Original article

A process analysis of the Namibian Health System: An exploratory case study

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Abstract

Background: The Namibian health system is fragmented and data are collected from disparate systems that are not interoperable. Interoperability in this case refers to the ability of health information systems (HISs) to communicate and exchange health-related data at various healthcare levels. The multiplicity of HISs has resulted in limited access to integrated data across the entire health system, leading to duplication of data and under-reporting from primary healthcare facilities, yielding unreliable institution-based data within the health system.

Methods: A qualitative approach was employed using a two-phase design. In phase one, a business process re-engineering (BPR) approach was applied to conduct a process analysis of the Namibian health system. A process model is developed to illustrate health inter-level data flows. In phase two, the process model was validated by experts, and semi-structured interviews were conducted as part of a Delphi study to elicit the opinions of experts on challenges and bottlenecks in the data flow process. Interview results were inductively analyzed using the NVivo software to identify themes and patterns from the data.

Findings: The national HIS faces pertinent challenges concerning fragmented systems, originating from vertical programmes and donor-funded systems that do not exchange data with the national-level district health information system (DHIS). Findings also highlight that Namibia, among other developing nations, faces similar integration challenges, such as a lack of a trained workforce, different healthcare interoperability standards used by various HISs, an inadequate foundational infrastructure, and an absence of policies, unclear roles and structures that are necessary for driving HIS integration initiatives.

Conclusion: There is a need to strengthen collaboration between the national HISs and vertical health systems (VHSs) to address curb the integration challenges. The Ministry of Health (MoH) needs to invest in capacity building projects to train HIS officers on data analysis and use of DHIS 2. In addition, a clear outline of structures and functions needs to be defined to ensure that various MoH units, particularly the IT department, fulfill their primary role of providing IT services, including HIS integration. [*Ethiop. J. Health Dev.* 2018;32(4):00-000]

Key words: Health information systems, process analysis, business process re-engineering, integration, interoperability, Namibia

Introduction

The Namibian health system is organized in an administrative health hierarchy consisting of primary, secondary and tertiary healthcare. Primary health facilities provide basic curative, preventive and rehabilitative care. At the district level, health facilities provide primary and secondary healthcare services, including electronic capturing of health information sent from lower levels of care. The health facilities at various healthcare levels of the Namibian health system are depicted in Figure 1.
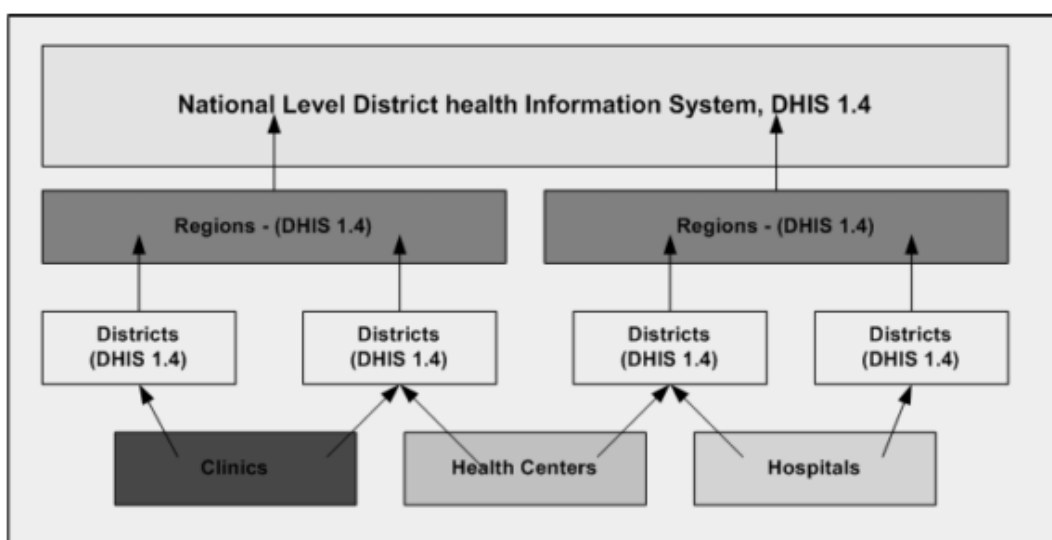

Figure 1: Primary **healthcare data flow in the Namibian Health care delivery system (5)**

