CHALLENGES AND APPROACHES OF IMPLEMENTING STANDARD HEALTH INDICATORS IN HIERARCHICAL ORGANIZATIONS: A MULTI-SITED STUDY

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Submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy (PhD)

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September 2021

To

Keisha-Louise (TA)

Thanks for your love and patience

Acknowledgments

What counts as learning, is also true for writing this thesis. Because, it is not just the final product that counts but also the processes of interacting and negotiating with multiple partners and stakeholders that has enriched my Ph.D. journey. Looking back into the past five year, the journey is filled with joy, pain, learning and unlearning, but surely not a lonely one. Many people walked into my life throughout the journey and I am thankful to all who contributed in making this work possible. Since I cannot thank all of them sufficiently in person, there are however, some people whom I want to mention specifically for one reason or another.

To Prof. Jens Kaasbøll, you have been an inspiring coach in getting me through the challenging process of completing a PhD. You have been the best supervisor a student can ever ask for. I am also grateful to my second supervisor, Prof. Eric Monteiro, thank you for your critical and insightful comments. I also extend my warmest gratitude to Associate Prof. Petter Nielsen, my supervisor in the first 4 year of my study. Thank you for your insightful comments and support.

I owe a great deal of gratitude to my family members. To Keshia-Louise, you have been my rock. Thanks for your patience. My special thanks goes to my parents who believed in my dreams, encouraged, and supported me to pursue the challenging academic life. To my brothers and sisters, particularly, Pa Tadoh, Manya, Kah, and Kadndi you took all the burden of taking care of Keshia-Louise. I say thank you. I am indebted to my in-laws particularly Brenda and Uncle Peter, for your support in taking care of Keisha-Louise. I also extend my warmest gratitude to Drs. Jay Agwe, George Ngwa, and friends, S. Khandlhela, Raymond, and P. Zondo for your support and encouragement throughout this journey. I owe a special thanks to Dr. Reshma Subbaye for being a good friend, always inspiring, and engaging me whenever I am low. To Dorothy Beng-Mauuarin and family, thanks for your hospitality.

I also extend my gratitude to staff and colleagues at IFI particularly, Profs. Jørn Braa, Sundeep Sahay, Margunn Aanestad and Arunima, Elaine, and Johan. To my PhD and master colleagues at IFI, thanks for your support and encouragement.

A special thanks to Mozhdeh, Anniken, and Co. of IFI administration. I gratefully acknowledge the financial support under the Quota program from the Norwegian Government. I wish to thank the International Student Office, University of Oslo, for their cheerful assistance, particularly, Michele Nysæter, Lynn Josephson, and Mariana Larsen.

Thanks and praises to the Almighty God for everything, particularly for the strength, persistence, and intellect He gave me to make this study possible.

FAN

List of Abbreviations and acronyms used

BO	Boundary Objects
CHPS	Community-based health planning services
CHIM	Centre for Health Information Management
CIS	Cellule d'information Sanitaire
CoP	Community of Practice
DIO	District Information Officer
DHIS	District Health Information Software
DHIMS	District Health Information Management System
DHIS2	District Health Information Systems v.2
DHS	District Health System
FIO	Facility Information Officer
GHS	Ghana Health Services
FGD	Focus Group Discussion
HIS	Health Information System
HISP	Health Information system Program
HPRS	Health Patient Register System
HIV/AIDS	Human Immune Virus/Acquired Immune Deficiency syndrome
HMIS	Health Management Information System
IHC	Integrated Health Centre
ICT	Information and Communication Technology
ICTD4	Information and communications technology for development
IMF	International Monetary Fund
IFI	Department of Informatics
IS	Information System
ISP	internet service providers
LAN	Local Area Network
LMIC	Low and Middle income country
PHC	Primary Health Care
PHP	Parallel Health Program
PP	Parallel Program
MAR	Monthly Activity Report
MDG	Millennium Development Goals
mhealth	Mobile Technology
MIHC	Manager of Integrated Health Centre
MINPOSTEL	Ministry of Post and Telecommunication
MoPH	Ministry of Public Health
MoPH-CIS	Ministry of Public Health – Cellule d'informations Sanitaire
MoH	Ministry of Health
NDoH	National Department of Health
NIDS	National Indicator DataSets
NHISSA	National Health Information System South Africa
NHIS	National Health Information System
SA-NDoH	South Africa – National Department of Health
OL	Organizational learning
SA	South Africa

SAP	Sustainable Adjustment Policy
SDGs	Sustainable Development Goals
SIS	Standard Information System
SPSS	Statistical Package for the Social Sciences
SoP	Standard Operating Procedure
TA	Technical Assistance
TB/HIV	Tuberculosis/ Acquired Immune Deficiency syndrome
UHC	Universal Health Coverage
UiO	University of Oslo
SVS	Stock Visibility System
WHO	World Health Organization

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PREFACE

This thesis is submitted in partial fulfilment of the requirement for the Doctor of Philosophy (Ph.D.) at the Faculty of Mathematics and Natural Sciences, Department of Informatics, University of Oslo, Norway. The research was funded by the Norwegian State Education Loan Fund (Lånekassen). This thesis comprises seven introductory chapters and five scientific papers that are included as appendixes. The papers included as appendixes are listed as follows:

1. Asah, F. N., Nielsen, P., & Sæbø, J. I. (2017, May). Challenges for health indicators in developing countries: misconceptions and lack of population data. *In International Conference on Social Implications of Computers in Developing Countries* (pp. 593-604). Springer, Cham.
2. Asah, F. N. (2021). Creating a "Community of Information Practice" for improved routine health data management in Resource-Constrained Setting: The case of Mbingo Primary Healthcare facility, South Africa. *The Electronic Journal of Information Systems in Developing Countries*, e12178.
3. Asah, F. N., Kanjo, C., Msendema, M. B., Addo, H., & Logo, D. D. (2020). The Digitalization of Routine Data Management at the Point-Of-Care: The case of Ghana. *Journal of Health Informatics in Africa*, 7(2), 18-28.
4. Asah, F.N., Kaasbøll J., Nielsen, P., Seukap R. (2021). Organizations failing to learn: Roadblocks to the Implementation of Standardized Information Systems. *Journal of Health Informatics in Developing Countries*, Vol. 15 No. 1 (2021).
5. Asah, F.N., Kaasbøll J. (2021). Deconstructing the Dichotomous Relation between Information System Analysts and End-Users: A Case of Implementing Standard Health Indicators in Cameroon. *Proceedings of the First Virtual Conference on Implications of Information and Digital Technologies for Development, 2021*

ABSTRACT

This thesis explores challenges associated with implementing standard health indicators in hierarchical organizations, and which approaches can be employed to mitigate these challenges. Hierarchical organizations are entrenched in fragmented healthcare system, coupled with fragmented information systems, and multiple stakeholders and partners with different views and perspective, a common scenario for low and middle-income countries (LMIC). The study was guided by a main research question and two sub-research questions:

- What challenges are associated with implementing standard health indicators in hierarchical organizations, and which approaches can be employed to mitigate these challenges?

    - **Sub-RQ1**: What are the challenges associated with implementing standard health indicators in hierarchical organizations?

    - **Sub-RQ2:** What approaches could be employed to mitigate the challenges of implementing standard health indicators in hierarchical organizations?

The research was qualitative, interpretative, and multi-sited study, in three empirical sites – Cameroon, Ghana, and South Africa. However, the study in Cameroon laid the foundation for this study, and the findings from Cameroon influenced the selection of the other two sites. Mixed methods were used to collect data, and the study applied both qualitative and quantitative data analysis methods. Data analysis was done when writing individual papers and writing the thesis, which followed five key steps; preliminary data analysis, preparing and familiarizing oneself with data, coding, creating categories, and identifying themes.

The findings showed that although implementing standard health indicators is one of the strategies to curb fragmented information systems, the process is embedded in several challenges, which hinder the generation and eventually the use of data to support decision-making, particularly among staff at the peripheral level in hierarchical and centralized organizations.

This thesis contributed to developing a new analytical framework to understanding the challenges associated in implementing standard health indicators in hierarchical and centralized organizations. The thesis builds on the rich understanding of boundary objects to discuss and

outline approaches that could help resolve different opinions, interests, and opinions among the different partners and stakeholder involved in IS/HIS in the healthcare domain. The thesis contributed to IS training literature by demonstrating the capabilities of Community of Practices (CoP) in building local capacity. Practically, the thesis adopted and extended the concepts of CoP by providing measures to building local capacity on HIS.

CHAPTER ONE

This thesis aims to understand the challenges of implementing standardized information systems in a hierarchical centralized organization. Drawing from the implementation of standard health indicators in Cameroon, this chapter introduces the research domain, and the overview of both the conceptual and research approach are provided. The list of articles used in building up this thesis are placed at the end of this chapter.

1.1 Introduction and Background

Over the past two decades, scholars, policy-makers, international development agencies such as the United Nations Agencies and international non-Governmental organizations (NGOs) have developed an immense interest in using numbers and continually establishing new indicators as tools for assessing and promoting a variety of policies (Merry, 2011; Davies et al., 2012; Fukuda-Parr et al., 2014). Although using numbers and quantitative reporting is one of the oldest forms of measuring activities that started as far back as the mid-1800 (Etches et al., 2006), but still flourishes today by using indicators. Today, indicators are used to understand everything: violence against women, sustainable development, United Nation General Assembly Special Session (UNGASS), One Health[1], Economic Development, among many others (Merry, 2011; Etches et al., 2006). For example, the health sector has experienced an enormous growth in the use of performance data through evaluation, health policies are linked to economic growth and productivity with a strong emphasis on efficiency and competition for which numbers and performance indicators play a crucial role.

In fact, numbers have become the central currency of governance by indicators (Mau 2020). First, politically to govern i.e., the means to influence behavior, the production, and distribution of resources (Davies et al., 2012). Second, pressure on governments to cut costs, support evidence-based decision-making, and be more accountable to public service (Bowen &

[1] 'One Health' is an approach to designing and implementing programs, policies, legislation, and research in which multiple sectors communicate and work together to achieve better public health outcomes.

Kreindler, 2008). Third, to control and rank countries or organizations based on their performance (Merry, 2011).

