. There is a growing understanding that improvement in each of these systems impacts on population health outcomes, thus necessitating greater collaboration amongst stakeholders. Multilateral efforts are ongoing to increase capacity for HMIS, CRVS and service provision. This includes strengthening data processes such as data collection, analysis and use. Increasingly,

stakeholders are advocating for collaboration and working together to make data reliable, visible and usable at source of generation (Centre of Excellence for Civil Registration and Vital Statistics (CRVS) Systems, 2019; MEASURE Evaluation, 2017) (Value-driven and Ownership of Data Network (VODAN)).

Quality data that is appropriately analysed provides information to decision makers and stakeholders, which in turn guides action towards improving healthcare services and uptake. However, Berrueta et al. (2021) reports that data is available at facility but not analysed or used for decision-making at facility level. This was previously described as "data rich, information poor" (Goodwin, 1996). Value-driven and Ownership of Data Networks (VODAN Africa), together with Findability, Accessibility, Interoperability, and Reuse (FAIR) data/GO FAIR are working toward building federal solutions for health and humanitarian data that is findable, accessible, interoperable and reusable, yet owned, retained locally and regulated under the jurisdiction in which the data was generated FAIR-Ownership in Locale with Regulatory compliance (FAIR+OLR) (VODAN, GoFAIR).

In their assessment of the national Health Information Systems (HIS), Kahn et al. (2012) identified 61 different reporting platforms in the Namibian health sector, predominantly reporting vertically and in exclusion of other data platforms, yet collecting the same or similar data. This resulted in parallel, fragmented and duplicate data processes, where programme funders and implementation partners own their data and systems, which are not necessarily aligned to the Ministry of Health and Social Services (MOHSS)'s own data requirements, nor do all of these data reach the MOHSS.

The main source of national health service-related data, and central to data collection in all government health facilities, is the electronic district health information system (DHIS2) which was implemented with support from United Nations (UN) Agencies (MEASURE Evaluation, 2017).

Figure 1 illustrates three of the major reporting streams in the current health care sector. Events at facilities are reported upline in parallel data streams, the DHIS, CRVS and to the national committee conducting confidential enquiries into maternal and neonatal deaths and stillbirths. Since event numbers should match between facility registers, DHIS and CRVS a triangulation of these data systems would be ideal to identify data gaps.

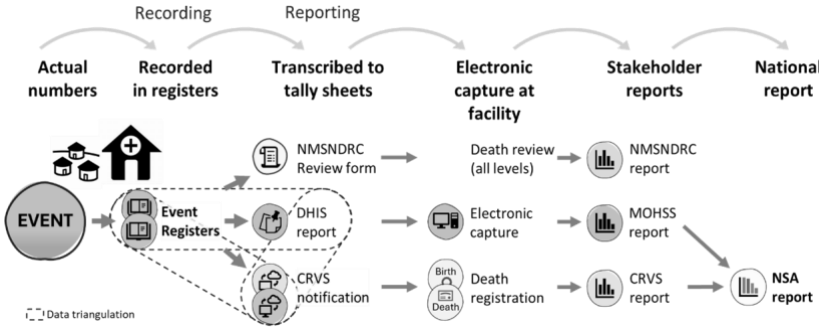

Figure 1. Three main parallel reporting pathways of event data from facility to national level

National maternal death, stillbirth and neonatal death review committee (NMSNDRC); DHIS district health information system; CRVS civil registration and vital statistics; Namibia Statistics Agency (NSA). The report for the confidential inquiry for the period 2018 to 2021 highlighted major discrepancies between the number of stillbirths and neonatal deaths reported into DHIS and the e-Notification platform of the CRVS (MOHSS, 2022). This invited the question, how can perinatal mortality data recording and reporting be optimised in the maternity departments in the Khomas region, Namibia?

The purpose of this study was to inform improvements in data quality (accuracy, completeness and timeliness) so that data recorded at service points would align with data reported to the national level, thereby strengthening the reliability of perinatal (disaggregated to stillbirth and early neonatal) mortality rates which are used to inform

decision-making around service and care provision at all levels. The study had the following objectives:

Objective 1: To determine accuracy and completeness of both DHIS and e-Notification data and examine variances as compared to the facility birth or death register (source data)

Objective 2: To map out the processes and stakeholders involved in recording and reporting of perinatal mortality data from source to District Office

Objective 3: To describe modifiable factors contributing to reduced quality or variances in the data flow from source to the District Office

Objective 4: To develop and implement a strategy for data verification using the three data platforms (Registers, DHIS and CRVS' e-Notification) to improve the accuracy of reporting to District Office.

This chapter reports on the second objective, the process mapping and the findings thereof.

Methodology

Research design

The study was conducted in the maternity departments of five hospitals in the Windhoek District, representing the entire Khomas region. This prospective, cross sectional, multi-site study followed a pragmatic approach (Kaushik & Walsh, 2019). The first objective assessed the data quality for duplications, omissions, accuracy and completeness (missing data values) for the minimum required perinatal data reporting sets for each facility. The second and third objective entailed a process mapping exercise for the purpose of evaluating existing data collection and reporting processes in participating facilities by using observations, key informant interviews and focus group discussions. These findings guided the fourth objective to explore and implement a strategy at one facility together with the staff, to enable them to optimise their daily, weekly and monthly recording and reporting of perinatal mortality data.

Location

Namibia is situated on the southwestern coast of the African continent with a population of 3.02 million people (NSA, 2024). The population comprises twelve ethnic groups with settlements along historical and colonial divides. Namibia is divided into 14 regions. The most recent population and housing census reported an even distribution of population between urban (1.52 million) and rural areas (1.49 million) with Khomas region reporting the highest number of people (0.49 million), and a population density of 13.4 people per square kilometre (NSA, 2024). The latest demographic and health survey (DHS) (MOHSS & ICF International, 2014) reported that >90 of pregnant women received antenatal care from a skilled care provider. With the Khomas region recording the highest percentage (>95%) of in-facility deliveries.

Data for this study were collected from January 2023 to May 2024 in the five hospitals providing maternity services in the Windhoek District, representing the entire Khomas region. Windhoek Central Hospital (WCH) is the only national referral facility and houses the largest (31-bedded) neonatal Intensive Care Unit (ICU) with an average of 100 monthly admissions, and a typical bed occupancy rate of 150-175%. Intermediate Katutura Hospital (IHK) is one of three intermediate hospitals in the country. WCH and IHK provide general and advanced obstetric and midwifery services for a monthly average of 450 and 650 births. IHK has a small Prem Unit caring for small and mildly sick newborns in need of step-up care. WCH and IHK are public sector facilities and receive referrals for advanced maternal or neonatal care from across the country. WCH reports to the national level, while IHK reports to the regional level.

Enrolled Nurse/Midwives and Registered Nurse/Midwives provide midwifery and neonatal care while Interns and Medical Officers provide day-to-day medical care in either the obstetric or neonatal departments with the support of the respective Obstetricians and Paediatricians. Both facilities are training facilities and have a high throughput of student Nurse/Midwives, doctors and radiographers.

Rhino Park Private Hospital, Mediclinic and Lady Pohamba Private Hospital are the three largest private sectors, for profit, facilities in the country receiving referrals from other private facilities in Namibia. These facilities fall under the District Office. The estimated average number of births for each of these facilities ranges from 80-120 per month. Khomas region maintained the top position in the country for the highest number of births and deaths in the country (NSA, 2023).

While Namibia is classified as an upper-middle-income country (UMIC), its mortality rates far exceed those of the average for countries in the same division. According to United Nations Children's Fund (UNICEF), Namibia's under-five mortality rate (U5MR) of 45.2 per 1,000 live births (45.2/1,000 LB) far exceeds the UMIC average of 14.4/1,000 LB (U5MR) (UNICEF, n.d.). The last available neonatal mortality rate was calculated at 20/1,000 LB, exceeding the current SDG target of 12/1,000 LB (MOHSS & ICF International, 2014).

Patient data and care provision are recorded manually in patient files, department and facility registers. Public facilities manually transcribe information into purposely designed DHIS tools for in-patient care and monthly tally sheets. These are forwarded to the DHIS officer who transcribes the data into electronic format. Both private and public facilities are linked to the CRVS' electronic birth and death notification platform, where authorized midwives and nurses capture births and deaths, while medical officers capture medical certificates for causes of death (MCCD). It is in this space where inconsistent data recording and reporting practices lead to data incongruence.

