The Status of Integration of Health Information Systems in Namibia

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Abstract: The acquisition of health information systems (HIS) by the Ministry of Health and Social Services (MoHSS) in Namibia has been uncoordinated, thereby resulting in fragmented silo systems and a lot of duplication of functionality across departments. Integration of ISs is required to provide consistent information support throughout the health sector. The aim of this paper is to assess the level of integration of IS in the Namibian health sector. The question therefore would be, "What is the current level of integration of HIS in the Namibian health sector and what are the factors that influence their level of integration"

The study adopts a qualitative research strategy through a case study of MoHSS departments. The case study research design was selected to focus on three MoHSS Electronic Records Management (ERM) systems, the DHIS2, EPI INFO and eHealth. A critical analysis of related IS integration literature was conducted, which fed into interview questions on the status of HIS integration in Namibia. Three categories of semi-structured interviews were performed – one with the information technology (IT) experts, one with the systems users who are the nurses and the doctors and the last with health policy experts. The interviewees were expected to have worked in one of the Ministry's departments for at least 3 years. The interview sample consisted of four systems analysts, two systems administrators, two computer technicians, one intern, two doctors, 30 nurses and 1 Deputy Director of IT. Interviews were recorded and later transcribed for data analysis.
The conclusion reached by this research was that although efforts have been initiated towards the integration of HIS in Namibia, a lot of ground is yet to be covered.

Keywords: health information systems, information systems integration, interoperability

1. Introduction

There is an urgent need to address the issue of fragmented health information systems (HIS) in developing countries (Sahay, et al., 2009). A common problem facing many organisations, including health organisations today is that of multiple, disparate information sources and repositories including databases, object stores, knowledge bases, file systems, digital libraries, information retrieval systems and electronic mail systems, etc. (Garcia-Molina, et al., 1995). Decision makers often need information from multiple sources but are unable to obtain and fuse the required information in a timely fashion due to the difficulties of accessing the different fragmented systems. When systems are fragmented, in most cases the information obtained can be inconsistent and contradictory. According to Sahay, Monteiro and Aanestad (2000) fragmentation and lack of integration creates redundancy and an additional workload for health workers as information regarding the health status, disease incidence, prevalence and treatments is often collected repeatedly and separately. This is due to the fact that HIS are heterogeneous, both technically (i.e. applications, platforms, protocols, language), in relation to funding mechanisms (i.e. governmental/national, donor agencies, universities, World Bank, local municipality) and with respect to institutional grounding (i.e. Central Ministries, district administrations, local health clinics) (Sahay, et al., 2009). According to Hasselbring (2000), integration of systems is impacted by three factors of autonomy, heterogeneity and distribution (Hasselbring, 2000). A horizontal integration of layers therefore that is required to support systems integration consists of inter-organisational processes, enterprise application integration and middleware integration. While horizontal integration refers to the coordination of functions, activities or operating units at the same level in the delivery of services, vertical integration refers to the coordination of functions and activities of units operating at different stages of processes involved in delivering patient services (Gillies, et al., 1993). Functional integration areas are associated with both physician systems and clinical integration systems that are positively related to one another, e.g. finance, human resources, information management, marketing and quality assurance across units. Clinical integration consists of both horizontal and vertical integration (Gillies, et al., 1993).

In the case of Namibia however, for long periods of time, the acquisition of HIS was driven by development partners. According to Nyella (2011), the multiplicity of vertical programs supported by a myriad of donors results in uncoordinated information systems which are in conflict with the primary healthcare goals of an

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integrated HIS (Nyella, 2011). As a result of the myriad of donors in Namibia's healthcare sector, there is duplication of functionality and a large number of systems are operating in silos in the different departments of the Ministry of Health and Social Services (MoHSS). Integrated access to information that is spread over multiple, distributed and heterogeneous sources is a problem that requires a solution in many scientific disciplines, including health (Naumann, et al., 1999). Data sources may be overlapping, replicated or disjointed both in the type of data they store as in the particular actual objects they contain. Therefore the need to move towards integrated HIS arises in Namibia. An integrated HIS would increase the efficiency of data capture and also generate big data which when processed in turn lessens the burden of decision-making in the health sector by providing up-to-date information.

Information Systems (IS) integration is defined as the extent to which data and applications through different communications networks can be shared and accessed for organisational use (Bhatt, 2000). The main purpose of IS integration is to provide a consistent information support throughout the whole organisation in order to respond to the dynamic challenges in the markets. Integration occurs when systems are able to talk to each other, when systems are able to share information among the different stakeholders and where information generated by the systems is available in one central repository. The benefits of information systems integration are the comprehensive scope of clinical and health-related services covered, meeting patients' needs rather than that of providers, extensive geographic coverage to maximise patients' access to services provided and to minimise duplication, standardised care delivery by inter-professional teams to promote continuity of the care process, and well-developed performance monitoring systems (Suter, et al., 2009)

Namibia's National Health Information System (NHIS) falls under the Primary Care Directorate in the Ministry of Health and Social Services (Haoses-Gorases, 2015). It is charged with the responsibility of providing a comprehensive source of data on a large number of health-related indicators. The NHIS was designed to improve service delivery in terms of quality and effectiveness of strategies and to monitor the trends in disease occurrence. In addition, it also provides information for national policy makers, socio-economic and health personnel, as well as the public at large (Haoses-Gorases, 2015). The organisational structure of the NHIS system is fragmented across different directorates and institutions. The challenge to the system is that there is a shortage of human resources to coordinate, analyse, and report on the information in a comprehensive and timely fashion. In the Namibian health environment, a large number of systems, databases, and processes are fully manual, paper-based, or only partially electronic, and to a large extent formats are either fragmented or non-standard. This adds significantly to work burdens and seriously undermines efficiency.