There is broad consensus that improved health outcomes cannot be achieved without strengthening health system, including health information systems (HIS). HIS permit adequate monitoring of progress towards the Sustainable Development Goals (SDG); and all these assessments are done using indicators as a standard to evaluate performances (Flowers et al., 2005; Etches et al., 2006). Presently, indicators have become the "*de facto gold standard*" for making decisions and for standards setting against which performances are measured (Davies et al., 2012).

Using numerical information to understand the world is the epitome of modern fact and the foundation of evidence-based decision-making, as it exist today in public health (Mau 2020; OHCHR 2012) and the global drive on the big data. For example in global health policy and research, indicators are a source of knowledge because they convey the objective truth (Murnaghan 1981; Merry 2011). This aspect highlights a crucial dimension of the power of indicators because they can convert a contextual variable into unambiguous, clear, and impersonal measures (Mau 2020). This characteristic of an indicators is supported in public health, as explained by Deming (2018) as '*if you can measure it, you can manage it*' because using numbers is easier and faster to measure activities. Indicators produce readily accessible and standardized form of knowledge (Merry, 2016; Davies et al., 2012; Mau 2020). Using indicators are based on values and rational decision-making as they indicate openness and fairness to decision and policy makers (Merry, 2016; Mau, 2020). While acknowledging the importance of big data, however, my focus is on standard health indicators in the healthcare sector, which have been agreed by implementing partners, Public Health ministries, and UN agencies.

Generally, most health indicators are produced by international organizations. For example, SDG, including indicators of UHC, were produced by United Nations (OHCHR, 2012; Merry & Wood, 2015). The HIV/AIDS[2], produced by UNGASS, and the global reference list of 100 core health indicators compiled by WHO (Klazinga et al., 2001; Murray & Lopez, 2013). In the

2 United Nations General Assembly Special Session indicators on AIDS. The most widely used set of indicators for HIV. The purpose of these indicators is to measure progress toward implementing the Declaration of Commitment on HIV/AIDS that 189 UN Members States adopted in 2001.

healthcare sector, policy and decision-makers rely on indicators to support decision-making and to monitor health service performances (AbouZahr and Boerma, 2005).

1.2 Research Doman and Problem Area

Reliable and timely health information (indicator) is an essential foundation of public health action and health systems strengthening both nationally and internationally; to support evidence-based decision-making (Lippeveld, 2017). This is because better information leads to better decision to measure health services (Health Metrics Network 2008).

Before dwelling on the research problem, at this point, I discuss to define an indicator.
An indicator, which is the main concept used in this thesis, is defined as follows:

> 'a named collection of rank-ordered data that purports to represent the past or projected performance of different units. The data are generated through a process that simplifies raw data about a complex social phenomenon. The data in this simplified and processed form are capable of being used to compare particular units of analysis (such as countries, institutions, or corporations), synchronically or over time, and to evaluate their performance by reference to one or more standard' (Davies et al., 2012, p. 73).

An indicator on the other hand is the thing that indicates the state or level of something. They are simple to construct, interpret, and use, more versatile in their applications, and less vulnerable to cross-cultural differences. Today, indicators are used to evaluate almost everything. For the purpose of this thesis, my focus is on health indicators as applied in the public health and HIS domains.

1.2.1 Defining Health Indicator within HIS

In Public health, health indicators are the measurement used in describing the health status (WHO, 2002). In HIS domain, indicators form part of the system. They are the core elements of data analysis used to compare performance across different catchment areas, facilities, periods and every IS should have core standard indicators to assess changes (WHO, 2002). An indicator should not be confused with a data element. Data elements are raw facts or statistics collected for reference or analysis. They are the raw materials of a health information system; they have little intrinsic value in themselves. For example BCG dose given to children. See examples on table one.

Table 1: Difference between data element and indicator

Data Element Name	Indicator
BCG dose	BCG dose coverage
Immunized fully under one year	Immunized fully under one year coverage
Measles 1st dose	Measles 1st done under one year coverage

Indicators are often calculated values. The example presented (figure 1) is the simplest way to calculate an indicator.

An example could be "*Immunized fully under one year at PHC X June 2019*".
This is raw data, and it is of little importance to the clinic manager who wants to know the coverage for the catchment area.
To process this, the manager has to divide the data element(s), which in this case is "*Immunized fully under one year' at PHC X June 2019*" with a denominator '*Children under one year in the catchment area*' and multiply it by a factor '*in this case it is a percentage (100)*'.

Figure 1: Example of how to calculate an indicator

Health indicators are statistics selected from the larger pool because they have the power to summarize, to represent a larger body of statistics, or to serve as indirect or proxy measures for information that is lacking. Indicators are often expressed as percentages, rates, and ratios so that the necessary comparison can be made, e.g. the number of children immunized fully under one year per 100 per population per year.

Every HIS should have a list of core indicators to assess and reflect changes over time in each of the three main domains.

- Determinants of health include socioeconomic, environmental, sanitation, behavioral, demographic, etc. This category of indicators characterize the contextual environment in which the health system operate.
- Health system indicators include inputs to a health system and related processes such as policy, organization, human and financial resources, health infrastructure, equipment

and supplies. These are health system outcome indicators such as service coverage and utilization.

- Health status indicators include mortality, morbidity, disability and wellbeing.

All countries therefore need to have a nationally defined minimum set of health indicators used regularly in national program planning, monitoring and evaluation. Some statistical manipulation is usually involved, at the very least aggregation (Lippeveld, 2017). The list of indicators will vary according to the epidemiological profile and development needs of countries.

However, the nationally defined minimum list of health indicators should be carefully reviewed regularly by national and international stakeholders and partners (Sapirie & Orzeszyna, 1995), and must meet international standards (Lippeveld, 2017). The list of health indicators must monitor local and national priorities, harmonize with key indicators in international and global initiatives, and should meet the needs of decision-makers at all level of the health system because it serve as the backbone of the system.

1.2.2 Standard Health Indicators within HIS:

Generally, the lack of common context information limits the sharing of information (Del Fiol et al., 2012). Standard is usually a formal document that establishes a uniform criteria, methods, and processes and practices. Spivak & Brenner (2001, p. 16) described standard as "an agreed-upon ways of doing something… [denoting] a uniform set of measures, agreements, conditions between parties". There are different types of standards however, within the study of HIS, my focus is on standard indicators. Defined as agreed upon procedures and ways or metadata of collecting and analyzing data health information. An example, is the WHO's Global Reference list of standard 100 core health indicators. The list is used for measuring different attributes, dimensions, and performances of the country's entire health system (WHO, 2018).

Therefore, standard health indicators if well implemented, could facilitate data exchange across the health hierarchies, across organizational units, and over time. A shared list of standard health indicators could be used to establish a lingua franca that guides public health ministries and coordinators of parallel health program (PHP) towards a common set of standard contextualized attributes and values where access to information is limited. The use of standard

health indicators facilitates cooperation and interactions among multiple stakeholders with conflicting views (WHO, 2008). Core standard health indicators and related data-collection strategies must be linked to a broader national statistics strategy and the reporting frequency may vary depending upon the type of indicators and likelihood of change (Kaiser et al., 2017). Furthermore, Braa et al., (2012) added that standard health indicators could be used to operationalize data use at the peripheral level, thereby improving data quality. If standard indicators are correctly implemented, can serve as boundary objects to align the heterogeneous actors and collaborates toward a functional and comprehensive HIS (Nyella & Kimaro, 2015).

While in the high income countries (HIC), standard health indicators are celebrated as the '*blueprint*' for achieving global accountability, transparency, in the LMIC, the main challenges are to identify a minimal or comprehensive list of standard health indicators and implement it to support macro and micro health system function and to implement (Timermans & Berg, 1997; Rolland & Monteiro, 2002).

1.2.3 Treads in implementing IS and the socio-technical approach

Implementation is defined as "putting a decision or plan into effect" (Klein & Sorra, 1996). In this study, I define implementing a new IS such as the WHO list of standard health indicators as putting the indicators into effect, ensuring that they are adopted, and properly used to meet the information needs of staff throughout the healthcare system. Since implementing standard health indicators is the strategy to curb fragmented IS, this has led to global calls to action within the premise of health systems strengthening. In the past two decades, international aids agencies have advocated for the implementation of standard health indicators on the premise that better quality, relevant, and comprehensive indicators in the healthcare domain will increase use of this indicators to support decision-making, which will ultimately improve health service delivery and health outcomes including monitoring Sustainable Development Goals and Indicators. Based on this, countries (MoPH) have increasingly engaged in developing and implementing IS including standard health indicators to support the processes of organizations (Health Metrics Network 2008). However, efforts have slowed down due to the number of failures (Heeks, 2006). Avgerou (2002) noted that when implementing standard health indicators in LMIC, issues of diversity and context dependency at the implementing sites

become extremely relevant. On the other hand, there have been differences perspective on what is HIS implementation (Sheikh, 2016).

First, on the aspect of what is HIS implementation, there are two school of thoughts. The traditional school believes that the implementation of a new HIS including health indicators is a technical process. This school of thought (Aart et al., 2004; Sheikh, 2016) focused on installing hardware and software for data collection, processing, and presentation (Sheikh 2016). Researchers have criticized this approach as being too narrow-minded (Aarts et al., 2004; Smith et al., 2003) and emphasized the need for developing a broader perspective that will take into consideration the social aspects embedded in HIS, as these aspects have been overlooked (LaFond & Fields, 2003; Sheikh, 2016).

The other school of thought is view HIS implementation as a socio-technical perspective. This perspective holds that HIS implementation should match the design processes with existing organizational routines, norms, and procedures as well as social, economic, and political aspects, which together highly determines its outcomes (Lorenzi & Riley, 2000; Silva & Hirschheim, 2007; Sheikh, 2016). Reason being HIS lies in the interaction between systems' functioning, the organizations' needs, and working patterns (Lorenzi & Riley, 2000; Mulugeta et al., 2007); should be considered during HIS implementation. Therefore, the socio-technical approach helps to understanding HIS implementation more broadly than the technical approach. This implies that HIS implementation is a complex process. The complexity comes from aligning and integrating the technological system into the social and organizational context to support the existing work processes and norms (Timermans & Berg, 1997). Therefore, in this study, I conceptualize implementing standard health indicators as a socio-technical process.