Respondents

The accessible population included all staff working in the maternity departments and HIS offices of the included facilities as well as staff working with perinatal data at national and sub-national levels of the MOHSS or e-Notification systems at the Ministry of Home Affairs, Immigration, Safety and Security (MHAISS). The study population included staff who had worked a minimum of six months in their

current position and were willing to provide insights relating to the data processes in their departments. Participants from labour and neonatal departments were selected by their supervisors based on availability and situations on the ground.

This study used purposive sampling for process mapping and interviews, and participants were selected according to their skills, expertise and/or key functions relating to the data recording and reporting process in-house. Staff working in the facilities' maternity departments or within the data processes of the HIS, District or e-Notification data processes, who would be able to provide rich information were invited to participate in a combination of semi-structured focus group discussions or key informant interviews, as was feasible for departments and office staff. Qualitative data were collected until the entire data process was clearly mapped out and validated in stakeholder feedback meetings or confirmed by other researchers within the Namibian context (Dlodlo & Hamunyela, 2017; Forsingdal & Munyika, 2020; Kapepo & Yashik, 2018; Nuuyoma & Ashipala, 2020).

Data collection

Data collection from field observations, process mapping exercises and interviews were conducted in all five participating facilities from 1 January 2023 to 31 May 2024. The intervention period at the participating facility spanned from 1 January 2024 to 30 April 2024.

Participant discussions

Prior to conducting this study, the researcher worked in the public health sector and the National Maternal Stillbirth Neonatal Death Review Committee, which drew attention to data gaps and discrepancies between multiple streams of data supposedly reporting the same information but reporting different results. Though partially familiar with the public health care system, the researcher was not familiar with the private sector. This study provided an opportunity to review the entire process for all maternity departments providing obstetric and neonatal services in Windhoek for both public and private sectors.

Qualitative data were gathered through field observations, key informant interviews (KII) and focus group discussions (FGD). Participant discussions were requested with healthcare workers active in labour wards and neonatal units, facility based HIS officers, and HIS officers based in regional or national offices. Additional interviews were planned with key individuals supporting health facility staff with the CRVS e-Notification processes for births and death and other informants involved in maternal or neonatal care in either the public or private sector.

For pragmatic reasons interviews planned to conduct one FGD per facility under review and individual KIIs with key stakeholders. As this study investigated the processes of data management, as opposed to knowledge, attitude or, experience, this limitation was deemed appropriate as facility processes would be illuminated through FGD and, in most cases, only one or two staff members managed the processes outside of maternity wards (e.g. DHIS or MHAISS offices).

The researcher conducted nine FGDs and eight KIIs involving 38 consenting participants. One respondent agreed to participate and completed the consent form without signing it. Those responses were withdrawn from the responses received. This deviation was reported to the institutional review board in November 2023. Participants comprised 39 participants of different range of cadres and working experiences. Amongst the participants were Enrolled Nurse/Midwives (3), Registered Nurse/Midwives (10), Unit (7) and Department Managers (2), Medical Officers (2), Obstetricians (3), Paediatricians (2), HIS Officers (3), clerical staff (1), one systems designer, and one Police Officer. The total duration of the KIIs was 4 hours 31 min (mean 33:52), while the total duration of the FGDs was 6 hours 59 min (mean 46:33). The FGD and KII informed the process maps, modifiable factors and challenges and strengths of the system.

Field observations

The process mapping for this study was informed by the work of Kalman (2002) and Antonacci et al. (2021) who outlined individual steps required in process mapping, starting with obtaining the buy-in

from facility and department management. The FGD participants (mapping team) included Midwives from the maternity departments, supervisors responsible for reporting data, facility statistics officers compiling facility reports. A suitable date and time were agreed with facility participants and management for the release of their staff to ensure least possible disruption to service or quality care. Facilities relieved their participating staff from normal clinical duty for the duration of the mapping exercise and interviews. Mapping exercises and interviews were held in venues identified at each facility. Rough process maps were drawn during interviews and facility discussions, using sticky notes, marker pens and subsequently converted into graphics using PowerPoint. Semi structured questions guided the interviews and FGD. Interviews and FGD were conducted in English, recorded on an Android Phone and transcribed verbatim into a Word Document (MSWord). These data were used to provide additional information into the process maps and identification of modifiable factors that could be targeted with an optimisation strategy.

Quantitative event data

Birth and death events were abstracted from birth (orange) or death (purple) registers respectively, colour coded and captured into a purposely designed Excel spreadsheet. Thereafter, maternal or neonatal discharge events were captured from the Midnight Census inpatient register (MC) (blue), a DHIS tool, and discharge events recorded into a second Excel sheet. Finally birth and death notifications for the relevant facilities were abstracted from the e-Notification platform (green) into a third Excel sheet. All recorded birth and death events and their individual data elements (e.g. time of birth, sex, facility) were matched for agreement between the three data sheets. Where events were unmatched or disparate data elements were found, these were reviewed by the researcher to identify genuine errors in data recording or potential transcribing errors made by the researcher. This ensured a robust data set.

Data analysis methodology

Qualitative data were analysed using descriptive analysis. Process maps were finalised after multiple iterations and edited or refined using information gleaned from transcripts of interviews and FGD. Time values for specific activities were not recorded as these were dynamic and inconsistent based on the facility, volume of events, staff availability, student presence and other clinical or administrative duties.

Quantitative data were assessed for accuracy, completeness and timeliness and will be reported elsewhere.

Relevance

Counting every stillbirth and newborn death is essential for identifying and assessing causes of death. And, analysing underlying causes of death for contributing factors can inform appropriate responses to identified maternal and child health care needs. Without relevant mechanisms to generate, report and use robust data, these deaths, even if counted correctly, will be meaningless. Namibia must improve her health information platforms and the parallel reporting structures. Likewise, it is imperative that facility data is owned by and remains in the domain of the facilities to enable these to meet the service needs of the communities they serve.

Ethical regulatory and data management considerations

The departmental research committee at the Department of Paediatrics, University of Cape Town (UCT) gave scientific review and approval after which the Health Research Ethics Committee (HREC) gave ethical approval to conduct this study (HR 626/2022).

Additional approval was received from the Directorate of Health Information & Research at the Ministry of Health and Social Services, Namibia to conduct this study in health facilities in Windhoek and to obtain data from the MOHSS' DHIS system (Ref: 22/4/2/3). Further approval was received from the Ministry of Home Affairs, Immigration, Safety and Security, Namibia for support and access to the CRVS' e-Notification platform. Approval was received from each

of the participating facilities to conduct the study in their maternity departments. Though study approval was obtained, two of the private facilities did not provide access to their registers.

The researcher explained the nature of the study, the nature of the individual's participation and potential risks (no more than minimal), benefits of the study, and an individual's choice to voluntarily withdraw from the study. Withdrawal from the study was possible throughout the entire study duration without penalty to the participant. Participation was entirely voluntary and without renumeration. When candidates agreed to participate, they were asked to sign a written consent form prior to their participation. Confidentiality and anonymity for each participant was upheld by the researcher. Study participants' responses were anonymised during transcribing and prior to analyses and dissemination.

Due to the nature of FGDs, participants were requested to adhere to the principles of confidentiality. However, the researcher was unable to guarantee that each participant would strictly adhere to their agreement in safeguarding other participants' identity or contribution. Similarly, Namibia has a small population with a limited number of interconnected health care workers and care facilities. Though facility data and participant responses were anonymised and aggregated for reporting and analyses purposes, a slight possibility remains that individuals or individual facilities may be recognizable to their fellow health care workers. Participants were made aware of this prior to signing consent.

Risks for harm to participants were low as this study required a secondary review of routinely collected facility data. The topic for discussion during key informant interviews and focus group discussions were mostly of a technical nature, though some participants expressed incidences of distress in their work situation relating to perinatal mortality. This did not require any follow-up or counselling intervention.

Data for this study were captured electronically and stored on a personal laptop and backed up daily onto google drive. The laptop,

the research folders and individual data files were each password protected. Only the researcher had access to password protected data. Portions of interviews were made available to an audio transcriber and research supervisor as required, but only with the understanding that they adhere to the same ethical guidelines outlined herein.

MOHSS, MHAISS and participating facilities were offered a feedback meeting to engage with the preliminary research findings and provide comments or request changes. During feedback sessions each facility was invited to participate in the planned intervention strategy. One facility, IHK, responded to the invitation.