In total, there are 446 health facilities in Namibia; the figures include the hospitals, health centres, clinics, stand-alone Voluntary Counselling and Testing VCT centres, and sick bays (MoHSS, 2011). The facilities are under various management authorities, including government, private-for-profit, and missionary, NGOs, Ministry of Defence (NDF) and the Police. All facilities aim to deliver reputable health care services to the communities (MoHSS, 2011). This is a clear indication that the health system in Namibia is reputable and functioning, although fragmented. The factors that influence HIS integration are factors such as: organisation goals, legislative power, healthcare accessibility and digital division (Suter, et al., 2009). While there are a number of national and healthcare sectorial policies and strategies, there is currently no HIS specific strategy or policy (Namibia, 2011) to guide the HIS evaluation processes towards integration of HIS. The MoHSS needs HIS in the following clustered operational and administrative categories: routine service data, disease surveillance, program monitoring and evaluation (M&E), tertiary healthcare, social welfare services, therapeutic information and pharmacological enter, national medicine board, administrative record and census surveys and vital statistics in the country (Office of the President, 2013)These sectors of the health care all have some sort of technology implemented and in use.

2. Information systems integration

Fernando (2004) states that because of the regulatory gap between implementing new and emerging information and communication technology (ICT) and managing the security risk the latter represents, integration is complex. Other impediments to integration include poor data quality and fragmentation, budgetary constraints, irreconcilable systems architectures, a history of incompatible data standards, privacy jurisdictions and a lack of access to proven evaluation results (Fernando, 2004).

The healthcare sector is built around collecting data from different sources such as doctors, patients and field visits at national, district and hospital levels (Alshawi, et al., 2003). As a result, the silo HIS heterogeneous and distributed nature exists in the healthcare sector. Sharing of data has become an issue (Batya & Achimugu, 2010) within these organisations. HIS tend to consist of enormous silos of paper-based or electronic data that are fragmented or of poor quality (Batya & Achimugu, 2010). It is almost impractical to integrate the HIS, because of its nature. But, today's technology can make it possible to have health data in real-time as they are entered into the system. Ideally, systems integration must occur in real-time to meet the increasing demands of the healthcare sector (Alshawi, et al., 2003). Therefore, in healthcare organisations, integration of disparate HIS is viewed as a high priority (Batya & Achimugu, 2010), hence studies like this one.

There are various models of integration that can be identified (Mykannen, et al., 2004; Adenuga, et al., 2015; Adenuga, et al., 2015):

- Information-oriented integration through information exchange, i.e. databases and APIs
- Process-oriented integration through centrally-managed processes to support the flow of information
- Service-oriented integration to share common business logic or methods
- User-oriented integration to allow the user to gain a consistent view of a multitude of systems

An appropriate platform for integration that can offer real-time services and ensure that heterogeneous systems in the healthcare sector are interoperable is necessitated. Alshawi, Missi and Eldabi (2003) state that a good integration strategy begins with a through data assessment study, and relies upon the quality of the data. Assessment of the healthcare processes, available technology, business cases and readiness assessments are required. Data quality is the state of completeness, validity, consistency, timeliness and accuracy that make data appropriate for exploitation (Alshawi, et al., 2003).

The European Standardisation Committee CEN TC310/WG1 recognises three levels of integration of IS including HIS (Panetto & Cecil, 2013). These are:

1. Physical integration, which is the interconnection of devices and networks. In the health sector, therefore, this would mean that the standalone HIS will be enabled to exchange data between themselves via communication networks
2. Application integration, which is the interoperability of software applications and database systems in heterogeneous environments. In the health sector, this would mean that the standalone HIS can access centralised databases, and the software systems can interface with one another through middleware.
3. Business integration, which is the coordination of functions that manage, control and monitor business processes. In the health sector that would mean that these standalone HIS all contribute towards a common business goal, which is, generating integrated information for decision-making.

Klischewski (2004) identifies two types of IS integration: information integration and process integration (Klischewski, 2004). Information integration aims at facilitating information flow, i.e., providing access to structured information resources across technical and organisational borders in order to enable new services based on a virtual shared information environment (Adenuga, et al., 2015). In health, this would be about access to health information anytime and anywhere. Process integration centres around interrelated steps and stages of process performance across technical and organisational borders in order to enable new services based on an overarching monitoring and control of process flow. The user is protected from the complexities of the distributed nature of the HIS when accessing health information (Grimson, et al., 2000).

Klischewski (2004) further identifies IS integration in terms of cooperation and interoperability between administrators in an organisation and their partners. Cooperation points to a common cross-organisational strategy and its implementation. The Namibian health strategy is geared towards integration of the standalone HIS that are distributed across the various health departments and centres. Interoperability points to the technical means which enable IT systems to exchange messages in order to realise machine performance across system borders (Hasselbring, 2000).