Looking at the nature of the healthcare sector in LMIC, it has hierarchical structures, diversity and multiplicity of parallel health programs (PHP), partners, and stakeholders having different views and perspective. Measuring the different aspects of health services is conceptually and technically complex because information is generated from a range of data sources and a wide array of stakeholders involved in different ways with each source. In Cameroon, for example, national statistics offices are usually responsible for conducting census and household surveys. Vital statistics including counting births and deaths may be shared between the national statistics office, Department of National Security, and MoPH. Therefore, efforts are needed to

ensure adequate coordination and sharing of information between health ministries and other sectors.

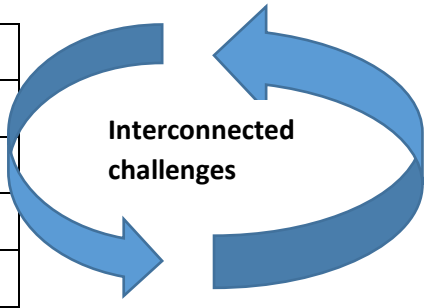
On the other hand, there are the parallel health program (PHP) such as TB, malaria, and HIV/AIDS programs. The PHP each has its information system (IS), data collection/ mechanism (such as registers, forms, software, and hardware), as well as its list of indicators (Sheikh, 2016). Each PHP maintains it has IS, competing among themselves and with the national HIS. The PHP embodied IS technical solutions and established work routines that are often poorly aligned with the national HIS. In addition, the PHPs have independent decision-making structures and internal systems for information reporting and resource distribution. These systems are directly linked to policies and procedures, which are also linked to donor agencies with different concerns, interests, and agendas. These issues account for the challenges when implementing standard health indicators. Hartswood et al., (2003) explained that these challenges have to be addressed during the implementation process. Murnaghan, (1981) added that without some consistency and standardization of the basic tools of measurement, one could not examine the differences and similarities and know whether changes are occurring (Murnaghan, 1981). Standard indicators are thus, an excellent means of promoting statistical comparability within and among health system. Undoubtedly, addressing these challenges offer a stage for conflicts and tensions between actors and different partners (Silva & Backhouse, 1997).

Implementing IS has been described as a challenging socio-technical undertaking characterized by tension and conflict from multiple partners and organizational culture (Timmermans & Berg, 2003; Aiga et al., 2008; Nyella & Mndeme, 2010). This is because an information system is implemented in an organization with existing norms and working conditions (Aart et al., 2004) and introducing a new and unfamiliar IS could lead to many challenges. There are several explanations; ranging from limited duration of donor funds, inadequate focus on local expertise, too narrow intervention, and technical bias of project (Shaw, 2006). In the HIS domain, there is a huge amount of literature on factors/determinants that hindered IS implementation. In this context, standard health indicators are considered as IS. Therefore, in explaining challenges of implementing standard health indicators, I shall draw my examples from IS literature. These are:

(i) Under investment of IS (Lippeveld 2001; Tossy, 2014). (ii) Limited and inadequate human resources to maintain the system (Lafond & Fields, 2003; Health Metrics Network 2008; Heywood et al., 2001). (iii) Rigid or inflexible of existing IS to accommodate new indicators (Nyella & Mndeme, 2010; Mengiste, 2010), leading to conflict between donors and recipients (Sahay et al., 2009; Wild & Domingo, 2010). (iv) The process of implementing HIS is considered a technical process, meaning the organizational context is neglected (Heeks, 2006) (v) Hierarchical organizational structure and centralized decision-making (Sheikh 2016; Nyella & Kimaro, 2015; Kimaro and Sahay, 2007). (vi) The process is time-consuming because data is collected from multiple sources, which in turn increase the burden on the already overloaded staff, and risking quality of data (Sheikh, 2016). (vii) The definitions of standard indicators are inconsistent (Lippeveld, 2001; Hozumi et al., 2002). (vi) The systems are fragmented caused by uncoordinated IS. According to Braa & Sahay (2012) and Sheikh, (2016), uncoordinated IS have been identified by researchers and practitioners as the main challenge to data generation for health indicators, particularly at the peripheral level, where data is generated, these challenges get aggravated. The use of poor quality data may lead to epidemics or pandemics discovered too late. Poor planning of the supply of essential drugs could endanger the lives of children or pregnant mothers. Chilundo & Aanestad (2004) noted that implementing a HIS is not a quick fix as it is often promoted. Instead, it is an ongoing process of negotiation and meditation because it is an arena for potential conflict between actors and multiple partners and other challenges caused by the organizational structure. The challenges caused by fragmented HIS are summarized on table 2.

Table 2: Challenges of fragmented HIS

Challenges caused by fragmented HIS
Duplication and multiple of data sources
Difficulties to collect and analyze data
Overburdened data managers
Poor data quality
Non-use of data for decision-making



To mitigate the challenges of implementing HIS, over the past two decades, Ministry of Health with support from HISP (Health Information System Program), with support from international

aids agencies and in collaboration from public health ministries in LMIC have implemented various interventions. HISP has developed systems to integrate multiple reporting and parallel health programs at the national and regional levels. See (Chilundo & Aanestad, 2004; Shidende, 2005; Nyella, 2009; Nyella & Mndeme, 2010). Organizing data use workshops to enable relevant stakeholders to discuss and see the value of data for local use (Braa et al., 2012). Introducing social learning methods to develop data analysis skills (Manya et al., 2015). However, most of these interventions focused on integrating fragmented IS in general and are not very specific in dealing with challenges that end-users encountered after standard health indicators are implemented (Manya et al., 2015). Also, these interventions are often short-term improvements rather than on long-term solutions (Moyo 2017). Furthermore, the interventions have not looked at challenges of implementing standard health indicators from the users' perspective (Pichault 1995).

In a country, the HIS provides the underpinnings for decision-making and has four key functions: data generation, compilation, analysis and synthesis, and communication and use (Health Metrics Network 2008). Data generation, the first function of the IS takes place at the peripheral level. The reason why Braa et al., (2002) explained that when implementing HIS including standard health indicators should guarantee the sustainability of the entire system. The authors added that the sustainability of the central system is highly dependent on achieving local sustainability at the peripheral level (ibid). Local sustainability includes providing infrastructural support and resources (in terms of human capacity and competencies) at the peripheral level to manage and use the system (ibid). So far, this has not been the case because these interventions have so far, concentrated on improving integrating systems, compiling, analyzing, synthesizing, communication, and use of data while the processing of generating data have been neglected (Lippeveld 2019; Nicol et al., 2018).

In the healthcare domain, the processes of generating data happens at the peripheral level and nurse are often in-charge of managing data. In LMIC, these nurses and frontline managers have neither the tools nor the capacities and are faced by many other challenges such as lack of staff with adequate skills and limited financial resources (AbouZahr & Boerma 2005). They have poor infrastructure (inadequate availability of transport, electricity and internet connection) which compromises data management processes (Lippeveld 2001; Hozumi et al., 2002). Where capacity exists, it is largely concentrated centrally (AbouZahr & Boerma 2005). The level

where data is generated is the most important; Redman (2020) noted that if data quality fails at this point, it is challenging and costly to restore it later on. Therefore, the aim of this study is to understand challenges that staff encountered after implementing standard health indicators in the public healthcare system. The thesis was guided by a main research question and two sub-research questions:

- **Main RQ**: What challenges are associated with implementing standard health indicators in hierarchical organizations, and which approaches can be employed to mitigate these challenges?

    - **Sub-RQ1**: What are the challenges associated with implementing standard health indicators in hierarchical organizations?

    - **Sub-RQ2:** What approaches could be employed to mitigate the challenges of implementing standard health indicators in hierarchical organizations?

Included in the main research question, this study explores factors that trigger conflict among different stakeholders while implementing standard indicators. Empirical data was collected from Cameroon, Ghana, and South Africa and was Cameroon my point of departure.

1.2.4 Personal Motivation

I am motivated by my professional experiences and the need to understand the continuous lack of support experienced by staff at the peripheral level as far as managing routine data is concerned and how best to provide to them. The peripheral level is the foundation (i.e. where routine data is generated). The literature explains that an essential outcome of implementing HIS is to guarantee local sustainability at the peripheral level by providing infrastructural support and resources, and human capacity and competencies (Braa et al., 2002; Jacucci et al., 2006). Similarly, the literature emphasizes that the peripheral level, which is the point where data is generated, is strategic; because if the data quality fails at this point, it is challenging and costly to restore it later on (Redman, 2020). This implies that those who are directly involved in managing data should be equipped with the necessary skills, competencies, and provided with the infrastructural support they might require. Although the literature emphasized this, the problem persists. Over ten years, I have worked as a health information broker and a consultant assisting health ministries and health programs to design and implement standard health indicators in some countries in Africa. From my experiences, when it comes to implementing IS, the department of HIS concentrates on developing hardware and software, while the parallel

programs coordinators ensure that their program indicators are included on the list, and little or no attention is paid to the primary data manager, particularly those at the peripheral level. At the same time, when there are any issues with data and data quality, all blame goes to primary data managers. These factors gave me the motivation to explore challenges staff at the peripheral level undergo daily as they struggle to manage routine data for health indicators.

1.3 Empirical Setting

Initially, the study was supposed to be conducted in Cameroon, as the country was implementing standard information systems (SIS), and standardized data collection. This was a national initiative by the MoPH corrdinated by CIS (Cellule d'information Sanitaire) and HISP Oslo provided some technical assistance. The process started at the same time I about to commence my fieldwork and was invited by MoPH-CIS to join the CIS team to facilitate the training workshops. After my first data collection from January – September 2017, political unrest broke out in the country; consequently, it became impossible and risky to continue with the rest of my research as planned. Nevertheless, I used the empirical material already collected to develop papers 1, 4, and 5 and the findings from the first fieldwork in Cameroon re-directed the rest of my research. Empirical material for papers 2 and 3 came from South Africa and Ghana respectively.