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Understanding the health system of a country, by all relevant stakeholders, which includes different components and processes, is important and central to delivering effective and efficient health services (1). Despite the importance of efficiently designed and managed national healthcare systems, this is the one aspect many countries have failed to address effectively (2, 3). Thus far, there are only a few developing countries that have sufficiently strong and effective HISs that cater to their country's needs and allow for progress towards the United Nations' Sustainable Development Goals (SDGs), particularly Goal 9 (3,4) on securing and constructing the necessary infrastructure to support health systems. Nabyonga-Orem mainly highlights the challenge of the multiplicity of data collection systems that are designed alongside disease programs and projects (4).

The Namibian health system is experiencing a similar challenge, as there are over 60 HISs (paper-based, electronic and hybrid) used by various directorates at the M

inistry of Health (MoH) (5). Among these systems is the District Health Information System (DHIS 2), which is used as hybrid system (5-7). DHIS 2 is an open source system coordinated by the Health Information Systems Programme (HISP) and is an open and globally distributed process with developers in Vietnam, India, Tanzania, Norway, Ireland, South Africa and the USA (7). Other systems running parallel to DHIS 2 are the Electronic Patient Management

System (EPMS) and Extended Tuberculosis Register (ETR), which are VHSs that require manual extraction of data into DHIS 2 (5). This manual extraction process is prone to human error and has led to duplication of data and poor integration between these health systems and the national HIS.

The current health system in Namibia is fragmented and data are collected from disparate systems managed by different divisions in different directorates (8). Khan & Edwards explain that this problem is also linked to multiple systems deployed at the MoH, with some systems not functioning fully to support the integration initiatives and objectives of the MoH (5). This leads to limited access to integrated data across the entire health system by various health service providers. As a result, duplication of data and under-reporting from primary healthcare facilities leads to unreliable institution-based data within the Namibian health system. A review of the literature has reported major challenges linked to fragmented HISs and data flow (7,9), shortage of staff and technical knowledge gaps, structural and political challenges, and a lack of policies (6,7,9-12). Other challenges and bottlenecks reported with the current HIS are incompatible data standards used by various institutional systems in the Namibian health system. Data standards provide a common language that enables interoperability between different systems and devices. Different systems illustrated in Table 1 are not interoperable, leading to data exchange challenges and systems operating in silos.

Table 1: **Institutional systems and databases in Namibia (5)**

Institutional system/Databases	Description of system function	e-health standards
District Health Information System (DHIS 2)	Captures aggregated data of national health indicators	Statistical Data and Metadata Exchange – Health Domain (SDMX-HD)
Electronic Patient Management System (EPMS)	A system that stores specific information for patients treated for HIV	
MEDITECH	An enterprise resource and planning (ERP) system that the Namibia Institute of Pathology uses to manage all the aspects of its laboratories throughout the country	Health Level 7 (HL7) ISO CDA for CDTHP DICOM 2011 UN/EDIFACT
Pharmacy management information system (PMIS)	Captures a number of operational indicators related to stock management and availability of medicines, and quality of care, gathered from all health facilities	
Integrated Health Care Information Management System (IHCIMS) *discontinued*	IHCIMS, also known as e-health, was a system aimed at integrating all hospital departments from patient registration (e.g. through outpatient or inpatient treatment), diagnostic testing, billing, and ultimately discharge. Based on the Oracle E-Business Suite, it integrates patient information	ICD – 10 HL7 DICOM
Extended Program for Immunization (EPI info)	Database in which all disease surveillance is captured and sent direct from the point of entry (forms at facilities) straight to national level	None – A database based on MS Access
Integrated Disease Surveillance and Response (IDSR Database)	A database that stores disease surveillance information	None – A database based on MS Access

In addition, information from different electronic systems is extracted and imported manually to DHIS 2 (5). While existing studies have clearly established the challenges, they have not particularly analyzed inter-level data transfer challenges and bottlenecks within the Namibian health system. To address this gap, it is important to conduct a process analysis to understand the inter-level data flow process, challenges experienced with the exchange of data, and standards used by these systems.

The purpose of this paper is to explore HISs used in the Namibian Health system and examine how they support data exchange between healthcare levels. The particular focus is to identify challenges and bottlenecks in the data flow process. This study exclusively concentrates on primary healthcare (PHC) data (e.g. patient demographics, disease surveillance) collected at various points (health facilities) in the Namibian health system.