According to Batra, Sachdeva, & Mukherjee (2015), the need to integrate a system that handles exchange of medical data coming from different healthcare service providers lies in the standards of the same medical record in different structures (Batra, et al., 2015). Web services technology is there to solve interoperability problems. Web services rather than standardising electronic health records will solve integration (Bicer, et al., 2015). The realisation of communication interface standardisation, function modularisation, common sharing of medical information resources and adaptation to local circumstances enables the system function, management function, information processing and communication function to be achieved on a complete platform, which provides such advantage as common sharing, openness, security, extensibility and simple operation (Zhanjun, et al., 2003). Inter-platform data exchange among different hospital IS such as HIS, RIS and PACS is through the seamless integration according to international standards such as Digital Imaging and Communication in Medicine (DICOM), Health Level Seven International (HL7) and TC251. In a framework for the integration of heterogeneous clinical, administrative and financial information elements of a hospital into a unified system environment, all existing local applications are preserved and interconnected to an information hub that serves as a central medical and administrative data warehouse (Zviran, et al., 1998). The standards for integrating the healthcare enterprise include Common Object Request Broker Architecture in Medicine (CORBAmed), HL7, DICOM, and Integrating the Healthcare Enterprise (IHE) (El Azami, et al., 2012). Integration standards can be distinguished between technical and semantic integration on one hand and functional integration on the other. There are a number of IS integration approaches such as Enterprise Resource Planning (ERP) and management control and IS integration in terms of data architecture which is commonly referred to as the single database concept (Chapman & Kihn, 2009). A combination of techniques to integration such as Service-oriented Architecture (SOA), Enterprise Application Integration (EAI), workflow management and grid computing gives rise the emergence of enterprise systems in health care (Editorial, 2012).

A sampling of global forces during the development of integrated systems is (Mercer, 2001):

1. Populations in industrialised countries are aging, which will result in an increase in the (Chapman & Kihn, 2009)prevalence of chronic disease
2. Fragmentation of health systems
3. Determinants of health
4. Improved technology for patient care
5. Economies unable to support the current and increasing proportion of GDP consumed by healthcare services
6. No proven benefit of health care services

3. IS integration and decision support

The greatest barrier to the routine use of health information decision support systems by health workers is that the systems are designed for single problems that arise infrequently and have generally not been integrated into the routine data management environment for the user (Muller, et al., 2001). Direct integration and embedding of knowledge-based functions in HIS provides an interactive and user-controlled, context-sensitive approach to decision-support, which is crucial for end-users' acceptance and compliance. To be termed integrated, the health decision support system (DSS) should be platform-independent, easily adaptable to different hospital/health centre settings, heterogeneous and using distributed component-based sources. Integration is understood in terms of access to information resources in the form of content, structure, visualisation of patient segments, with the goal of creating a virtual patient record at the medical work stations (Leisch, et al., 1997). A middleware layer of such a HIS architecture enables services for data mediation, distributed directory access and workflow management and shields the user from the complexities of a distributed system.

The non-integration of systems has been a barrier to business process automation, as whole incoming research which looks at 3 layers of integration is still ongoing to piece together disparate systems (Irani, et al., 2003). This can be said of health information systems management in Namibia. However, a new generation of software, termed Enterprise Application Integration (EAI) has emerged that specifically addresses integration problems from a technical perspective and leads to more flexible and maintainable IS. However, this is only on the software side and specifically on business process integration. Enterprise IS engineering processes develop IS to align with the IS business goals of an organisation. (Panetto, 2013).

Information systems integration, namely in terms of data architecture, are commonly referred to as a single database concept. Data integration means the standardisation of data definitions and structures through the use of a common conceptual schema across a collection of data sources (Goodhue, et al., 1992). Data integration ensures data have the same meaning and use across time and users, making data in different systems or databases consistent or logically compatible. IS integration is the extent to which different organisations can share databases for coordinating their activities (Goodhue, et al., 1992).

Enterprise Resource Planning (ERP) is business process management software that allows an organisation to use a system of integrated applications to manage the business and automate many back office functions related to technology, services and human resources. ERPs integrate and draw data from a common database. They systematise and coordinate record keeping, design and implementation of structures of categorisation and aggregation of transactions, ultimately allowing for the generation and manipulation of comprehensive virtual perspectives on the nature and flow of operations and resources (Chapman & Kihn, 2009). The concept of ERP is drawn into the integration of HIS.

Wilhelm(2000) insinuates that integration is only possible if message formats and message content are standardised; the challenge of heterogeneity of hardware platforms, Operating Systems, Database Management systems , programming languages and naming conventions is overcome; and middleware infrastructure such as CORBA, Database Gateways and Transaction Monitors is in place to integrate the software and physical layers (Wilhem, 2000).