Theoretical framework

The two frameworks considered for this study were the Performance of Routine Information System Management (PRISM) framework (Aqil et al., 2009), and the conceptual framework for process mapping described by (Antonacci et al., 2021).

The PRISM framework and its assessment tools were designed to evaluate the performance of individual aspects or whole components of information management systems for the purpose of identifying systems and knowledge gaps needing redress (Aqil et al., 2009; Lippeveld et al., 2000). The authors posit that multiple factors potentially influence the quality of data and thus hinder or enable the overall performance of any health system. While they argue that routine HIS are fraught with multiple challenges, these also hold positive aspects that warrant strengthening. Moreover, performance within systems is directly or indirectly influenced by the environment in which they operate. Guidelines and tools for conducting systems evaluations using the PRISM framework were tested and found to be sensitive in different settings (Aqil et al., 2009). Input, Processes, Outputs, Outcomes and Impact are the overarching components of PRISM. Inputs relate to Routine Health Information System (RHIS) determinants that determine the quality of data at collection while Processes determine how effectively the entire data cycle from collection to feedback is managed. Outputs and Outcomes relate to RHIS and health systems performances while Impact, relates to

population health status. Only routine HIS determinants and processes are relevant to this study as they focus on the data recording and reporting aspects within the data cycle.

Research found that data quality improvement activities targeting one or more of the PRISM determinants were effective in improving accuracy, completeness and timeliness of data (Lee et al., 2009). Even though the PRISM framework is useful in evaluating the overall performance of routine health systems, Objective 2 of this study was to illustrate the processes and stakeholders for recording perinatal mortality data to gain insight into the pathway from data generation to transmission. Process maps, on the other hand, were used in various settings, at macro and micro levels and are used to visually illustrate existing or desired processes (Antonacci et al., 2021; Cobos Muñoz et al., 2020). For this reason, process mapping (PM) was included as an additional resource, to offer a visual representation of the processes involved in the data management at facility level.

According to de Savigny and Cobos Muñoz D (2018) process mapping (PM) is a smaller step in the broader field of Enterprise Architecture and a tool used to visualise intricate process flows, stakeholders and their activities and relationships. Process maps can be used to reflect processes or workflows in their current form (as-is) or to design future processes in their desired form (to-be) (de Savigny & Cobos Muñoz D, 2018; Kalman, 2002). At macro level these maps can be used to identify and prioritise systems gaps and bottle necks, whereas the maps at micro level can identify root causes of flow interruption or delays (Kalman, 2002). There also seems to be a reasonable overlap between activities in process mapping and activities aiming for quality improvement (Antonacci et al., 2021). The value of using PM as a research tool lies in its ability to plainly illustrate sequential steps in complex workflows, identify key contributors to flow interruptions, to examine core processes within the system to then identify remedial action and redesign more effective and efficient work processes (Cobos Muñoz et al., 2020; de Savigny et al., 2017).

Cobos Muñoz et al. (2018) developed ten milestones indicating the desired flow processes (to-be map) of a well-functioning CRVS system. They used these to benchmark them against countries' CRVS process maps (as-is maps) to identify deviations and re-align processes to the 'to-be' model. (Antonacci et al., 2021), on the other hand, developed a conceptual framework for PM specific to health care settings. After an extensive review of the literature, they advance collaboration, discourse and information sharing between participants to detect problem areas and find evidence-based solutions by creating visual charts of bottlenecks, related or competing priorities, concepts, and other factors influencing aspects of healthcare for better or worse.

Different versions of maps can be drawn, each with their own purpose and usefulness. This study employed the geographical flowchart, otherwise known as String Diagram, as these illustrate the physical pathways within processes or organisations. The visual display of existing pathways was deemed to better illustrate the raw and complex, intertwined and duplex pathways than other 'neater' and more 'clinical' flowcharts offered by Kalman (2002).

Findings

The results will be reported in four parts. The micro level process map (PM) highlights the recording and reporting processes at source, within the facility at departmental level. The meso level PM highlights the reporting processes and gaps within the facility, where data is moved from the department level to the DHIS officer. The macro level PM highlights reporting processes and gaps for data moving from facilities through the relevant ministerial offices to the national statistics agency responsible for compiling and reporting national statistics. The final part discusses the recordkeeping burden experienced by midwives/nurses in the process of patient care during birth and death events. The process maps depicted in this section illustrate the three major data streams. Yellow was added to reflect monthly tally sheets (DHIS) and other administrative documents,

whereas grey indicates records used by parties external to the facilities (e.g. Mortuaries, MHAISS).

Micro level of a large facility in the public sector

After matching, a total of 5,018 unique birth and 109 unique death events were identified at baseline and during the intervention period (Table 1). Events recorded into birth (98.5%) and death (93.6%) registers were most complete, whereas the Midnight Census tool (95.7% and 38.5%) was least complete for each event. This was due to the non-recording into the MC of stillbirths and neonatal deaths occurring in labour and postnatal wards. This became a major focus for the intervention.

Table 1. Unique events identified for participating facility at baseline and intervention

	2023	%	2024	%	Total	%
Births	n=2,705	100	n=2,313	100	5,018	100
Registers	2,644	97.7	2,297	99.0	4,941	98.5
DHIS	2,562	94.7	2,241	93.5	4,803	95.7
CRVS	2,608	96.4	2,267	98.0	4,875	97.2
Deaths	n=60	100	n=49	100	109	100
Registers	55	91.7	47	95.9	102	93.6
DHIS	3	5.0	39	79.6	42	38.5
CRVS	54	90.0	45	91.8	99	90.8

While Table 1 indicates the total number of events recorded into each data stream, Table 2 indicates the number of events duplicated into each data stream. For comparison purposes across data streams an error rate (ER) was calculated. Duplications were common in both DHIS and CRVS data streams. The number of duplications and omissions reduced during the intervention strategy, most remarkably for DHIS entries. Maternal entries for birth data reduced from an ER of 15.8/1,000 to 3.5/1,000 events during the intervention.

Table 2. Number of events duplicated in each data stream

	2023	ER	2024	ER	Total	ER
Births						
Registers	2	0.8	0	-	2	0.4
DHIS	42	15.8	8	3.5	50	10.4
CRVS	45	15.9	28	12.0	73	15.0
Deaths						
Registers	1	18.2	0	-	1	9.8
DHIS	0		0	-	0	-
CRVS	1	18.5	0	-	1	10.1

Note: Error rate (ER) = number of events / by number of events identified for that data stream, multiplied by 1,000.

According to Rahbar et al. (2013) the Centre for Disease Control and Prevention (CDC) considers three errors per 1,000 variables (3/1,000) an acceptable error rate (ER) in trial data. while the Namibia Statistics Agency (2024) reported an error threshold of 10% or 100

errors in 1,000 events. This study accepted an error rate of 50/1,000 events (5%).

MOHSS' data records are paper based and rely on manual processes: recording, reporting, archiving, and storage. During facility visits, diagnostic and treatment information is recorded into patients' handheld health cards. Statistical data are captured in outpatient or inpatient registers or tally sheets depending on services provided and levels of health care. Data for facility, service or population-based statistics are manually aggregated onto monthly summary forms and forwarded to the District Health Officer, where they are transcribed electronically into the DHIS database and immediately accessible to management at regional and national level. The event (birth and death) registers are the sources for all data collected by the MOHSS or private sector.

Larger facilities have different wards for labour, postnatal care and specialist care for sick neonates (Figure 2). Instead of 'transferring' the women in the MC records between wards within the same facility, they are discharged, readmitted and discharged again, thereby duplicating DHIS entries. Similarly, women referred between facilities should be recorded as 'referrals' and not be discharged and readmitted.