This study is grounded in the business process re-engineering (BPR) approach. BPR is one of the business process management (BPM) principles and it is a widely known and used approach to improve clinical workflows. "Business process management (BPM) is a systematic approach for analyzing an organization" (13). A process analysis is undertaken to understand challenges and bottlenecks inherent in the inter-level data flow. The main goal of this analysis is to model data exchange between healthcare levels in order to highlight areas that need improvement.

Health practitioners are provided with a better understanding of data flow across levels of healthcare in the face of the challenges and bottlenecks to interoperable HISs. In so doing, system developers can design HISs with compatible standards to promote integration initiatives.
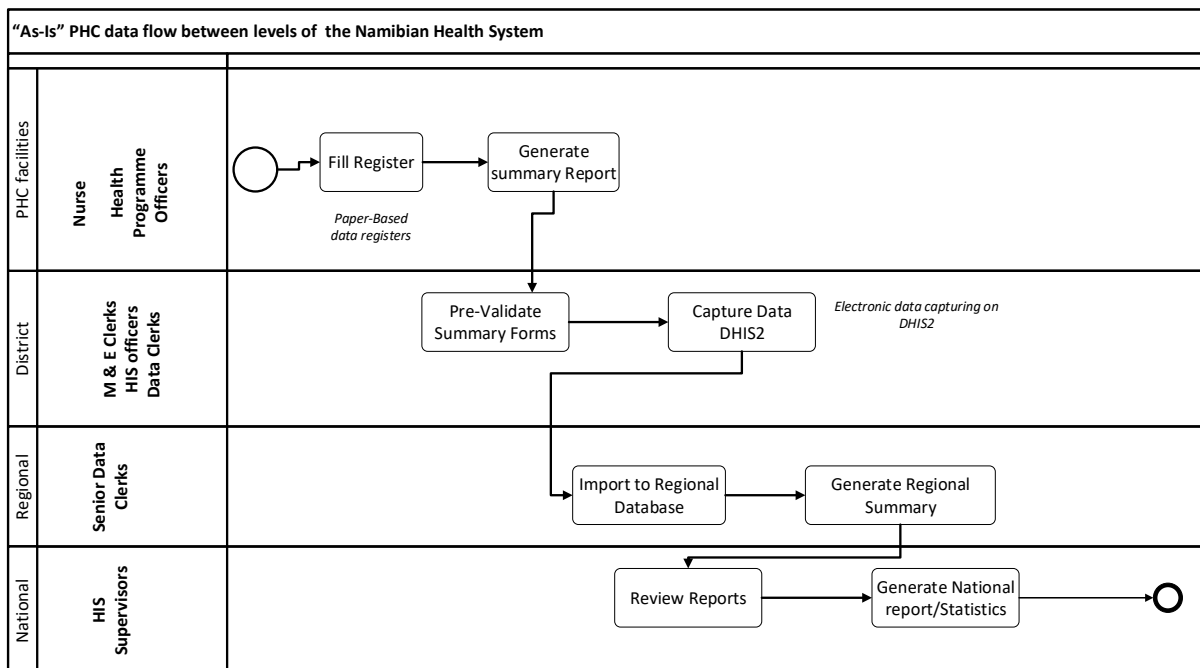
The paper therefore interrogates the questions: How do HISs support the exchange of data between healthcare levels in the Namibian Health system? What are challenges and bottlenecks inherent in the data transfer process? How can these challenges be addressed?

Materials and methods
This study employed an exploratory qualitative approach to examine inter-level data transfer across HISs in the Namibian health system. To achieve this, a situation analysis was conducted to establish existing HISs, data standards used by various systems, and challenges and bottlenecks inherent in the data transfer process. Consequently, a process model was developed to depict the inter-level data flow process. The process model facilitated understanding of the data flow process in order to analyze and suggest ways of improvement. Finally, interviews were conducted with experts from the MoH to validate the process model. A two-phased design that was followed to conduct this analysis is discussed in the next section.