The ten universal principles of successfully integrated healthcare systems which may be used by decision-makers to assist with HIS integration efforts are (Suter, et al., 2009):

1. Comprehensive services across the continuum of care
2. Patient focus, i.e., meeting patients' needs
3. Providing geographic coverage to maximise patients' access to services and minimise duplication
4. Standardise care delivery through inter-professional teams in order to promote the continuity of the care process
5. Well-developed performance monitoring that includes indicators to measure outcomes at different levels
6. Computerised IS that allows data management and effective tracking of utilisation and outcomes
7. A vision and an organisational culture that speaks into the vision
8. Physicians integrated at all levels and playing a leadership role
9. Governance networks that promote coordination
10. Proper financial management

The critical success factors for managing IS integration are (Mendoza, et al., 2006):

1. Appropriate configuration of communication software
2. Standard data models for documentation, unification, updating
3. A known organisational structure
4. Change determined and justified at a production level

4. Integration architectures

Different architectural approaches and frameworks are engaged in information systems integration and related studies. The most commonly adapted application frameworks are Zachman's framework (Zachman, 2002)and Spewak's EAP (Spewak & Tiemann, 2006).

Integration and interoperability contribute largely to the failure of ICT and HIS activities in any organisation hence, there is need for a health care architecture model (Adenuga, et al., 2015). Interoperability is the ability of two systems to understand each other and to use the functionalities of each other.

Zachman's framework for Enterprise architecture and Information Systems architecture is a framework that is independent of tools and methods used in any IT business. It has a 36 cell table with 6 rows (scope, business model, system model, technology model, components and working system and 6 columns (who, what, where,

when, why and how). It has an ideal set of rules for the management of complex and evolving IT enterprises. It aligns business goals with IT investment.

Zachman's framework is divided into business, application, data and technical-centric architectures. The business centric architecture processes business uses to meet goals. The application-centric architecture focuses on defining the main applications needed. Since applications cannot interoperate unless tightly coupled to each other, selection of the application that can improve data management and business support is important. Application architecture, also known in some literature as application centric is described as suitable for avoiding monolith distributed systems if selected applications are adopted across the board. Application integration, such as integration of software applications and database systems; and business integration involves coordination of functions that manage, control and monitor business processes.

The information/data architecture is basically how data sources are organised and accessed. The major objective of information/data architecture is to identify the data types that support business development. The technical architecture defines technology that can provide an environment for application building and deployment. At this stage, the main technology concepts are identified; such as the technology to implement applications, data storage and so on (Vasconcelous, et al., 2004). Some researchers referred to this approach as the physical integration. This is because the focus is on interconnection of devices and connecting machines via computer networks ((Adenuga, et al., 2015).

4.1 Spewak's Enterprise Architecture Planning (EAP)

Spewak's Enterprise Architecture Planning (EAP) is the "process of defining architecture for the use of information in support of the business and the plan for implementing those architectures". It takes a business approach to architecture planning to provide:

- Data quality
- Access to data
- Adaptability to changing requirements
- Data interoperability and sharing
- Cost containment

5. Factors for consideration for a successful HIS integration

There are a number of factors to consider for the success of HIS integration. These are interoperability and organisational change management.

5.1 Interoperability

Service providers use products from different vendors to reduce their cost to build the system needed to sell their service. In addition, service providers increasingly rely on working with other service providers to offer their service. Therefore there arises the challenge of interoperability of such systems. Technical standards are the building blocks of interoperability. Without them, the necessary nomenclature, structure and messaging required for health information integration cannot be implemented. Interoperable systems are essential to advance patient care and safety (CGI, 2013). There are a number of issues to consider when talking about integration.

Interoperability and standards are the main challenges to achieving interoperability. There are three levels of health information technology interoperability, and these are: 1) foundational; 2) structural; and 3) semantic (HIMSS, 2013); (Fernando, 2004); (CGI, 2013).

The foundational interoperability allows data exchange from one information technology system to be received by another and does not require the ability for the receiving information technology system to interpret the data.

The structural interoperability is an intermediate level that defines the structure or format of data exchange (i.e., the message format standards) where there is uniform movement of health data from one system to another such that the clinical or operational purpose and meaning of the data is preserved and unaltered.

Structural interoperability defines the syntax of the data exchange. It ensures that data exchanges between information technology systems can be interpreted at the data field level.

The semantic interoperability provides interoperability at the highest level, which is the ability of two or more systems or elements to exchange information and to use the information that has been exchanged. Semantic interoperability takes advantage of both the structuring of the data exchange and the codification of the data including vocabulary so that the receiving information technology systems can interpret the data.

This level of interoperability supports the electronic exchange of health-related financial data, patient-created wellness data, and patient summary information among caregivers and other authorized parties. This level of interoperability is possible via potentially disparate electronic health record (EHR) systems, business-related information systems, medical devices, mobile technologies, and other systems to improve wellness, as well as the quality, safety, cost-effectiveness, and access to healthcare delivery.