As already mentioned above, the study was planned as a single case to be conducted in Cameroon, but my fieldwork was interrupted due to the breakout of civil unrest in Southern Cameroon (Ambazonia crisis); where my study was focused. However, after analyzing data collected from Cameroon after my first fieldwork, the findings revealed that the process of implementing standard indicators is embedded by challenges and conflicts at the central level between MoPH-CIS and PHP and within PHP. While at the peripheral level, the focus of my study, recurrent challenges were the hesitancy of collecting huge amount of routine data manually and the lack of capacity. During that same period, the Ghana Health System (GHS) was implementing mobile technology to support manual data collection processes. I used the implementation of mobile technology in Ghana to conduct a mobile technology usability assessment among frontline nurses; case 2 and paper 3. Furthermore, while analyzing data from Ghana, I realized that although nurses were interested in using mobile technology, the training they received was insufficient, too general, and not contextual, hence, they had difficulties

grasping the content. The study highlights the need to contextualize IS training for healthcare staff, particularly nurses. This need took me to South Africa (SA) to explore how nurse managers contextualize and integrate data management-related activities into nurses' day-to-day routines; case 3 and paper 2.

Interviews and participant observations were used as the primary data sources and were complemented with document review. More detail about the research approach is given in Chapter 4.

1.4. Conceptual Approach

In LMIC, implementing IS including standard health indicators is a complex and dynamic process (Braa et al., 2004). The complexity stemmed from the involvement of diverse stakeholders, multiple institutional practices, and complex activities and tasks. The complexity and diversity of the partners involved and their different commitments, interests, and values there are, in no doubt, offer an arena for power play, tension, and conflicts to prevail. The study adopted an interpretive approach to understand the depth and breadth of the reason for the challenges. It also has some elements of critical perspective. For example, in the case of Cameroon, I was critical of the existing HIS situation and subsequently proposed approaches to mitigate the challenges. Furthermore, I used the cases from Ghana and South Africa as examples of such approaches.

1.5 List of Papers Included in this Thesis

Asah, F. N., Nielsen, P., & Sæbø, J. I. (2017). Challenges for health indicators in developing countries: misconceptions and lack of population data. In *proceedings of International Conference on Social Implications of Computers in Developing Countries IFIP.94* (pp. 593-604). Springer, Cham.

Asah, F. N. (2021). Creating a "Community of Information Practice" for improved routine health data management in Resource-Constrained Setting: The case of Mbingo Primary Healthcare facility, South Africa. *The Electronic Journal of Information Systems in Developing Countries*, e12178.

Asah, F. N., Kanjo, C., Msendema, M. B., & Addo, H. (2020). The Digitalization of Routine Data Management at the Point-Of-Care: The case of Ghana. *Journal of Health Informatics in Africa*, 7(2), 18-28.

Asah, F.N., Kaasbøll J., Seukap R. (2021). Organizations failing to learn: Roadblocks to the Implementation of Standardized Information Systems. *Journal of Health Informatics in Developing Countries*, Vol. 15 No. 1 (2021).

Asah, F.N., Kaasbøll J. (2021). Deconstructing the Dichotomous Relation between Information System Analysts and End-Users: A Case of Implementing Standard Health Indicators in Cameroon. In *proceedings of the Conference on Implications of Information and Digital Technologies for Development IFIP9.4, 2021*

1.6 Expected Contributions

This thesis make theoretical and practical contributions in the domain of IS in LMIC. First, this thesis advances a new analytical framework to understanding challenges associated with implementing standard health indicators in hierarchical organizational structures. Second, this thesis suggests approaches that can be employed to mitigate these challenges. The suggested approaches contributes to discourse on IS implementation in hierarchical organizational structures by adopting socio-technical view to implementing and theorizing the implementation of standard health indicators. Third, the thesis extends community of practice (CoP) by expanding the role of the facilitator in CoP beyond organizing meeting to champions of CoP. Fourth, the thesis contributes practically by illustrating a practical approach to operationalizing and integrating data management-related activities in staff work practices in resource-constrained health facilities. Finally, individual papers that are part of this thesis also contributed to literature on organizational learning (papers 4 & 2), CoP (paper 2), mobile technology (paper 3), and power in IS (paper 5) either by proposing new theoretical perspective or extending on existing ones.

1.7 Organization of the Thesis

The chapters of this thesis are organized as follows: In the next chapter, I will present relevant literature on the main concepts covered in the thesis. The chapter starts by explaining the treads in IS implementation and highlights the key concepts used in the study. I reviewed the literature on organizational decision-making and on IS in a hierarchical organizational structure.

Chapter **three** provides the empirical settings where empirical data were drawn. It gives background information on HISP programs. Chapter **four** provides the study's methodology, design, data collection methods, and analysis. The chapter also responds to ethical issues.

Chapter **five** summarizes the results; besides providing the list of published papers, it summarizes each article and its relationship with the research questions. In chapter **six**, I present the findings from papers 2 and 4 to discuss the entire study. Finally, chapter **seven** is dedicated to contributions and conclusions. The chapter ends with a suggestion for further research and the published papers are attached as annexures at the end of the thesis.

CHAPTER TWO

2 OVERVIEW OF RELEVANT THEORETICAL CONCEPTS

In this chapter, I present the theoretical concepts, which helped to address the research aims in this thesis. In developing my theoretical concepts, I draw upon four key strand of research: 1) boundary phenomenon; 2) community of practice (CoP); 3) organizational decision-making; and 4) the influence of organizational culture on information systems.

2.1 The Boundary Phenomenon

The healthcare domain constitutes of diverse professionals (physicians, nurses, and health assistants), different levels (district, regional, and national) healthcare institutions (hospitals, health centres, and clinics), parallel health programs and services (MCH, HIV/AIDS, TB, Malaria, etc.), donor agencies (such as WHO, Global Fund, UNICEF, etc.). These different professionals groups pursue their own agenda and interests beyond the interest and agenda of the organization. For example, there are several parallel programs with their own structure, data collection tools, and work practices. Each parallel program has branches at district, regional and national level that interact and negotiate on several issues including data collection and reporting formats, and content of reports. These issues poorly often aligned with the national HIS, therefore developing and implementing a core list of standard health indicators in this context is challenging (Braa et al., 2002; Jacucci et al., 2006), hence an arena for conflicts (Sheikh 2005). According to the literature, constant interaction, communication, collaboration, and negotiation with the different stakeholders (social world) on a variety of issues including generating reports, data collection tools and formats, routines, and selecting health indicators, could resolves conflicts and different opinions arising during the implementation of IS (Nyella & Mndeme, 2010; Mengiste, 2010).

When looking at the health information domain, different health professionals interact daily to achieve a single purpose: patient and population. Nonetheless, there are many conflicts in their roles, with salaries, training, practices, leadership, and recognition. Let us take the case of a

pregnant woman in maternity during delivery. There is a team made-up of the midwife, nurse, nutritionist, anesthesiologist, and the medical doctor who have to work together in a well-coordinated manner until after the baby is delivered and mother and baby are sent to the maternity ward. Star (2010) explained that such a team rarely reaches a consensus, and their collaboration is often fragile. However, their cooperation often continues without much of a problem and what allows them to interact professionally is a set of medical guideline put together is the 'patient record.' The patient record has different sections, while the entire patient record is not helpful to everyone; a particular section is vital to different healthcare providers. For example, as in the case of the midwife, she will look at the doctor's prescription, while the information on the baby's weight might not be helpful to the anesthesiologist but valuable to the nutritionist to ensure that the baby is well fed.

From the point of view of developing and implementing standard health indicators in the healthcare sector, it is clear that different professional groups with shared values, interests, and practices could build their own identity in contrast to other groups. Regardless of their respective norms and values, they can work together (Wenger, 2000). In this context, the different stakeholders and partners with diverse interests would find ways of building common ground to work with one another in resolving conflicts and challenges that could emerge in the process; this is one instance where boundary objects could be developed.

According to Star & Griesemer (1989), boundary objects were described as "*objects which are both plastic enough to adapt to local needs and constraints of the several parties employing them, yet robust enough to maintain a common identity across sites. They are weakly structured in common use, and become strongly structured in individual site use"* (Star & Geiesemer, 1989, p. 393). These objects could be dynamic, having different meanings in different worlds, but their structures are common enough, making them identifiable through translation. A boundary object is any object that is part of multiple social worlds, facilitates communication between them, and has different identity in each social world that it inhabits (Star & Griesemer, 1989).

Communities can adopt boundary object to fit their practices within their social worlds (Star, 2010). In this case of implementing standard indicators, example of communities are CIS (national HIS authority) on the one side and the parallel health programs on the other side, also

known as the social worlds. They have to interact to resolve their different concerns and interests and to satisfy the informational needs of each. While the term 'object' may imply to be material in nature, but may also include non-material processes (Star, 2010). What is more important about these objects are that they carry shared values that facilitate negotiation and coordination while maintaining each group's specific viewpoints and interests. Furthermore, they offer a common reference point for translating knowledge without necessarily enforcing a particular shared meaning among those involved (Barret & Oborn 2010).

Boundary objects perform a range of other functions including knowledge transfer between groups through a shared value (Carlile, 2004). Their common structure and adaptability to different viewpoints also make them a means of translation between groups (Star & Griesemer, 1989). For example, boundary objects can solve different concerns and interests by enlisting participation in negotiating a shared understanding (Star & Griesemer, 1989), could resolve conflicting interests by negotiating and power relations by transforming the knowledge and practices of those involved (Carlile, 2002; Barret & Oborn, 2010). While much of the literature on boundary objects emphasize their facilitative roles (interpretive flexibility) in collaboration, negotiation, and information/ knowledge sharing, Zachry (2008) explains that such objects do not always function positively across different groups because their characteristics are hard to sustain as problems and people changes (Carlile 2002, p. 452). Star (2010) emphasized the importance of context when creating boundary objects. The author noted that while boundary objects can be flexibly interpreted, they should be created genuine collaboration among different communities. That is to say when different partners have a specific work requirement but conflicting interests.