Phase 1 – Process analysis
During this phase, key documents were examined, such as the MoH annual reports, guidelines, manuals and catalogues of HISs, guidelines and policies. The annual reports and assessment report of HISs facilitated understanding of the data transfer process (5, 6). The guidelines and catalogues of HISs provided insight into data standards used by various HISs at the MoH. With these insights, a description of the current ('as-is') data transfer process is mapped in a process model, as shown in Figure 2.
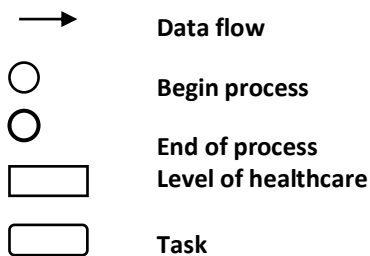
Legend:

⟶   **Data flow**

◯   **Begin process**

◯   **End of process**
▭   **Level of healthcare**

▭   **Task**

Figure 2: **'As-is' process model for the data flow process**

The process analysis was grounded in the business process re-engineering (BPR) approach. BPR is a systematic business process management approach used for analyzing an organization (13), and thus is one possible mechanism to analyze the current situation regarding interoperability. BPR "refers to the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality and speed" (14). Patwardhan & Patwardhan offer a similar definition: "a management approach that rethinks present practices and processes in business and its interactions" (15).

BPR in general enhances the redesign of processes, workflows and structure of organizations to improve service quality and cost and time reduction. In healthcare, BPR has been used to analyze clinical processes in order to identify bottlenecks and delays in information flow, and further redesign the healthcare processes to ensure patients receive timely quality care at the right cost. The BPR approach was therefore suitable for this study, as it attempts to "improve underlying process efficiency by applying fundamental and radical approaches by either modifying or eliminating non-value adding activities and redeveloping the process, structure, culture" (16). A Delphi study is discussed in the next section.

Phase 2 – Delphi study
Interviews were conducted in the second phase of this research to seek experts' opinions on the 'as-is' model developed during the process analysis phase. The 'as-is' model was developed to map an ideal data flow in the health system, which is called the 'to-be' model (18).

The 'as-is' model was later validated by experts from the MoH to identify non-value adding activities in the process. The experts were interviewed, particularly those involved in the HIS Technical Working Group (TWG) of the MoH and the Directorate of Primary Health Care, were interviewed. The experts were identified based on the following criteria: 1) Involvement in the HIS TWG of the MoH in Namibia; 2) member of the HIS primary directorate unit or IT department; 3) active involvement in assessment and monitoring of HIS in the Namibian health system. These criteria were used to ensure that knowledgeable experts were involved in the validation process. In order to obtain a collective view, nine experts were interviewed to: 1) evaluate the 'as-is' model; 2) collect expert opinion on bottlenecks experienced in the data flow process; 3) incorporate improvements in the current ('as-is') model and reach a consensus on the 'to-be' model in attempts to improve the process by eliminating non-value adding activities (16).

Data analysis
An inductive thematic analysis approach was used to code and develop themes from the interview results. The interviews were recorded and these recordings were listened to prior to transcription in order to gain better understanding of each interview session. The interviews were then transcribed verbatim, and typed in a word processor (17). The transcripts were then imported into NVivo for analysis. Themes were generated based on the data, particularly to identify challenges and bottlenecks in the current inter-level data flow. Following a thematic approach, the data was subjected to a rigorous pattern identification (18).

The researcher re-read the data, after which it was analyzed and organized into meaningful categories by identifying themes and patterns across the data set. The five themes generated from interview results were grouped into technical and organizational categories, as shown in Table 2.

Table 2: **Challenges and bottlenecks in the data flow process**

	Theme	Description
Organizational	Shortage of staff and lack of trained work force	• There is a severe shortage of skilled technical personnel to support the clinical staff in their utilisation of the DHIS for data capturing
	Governance and policies	• The roles and function of the IT department are not clearly defined and this affects data management at the MoH
	Data management	• HIS data are fragmented
		• Multiple isolated, *ad hoc* and parallel systems, databases and data collection processes have been created due to inadequate coverage of information by the primary systems or a lack of coordination with already operational institutional systems and processes
Technical	Interoperability and standards	• Different interoperability standards are used by various HISs
	Insufficient infrastructure	• Poor infrastructural conditions challenge the flow of data from lower levels of care to district and national health administration levels
		• A lack of uniform infrastructure development at various levels of care (e.g. lack of computer equipment and internet)

Results

The objective of this study was to explore how various HISs are used to support the process of data flow between healthcare levels in the Namibian Health system. The particular focus was to identify bottlenecks and challenges inherent in the data transfer process in order to highlight areas that need improvement.