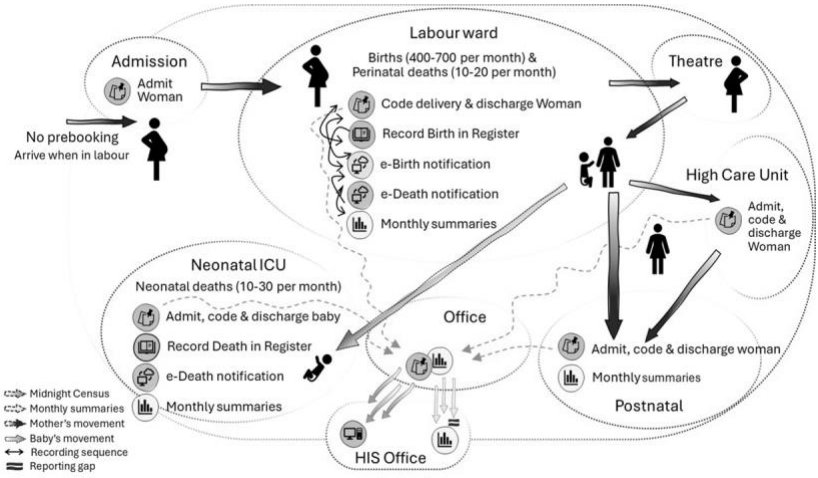

Figure 2. Patient and data flow through the maternity department

The most prominent gap at the departmental level is that all source records capture the mothers' details. Only the patient record reflects the birth (live or still) of the child. Women admitted to the facility are captured in the Midnight Census as an admission followed by the birth register with the birth details. Women are given an Apgar score card with the relevant birth details of their child. When referred to another unit, or discharged from the facility, the mother is recorded as a discharge (or death) in the MC. However, babies are not captured in the MC record. Any death events occurring in labour wards, maternity theatres or postnatal wards are not recorded into the MC, and therefore not recorded as an inpatient death in the MC. Only when the newborn is referred to a dedicated neonatal unit is the baby recorded as an admission and, upon death, as a discharge (death). Women discharged from the department are allocated an International Classification of Disease (ICD) 10 code indicating the mode of delivery and, if applicable, one code is allocated for a complication or an indication for a caesarean section. Coding is limited to two codes and no standards exist defining how coding should be done. Errors of duplication and omission occurred for the following reasons:

- Multiple pages were used to record a day's events, often resulting in the same entry being duplicated on two different pages.
- Transposition of surnames and first names resulted in events being recorded once under the surname and then again under the first name of the woman.
- Event coding errors due to use of generic or incorrect ICD-10 code.

All public and private maternity departments have access to the electronic birth and death registration platforms. Midwives with user credentials notify each birth and each death separately on the system. For stillbirths, this necessitates a corresponding death notification as the system does not automate a stillbirth notification into a matching death notification.

Errors resulted from end-users' lack of knowledge of navigating through the e-Notification system and completing all required fields or signoffs. Notification errors resulted from transposition or abbreviation of dates (e.g. yy/mm/dd, dd/mm/yy) and spelling errors, incorrect phonetic spelling or non-use of special characters in first and surnames (e.g. !Goagus or Xoagus). These errors contributed to a high number of duplicate entries on the system as staff did not amend the errors in existing entries but simply completed a duplicate entry. Omission of entries occurred when systems connectivity was slow or off, or when staff were overwhelmed with clinical duties.

Meso level of a large facility in the public sector

Occasionally children are born in emergency departments or gynaecology wards. When these children were between 500-1,000 grams mothers and babies may be transferred to the labour wards, where the births will be recorded. However, if these children were stillborn, the mothers may be referred to gynaecology ward, following a 'miscarriage'. In such cases, neither the birth nor the death of the child was recorded in maternity records, while e-Notifications may have been recorded. Similarly, when a newborn was discharged from hospital and was subsequently admitted in a non-maternity ward (e.g. cardiac ICU or paediatrics) and died thereafter, the death would be recorded in the MC inpatient forms. However, if the death occurred in the paediatric outpatients or emergency departments, this would not be the case as these departments do not record inpatient data. Neonatal deaths occurring in non-maternity departments were not recorded as neonatal deaths on the monthly tally sheets, resulting in data discrepancies between the inpatient and aggregate module of the DHIS. Figure 3 indicates the reporting gaps from non-maternity wards.

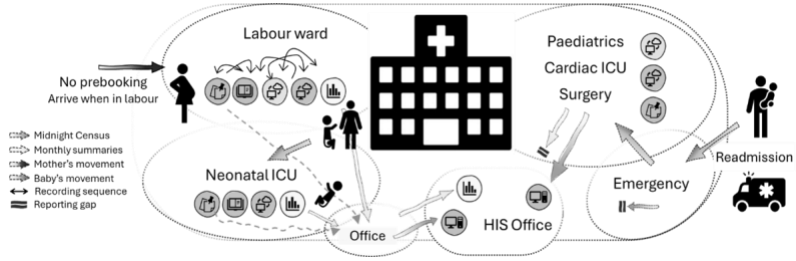

Figure 3. Patient and data flow in non-maternity wards

Public facilities report their births and deaths to the MOHSS using the MC inpatient forms and monthly tally sheets. This, however, is not the case for events occurring in the private sector. Similarly, reporting of community births and deaths depends on which pathway of care is followed following an event.

Macro level (National)

Figure4 below illustrates the pathway of DHIs data and CRVS e-Notifications for birth and death events. Births are indirectly reported through the maternal inpatient MC data which is transcribed into the inpatient data module of DHIS. Monthly tallies are hand counted manually and transcribed into the aggregate module of the DHIS. As indicated earlier, stillbirths and neonatal deaths occurring in labour or postnatal wards are not captured into the inpatient MC forms, resulting in underreporting of death events into that module.

e-Notifications are captured into the CRVS platform at facility level and stored on the server housed at the Prime Minister's office. Once the notification is signed off it is visible and accessible to external parties, such as mortuary attendants and MHAISS office personnel. After event details are verified with the parent/s, a birth or death certificate is issued. Parents apply to the relevant municipal authority to obtain a burial order, with which they can move the body from the mortuary for burial purposes.

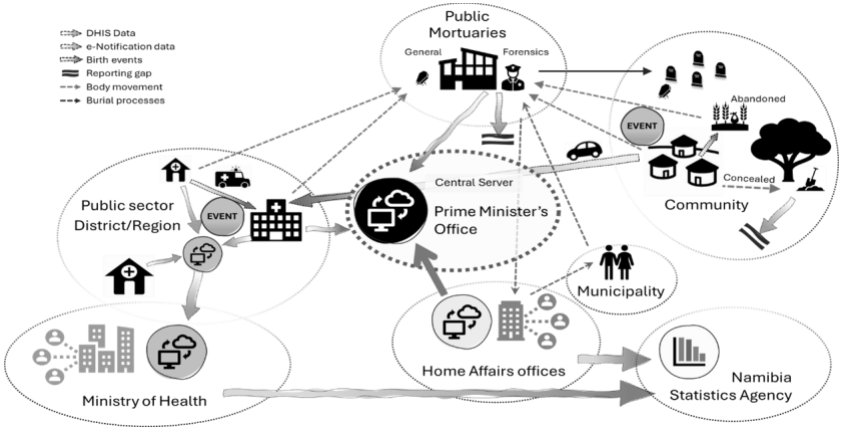

Figure 4. patient and data flow at macro level for the public sector

Births and deaths in the community can follow different pathways. When a birth occurs in the community and mother and baby are transported to the closest maternity ward, the birth or death will be recorded following normal procedures. However, if a death occurs in the community the body is moved to the mortuary. In cases of unnatural deaths postmortems will be conducted to establish the cause of death. Mortuary personnel have access to the e-Notification platform and are able to notify community births and deaths. In the case of abandoned babies who are found alive, their birth circumstances will be investigated by the police and registered and notified by the nearest hospital where the baby will be admitted. In the event that the baby has died, the body will be taken to the forensic mortuary and birth and death circumstances will be investigated. If the birth mother is found the birth and death will be e-notified. If no birth parent is found the birth and death will be notified against an "unknown" parent. However, since mortuaries do not have in- or outpatients they also do not report community events to the MOHSS using DHIS forms, resulting in under-reporting to the MOHSS.