A boundary object could also be any object that is part of multiple social worlds, facilitates communication between them, and has different identities in each social world that it inhabits. The broad definition of boundary object makes it challenging to determine what may not be considered a boundary object. Trompette & Vinck, (2009) emphasized that boundary objects denote objects that "promote collective action and coherence of information from different sites" (p. 174). Fujimara, (1992) noted that boundary objects act a interoperability devices enabling communication within standards, classification schema, schematic process maps, and structured forms. Of interest to this study are standards.

Standards are agreed ways of doing things or "devised as methods of common communication dispersed across different work groups" (Star & Griesemer 1989, pp 411). Together, this description and classification allowed the study to name health indicators, develop standards for measuring healthcare services, and hence utilize the same as the object of study (Miles and Huberman 1984).

2.1.1 Standard health Indicators as Boundary Objects

In the healthcare domain in LMIC, building a shared understanding among multiple actors and stakeholders when introducing a new IS including standard health indicators and data collection tools is a challenging process caused by the heterogeneity of stakeholders, an arena for fraught conflicts. The boundary object concept would facilitate collaboration and communication among these different stakeholders without necessarily coming to a consensus (Star 2010). Koskinen & Makinen (2009) noted that developing this type of boundary objects requires understanding of the perspective of others, and achieving this will require negotiation and communication amongst the different stakeholders. Negotiation facilitates coordination and integration of the new IS including work practices. Such negotiation and collaboration evolve incrementally through long and complex negotiations among the different actors from distinct social worlds. In this study, the process of implementing standard health indicators and data collection tools serve as creating boundary objects. Implementing these IS require the collaboration, negotiation and mediation with different partners and stakeholders in the different social worlds aimed at resolving their different concerns. Therefore, this study considers developing standard health indicators as a process of balancing the conflicting interests and views of the different parallel health programs, national HIS, and coming up with a comprehensive set of indicators and data collection tools through ongoing interactions and negotiations. The method of selecting and implementing standard health indicators facilitates the smooth flow of knowledge and information and mutual learning (Mengiste 2010; Pyrko et al., 2017). When IS are developed and implemented through such a process (developing boundary objects) could be used as tools to mediate the flow of information between different levels, and to mobilize resources (Crisp et al., 2000; Poppe et al., 2013; Braa et al., 2004). In this setting, boundary object has a role in developing and maintaining coherence across intersecting but different social worlds. Therefore, boundary objects are a sort of arrangements that allow the different partners and stakeholders involved in information/data management-related work activities to work together without consensus.

The boundary object concept provides an appropriate approach to mitigate the challenges and conflicts that arise when different actors and stakeholders come together to implement standard indicators. By coming together, what they form may take not arbitrary but are essentially organic infrastructures that have arisen due to their information need and work requirements as perceived locally by the group as they wish to cooperate.

In IS research, different types of artifacts have been used as boundary objects between heterogeneous groups with diverse interests. For example, Mengiste (2010) conducted a study in Ethiopia, where the author used a software tool as boundary objects to bring public health officials, medical practitioners, and software development team to initiate and engage in a dialogue thereby facilitating collaboration across divergent social worlds. In another case, the author studied timelines – a graphical representation of a set of temporal units in the lifetime of a project as boundary objects. The finding demonstrated their ability to reconcile diverse socially constructed temporal arrangements (Yakura, 2002). Even further, Henderson (1991) studied visual representations as boundary objects to facilitate communication and collaboration among design engineers with different interests. The flexibility and advantages of the boundary objects concept could be the answer to resolving the conflict and tensions encountered by stakeholders and partners during the implementation of standard health indicators. From the perspective of this research, boundary objects have the ability to facilitate interaction, collaboration, and negotiation between different stakeholders with conflicting interests and agenda during the implementation of IS including standard health indicators.

2.2 Community of Practice (CoP)

The concept of community of practice originated in Etienne Wenger's work with Jean Lave (Lave & Wenger, 1991), which challenged long-standing notions about learning. In particular, they argued that learning does not rest with the individual but is a social process that is situated in a cultural and historical context (Farnsworth et al., 2016). A key premise of his theoretical work is that CoP can arise in any domain of human endeavor, for instance, the practice of creating new forms of artistic expression, or the practices involved in solving data management problems in a healthcare facility.

A CoP is cultivated when a group of people "who share a concern or a passion interact on an ongoing basis and in the process, do it better as they interact regularly" (Wenger-Trayner &

Wenger-Trayner, 2014, p. 1). A CoP has three main features; a shared domain of interest, a sense of community, and a shared practice. The domain provides a common identity for the members, guided by their thoughts and actions while providing them with a sense of purpose and value. The community is where interactions and relationships are built through mutual understanding and trust. Finally, the practice is what members do in the domain; they define ways or procedures of doing things in a specific domain (Wenger et al., 2002).

Cultivating a CoP could be intentional, that is, to meet the organization's needs (Dubé et al., 2006), or could be developed spontaneously in response to members' needs (McDermott, 1999). Small communities have few specialists, while larger could have hundreds of people within an organization or across organizational departments. However, to ensure sustainability, CoPs should have a core of experienced members and what is more important is that members are able to create solutions to their problems through interactions and participation, thereby harnessing and building knowledge within the group instead of relying on outside interventions (Chua, 2006). At the same time, members can develop their own professional identity and build a professional working team where information and experiences are shared (Fontaine & Millen, 2004).

Organizations play a significant role in building capacities. Same as it can also lose capabilities and capacities through, for example, staff turnover, lack of organizational learning systems, a reduction in resources, or the failure to update technology systems (Chaskin 2001). In LMIC, public organizations have difficulty recruiting and retaining skilled staff. Gimbel et al., (2017) and Njuguna et al., (2019) note that the lack of adequate competencies to analyze data is a significant challenge affecting the implementation of HIS and use of information, particularly among staff at the peripheral levels. For example, due to the lack of finance, staff do not have opportunities to attend refreshers course or workshops and as a result, there is lack of trust and ownership in the data generated. Eraut (2004) explained that in resources constraint areas, the skills and competences of staff can be developed through collective learning by creating CoP. Wenger's study of learning in contexts other than formal educational contexts has helped many to think differently about formal learning (Wenger, et al. 2002). In this context, learning is described as a situated social phenomenon among individuals and the environment.

2.2.1 Cultivating Knowledge in CoPs

Within CoP, knowledge is created, shared, organized, revised, and passed (Pyrko et al. 2017). This is because members of a CoP are informally bound by what they do together. That is, as the members interact and engage in actions within CoPs learning takes place, hence knowledge is transfer. In this context, learning can be described as a situated social phenomenon among individual and the environment. In CoPs, learning affects both the members and community – members contribute to their community by bringing in improvements to their practices as new insights are transformed into knowledge (Brown and Duguid 2001).

In CoP, interactions take place through participation in groups. Since those participating have common interest and concerns, sustained interactions give rise to identities and boundaries, creating a practice-related social network with collection action (Lave and Wenger 1991; Brown and Duguid 2001; McDermott et al. 2002; Roberts 2006). Once the members are aware of the way things are done within the community in which they belong, the knowledge generated can be appreciated. The way knowledge is cultivated within CoP shows that it should be nurtured over time. Much as people are trained, the training should be tailored to meet people's needs. As such, CoPs provide a platform where learning takes place and knowledge is cultivated through observation and participation. Pyrko et al., (2017) explained that in a CoP, as members interact and engage in their activities, learning takes place, and knowledge is cultivated. Ranmuthugala, et al., (2011) added that decision-makers have come to understand that CoPs facilitate the sharing of explicit and tacit knowledge, and can be used to link learning with performance. Furthermore, CoP provides a more nuanced approach to harness the skill of staff internally, something that (Leadbeater 2000) suggest as a solution in resource-constrained settings in the absence of formal training.

In the IS domain, CoP concept has been used extensively. For example, the CoP concept was applied in a study between traditional and modern practices for improving data quality in health information systems (Kanjo, 2012). Similarly, in Sri Lanka, the concept was used to describe collaboration among HIS staff, the global HIS expert community, and other stakeholders in the development of the web-based District Health Information Software (Siribaddana & Hewapathirana, 2016).

In the healthcare domain, examples of CoPs are the different social worlds and boundary objects are instituted between these CoPs to provide a means for the members to connect in various ways, coordinate perspective, and to solve the problems of common concern. This implies that CoP if well cultivated could break the boundaries that hinder the sharing of information and other resources when implementing IS including standard health indicators and could facilitates the process of developing and harnessing skill in resource constraint areas.

2.3 Decision and Decision-Making in the organization

Decision-making is the act of processing information related to a problem(s), for either an individual or an organization (Mintzberg et al., 1976, pp. 246). In an organization (the focus of this study), a decision-making is an administrative process and it is a product of how individuals make decisions, and the context in which these decisions are made. Decisions are classified as tactical, strategic, or critical. Strategic (non-routine) decisions have long-term consequences and include complex issues (Akdere, 2011). Making strategic decisions involve leadership (Patel et al., 2002). Critical decisions are made when there is a threat. For example, at the beginning of the COVID-19 pandemic, decision-makers made critical decisions such developing new indicators to monitor the pandemic's impact on the population. However, tactical decisions are routine; they follow established practices and procedures and have clearly defined objectives (Lant & Hewlin, 2002). They are usually the purview of supervisors and middle-level managers. However, managers making strategic decisions must consider the broader implications of the situation, take an active role in defining the problem, explore potential solutions, and apply judgment as to what should be done (Wang & Ruhe, 2007). Whether, decisions are made at either an individuals or organizational level, there exist two main types of decision; rational and non-rational decisions (Cohen, March, and Olsen, 1972; Rue & Byars, 2005).

2.3.1 Rational Decision-Making in the organization

Decision-making is often thought of as a linear process that takes the decision-maker from the point of problem perception, identification, and formulation, through to actions. This includes searching for and evaluating alternatives, and finally making the best choice from among those alternatives given the information available (Akdere, 2011). This is known as rational decision-making (RDM). This type of decision-making has been criticized that it gives little attention to

the institutional, cognitive constraints, human mistakes, and the complications of limited engagement (bounded rationality). Simon (1945), March and Simon (1945), and Cyert and March (1963) examined the components of RDM and explained that in an organization, whether the decision was to restructure the organization, select indicators, or outsource a given product, they follow several decision-making procedures before determining a solution. These procedures often follow a logical manner (Pfeffer et al., 1976; Masuch & LaPotin, 1989). Due to the limitations of RDM, it is no guarantee that the decision-maker will make an optimal decision for the particular task, instead, they apply satisfice. The limitations of RDM forces decision-makers to make a satisfactory decision rather than an optimal one (Simon, 1945). In this context, decision-makers examine only a few alternatives (Patel et al., 2002; Child & Hsieh, 2014; Calabretta et al., 2017). Despite the limitations, RDM approach is one of the oldest human decision-making model and has been extensively used in many different domains (Gavetti & Levinthal, 2000).