Data flow process: 'as-is'

The 'as-is' model in Figure 2 was developed as result of a process analysis and review of literature, documents and guidelines at the MoH. This model illustrates that the Namibian health service is composed of levels of care, namely primary, district, regional and national. The PHC data collection begins at a facility level (clinics, health centers and hospitals), where data are captured on paper-based data registers. These paper-based registers are collected from service records by nurses, health program officers and data clerks deployed at clinics, health centers, and district and regional offices, respectively. The primary role of data clerks and HIS officers is to capture and undertake all duties related to transferring and processing all PHC-related routine data. The data registers are usually designed in a standard format, but at times they differ depending on services rendered to patients.

Thereafter, the registers are compiled into paper-based summary forms by a facility manager and are passed on to the district office on a monthly basis. At the district level, the data are validated by monitoring and evaluation officers (M&E officers). At this level, the M&E officers monitor various indicators or specific diseases. After the data are validated, they are then electronically captured on DHIS 2 by data clerks, and transferred from the district level to the regional and then to the national level, as illustrated in Figure 2.

Organizational challenges
Shortage of staff and lack of trained workforce
Findings from the study confirm that there is a shortage of skilled technical personnel to support the clinical staff in capturing summary forms on the DHIS 2. The majority of interview respondents conveyed that the Ministry was understaffed in areas of HIS, especially at

the district level. In some cases, where skilled health program officers or data capturers are absent because of study leave, some districts simply make use of untrained personnel to capture the data. In one case, the role of the program officer was rotated between untrained staff:

"Let me say we train staff. Like we had a scenario whereby in one hospital, the person who was supposed to be entering data went on study leave. So now the hospital did not have a replacement but instead got clinical personnel working in the wards to capture the data and they shifted from day to day to ensure that task was completed." Respondent 2

This posed data quality concerns, as the clinical personnel were not trained on how to enter the data on DHIS 2. This led to human errors, data incompleteness and repeated data inconsistency. Primary healthcare supervisors perform a quality check on information entered on the system. This does not completely eliminate errors, but leads more to duplication of effort. Additionally, not all clinical staff are skilled in how to use DHIS 2:

"It's only this generation of today. But those old nurses, if you give an old nurse a task or data to enter on a computer system, it will take decades. They are not skilled and it takes time to train them." Respondent 1

Governance and policies
Challenges related to governance and a lack of policies were highlighted. Findings also show that there are vertical health programmes (VHP) systems running parallel to DHIS 2. Various donors fund these systems, mostly with interests related to specific disease programmes, such as HIV/AIDS or tuberculosis:

"In most cases, malaria, HIV and TB data, if you look at their databases/systems, it's mainly a duplication of DHIS 2 data. When you go to this HIV, TB, malaria system, it's a duplication." Respondent 3

Respondents also reported that there were no clear policies and frameworks that guide and govern the use and implementation of HISs at the MoH. The respondents particularly reported that the role of the IT

department is not clearly defined within the entire structure of the MoH. For example, DHIS 2 is managed by the primary healthcare directorate, and the IT division is more involved in the technical support of such systems at various levels of the health system. For example, the IT division ensures that health facilities are connected to the internet and that district and regional offices have operational computer equipment:

> *"The IT department is working on that now. They are trying to make sure that all the facilities, all health facilities... But now they are busy at the district facility, looking that they are all connected."* Respondent 4

Findings also confirm the lack of policies and frameworks to drive integration initiatives at the MoH:

> "We don't know the policy of the Ministry. Because it's like now the PAs or the minister need to intervene and give us the proper integration, and that is why are we having different systems which don't report to health information system. What is the use of creating health information system, why it's reporting? All these systems are not reporting, they are not integrated." Respondent 5

Disparate data sources and VHPs
Findings from this study confirm that the MoH uses heterogeneous HISs that support inter-level data transfer, even though there is a national DHIS 2. The multiple, isolated, *ad hoc*, parallel systems, database and data collection processes have been created due to inadequate coverage of information by the primary systems or a lack of coordination with already operational institutional systems and processes. The introduction of these systems leads to fragmented data sources in the health system. Moreover, the data collection tools used at various levels are not standardized and this leads to duplication of data from various systems:

> *"The IT department, particularly the IT technical advisor, is supposed to be involved in decisions related to the implementation of HIS. For example, where all these HIS are recommended by software developers, the IT advisor and different stakeholders need to sit around the table and decide on these systems. Because if you have data from*

> *Directorate of Special Programmes (e.g. HIV, TB and malaria surveillance), it will be duplicated in DHIS 2."* Respondent 4

Technical challenges
The institutional systems currently used in the Namibian health system are based on different standards that are not compatible. Heterogeneous systems are not interoperable, leading to data exchange challenges and systems operating in silos. Due to the lack of interoperability, information is extracted from disease programmes such as Epi info (EPI = Extended Program for Immunization), and IDSR (Integrated Disease Surveillance and Response), and later imported manually into DHIS 2.

Poor infrastructural conditions challenge the flow of data from lower levels of care to district and national health administration levels. This is caused by a lack of computer equipment and limited internet connectivity. Furthermore, there is no uniform infrastructure development at various health institutions and district offices. In some instances, the facilities are equipped with computers but are not connected to the internet:

> *"Health institutions should first be provided with the internet connectivity. Because you can have computers but then what are you going to do with it? You can only capture data but not connect the DHIS system to the internet to send the data to the next level."* Respondent 5

The bottlenecks experienced in the data flow process, as reported in the semi-structured interviews, are described in the next section. In addition, recommendations of an ideal ('to-be') data flow process is discussed.

The 'to-be' model
The experts were involved in the adaptation of the 'as-is' model in an attempt to identify bottlenecks and suggest ways to improve the process by eliminating non-value adding activities. The researcher then developed a 'to-be' process model, as shown in Figure 3, to depict the ideal data flow between the healthcare levels (16, 19).

"To-Be" PHC data flow between levels of the Namibian Health System
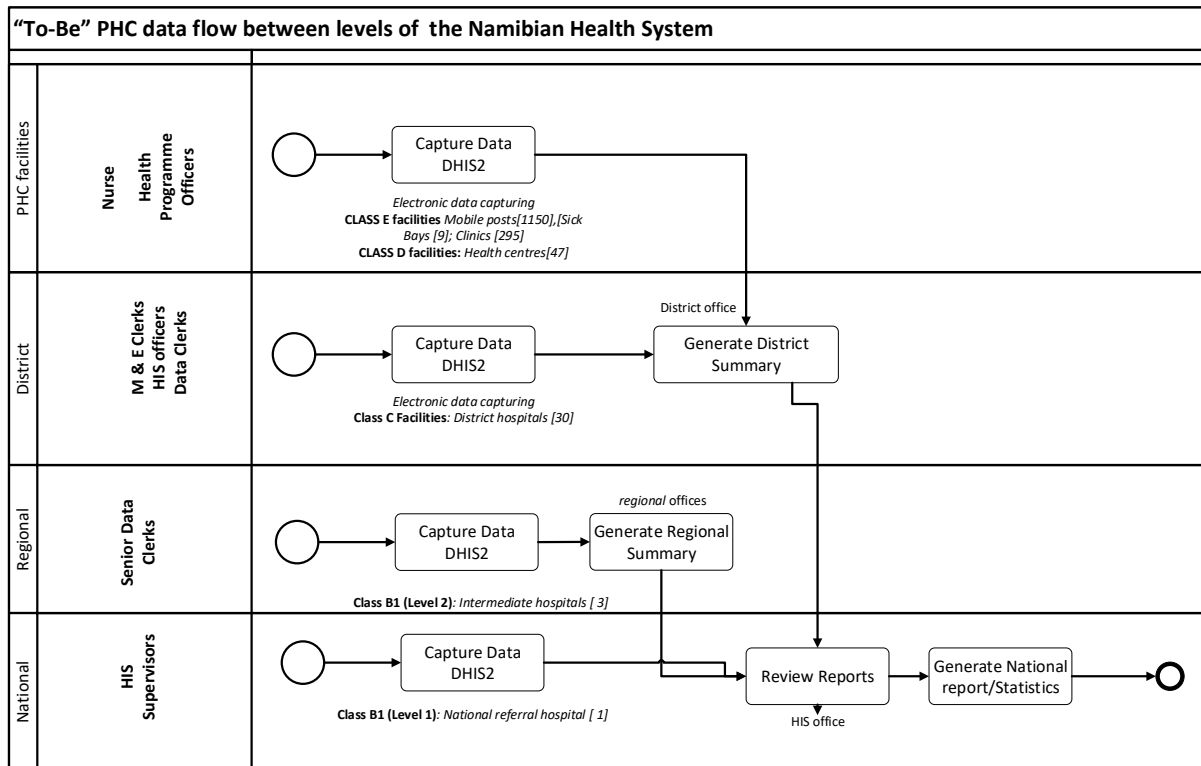
Figure 3: **'To-be' process model for the data flow process**