5.2 Organisational change management

Organisational change management is crucial to successful integration of HIS including organizational readiness, planning, social engineering, design and development, training, managing expectations, and user acceptance. Assessing organizational readiness determines an organization's capacity for change (CGI, 2013) Suter, et al. (2010) articulated ten key principals for successful health systems integration, as mentioned in the previous section. Organisations that achieved successful integration of HIS have a focus on a combination of the listed principles. These organisations also achieve real time data (Suter, et al., 2009)

6. Statement of the problem

The main motivation to the implementation of HIS is the need to have an information driven sector. Presently, HIS in developing countries including Namibia health systems are characterised by segmented information systems and medical records that are paper-based (Clifford, et al., 2008); (WHO, 2012)). This has a negative impact on the delivery of health services in that patient records captured by health persons in one region of Namibia are inaccessible to health personnel in other regions should the patient seek health services outside their jurisdiction. Pina et al (2015) expressed that the escalating complexity of heterogeneity of health care delivery systems has led to increased fragmentation of how and where health care is delivered and fragmentation creates ill-defined relationships between fragments (Pina, et al., 2015)). Also, a lot of data is generated but never used in decision-making due to the fragmentation. To plan the way forward, the Namibian government needs the information on the current state of integration of the technical aspects, processes and business functionality of its HIS.

In the case of Namibia however, for long periods of time, the acquisition of HIS was driven by development partners. According to Nyella (2011), the multiplicity of vertical programs supported by a myriad of donors results in uncoordinated information systems which are in conflict with primary healthcare goals of integrated district-based HIS (Nyella, 2011). As a result, there is duplication of functionality and a large number of systems are operating in silos in the different departments of the Ministry of Health and Social Services (MoHSS). Integrated access to information that is spread over multiple, distributed and heterogeneous sources is a problem that requires a solution in many scientific disciplines, including health (Naumann, et al., 1999). Data sources may be overlapping, replicated or disjointed both in the type of data they store as in the particular actual objects they contain. Therefore the need to move towards integrated HIS arises in Namibia.

7. Methodology

The following section considers the aims and objectives, research design, data collection, data analysis and the study protocol.

7.1 Aim and objectives of the study

The primary aim of this paper is to assess the level of integration of IS in the Namibian health sector, in order to improve the service delivery at the MoHSS facilities.

The objectives were as follows:

- Investigate the level of integration of HIS in MoHSS agencies of Namibia.
- Identify factors that influence integration of HIS in the MoHSS agencies of Namibia

The question that this research asks is, "What is the current level of integration of HIS in the Namibian health sector and what are the factors that influence the levels of integration?"
The sub-questions are:

- What is the status of HIS integration in Namibia?
- What are the critical success factors to HIS integration in Namibia?

7.2 Research design

The research design refers to the overall strategy that the research study chose to integrate the different components of the study in a logical way in order to effectively address the research problem. A case study research design was selected to focus on five MoHSS ERM systems. The five systems were selected randomly from a pool of 67 systems. The focus of the study is on clinical data specifically, hence the selection of ERM systems only.

A background literature review was undertaken on integration such as integration criteria, and different levels of integration. A critical analysis of related literature was carried out to identify strengths and weaknesses of research that had been undertaken on health information systems integration. The critical analysis paved the way to craft the interview guide instrument. From the critical analysis, questions for the semi-structured interviews were extracted. Interviews were conducted with health personnel such as doctors, nurses, IT technicians, systems analysts, and systems administrators to get their views on integration. Interviews conducted were recorded by the researchers and later transcribed to enable data analysis and-cross analysis to establish related answers. The interviews were carried out between June and August 2016.

The study protocol was meant to improve and achieve reliability of study. Table 1 shows the study protocol adopted

Table 1: Study protocol

Purpose	Study issue	Effects
Literature survey	A background literature survey on integration was conducted	Technical report on integration
Identify questions	A critical analysis of related work was conducted which spoke into the structured interview questions	Critical analysis report, structured interview questionnaire
Identify respondents	People that are active stakeholders in the development, use and policy-making are identified	Health personnel and policy makers identified for interviews
Ensure comprehensive response	To obtain optimum response to the questions posed	The responses are recorded and transcribed

7.3 Research paradigm

The study adopted a qualitative research strategy. The strategy was found suitable for the required description to understand HIS, evaluation and integration. The qualitative data collection and analysis methods of semi-structured interviews and interpretation respectively were found suitable because of the required descriptions stated above. As specified by Silverman (2010), qualitative research strategy strongly features interest in the subjective matter and human experience and understanding (Siverman, 2013). A qualitative case study research is defined by Babbie and Mouton (2001) to have a special focus on quality and richness of data and not quantity (Babbie & Mouton, 2001)). Hence, the interviews conducted had to stop at a point of saturation, that is, when there was no new information coming from the interviewees.

7.4 Research sample

Two categories of interviewees were identified: 1). The IT experts in the MoHSS, 2) the system users, that is, nurses and doctors. Purposive sampling guided the selection of the interviewees based on experience. Interviewees were required to at least have worked in one of the ministry's departments for three (3) years.

The sample consisted of doctors, nurses, systems analysts, systems administrators, computer technicians, doctors and nurses. In any hospital environment, nurses consist of the bulk of the professional staff, hence 30 nurses were interviewed, as compared to single digit numbers of the other users.