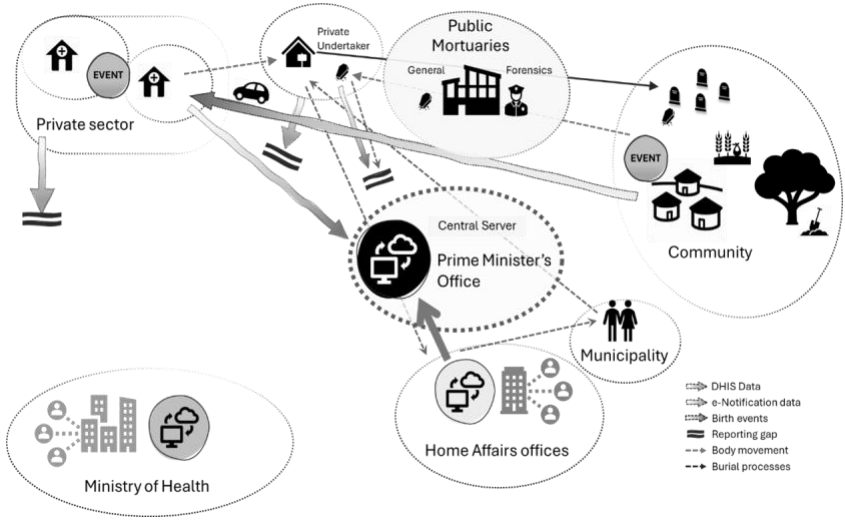

Figure 5. Patient and data flow at macro level for the private sector

Similar reporting gaps exist in the private sector (Figure 5). The private sector is not mandated to report data to the MOHSS. However, neonatal deaths and stillbirths are considered notifiable events and should be reviewed and reported, but this is not readily done. Nevertheless, facility staff do record e-Notifications into the CRVS platform. However, if community deaths occur and a private medical practitioner certifies that the death resulted from natural causes the body may be taken to a private undertaker. However, often private medical officers and private undertakers do not have access to the e-Notification platform if they are not linked to a private facility. In such cases e-Notifications are not possible without the collaboration of public mortuary staff by moving bodies to the private undertakers via the public mortuaries, further complicating the system. As with public mortuaries, private undertakers do not report data to the MOHSS.

Recording burden

Figure 6. Records into which birth and death events must be recorded

The process mapping exercise illuminated a critical aspect of the recording process that may have been tangible, but not necessarily obvious or visible. Data elements for each event are captured into multiple paper records, needlessly increasing the recording burden for staff that are already overwhelmed by a high clinical and administrative workload. Figure 6 illustrates the number of records midwives are required to complete for each event, while Figure 7 depicts how often a particular data element must be recorded into different paper records.

Figure 7. Minimum set of data elements recorded into multiple paper records

The above illustrates the basic recordkeeping requirements for each event and record. Additional recordkeeping entries are required for other data processes and care delivery for the mother-child dyad, which were not captured in this study.

Data quality improvement initiative

The implementation strategy focused on adding value without adding additional recording burden; improving mechanisms for recording or reporting processes that were low-cost and sustainable; identifying errors, duplications or omissions early, and, above all, retaining data ownership of data or potentially designed tools with the facility with minimal post intervention support from the researcher.

Some of the identified modifiable factors that could easily be addressed were the non-recording of stillbirths and neonatal deaths into the MC form, reducing duplications resulting from use of multiple MC forms for each day and identifying duplications or omissions occurring in either of the data streams. The facility team agreed to standardize recording of names following the Surname, First name format in all of its records, thereby increasing the ability to recognize if an event had previously been recorded. Furthermore, each baby (stillbirth, neonatal death, referral to another facility) would be recorded and coded in the MC as an individual entry, while the

relevant maternal entry would not be affected. Lastly, when a second or third MC page was opened for the same day, the Z-line, a horizontal-diagonal-horizontal line resembling the letter Z, was to be drawn under the last entry of that page, thereby "closing off" each page and eliminating the risk for other entries to be added on a previous page.

To identify errors in the e-Notification system, staff were trained to conduct comprehensive search strategies on the CRVS systems to identify existing entries, or incomplete or erroneous entries created by other users. This allowed opportunity for correction and to complete sign offs of existing records.

To identify missed entries in either data stream, staff agreed to verify entries across all data streams to ensure all daily events appeared in all data streams. Where an event was found in one or two of the data streams, but not in all three, it provided an opportunity to add the relevant entry to the third data stream.

The researcher sought a method to measure if the above steps were undertaken, to evaluate if these agreed upon steps were adhered to and if they had an impact in the recording process (Figure 9). An Excel-based dashboard (Figure 8) was designed to track this daily. However, the dashboard was not to be a research-based, or researcher-owned, activity alone but should assist the staff in managing their daily or monthly data collection processes. The dashboard had three data collection sheets, one for each data stream, and a data visualization tool, reflecting daily and monthly events for the facility. Back-end and front-end controls minimized potential for capturing errors, automated monthly calculations and prepared a print-ready summary sheet of all data elements typically tallied (and retallied) by staff at month-end.

The dashboard was implemented towards the end of December 2023 and midwives were trained to use the dashboard and sensitized to the agreed upon standards for the first month of implementation. Once staff started training each other, understanding and ownership of the dashboard incrementally transferred to the facility staff, who began

to understand the value of the daily verification processes and the automated features of the dashboard.

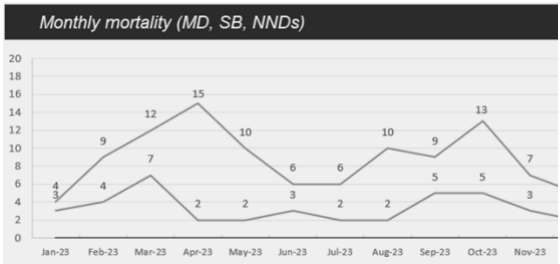

Figure 8. Dashboard display for mortality data for the participating facility on 14 March 2024

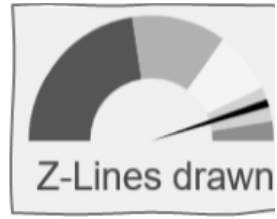

Figure 9. Performance tracker for Z-lining MC forms

Missing sign offs at Facility 1, reduced from an ER of 434.8/1,000 at baseline to 113.4/1,000 for the intervention period, with a steady decrease during the intervention period. This suggests that the verification process implemented, along with the dashboard, had a positive effect of identifying incomplete and unsigned notifications. Furthermore, missing e-Death notification sign offs reduced from an ER of 463/1,000 to 88.9/1,000 events in the same timeframe.

The agreed upon activities, adhering to name formats, Z-lining MC forms and cross-verifying entries between data streams decreased errors, duplications and omissions. Recording stillbirth and neonatal death events into the MC forms reduced the number of perinatal deaths that were initially missed. Completing the dashboard and its automated tabulation and calculation of monthly tallies improved the timeliness of monthly reporting upline, while the back-end controls reduced counting and calculation errors.

Discussion

Birth registers, though not complete, are still the more accurate data source at present, though this is not supported in another African setting (Chiba et al., 2012). Manual data extraction from registers is time consuming and fraught with risk for errors (Shamba et al., 2021).

Beginning at facility level the data systems are outdated and ill coordinated, requiring multiple duplicate entries, thus reducing oversight of what was recorded where and adding to the overall clinical workload experienced by staff. Gonzalez et al. (2024) report that rigid documentation requirements may add to burnout risks amongst healthcare workers. Further work in assessing the true effects of recordkeeping burdens is required (Gesner et al., 2022; Moy et al., 2021). Hutchinson et al. (2018) advance that with added training and sensitisation, healthcare workers would be able to align care value with data value and prioritise both in the need for advancing health care. Nevertheless, it is essential that data recording tools are revised and updated to meet indicator reporting requirements as well as reducing the number of paper records, aligning data elements and integrating multiple streams.

Simple, low-cost interventions can immediately improve recording standards and data accuracy. Standards in how data is recorded and what data is captured improves the overall consistency with which individual data elements are recorded. Four effective interventions showed immediate results. Daily verification of events recorded in each data stream identified omissions and duplications and incomplete entries in either data stream. This was aided by recording all entries using the Surname, First name and yyyy/mm/dd orders, while Z-lining each MC page ensured no entries were re-recorded on different pages of the previous or the same day. The biggest shift was achieved by adding each stillbirth or neonatal death event as a standalone entry into the MC, adding the relevant perinatal ICD 10 code into the MC for electronic capture into the DHIS database. The verification also improved the completeness and accuracy of individual data elements within each entry. The reduction in error rates during the intervention suggests that daily event verification is possible and beneficial and should be integrated into the daily routine. This could be done by clerical staff to allow midwives to focus on clinical duties (Mpofu et al., 2014).