It was established during the semi-structured interviews that the PHC data are collected from various health facilities (e.g. mobile clinics, wards in hospitals) located at regional and national levels. This slows down the data capturing process at district level, as different tools (paper-based and electronic) are used to collect data at PHC and higher levels of care, respectively.

To address this bottleneck, some experts recommended the decentralization of electronic data capturing by introducing more service points at lower levels of the health system (e.g. clinics, wards) and using a cloud-based approach to capture data on DHIS 2. Since DHIS 2 is used as the institutional system at the MoH, The model was modified to show a decentralized DHIS 2 that support the collection of routine data at all the levels (primary, district, regional and national) and disseminate data to other health systems.

Experts also recommended that hospitals should ideally be grouped into different categories. These classifications (Class A – Class D) will group hospitals based on the services the hospital renders at each healthcare level. Access to services and equity will be promoted by having fewer referrals to higher levels of care, such as a Class A hospital (e.g. Windhoek Central Hospital), by diversifying the specialized services to Class B hospitals. This is in agreement with the Namibian roadmap for the development of the hospital and health facilities implementation plan (6). It is hoped that with these new classifications, more health facilities will be equipped with a better infrastructure to adopt DHIS 2 for their electronic data management. Another recommendation to improve the current data flow process is to promote collaboration with other countries as part of the HISP (Health Information Systems Program) initiative. This will aid capacity development and the sharing of experiences from lessons learned in using DHIS 2.

Discussion
This study confirms that there are organizational challenges hindering the data flow process in the Namibian health system. These organizational challenges are related to a shortage of skilled personnel, and a lack of clear governance structures and policies. The findings are similar to those of Khan & Edwards (5), who report that there is a shortage of skills, system administrator competencies and technical

support capacity critical to the general operation of the HIS in Namibia.

Although there is an initiative from the IT division to send trainers to the regional DHIS 2 workshops, these workshops are not arranged for clinical staff. The potential trainers are sent to regional workshops as part of the HISP to enrich their knowledge on the administrative functions of the system. The master trainers are later tasked with training data entry operators for the public health facilities to enrich their capacity in data entry, analysis and reporting of the disease burden in different regions. The training poses a challenge, as sometimes data operators are trained and then resign, leaving other personnel with no option but to enter the data on the DHIS 2.

The shortage of skilled personnel, therefore, remains a challenge at the MoH. This finding is in agreement with Sheikh (23), who investigated the challenges of HIS use in other developing countries. The experts recommended that the MoH should diversify training to include more personnel and clinical staff, to ensure that there are several personnel knowledgeable in administrative functions, particularly data entry. Furthermore, since DHIS 2 has a centralized database that enables instant access to data at any health system level, it will be beneficial to make data instantly accessible at various health levels, as shown in Figure 2. The improvement of data timeliness and data quality issues related to accuracy and completeness can be addressed by decentralizing the DHIS 2.

Governance issues were raised regarding VHP systems collecting the same data as collected by the DHIS 2, leading to duplication of effort. Similar reports from the USAID assessment conducted in 2012 highlight that these VHPs "had their own central staff and data collecting enterprise that was not properly coordinated with other aspects of the DHIS 2" (5). This is in agreement with Nyella's finding that VHPs run their separate systems and maintain their own management structures in developing countries (21).

The MoH has put in place a change strategy and appointed a TWG that is tasked with the assessment of the current HIS. The group has conducted various initiatives to make an inventory of the numerous HIS-related information systems and databases used by the MoH. The group is also conducting a comprehensive assessment of their functions, content data elements and which vertical programmes they belong to. The objectives are to identify strengths and weaknesses of these systems and find solutions to integration planning efforts. So far, the group has managed to make useful recommendations to discontinue some legacy and duplicate vertical systems.