Personnel grade	Number
Systems analysts	4
Systems administrators	2
Computer technicians	2
Interns	1
Doctors	2
Nurses	30
MoHSS – Deputy Director IT	1

7.5 Data collection

Data collection is the process of collecting data from the participants that are engaged in the study with the purpose of answering the research questions and achieving the research objectives in order to draw a conclusion on the findings. To come up with questions a critical analysis of related literature was conducted. This critical analysis identified gaps in the literature on HIS integration. The study interviewed participants from two hospitals in Windhoek and a Deputy Director from the MoHSS.
The questions that were asked included the following:

1. What integrated HIS do you know of in the MoHSS? Are the systems customised to the Namibian environment or off-the-shelf?
2. How are the systems sustained?
3. Does the MoHSS have a policy that guides the selection and integration of HIS?
4. Are there any bodies/committees that guide integration efforts?
5. What are the challenges to integration?
6. What are the critical success factors to the integration of HIS?

7.6 Analysis

Data analysis entails examining, categorising and summarising information in order to establish meaning and maintain evidence (Schoenbach, 2014). An interpretive approach was adopted to analyse the qualitative data. The information from the findings was classified according to governing policy, criteria for integration, level of HIS integration, data access and analytics, and data security from a deductive analysis. Conclusions were then drawn in which the research questions are answered by determining what the identified themes stand for.

8. Findings on the state of integration of HIS systems in Namibia

From a qualitative analysis of the data that was collected from the semi-structured interviews with various stakeholders in Namibia's health sector, a number of findings were derived. This data was then classified into different themes, as follows.

8.1 Integrated HISs for health records management

Of the 67 HIS identified in the Namibian public health sector, there are 3 integrated systems for patient health records management. Currently the MoHSS's Directorate of Health Information Systems and Research (HRD) is the custodian of the three systems in place, that is, the DHIS2, the Epidemic Info (EPI INFO) and the eHealth. EPI INFO (Anon., 2017) is an interoperable software tool to support outbreak investigations, disease surveillance, data analysis and visualisation of epidemiological statistics using maps and graphics. It has enhanced analysis and GIS functions. It extends desktop features to mobile devices and web platforms and also collects distributed data. The DHIS2 enables the collection, management and analysis of transactional, case-based data records (Anon., 2017). Information captured about individuals enables the tracking of persons over time using a flexible set of identifiers. Clinical health records from across multiple health facilities is collected. The eHealth system, also known as the Integrated Health Care Information Management System (IHCIMS) (Anon., 2017) is designed to cater for the day-to-day operational activities and services rendered by hospitals to patients. Medical information of patients is stored in digital form. Each patient is given a unique number which can be used across all the 34 government hospitals in Namibia.

Adopting the new systems means moving from standalone databases to an integrated database that supports the MoHSS's 66 systems. Before integrated HIS came into existence, each department had its own systems. Now, with integration, those systems that can exchange data will be integrated, while those that are not compatible will be deactivated. Support for back-end systems in the systems mentioned above is done by consultants, while local analysts are trained for user support in the usage of the systems. The users of the systems are the nurses, doctors, receptionists, administrative assistants in wards and data capture clerks.

The DHIS2 is an open source HIS. The DHIS2 has online capabilities and has strong support from international consultants. DHIS2 has a number of modules one of which summarises/analyses data, e.g. on disease spread. The EPI INFO is a case-based system. Case-based means that patient details are captured only for communicable diseases. The EPI INFO is an off-the-shelf system that only satisfies 70% of the hospital needs since it is not customised to the local Namibian environment. EPI INFO is a data analytics tool. The eHealth is an off-the-shelf integrated system on patient information such as patient registration, admission, discharge and billing. The nuclear medicine, pharmaceutical, X-ray, patient care and financial systems of eHealth are all integrated into this HIS. Management can easily obtain summary reports from the system. At the moment, the eHealth system captures data on diagnoses. Although the eHealth system is to be rolled out to all hospitals in the country, at the moment it is only at the Central and Katutura Hospitals in Windhoek and Oshakati Hospital in the north of the country. Katutura and Central Hospitals share one database, while Oshakati has its own database.

8.2 Policy on sourcing and integration of HIS systems

The ICT policy for the MoHSS and the MoHSS strategic plan guides the adoption and implementation of integrated HISs. The MoHSS ICT policy, whose custodian is the Permanent Secretary, guides people through the integration process in an effort to kill the systems of silos that exists currently. It is a move towards centralisation of health data. The ICT policy stipulates a number of standards that developers of such systems should follow such as what the system does, the purpose it serves, and does the purpose fit into the Ministry's strategic plan. The strategic plan talks into what the silo systems have in common and rolls out integrated systems throughout the country.

The HIS Technical Working Group (HTWG) is responsible for issues relating to the implementation and support of the integrated HIS. It is made up of different stakeholders from partner agencies. They have drafted a policy on technology for developing HIS systems. The HTWG defines policies on steps to be taken before any integration can occur. They are working on standards to be followed such as unique identifiers for patients, national data indicators, and interoperability of patient records to enable data exchange. The HTWG is working on a framework to integration, that is, for the systems to be able to talk to each other and to cut down on the numbers of silos. The HTWG will identify systems, evaluate them, and discover which ones to discard or keep, and those that can be integrated.

There is a draft policy on technologies to be used in further developing HIS systems. It falls short of identifying systems to use or the environment. The systems that are managed by the MoHSS support the country's overall health structure. They sit at points of service, facilities, regions, districts and at national level. Data is collected by the facilities and forwarded to the districts for capture. The regions oversee the work of the districts and validate the data. The national level implements technical solutions.