The RDM approach reflects many of the tenets of evidence-based decision-making (EBDM), which is the use of objective facts to support the basis of decisions in healthcare (McCaughey & Bruning, 2010). Studies suggest that RDM is good at solving structured problems in predictable environments. Unfortunately, RDM is often unrealistic in public organizations because they deal with complex issues, limited time, resources, and capacity (Cohen, March, and Olsen, 1972).

2.3.2 Non-Rational decision-making (NRM)

Non-Rational decision-making (NRM) is the opposite of RDM and involves judgmental process of decision-making (Bartol et al., 2006). NRM is an umbrella team to describe non-rational decision-making approaches. In this context, the decision-maker understands that making-decision is risky, and achieving optimal decisions can be a complicated process. Here, the decision-makers use different approaches including incremental, satisficing, and intuition. There are so many models and styles of NRM. This study will focus on the incremental type of decision-making, as this is relevant to public organizations (Bartol et al., 2006).

The incremental approach to decision-making is used when making short-term decisions. The process involves small analytical increments in response to events and circumstances focusing on familiar and better-known experiences (Lindblom, 1958). In the satisficing approach,

managers seek other options until they find one that is satisfactory. With the pressure of limited time and resources, this approach becomes ideal when making short-term decisions and allows for decision-making postponement while a better alternative is established (Rue and Byars, 2005). The intuition model relies heavily on expert judgment when deciding but maximizes the probability of success when under a time constraint and lack of information. However, with high risk comes a higher rate of success when using the intuition approach as incorrect decisions are made which could have detrimental effect to the organization (Bayt, 2000).

The incremental approach of making NRM describes how decisions are made in the public arena. It explains why problems are solved in a piecemeal rather than comprehensive fashion (Kremer-Asaf, 2015). The incremental decision-making style is similar to how short term decisions are made in the organization and are similar to using health indicators in the healthcare domain. In this context, when evaluating performances, as long as the outcome of an indicator gives satisfactory results, no problem solving is triggered to find another way to achieve the task. Manager will be forced to start looking for an alternative when the outcome of the indicator is below the expected target. This manner of making decisions is the shared practice within the CoPs.

In most public organizations, this approach has become the norm because of the long time it takes to get a consensus from multiple stakeholders. Unfortunately, the attainment of short-term solutions may be at the expense of more critical and far-reaching goals. The reliance, however, on minor problems and failure to confront the larger issues may result in what Allen et al. (2012) describes as "kicking the can down the road" to deal with later when the situation may be more complex and dangerous. According to the literature, this approach is suitable in hierarchical organizations to monitor the performances of program and to achieve organizational rationality. Closs & Cheater (1997) argue that since it simplifies decision-making processes then it is the same or similar to RDM.

Rational decision-making thinks decision-making is a linear process that takes decision-making from one point to the action. On the other hand, advocates for non-rational decision-making argue that decision-making is not so clear-cut. Whatever the approach used, numerous factors, including the availability of choices, the extent of the decision-maker relationship among stakeholders, recognition of familiar patterns, are all consciously or unconsciously considered.

2.3.3 Organizational Culture and Decision-Making

Decisions are not made in vacuum; whether making a rational or non-rational decision, they are shaped by the organizational context (Carley & Prietula 1994). March & Simon (1958), Cyert & March (1963), and Pfeffer et al., (1976) argued that individual, and hence organizational, decision-making depends on what information the decision-maker has, which is influenced by the individual's position in the organizational structure. Similarly, Krackhardt & Brass, (1994) added that the structure of the organization affects individual decision-making. Organizational structure can be viewed as a coordination scheme whose performance depends on the organization's network of connections and procedures.

Organizational culture is a major factor that influence a decision-making process (Krackhardt & Brass, 1994). Culture refers to the shared practice of people, which is transferred from one generation to the next via the structures and systems created by the people in the organization (Krackhardt & Brass, 1994). Numerous entities have cultures, including nations, societies, organizations, families, departments. In this thesis, I consider organizational culture as the cultures' values and beliefs of the people (Glazer et al., 2014).

The organizational culture explains why we observe artifacts (e.g., organizational processes) or experience events (Glazer et al., 2014). It provides the foundation for understanding the underlying assumptions that guide people's behaviors, feelings, and interpretations of events. Cultural values shape how people behave when gathering information to make decision, how they interpret data, and what kind of explanation people give to justify their choices (Mintzberg, 1984; Scheider et al., 2013). Organizational culture also represents the collective values, beliefs, norms, and guidelines of the members and governs the flow of information within and between organizations (Mintzberg, 1984).

According to the literature, organizational structures can be categorized as; clan, market, adhocracy, functional, and hierarchical. In Clan, there exist a shared understanding and commitment among the people (Mintzberg, 1984). Adhocracy gives importance to flexibility, external competitive positions, promotes creativity, and entrepreneurship. Functional encourages knowledge and skill development, while hierarchical structure gives much emphasis on the differentiation of power, roles, and resources (Glazer et al., 2014). Here, the

decision line is formal and flows from top to bottom (Scheider et al., 2013) and power is concentrated to few leaders at the top of the organizational hierarchy. Those at the top or central level make decisions, communicate to their subordinates to implement, and results are sent back to the central level as illustrated in figure 2.

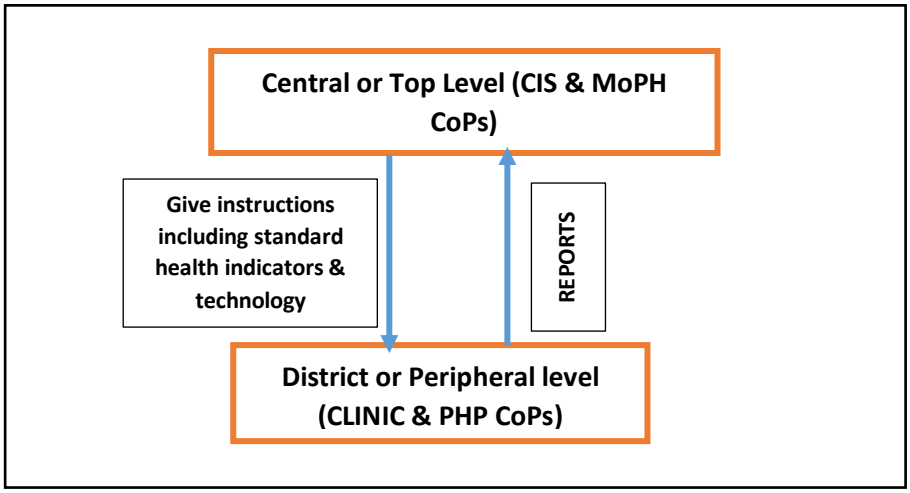


Figure 2: Decision-making & information flow within hierarchical organization

In this context, there are several CoPs (clinic, PHP) and the shared practice is that decisions are made at the central level or at the top of the organizational structure without consultations with subordinates at the peripheral level. The flow of information is one-sided as senior managers make decisions including selecting standard health indicators, the technology, designing data collection tools, and allocate resources, while managers at the peripheral level collect, analyze data and then send reports to the central level. Most often, there is no feedback and those at the lower level suffer from the lack of information; a common behavior in public organizations.

2.4. Influence of hierarchical organizational structure on IS

Computers and the department of IS in an organization have a long history going back to when computers were first introduced in the organization (Bariff et al., 1978; Markus, 1983). When computers were first introduced in organizations by the military immediately after the Second World War they were large centralized data processing boxes managed by those at the top of the organization (Bariff et al., 1978). Since computers process information of the entire organization, this led senior management to equate information with power, and computers'

information processing capacity were considered as an extension of managerial control (Bariff et al., 1978). According to these managers computer is a source of power to be own and managed by those at the top of the organizational hierarchies (Gotlieb and Borodin, 1973, p. 210, in Bloomfield et al. 1992).

Eventually, as computers become smaller and affordable, the fundamental issue in terms of power was seen as one of ownership. That is, those who are able to own a computer depicts power and its proliferation in the organization indicates a decentralization of power (Bariff et al., 1978). This implies that the advancement of ICT including increasing access to and use of computers by staff at the peripheral level creates a conundrum for top-level managers (Bariff et al., 1978; Markus 1983). Rosey, (1981) added that giving computers to staff at the peripheral is causing a clash with formal arrangements with senior managers in centralized organizations. Although this example is related to computers but could apply to the introduction of IS as well. Today, IS staff managing information hold the same beliefs. Hickson et al., (1971) noted that IS managers perceive information provides a means by which organization reduce uncertainty, a source of dependence. As a consequent, today's IS staff, particularly those in centralized organizations perceive themselves as custodians of information and eventually become the controller of powers because of the potential position of information has in the organization (Hickson et al., 1971). Since information is power and the IS department is the gatekeeper of information, the IS department has become a strategic department (Markus & Bjørn-Andersen, 1987). Saunders & Scarnell, (1986) and Markus & Bjørn-Andersen, (1987) noted that power as the source of dependence gives preference to the IS department in terms of "strategic contingencies," in which departmental power results from a combination of three attributes. These are; the ability to cope with environmental or task uncertainty faced by other departments or the organization, indispensability, and the influence on the organizations' workflow. The strategic position of IS department (i.e. gatekeeper of information) tend to give IS staff more authority in terms of access to and allocation of resources (Saunders & Scarnell, 1986), which in turn led these managers to assert control over their subordinates, particularly those at the peripheral level (Markus & Bjørn-Andersen, 1987). Similarly, Cohen, (1969) added that IS professionals also known as technological gatekeepers often use their positions to either increase their power status or thwart the development of systems. In this context, information is considered an instrument for advancing staff status (Pettigrew 1972) and organizational structure (hierarchy and centralization) are blockage of information flow (Glazer et al., 2014).