Other challenges experienced are related to technical issues. Namibia, among other developing nations, faces integration challenges, such as different interoperability standards used by HISs, and an inadequate foundational infrastructure for driving HIS integration initiatives (8-21). The different systems illustrated in Table 1 use different data standards. These systems are not interoperable, leading to data exchange challenges and systems operating in silos. In addition, information is extracted from different electronic systems in a printed format and later imported manually into DHIS 2 (5).

Given the above challenges and bottlenecks, the experts recommended various ways in which integration can be achieved in the Namibian health system.

Utilizing DHIS 2 has allowed data integration to be achieved to a certain degree. For example, with the first version of DHIS, users could import and export data from the system and organize data into different formats. DHIS 2 is web-based and more flexible, as it can interoperate and collate disparate types of aggregate data. The current version also offers additional functionalities of visualizing data in charts and pivot tables. Even though integration initiatives have been achieved through DHIS 2, the system is not implemented at health facilities at primary healthcare levels. This has led to delays in data reporting at regional, district and national levels of care.

Despite the reported benefits of DHIS 2, some respondents preferred paper-based tools for data collection. They reported that paper-based tools are best for some service points, given that clinical staff lack skills in operating electronic systems. This finding brings to light the digital divide between healthcare levels in Namibia caused by hybrid methods of data collection tools.

Literature reports that DHIS 2 has been widely adopted in many countries in Africa to achieve integration, as shown in Table 3 (9, 11, 20-22). These countries share the same integration challenges as those experienced in Namibia.

Table 3: **A summary of DHIS 2 use in developing countries (9, 20-22)**

DHIS 2 implementation globally	Countries
Completed national implementation	Bangladesh, Burkina Faso, Ghana, India, Kenya, Liberia, Mozambique, Nigeria, Rwanda, Sierra Leone, Tanzania, The Gambia, Uganda, Zambia, Zanzibar, Zimbabwe
Partial national roll-out	Algeria, Bhutan, Burundi, Colombia, Democratic Republic of Congo, Laos, Malawi, Solomon Islands, South Africa, Sri Lanka, Tajikistan, Vietnam
Pilot stage or early phase in roll-out	Afghanistan, Benin, Congo Brazzaville, Côte d'Ivoire, Guinea Bissau, Mexico, Myanmar, Namibia, Nepal, Niger, North Korea, Samoa, Senegal, South Sudan, Sudan, Togo, Vanuatu

Conclusion:
The purpose of this paper was contribute towards an analytical understanding of transferring PHC data between primary, secondary and tertiary health institutions in the Namibian health system. Furthermore, the main focus was to determine how HISs support inter-level data transfer between these institutions.

The findings of the study confirm that Namibia, like other Southern African Development Community countries, uses DHIS 2 as an institutional system to collect, process and disseminate data to higher levels of the health system. The gaps and challenges experienced in the data transfer process are related to the use of parallel systems owned by vertical programmes and donors collecting similar data, leading to duplication of effort and issues related to disintegration. This presented both a challenge and opportunity to integration initiatives. Ensuring compliance of integration of various HISs, including systems owned by vertical programmes, continues to be a daunting problem. As implied by this study, there is a need to strengthen collaboration between the national HIS and VHS to address the integration challenges. To ensure there is a smooth data flow within the health system, the MoH needs to pay close attention to structural challenges, for example to clearly define roles and structures involved in data communication tasks. It is recommended that the MoH clearly defines its structures to ensure that the IT department fulfills its primary role of providing IT services, including HIS integration. The study results reveal that there is a dire shortage of staff in various key functions, particularly at the district level. In some cases, HIS officers are not competent and skilled to operate electronic systems such as DHIS 2.

In conclusion, there is a need to strengthen collaboration between the national HISs and VHSs to address the integration challenges. The MoH needs to invest in capacity building projects to train HIS officers on data analysis and the use of DHIS 2. In addition, a clear outline of structures and functions needs to be defined to ensure that various MoH units, particularly the IT department, fulfill their primary role of providing IT services, including HIS integration. This study was limited to modelling the inter-level data flow between levels of healthcare in Namibia to understand challenges and bottlenecks inherent in the process.

Future studies should examine integration frameworks to promote better data flow within the Namibian health system.

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