The stringent controls in purchasing systems that can be integrated are on paper. However, there is still lack of controls in systems that are coming in. Departments are failing to follow procedure and they continue to purchase autonomous systems that cannot be integrated.

8.3 Data access and analytics

When health information is integrated and shared via sophisticated software applications and solutions, the volume and variety of information constitutes big data (CGI, 2013). Therefore big data analytics have to be conducted to convert the data into a meaningful form for decision-making.

A lot of data is collected through the integrated HISs and updated on a weekly basis but is not used. Currently the HIS subdivision needs aggregated data on diseases while the electronic patient management systems (EPMS) operate at hospital level to collect patient data. Therefore disease and health intelligence is not easily available for quick and easier decision-making. This can be attributed to the lack of awareness of data that is

available by the different sectors of the health fraternity and the bureaucratic processes involved in obtaining data for those that are aware of its existence. Any requests for health-related information can only go through the Permanent Secretary (PS) office. This is because of privacy issues. Therefore there is a need to develop reporting tools that are customised to the local Namibian environment.

9. Challenges faced in integrating HIS

The challenges that are likely to be faced towards integration of HIS are as follows:

9.1 Interoperability and standardisation

Interoperability of HIS platforms is the ability of a HIS system to work with other HIS systems in access to health information. Unfortunately, HIS in Namibia are currently running on different platforms, running on different databases, developed in different languages. When patient records are similar between two systems, then interoperability is possible. Standards must be set for interoperability to occur. Unfortunately different vendors have different standards, which is why we talk of the disadvantage of standalone HIS. In software, different programs exchange data via a common set of formats. When communication protocols are similar then interoperability is a possibility. The Telecommunications Standardisation Sector of the International Telecommunications Union (ITU-T) provides standards for international communications. One system must be able to interpret the information exchanged meaningfully. Data and technology incompatibility occurs due to lack of standards.

9.2 Unique identifiers for patients

Patient records for one and the same person in different health centres may bear different identities, making it difficult to retrieve medical information. A standard unique health identifier for each individual makes it easy to link a person to all his/her health information. While Namibia is yet to come up with these unique identifiers, countries like Denmark, Botswana, Brazil, Thailand, Zambia, Kenya, Ukraine and Malawi are already using these unique identifiers in their Aids Programmes (UNAIDS, 2009).

9.3 National health data indicators

Before talking of any integration, national health data indicators must be identified to guide the integration. National health data indicators identify health outcomes for reporting the status of national health (Chrvala & Bulger, 1999). They feed into reasons for HIS integration. They describe aspects of health or health systems performance such as access to health services, integration and continuity of care, sustainability of healthcare services, level of patient-centredness, etc. An example of health indicators is available in Chrvala and Burger (1999)

9.4 Data warehousing

Data from the distributed systems should be brought into a single data warehouse from where integration is done for the purposes of business intelligence. Data warehousing brings together data from distributed sources for data analysis and reporting. The issue though at the moment is that most of the systems are outsourced and hence cannot integrate. For example, the X-ray department runs its own system on its own network.

9.5 Data security and privacy

Before full integration of HIS occurs, each department currently has its own network for privacy and security of health data since health information is sensitive. Therefore to centralise the large volumes of data on a cloud platform poses its risks. At the end of the day, privacy of health information comes down to the level of the doctor. It cannot be at the level of a private cloud for the different departments, for the hospital or for the health department.

9.6 Framework for integration

A framework for integration of HIS has to be in place for any success. Back-end systems should enable systems to communicate. Integrated reports and once-off repository of all information should be available. The proliferation of HIS and the high number of HIS under the MoHSS is due to the fact that these systems in the departments are predominantly donor-provided and outsourced. Each donor agency comes up with its own system because the efforts are not properly coordinated. The IT unit in the MoHSS was only established in

2003 and has a few years to correct these uncoordinated efforts. The MoHSS does not employ any staff to develop HIS.

9.7 Human resources and high staff turnover

As systems are integrated, more staff have to be trained in development, user support and usage and integrated HIS. However, staff turnover is high, meaning that retraining has to be done to replace those that leave. According to Brems, Johnson, Warner and Robert (2006) optimal healthcare delivery regardless of location is technology-demanding, costly without economies of scale and dependent upon availability of a skilled workforce (Brems, et al., 2006),. Expertise to spearhead integration is lacking. Not only are that, but local systems development capacity and maintenance capacity also lacking.

9.8 Connectivity in Namibia

Although the national ICT backbone is 12000 kilometres of fibre cable and there is also a sea cable landing on the shores of Swakopmund known as West Africa Cable System (WACS), data connectivity and infrastructure in Namibia offers a challenge. Currently a few regions have internet connectivity and where there is, the speed is very low. Very few offices are using 3G and 4G. Where there is integrated HIS, there is exchange of high volumes of data. The current infrastructure is not in a position to handle such large volumes. This is also associated with low computing capacity.