Interfacility reporting gaps necessitate a rethink of how inpatient and monthly aggregate data are recorded into the DHIS tools within

individual departments and the facility as a whole. Stillbirths and neonatal deaths occurring in non-maternity facility departments must be included in the overall numbers reported by maternity departments. This may be less cumbersome in smaller hospitals, but bigger facilities must be aware of reporting requirements and active surveillance and reporting must be facilitated for emergency departments and other wards where 'miscarriages' may occur or neonates are admitted. Underreporting of stillbirths based on birth weights below 1,000g and misclassifications between live and stillborn are not unique to this setting (Biks et al., 2021). Similarly, misclassifications between early (<198 hrs or seven days of life) or late neonatal deaths (<28days of life) are known (Blencowe et al., 2021). Though not included in this study, it was observed that late neonatal deaths were not tallied into the facilities' monthly summaries if these deaths occurred outside of maternity departments. This may be an important consideration for other facilities elsewhere with similar setups and where underreporting of stillbirths or neonatal deaths is possible for the same or similar reasons found herein. While population health data derived from hospital discharge records (in this case DHIS) may be reliable or generalizable for high income countries, this study suggests that this may not be the case for limited resource settings (Roberts et al., 2009).

A few community events may remain 'hidden', while others may be identified and recorded by mortuary staff attending to these cases. Nevertheless, reporting pathways must be designed into existing systems to allow mortuaries to report community deaths (and births) to the MOHSS for inclusion of their numbers into total district, regional or national aggregates. Equally, private sector facilities should participate in reporting their data to the MOHSS. Other countries experience similar challenges with the private sector not contributing to the national data system (Boadu et al., 2019; Ohiri et al., 2023). Perhaps the next focus of international data advocacy can address the lack of legislation mandating private healthcare providers to submit their data to national bodies.

Prior to the dashboard, facility staff had not engaged with their data. However, upon seeing the historical trends of number of births and stillbirth on the dashboard, midwives began asking questions about these trends in relation to their workload experiences. Furthermore, they expressed appreciation for no longer needing to manually count, recount, tally and correct monthly statistics. Once they submitted the monthly summaries, they were confident that these were complete and correct. Furthermore, the dashboard allowed staff to retain their data in the department and use such for further analyses of trends and service provision. At time of writing the dashboard is still being populated by midwives in the department, without support from the researcher. Dashboards are known to support and encourage staff to interact with the data they generate (Development Gateway, 2020)

In the use of electronic records, data integrity may need other back-end controls in software to prevent manipulation or falsification of data (Gass et al., 2017; Kim et al., 2020). This may require conditional formatting to limit fields to texts, numbers or use drop-down menus. These were some of the considerations during the design of the dashboard. Reports of deliberate data fraud or bypassing mandatory fields with zero values or incorrect data are not uncommon (Medhanyie et al., 2017; Mulissa et al., 2020). Therefore, individual integrity and supervision are key and cannot wholly be replaced by back-end or front-end controls. Moreover, data and cybersecurity must remain essential to all data processes and should be strengthened for this dashboard. Potential errors or shortcomings in the existing dashboard design are not excluded. Some built in logic functions might not be discernible without intentional and focused audits and Douglas et al. (2010)) suggests some errors may remain undetected (Chiba et al., 2012). Other input errors, while recognisable, may be difficult to rectify retrospectively due to software constraints. Errors in existing paper-based systems must be corrected prior to migrating from paper-based to electronic systems (Douglas et al., 2010; Shamba et al., 2021; Sites, 2023).

The practical interventions, recording formats, Z-lining, daily verification and adding death event entries into the Mc came at no

additional financial cost. The Excel dashboard was designed and implemented by the research at no cost to the facility. However, opportunity cost and time spent on the design and implementation were not costed. Had these been done by a professional designer, fees for design, copyright and software licenses may have applied. Nevertheless, this exercise illustrates that effective solutions to in-house problems can be found locally.

Finally, the implementation of the dashboard allowed staff to extract important data from their paper-based records and have these available to visualise or analyse these as required, but without losing ownership of their data. In terms of FAIR data principles, facility data was made findable, accessible, and usable/re-usable, while retaining ownership within the jurisdiction of the facility. Still, Sites (16 November 2023) advocates that digital tools be simplified to minimize the risk of merely translating a paper-based recording burden into a digital version.

Recommendations

While small interventions can be effective, other interventions must be assessed and effected at macro level with a wider stakeholder involvement. DHIS modules should be adapted to allow verification of data captured across modules, while private facilities could be added to the reporting platform, along with legislation updates mandating private health care providers to report their data to the MOHSS.

The implemented dashboard can be trialled at other facilities and incorporated into the MOHSS' data network if found effective elsewhere. This would necessitate an extensive exercise to ensure data and cyber security as well as tightening back- or front-end controls to improve accurate data entry. Due to staff rotation through clinical departments, ongoing training of incoming staff remains essential.

Without a parallel revision of recordkeeping requirements and clinical workload, midwives may not be in a position to record relevant data consistently and accurately. This includes standardizing

nomenclature, documenting formats and defining cadres responsible for data collection and verification at source.

Conclusion

Stillbirth and neonatal deaths are tragic, mostly preventable and commonly underreported. This study mapped out the processes and stakeholders involved in recording and reporting of perinatal mortality data from source to District Office. The study was carried out in Namibia. In the research the reporting of stillbirth was mapped out in large facilities at micro and meso level and at national level. The study looked at the reporting burden and tested an intervention to understand whether the reporting could be improved by a simple interoperable dashboard for stillbirths. The intervention showed increased data quality upon inspection of the data, which were more complete, and showed less duplicates or missing events. The automation of computation helped to generate insights from the data.

This study found that simple, low-cost interventions can significantly improve data recording standards and accuracy, particularly:

1. Daily event verification: Helps identify omissions, duplications, and incomplete entries.
2. Standardized recording format: Using "Surname, First name, yyyy/mm/dd" improves consistency.
3. Z-lining pages: Prevents duplicate entries across pages.
4. Standalone entries for stillbirths and neonatal deaths: Including perinatal ICD-10 codes enhances data capture into DHIS.

These changes improved the completeness and accuracy of records. The most effective intervention was the routine verification of events, suggesting this task could be assigned to clerical staff to reduce the burden on clinical staff like midwives. Meaningful action on perinatal deaths requires not just counting but analysing and using quality data. Moreover, facility-level data ownership and improved health information systems are key for effective service delivery.

This study suggests that small, low-cost interventions can improve facility-based recording of such events. Improvements to existing

data collection systems and recordkeeping requirements must be reviewed to reduce duplicity and parallel reporting of the same data. Simple, low-cost interventions can improve data quality and trustworthiness of data generated at source, while the implemented dashboard retained ownership of facility data at point of generation as well as enabling staff to visualize and engage with their data, in keeping with FAIR data principles.

Acknowledgements

The author thanks the Ministry of Health in Namibia for its collaboration in conducting this research. The author also thanks the health facilities, and the health workers who collaborated in the research.

The author is grateful for the supervision and guidance received from the PhD supervisors at the University of Cape Town, under whose guidance this research was conducted.

The author thanks the Leiden University Seed Fund for its contributions to explore collaboration with VODAN in Namibia to resolve data quality issues. This article is prepared as an exploration of the contribution of VODAN to improved service delivery on maternal health in Namibia, recognising the value of maternal health data. The author thanks Thomas van den Akker, Steffie Hemelaar and Mirjam van Reisen for the collaboration.

Author's Contributions

Beatrix Callard conducted this study as part of a PhD research carried out in the University of Cape Town in South Africa. Callard conceptualised the study and conducted the research and wrote the chapter.