It should be noted that these beliefs and behaviors still flourish in most LMIC, particularly senior managers in hierarchical organizational (Bloomfield et al., 1992). According to the literature, they contribute to the challenges of implementing IS including standard health indicators in a hierarchical organizational (Mengiste 2010).

In this chapter, I discussed the boundary phenomenon in relation to standard health indicators as creating boundary objects. In the second section, I looked at the cultivation of CoPs in the organization, its roles in capacity building and cultivation of knowledge. Later, I discussed decision-making processes and highlighted a couple of decision-making models mostly used in public organizations. Finally, I discussed the influence of organization structures on decision-making. In the next chapter, I will discuss the research context.

CHAPTER THREE

3. RESEARCH CONTEXT

The chapter presents the context of this research, which was conducted under the framework of the Health Information systems Program (HISP). I will start by giving a brief overview of HISP and its connection with the various research sites.

3.1 The Health Information Systems Program (HISP)

HISP is a global research program housed at the Department of Informatics, University of Oslo, Norway, and has been going on for over two decades. It aimed at its initial stages to investigate if the Scandinavian approach to the democratic design of IS may be useful in a LMIC such as SA and how the approach could be further replicated to other LMIC contexts. Its first approach was in South Africa (SA) first as a pilot project from 1994 and its purpose was to reconstruct SA's fragmented HIS caused by the social structure of the then apartheid regime (Braa et al., 2002). The objectives of the project were; (1) to develop an "essential data set" for primary healthcare. (2) To identify the information needs at the facility, district, and provincial levels and to design, develop and implement a District Health Information Software (DHIS) (Braa et al., 2002). To date, this project and its outcome of reconstructing SA's HIS is regarded as one of the most profound developments and has remained a significant part of SA's HMIS (SA-DoH 2011). The same approach was replicated in neighboring countries; Mozambique, Tanzania, and other parts of the continent. In 2006, HISP experienced a significant development with the introduction of DHIS2, a web-based version, by the Department of Informatics at the University of Oslo.

DHIS2 is a web-based system, which users at all levels can access provided they could access the internet. The introduction of DHIS2 changed the way routine data is managed. It is worth noting that the DHIS program that started in SA was the first version of DHIS and was based on Microsoft Access, offline installations, but was able to export and import data between databases. Today, DHIS2, which is web-based has extended the HISP network not only within

Africa but worldwide. The DHIS2 platform is the world's largest HMIS platform used by over 73 countries, including Cameroon. DHIS2 is built on modern technologies, database and is platform-independent (Staring et al., 2006). The main HISP strategy is to support countries in strengthening their local capacity to govern and sustain their HIS. This is achieved by creating networks using a participatory approach in implementing HIS, in-country capacity building, and software development, which are the main tenets of the network (Braa et al., 2004). The cases or sites (Cameroon, Ghana, and SA) where this research was conducted forms a part of the HISP global network.

Normally when a research is conducted at two or more sites, the purpose is to gain a broader understanding of the research problem because the sites could be similar. However, it was not the case in this research study as each site was independent and informed by the research aims as illustrated in figure 3.

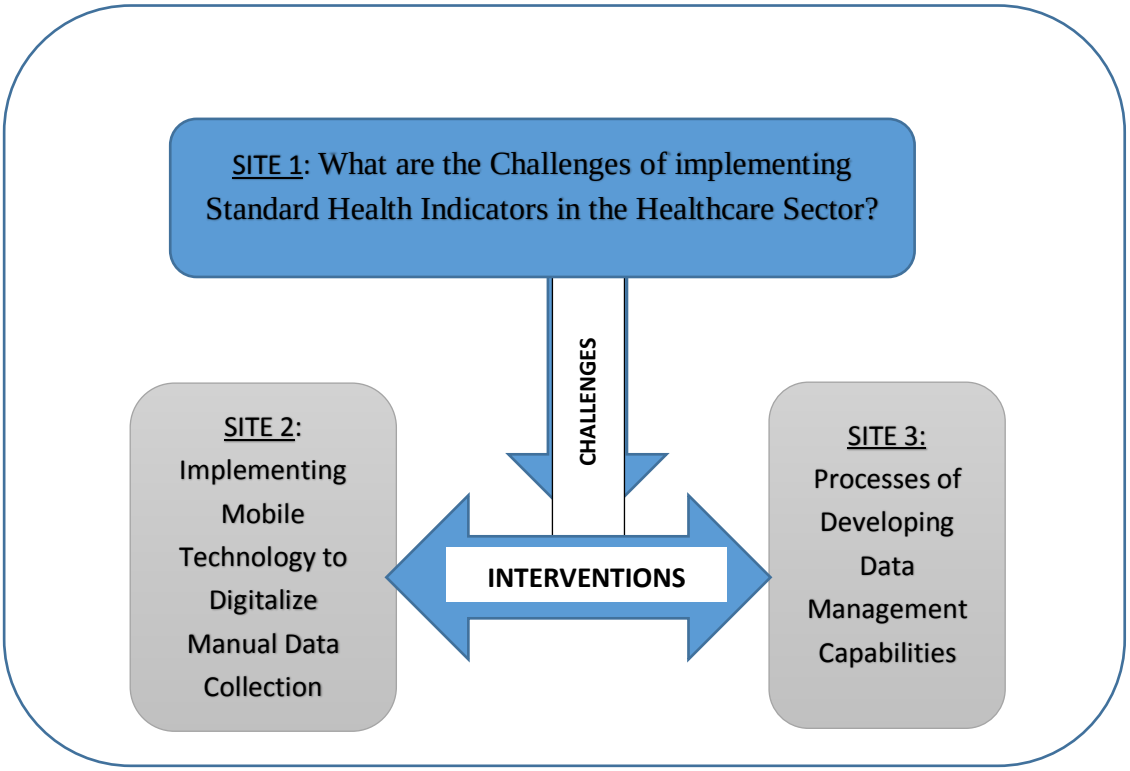


Figure 3: Linking Research Sites

Site one (Cameroon) serves as the foundation of this study. It explored challenges of using standard health indicators in the healthcare sector. The findings from this study directed the rest of the research as illustrated on figure 3. I, which will be elaborated in the next chapter. The

rest of the chapter presents the background information and the state of HIS/IS of Cameroon, Ghana, and South Africa.

3.2 Cameroon: Brief Overview

The Republic of Cameroun is made of two countries; the Republic of Cameroun (a former French colony), got her independence on 1 January 1960 and the British Southern Cameroon (a former German colony from 1884 -1916 and after World War 1, was placed as a mandated territory of the League of Nations, ruled by the Britain). The British Southern Cameroon got her independence on 1 October 1961. In the same year, there was a referendum, which joined both countries (British Southern Cameroon and the Republic of Cameroon) on a federated basis, hence the birth of a new nation named The Federal Republic of Cameroon. Between 1972 until date, the country's name has changed to The United Republic of Cameroun, and presently the Republic of Cameroun (Gascoigne, 2001), which has ten regions, 58 divisions, and 306 districts (WHO, 2017).

The Republic of Cameroon is a low and middle-income country (LMIC) and ranks 153/189 globally on the Human Development Index for 2020. The country's geographical region varies; sometimes, it is identified as in West African and other times as in Central African due to its strategic position at the crossroads between West and Central Africa. Cameroun, theoretically, has English and French as her official languages and is the second bilingual country in the world after Canada. However, bilingualism in Cameroon exists in theory only; because neither the president nor the National Assembly president are able to construct a sentence or understand English (Gascoigne, 2001). In 2019, the Economist's 'Democracy Index' categorized Cameroon as having a flawed[3] democracy, the same category as South Africa and Ghana (Economist Intelligence, 2020). However, Cameroon's democracy is placed in the authoritarian category (ibid), characterized by the rejection of political plurality, and centralized power is the political status quo (Gascoigne, 2001). Despite its authoritarian democracy, the country is known as "Africa miniature" because it is the home to over 260 native languages spoken by nearly 25 million people. The country has a large youth population, with more than 60% of the people under 25. Forty percent (40%) of the population lives below the poverty line, and its human development indicators remain low (WFP, 2018). Despite its modest oil resources and

[3] It is a governing system in which, although elections occur, citizens are cut off from knowledge about the activities of those who exercise real power because of the lack of civil liberties; thus, it is not an open society.

favorable agricultural conditions, Cameroonians are facing problems such as stagnant per capita income, relatively inequitable distribution of income, and the lack of basic amenities such as the absence of potable water and sanitation, and top-heavy civil service, endemic corruption, and a generally unfavorable climate for businesses (WFP, 2018). Over the past 5 years, there is war ravaging the British Southern Cameroon called the Ambazonia War.

3.2.1 Healthcare System

Cameroon, like most LMICs, adopted the district-based health services, implemented through the primary healthcare approach (WHO, 2017). The public health sector is pyramidal with the Ministry of Public Health (MoPH) at the apex. It has a centralized system of administration that runs from the central, MoPH, through the intermediary (regional delegations), and cumulating at the peripheral (health districts) levels. Cameroon's healthcare system has two evolutionary periods. In 1985, MoPH adopted the Re-orientation of Primary Health Care (RPHC) approach to bring healthcare closer to the people. This approach emphasized decentralized planning, community participation, co-financing, and co-management and the initiation of the "cost recovery approach" within the healthcare system involving the sharing of healthcare costs between the government and the population (WHO 2017).

In 1994, it developed legislation and a regulatory framework that resulted in the reorganization of the national health system (NHS) into three levels; central (MoPH), intermediate (region), and the peripheral level (district) as the foundation stone of PHC management. The restructuring of the NHS formed the basis of the Health Sector Strategy or the government policy framework. The district, the lowest level, represents the operational units for implementing primary health care services. The district consists of district hospitals, health clinics, medical centres, dispensaries, and sub-district hospitals and serves as the first point of interaction between the communities and the formal health sector. This is the hub of health care delivery, providing essential preventive, promotive, and curative health care services. This foundation stone for primary health care management is enshrined in the National Declaration on the Implementation of PHC. This is also the level where routine data/information is generated (WHO, 2017). The secondary level (regional) consists of regional hospitals and regional pharmaceutical supply centres, providing more specialized clinical care. At the top are the national referral hospitals providing more comprehensive specialist services (Goergen et

al., 2004). According to a WHO assessment, most of the policies developed to facilitate the decentralization of health services have been abandoned and community participation remains marginal (WHO 2017). Today, Cameroon has the highest healthcare expenditure levels occurring in the informal sector (up to 30%, mostly in primary healthcare). User fees are usually charged at the point of use, except for some services for specific population groups. Up to 66% of health expenditure comes from out-of-pocket payments (WHO, 2017).