9.9 Barriers of access to real-time information

Even if the HIS were to be integrated, it would not fully serve its purpose of providing real-time information for decision-making as long as there are bureaucratic processes to obtaining the information. To have access to any health information there are set procedures. One has to go through the office of the Permanent Secretary

9.10 Centralisation versus decentralisation

Each department owns its own decentralised data which it manages. As a result, because of the proliferation of systems, there is duplication of functionality. Data is forwarded by facilities for capture at district level. The districts forward the data to regional level for validation, implementation of technical solutions and analysis. Integration brings the challenge of centralisation of data. If the centralised system collapses then all departments are affected, as opposed to a decentralised scenario, where when one node fails all the others continue to function still. Therefore, it is advisable to have in parallel an integrated system and then the silos, so that if one fails the other can take over. In decentralised systems when someone goes for treatment out of their jurisdiction, the doctor cannot access their records, communication lines may be down, the systems may not be interoperable because there is no uniformity in data records, no technical interoperability, or no organisational interoperability

9.11 Resistance to change

Doctors are resistant to use the new integrated system. The reason given is time constraints. They do not have the time to sit down and capture data and neither can they delegate such work to someone else as it involves confidential data

9.12 Lack of systems documentation

Current systems are not fully documented, hence it is difficult to follow. NGOs do not provide their documentation of systems. There is no guiding policy on documentation. As a result it is difficult to integrate such systems without full knowledge of their functionality

10. Business benefits of HIS integration

When systems are integrated, real-time querying is enabled and decision-making is based on reliable data from multiple sources. Decision makers can then make timely decisions as the loads of data generated eventually becomes useful. When systems are integrated there is a reduced duplication of functionality and a reduction in unnecessary expenditure on duplicated resources. The integration is comprehensive and at all levels including physical, application and business integration. There is no more complexity of heterogeneity of hardware, OS, DBMS, as middleware will enable communication. Hardware, software and communications are standardised. Systems are able to talk to one another. Integrated systems become multi-purpose systems as opposed to non-integrated systems which are single purpose. New services can be identified once systems are fully integrated. Cooperation between health administrators is enabled through integration.

A framework for acquiring systems that are platform-independent, customised, and interactive and with a data analytic component has to be in place as part of the integration strategy. The users should be shielded from the complexities of the distributed nature of the integrated systems. Business processes are automated in integration. Centralisation of databases ensures improved security of data and standardisation of access since there is only one access point to the data. The cons though of a centralised system are that the whole system goes down if the central database fails. The ill-defined relationship between fragmented systems becomes a thing of the past.

Geographic access to health information is widened. Patients can access health records from anywhere at any time. The functioning of inter-professional teams is made possible for continuity of care processes. Therefore the integration of HIS leads to an information-driven sector, as we move towards the knowledge economy.

The integrated systems are a combination of open-source and off-the-shelf systems, all with the pros and cons. Locals and external consultants maintain the systems.

There are security issues due to integration, privacy issues, compatibility issues and issues of quality of data. Data can now be shared. There is real-time access to data to meet the increasing demands of the healthcare sector. A good integration strategy and policy framework needs to be in place through assessment of healthcare processes, available technology, and readiness assessment and business cases. A sound healthcare architecture model also has to be in place for interoperability of data, hardware, software and access to data. Policy-making bodies such as the HIS Technical Working Group are in place.

Unique identification for patients is a requirement for integration, to ensure that doubt is eliminated on the identity of the patient. Trained staff will be required to maintain and run the integrated systems. Connectivity is also a critical success factor to integration of HIS. Unfortunately not all regions have connectivity and where there is, the connection speeds are low.

11. Conclusion and further work

There is an urgent need to address the issue of integration of the disparate information sources and repositories from the 446 health facilities of the Namibian health sector in order for the decision makers to gain access to information timely and efficiently. The Namibian fragmented HIS arose as a result of an uncoordinated effort of acquisition of HIS through various donor agencies. As a result, this paper is a first step towards the integration of HIS through the assessment of the levels of integration of HIS in Namibia. If the three levels of IS integration of physical, application and business are met, the Namibian integrated systems platform will be independent, heterogeneous and using distributed sources. Of the 67 HIS identified in the Namibian health sector, there are only 3 integrated systems for patient records management and these are DHIS2, EPI INFO and eHealth. While an ICT policy of the MoHSS is there to guide the adoption and implementation of HIS in Namibia, its implementation is still an ongoing process with the HIS Technical Working Group overseeing the implementation of the policy. There are challenges to integration which lie in the lack of interoperability standards, lack of unique identifiers for patient records, data security and privacy, lack of a framework for integration, lack of human resources to develop and support an integrated system, low levels of internet connectivity in Namibia, resistance to change in the adoption of integrated systems, to name but a few. The critical success factors to HIS integration in Namibia would be a functional telecommunications network, interoperability of HIS platforms and a skilled workforce to maintain the integrated HIS. Unfortunately, there are a number of hurdles to be overcome. The network coverage is not fully reliable in some parts of Namibia, the sourcing of HIS platforms has been uncoordinated this far leading to interoperability issues of the heterogeneous platforms and a need for a trained skilled workforce exists. By all accounts, integration will support data analytics for effective and efficient decision making. Due to the need for efficient and effective decision-making, integration of IS data, processes and infrastructure is required so that data from different sources can be analysed and used in health decision making. It would take the active commitment of policy makers in the health sector to ensure HIS integration is a success. There is a need for further research on the identification of research criteria for integration, evaluation of such integrated systems, a good integration strategy and a policy framework for integration.

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