References

Akuze, J., Cousens, S., Lawn, J. E., Waiswa, P., Gordeev, V. S., Arnold, F., Croft, T., Baschieri, A., & Blencowe, H. (2021). Four decades of measuring stillbirths and neonatal deaths in Demographic and Health Surveys: historical review. *Population Health Metrics*, *19*(1), 8. https://doi.org/10.1186/s12963-020-00225-0

Antonacci, G., Lennox, L., Barlow, J., Evans, L., & Reed, J. (2021). Process mapping in healthcare: a systematic review. *BMC Health Services Research*, *21*(1), 342. https://doi.org/10.1186/s12913-021-06254-1

Aqil, A., Lippeveld, T., & Hozumi, D. (2009). PRISM framework: a paradigm shift for designing, strengthening and evaluating routine health information systems. *Health Policy Plan*, *24*(3), 217-228. https://doi.org/10.1093/heapol/czp010

Berrueta, M., Ciapponi, A., Bardach, A., Cairoli, F. R., Castellano, F. J., Xiong, X., Stergachis, A., Zaraa, S., Meulen, A. S., & Buekens, P. (2021). Maternal and neonatal data collection systems in low- and middle-income countries for maternal vaccines active safety surveillance systems: A scoping review. *BMC Pregnancy Childbirth*, *21*(1), 217. https://doi.org/10.1186/s12884-021-03686-9

Biks, G. A., Blencowe, H., Hardy, V. P., Geremew, B. M., Angaw, D. A., Wagnew, A., Abebe, S. M., Guadu, T., Martins, J. S. D., Fisker, A. B., Imam, M. A., Nettey, O. E. A., Kasasa, S., Di Stefano, L., Akuze, J., Kwesiga, D., Lawn, J. E., Byass, P., Lawn, J., . . . the Every Newborn, I. S. C. G. (2021). Birthweight data completeness and quality in population-based surveys: EN-INDEPTH study. *Population Health Metrics*, *19*(1), 17. https://doi.org/10.1186/s12963-020-00229-w

Blencowe, H., Bottecchia, M., Kwesiga, D., Akuze, J., Haider, M. M., Galiwango, E., Dzabeng, F., Fisker, A. B., Enuameh, Y. A. K., Geremew, B. M., Nareeba, T., Woodd, S., Beedle, A., Peven, K., Cousens, S., Waiswa, P., Lawn, J. E., Byass, P., Tollman, S. M., . . . the Every Newborn, I. S. C. G. (2021). Stillbirth outcome capture and classification in population-based surveys: EN-INDEPTH study. *Population Health Metrics*, *19*(1), 13. https://doi.org/10.1186/s12963-020-00239-8

Boadu, R. O., Agyei-Baffour, P., & Edusei, A. K. (2019). Data accuracy and completeness of monthly midwifery returns indicators of Ejisu Juaben Health Directorate of Ghana [Article]. *International Journal of Public Health Science*, *8*(1), 106-117. https://doi.org/10.11591/ijphs.v8i1.15934

Centre of Excellence for Civil Registration and Vital Statistics (CRVS) Systems. (2019). *Compendium of Good Practices in Linking Civil Registration and Vital Statistics (CRVS) and Identity Management Systems*. International Development Research Centre,.

https://crvssystems.ca/sites/default/files/assets/files/CRVS_Compendium_e_WEB.pdf

Chiba, Y., Oguttu, M. A., & Nakayama, T. (2012). Quantitative and qualitative verification of data quality in the childbirth registers of two rural district hospitals in Western Kenya. *Midwifery*, *28*(3), 329-339. https://doi.org/10.1016/j.midw.2011.05.005

Cobos Muñoz, D., Abouzahr, C., & de Savigny, D. (2018). The 'Ten CRVS Milestones' framework for understanding Civil Registration and Vital Statistics systems. *BMJ Global Health*, *3*(2), e000673. https://doi.org/10.1136/bmjgh-2017-000673

Cobos Muñoz, D., de Savigny, D., Sorchik, R., Bo, K. S., Hart, J., Kwa, V., Ngomituje, X., Richards, N., & Lopez, A. D. (2020). Better data for better outcomes: the importance of process mapping and management in CRVS systems. *BMC Medicine*, *18*(1), 67. https://doi.org/10.1186/s12916-020-01522-z

de Bernis, L., Kinney, M. V., Stones, W., ten Hoope-Bender, P., Vivio, D., Leisher, S. H., Bhutta, Z. A., Gülmezoglu, M., Mathai, M., & Belizán, J. M. (2016). Stillbirths: ending preventable deaths by 2030. *The Lancet*, *387*(10019), 703-716.

de Savigny, D., & Cobos Muñoz D. (2018). *Understanding CRVS systems: The importance of process mapping. CRVS best-practice and advocacy*. www.mspgh.unimelb.edu.au/dataforhealth

de Savigny, D., Riley, I., Chandramohan, D., Odhiambo, F., Nichols, E., Notzon, S., AbouZahr, C., Mitra, R., Cobos Muñoz, D., Firth, S., Maire, N., Sankoh, O., Bronson, G., Setel, P., Byass, P., Jakob, R., Boerma, T., & Lopez, A. D. (2017). Integrating community-based verbal autopsy into civil registration and vital statistics (CRVS): system-level considerations. *Global Health Action*, *10*(1), 1272882-1272882. http://ezproxy.uct.ac.za/login?url=https://search.ebscohost.com/login.aspx?direct=true&db=awn&AN=28137194&site=ehost-live

Development Gateway. (2020). *Critical review of data visualization tools for Women's, Children's & Adolescents' Health (WCAH) and COVID-19 Response*. www.developmentgateway.org

Dlodlo, N., & Hamunyela, S. (2017). The Status of Integration of Health Information Systems in Namibia. The Electronic journal information systems evaluation, 20(2), 61-75. https://academic-publishing.org/index.php/ejise/article/view/143/106

Douglas, G. P., Gadabu, O. J., Joukes, S., Mumba, S., McKay, M. V., Ben-Smith, A., Jahn, A., Schouten, E. J., Landis Lewis, Z., van Oosterhout, J. J., Allain, T. J., Zachariah, R., Berger, S. D., Harries, A. D., & Chimbwandira, F. (2010). Using Touchscreen Electronic Medical Record Systems to Support and Monitor National Scale-Up of Antiretroviral Therapy in Malawi. *PLOS Medicine*, *7*(8), e1000319. https://doi.org/10.1371/journal.pmed.1000319

Forsingdal, A., & Munyika, T. (2020). The synergy between Civil Registration and social protection: a case study of Namibia. In C. o. E. f. C. R. a. V. t. Systems (Ed.), The Nexus Between Civil Registration and Social Protection Systems: Five Country Practices. https://crvssystems.ca/

Gass, J. D., Jr., Misra, A., Yadav, M. N. S., Sana, F., Singh, C., Mankar, A., Neal, B. J., Fisher-Bowman, J., Maisonneuve, J., Delaney, M. M., Kumar, K., Singh, V. P., Sharma, N., Gawande, A., Semrau, K., & Hirschhorn, L. R. (2017). Implementation and results of an integrated data quality assurance protocol in a randomized controlled trial in Uttar Pradesh, India. *Trials*, *18*(1), 418. https://doi.org/10.1186/s13063-017-2159-1

Gesner, E., Dykes, P. C., Zhang, L., & Gazarian, P. (2022). Documentation Burden in Nursing and Its Role in Clinician Burnout Syndrome. *Appl Clin Inform*, *13*(5), 983-990. https://doi.org/10.1055/s-0042-1757157

Gonzalez, J., Fisher-Grace, K., Carpenter, J., & Pronovost, P. J. (2024). Nursing Governance to Reduce Documentation Burden. *Nurse Leader*. https://doi.org/https://doi.org/10.1016/j.mnl.2024.11.006

Goodwin, S. (1996). Data rich, information poor (DRIP) syndrome: is there a treatment? *Radiol Manage*, *18*(3), 45-49.

Haider, M. M., Mahmud, K., Blencowe, H., Ahmed, T., Akuze, J., Cousens, S., Delwar, N., Fisker, A. B., Ponce Hardy, V., Hasan, S. M. T., Imam, M. A., Kajungu, D., Khan, M. A., Martins, J. S. D., Nahar, Q., Nettey, O. E. A., Tesega, A. K., Yargawa, J., Alam, N., . . . the Every Newborn, I. S. C. G. (2021). Gestational age data completeness, quality and validity in population-based surveys: EN-INDEPTH study. *Population Health Metrics*, *19*(1), 16. https://doi.org/10.1186/s12963-020-00230-3

Hug, L., You, D., Blencowe, H., Mishra, A., Wang, Z., Fix, M. J., Wakefield, J., Moran, A. C., Gaigbe-Togbe, V., Suzuki, E., Blau, D. M., Cousens, S., Creanga, A., Croft, T., Hill, K., Joseph, K. S., Maswime, S., McClure, E. M., Pattinson, R., . . . Alkema, L. (2021). Global, regional, and national estimates and trends in stillbirths from 2000 to 2019: a systematic assessment. *The Lancet*, *398*(10302), 772-785. https://doi.org/10.1016/S0140-6736(21)01112-0

Hutchinson, E., Nayiga, S., Nabirye, C., Taaka, L., & Staedke, S. G. (2018). Data value and care value in the practice of health systems: A case study in Uganda. *Soc Sci Med*, *211*, 123-130. https://doi.org/10.1016/j.socscimed.2018.05.039

Kahn, M. G., Raebel, M. A., Glanz, J. M., Riedlinger, K., & Steiner, J. F. (2012). A pragmatic framework for single-site and multisite data quality assessment in electronic health record-based clinical research. *Med Care*, *50 Suppl*(0), S21-29. https://doi.org/10.1097/MLR.0b013e318257dd67

Kalman, H. K. (2002). Process Mapping: Tools, Techniques, & Critical Success Factors. *Performance Improvement Quarterly*, *15*(4), 57-73. https://doi.org/https://doi.org/10.1111/j.1937-8327.2002.tb00265.x

Kapepo, M. I., & Yashik, S. (2018). A process analysis of the Namibian Health System: An exploratory case study. Ethiopian Journal of Health Development, 32, 200-209.

Kaushik, V., & Walsh, C. A. (2019). Pragmatism as a Research Paradigm and Its Implications for Social Work Research. *Social Sciences*, *8*(9), 255. https://www.mdpi.com/2076-0760/8/9/255

Kim, S. M., Choi, Y., Choi, B. Y., Kim, M., Kim, S. I., Choi, J. Y., Kim, S.-W., Song, J. Y., Kim, Y. J., Kee, M.-K., Yoo, M., Lee, J. G., & Park, B. Y. (2020). Prospective cohort data quality assurance and quality control strategy and method: Korea HIV/AIDS Cohort Study. *Epidemiology & Health*, *42*, e2020063-e2020063. https://doi.org/10.4178/epih.e2020063

Lawn, J. E., Cousens, S., & Zupan, J. (2005). 4 million neonatal deaths: When? Where? Why? *The Lancet*, *365*(9462), 891-900. https://doi.org/https://doi.org/10.1016/S0140-6736(05)71048-5

Lee, S. K., Aziz, K., Singhal, N., Cronin, C. M., James, A., Lee, D. S., Matthew, D., Ohlsson, A., Sankaran, K., Seshia, M., Synnes, A., Walker, R., Whyte, R., Langley, J., MacNab, Y. C., Stevens, B., & von Dadelszen, P. (2009). Improving the quality of care for infants: a cluster randomized controlled trial. *Cmaj*, *181*(8), 469-476. https://doi.org/10.1503/cmaj.081727

Lippeveld, T., Sauerborn, R., Bodart, C., & World Health, O. (2000). *Design and implementation of health information systems / edited by Theo Lippeveld, Rainer Sauerborn, Claude Bodart*. World Health Organization. https://apps.who.int/iris/handle/10665/42289

MEASURE Evaluation. (2017). *Using DHIS2 to strengthen health systems*. https://www.measureevaluation.org/his-strengthening-resource-center

Medhanyie, A. A., Spigt, M., Yebyo, H., Little, A., Tadesse, K., Dinant, G.-J., & Blanco, R. (2017). Quality of routine health data collected by health workers using smartphone at primary health care in Ethiopia. *International Journal of Medical Informatics*, *101*, 9-14. https://doi.org/https://doi.org/10.1016/j.ijmedinf.2017.01.016

MOHSS. (2022). *National maternal, stillbirths and neonatal death review report for 2018-2021*. John Meinert Printers.

MOHSS, & ICF International. (2014). *Namibia Demographic and Health Survey 2013*. http://dhsprogram.com/pubs/pdf/FR298/FR298.pdf

Moy, A. J., Schwartz, J. M., Chen, R., Sadri, S., Lucas, E., Cato, K. D., & Rossetti, S. C. (2021). Measurement of clinical documentation burden among physicians and nurses using electronic health records: a scoping

review. *Journal of the American Medical Informatics Association*, *28*(5), 998-1008. https://doi.org/10.1093/jamia/ocaa325

Mpofu, M., Semo, B. W., Grignon, J., Lebelonyane, R., Ludick, S., Matshediso, E., Sento, B., & Ledikwe, J. H. (2014). Strengthening monitoring and evaluation (M&E) and building sustainable health information systems in resource limited countries: lessons learned from an M&E task-shifting initiative in Botswana. *BMC Public Health*, *14*, 1032. https://doi.org/10.1186/1471-2458-14-1032

Mulissa, Z., Wendrad, N., Bitewulign, B., Biadgo, A., Abate, M., Alemu, H., Abate, B., Kiflie, A., Magge, H., & Parry, G. (2020). Effect of data quality improvement intervention on health management information system data accuracy: An interrupted time series analysis. *Plos One*, *15*(8), e0237703. https://doi.org/10.1371/journal.pone.0237703

NSA. (2023). *The national strategy for the development of statistics: 2023/24-2026/27*. Windhoek: NSA Retrieved from https://nsa.org.na/wp-content/uploads/2024/06/NSDS-Report.pdf

NSA. (2024). *2023 Population & Housing Census Preliminary Report*. Windhoek Retrieved from www.nsa.org.na

Nuuyoma, V., & Ashipala, D. O. (2020). Healthcare System in Namibia: An Overview. In S. G. Taukeni (Ed.), Biopsychosocial Perspectives and Practices for Addressing Communicable and Non-Communicable Diseases (pp. 1-17). IGI Global. https://doi.org/10.4018/978-1-7998-2139-7.ch001

Ohiri, K., Makinde, O., Ogundeji, Y., Mobisson, N., & Oludipe, M. (2023). Strengthening routine data reporting in private hospitals in Lagos, Nigeria. *Health Policy and Planning*, *38*(7), 822-829. https://doi.org/10.1093/heapol/czad035

Rahbar, M. H., Gonzales, N. R., Ardjomand-Hessabi, M., Tahanan, A., Sline, M. R., Peng, H., Pandurengan, R., Vahidy, F. S., Tanksley, J. D., Delano, A. A., Malazarte, R. M., Choi, E. E., Savitz, S. I., & Grotta, J. C. (2013). The University of Texas Houston Stroke Registry (UTHSR): Implementation of enhanced data quality assurance procedures improves data quality [Article]. *BMC Neurology*, *13*, Article 61. https://doi.org/10.1186/1471-2377-13-61

Roberts, C. L., Bell, J. C., Ford, J. B., & Morris, J. M. (2009). Monitoring the quality of maternity care: how well are labour and delivery events reported in population health data? *Paediatric and perinatal epidemiology*, *23*(2), 144-152. https://doi.org/https://doi.org/10.1111/j.1365-3016.2008.00980.x

Setel, P. (2020). *Getting the Numbers That Matter for Public Policy*. https://doi.org/10.48558/J4Z4-E689

Setel, P. W., Macfarlane, S. B., Szreter, S., Mikkelsen, L., Jha, P., Stout, S., & AbouZahr, C. (2007). A scandal of invisibility: making everyone count

by counting everyone. *The Lancet*, *370*(9598), 1569-1577. https://doi.org/https://doi.org/10.1016/S0140-6736(07)61307-5

Shamba, D., Day, L. T., Zaman, S. B., Sunny, A. K., Tarimo, M. N., Peven, K., Khan, J., Thakur, N., Talha, M. T. U. S., K.C, A., Haider, R., Ruysen, H., Mazumder, T., Rahman, M. H., Shaikh, M. Z. H., Sæbø, J. I., Hanson, C., Singh, N. S., Schellenberg, J., . . . En-Birth Study Group. (2021). Barriers and enablers to routine register data collection for newborns and mothers: EN-BIRTH multi-country validation study. *BMC Pregnancy and Childbirth*, *21*(1), 233. https://doi.org/10.1186/s12884-020-03517-3

Sites, M. (16 November 2023, 13 February). Nursing documentation burden: a critical problem to solve. https://www.aacn.org/blog/nursing-documentation-burden-a-critical-problem-to-solve

UNICEF. (n.d.). Namibia health budget brief 2022/23. In WHO & Joint SDG Fund (Eds.), *Strengthening health financing to accelerate progress towards universal health coverage* (pp. 10). [online].

WHO. (2018). *2018 Global reference list of 100 core health indicators (plus health-related SDGs)* CC BY-NC-SA 3.0 IGO). https://apps.who.int/iris/handle/10665/259951