3.2.2 Access to and Use of Information and Communication Technologies (ICT)

Generally, ICTs have proved to be the backbone of many economies, both in the developed and developing countries. This has led to many countries making considerable investments in this sector, ranging from internet service providers (ISP) to postal services, television, and radio broadcasters. ICTs and the Internet have provided a breakthrough to access and disseminate information and to improve access to and quality of care. In terms of access to ICT, as of 2021, 21.4 million Cameroonians have a mobile cellular subscription, and 607,991 active fixed telephone subscriptions. The number of internet users increased from 20.68% in 2015 to 28.9% in 2019 (World Factbook 2021). On exposure to mass media, 42% households are exposed to television, 24% to radio and 11% to reading newspapers (MINPOSTEL, 2014). While in 2001, the government launched a project, "Cyber Education for secondary and tertiary education," targeting government institutions only; the project is moving at a snail pace because no budget has been allotted to support the ICTs-related activities (Tchinda, 2007). In the healthcare sector, ICTs are very rudimentary (IT-Online, 2017).

3.2.3 HIS/IS Management

Generally, HIS, IS, and e-health are the foundation for generating good-quality data and are major building blocks of a health system (WHO, 2007a). The HIS collects, processes, reports and uses information to improve the effectiveness and efficiency of health services through enhancement of management at all levels of the health system. In recent times, the emergence of accurate health data is driven by: i) The need to be more responsive to emerging health threats (WHO, 2007b). ii) Increasing emphasis on health sector reform and decentralization; global and national shifts towards performance-based management. iii) Results-based approaches to monitoring progress towards attaining health goals by government departments and development agencies (WHO, 2007). It is well acknowledged that without a coherent HIS, the

production and availability of health information required for health systems strengthening, health evaluation, and reporting will be fragmented, sub-optimal, or will not meet the needs of policy/decision-makers and end-users (WHO, 2008). Eysenbach, (2001) added that e-health is an emerging field in the intersection of medical informatics, public health, and business, with referral and information delivery enhanced through the Internet and related technologies.

While Cameroon can boast of a nationwide HMIS, however, it has a long history characterized by a series of evolutionary periods. Before 1995, routine health data was collected haphazardly as each donor agency had their own information system (ADF, 2000). For example, in the North-West and the South-West regions there were GTZ financed projects, while in the South and Adamoua regions there were SESA[4], and OCEAC[5] funded initiatives. Each partner has and managed their individual IS, which led to multiple and uncoordinated IS.

From 1995 to 2013, with the arrival of ICTs in the health sector, the country adopted the District Health Information System (DHIS2) and was the first attempt to introduce ICTs for supporting healthcare delivery. This was followed by the creation of a national department of information, popularly known by the acronym CIS (Cellule d'information Sanitaire) and a director was appointed to head the unit (ADF, 2000). The CIS was charged with the responsibility to develop and manage the country's national HMIS. The CIS is responsible for coordinating the activities, generating reports in different ready-to-use formats, and disseminating information to relevant stakeholders. Although a national department of HIS was created (CIS), no funds were allocated to support it and as a consequence, no activities could be effectively done. While on the other hand, international aid agencies continued developing their independent ISs (WHO, 2017).

The year 2014 was remarkable in Cameroon's health sector with the restructuring of the HMIS, which was triggered by the emergence of Millennium Development Goals (MDG) and the need to have comparable and accurate data to monitor the goals. This prompted massive reforms and support as the government received substantial financial support from the Global Fund and Centre for Disease Control (CDC), which boosted the activities of CIS in the country. For example, CIS prepared a national HMIS roadmap to promote evidence-based decision-making, which emphasized the restructuring of the HIS. Having adopted DHIS2, first, CIS promoted the use of DHIS2 as a central data repository. Second, they restructured and implemented standardized the data collection tools named Monthly Activity Register (MAR). Third,

[4] UNICEF sponsored project on Child Health in the South and Adamaoua regions
[5] Organization of Coordination for the Control of Endemic Diseases in Central Africa

developed and implemented standard health indicators (national indicator datasets) (MINSANTE-WHO, 2018). Fourth, the MoH created new posts for District Information Manager (DIM) at each district health office and facility information officers at the central and regional hospitals to assist with data management related-activities. Although the National Health Framework advocates for decentralization of health services as enshrined in the PHC approach (WHO, 2017), - the HMIS remains to be primarily centrally managed.

On e-health, there are some pockets of activities taking place. The country is ranked 126/143 on the Network Readiness Index. For example, some applications used in healthcare are CardioPad and DAMA. DAMA is an electronic medical record (EMR) platform for managing HIV/AIDS data, housed by the National AIDS Council. DAMA is promoted by CDC, and technical support is provided by Jembi in South Africa. E-learning is practiced at a very small scale. The only known e-Learning project is the RAFT[6] (Réseau en Afrique Francophone pour la Télémédecine), involving the Yaoundé Central Hospital offering continuous medical education to healthcare providers.

In terms of health structures equipped with ICTs at the national level, only 32% of health facilities have individual computers, while 16.8% use private computers with limited internet access. It should be noted that no health facility has internet access beyond the national level (Arreymbi & Agbor, 2008). Staff have little or no access to print information because the books are outdated; no access to the Internet or journals, and available information is not relevant for the local situation. It is worth noting that there is neither a public/school library. While the university has a library building, but there are limited books of relevance. Students prefer to use the French, German or British cultural centres instead.

Numerous obstacles hinder the introduction of e-health services in the country:

- The lack of policy, although the MoPH developed a digital National Strategy Plan for 2020- 2024, it is still to be finalize to include a telemedicine policy. There is neither a policy nor strategy to establish an appropriate system for infrastructure maintenance;
- No regulatory and ethical framework is in place for the implementation of digital health interventions. Although, there is a national ethics committee for research on human health and review committees that promote medical and biomedical ethics (WHO 2017).

6 The RAFT is a telemedicine network created by the University hospitals and the University of Geneva (HUG and UNIGE) in French-speaking Africa (Mali) in 2001.

- Poor coordination between MoPH and MINPOSTEL (Ministry of Post and Telecommunication) and no real political will to speed up the expansion of ICTs use. This is due to corruption and the lack of democratic practices, resulting in limited political will and commitment from the state to expand the ICT sector (Bakehe et al., 2017).
- The lack of an e-health financing plan. While the government, technical partners, and the private sector have invested in the procurement of ICT infrastructure and healthcare providers have been trained, there is limited political commitment reflected in the absence of a body in charge of steering, coordinating and monitoring the use of e-health funds (MoPH National Digital Health Strategic Plan 2020-2024).

3.2.4 Management of Routine Health Data

Data flow is mainly unidirectional, that is, from the peripheral to the central levels. The central and regional levels health facilities have dedicated posts for a facility information manager, while at the peripheral level, where routine data is generated, there is no position for data management staff. Instead, the facility managers are those in-charge of managing information related activities. Many studies have described the HMIS to be largely dysfunctional (ADF, 2000; Nkoa et al. [n.d.]; Ngwakongnwi et al., 2014).

3.2.5 Empirical Case in Cameroon

Data management is characterized by multiple data collection tools, constant requests for data from parallel programs, coupled with poor infrastructure, such as frequent electricity disruptions (Ngwakongnwi et al., 2014). Collecting data from multiple sources increase the burden on the already overloaded staff, risking the quality of both the data collected and the services provided. Although a national indicator dataset has been implemented, not much has changed because all decisions continue to be made at the central level. Managers and coordinators of parallel health programs frequently introduce new data collection tools to collect new data because the existing HIS is rigid to accommodate new indicators, often creating institutional conflict.

At the peripheral level, routine data is collected manually in registers and summarized in the MAR booklets. These booklets are forwarded to the district, where they are supposed to be validated and captured electronically on the DHIS2 platform. Thereafter, staff with access to DHIS2 could access their data. Despite the lack of support and poor infrastructure, data managers often endeavor to submit data on time. There are no systems at the peripheral level to validate data. This case focused on understanding challenges in using of standard health indicators, which provides the foundation of my research project.

3.3 Ghana: Brief Overview

Ghana, a previous British Crown Colony, is a country along the Gulf of Guinea of the Atlantic Ocean, situated in the sub-region of West Africa. It became independent on 6 March 1957 under the Nkrumah's leadership (Gascoigne, 2001) and adopted English as her official language but has 46 different dialects. Ghana is a unitary constitutional democratic country led by a president who is the head of state and head of the government. Ghana's growing economic prosperity and democratic political system have made it a regional power in West Africa. Ghana is one of the countries in the region consistently ranked in the top where there is freedom of speech, press, with a wide access to media and radio. Ghana ranks 138/189 globally on the Human Development Index for 2020.

The country has a population of approximately 30 million, spanning a variety of ethnic, linguistic, and religious groups. It has a large population of youths (29 percent of the population is under the age of 15) provides a window of opportunity for high growth and poverty reduction. (CIA World Factbook, 2020). The country is divided into ten regions and 170 districts (including six metropolitan assemblies), 275 constituencies with Accra in the Greater Accra region as her capital.

3.3.1 Healthcare System

In Ghana, healthcare is provided by both public and private institutions (private commercial and faith-based or religious institutions), while the MoH, with its various departments and agencies serve as the executive regulatory body for both the sectors. Although the governing body of Ghana's health system is the MoH, however, under Act 525 of 1996 (Ghana Health 40 Services Act), some responsibilities have been shifted to a more autonomous and apolitical institution, Ghana Health Service (GHS).

GHS as an institution is responsible for implementing national policies under MOH, regulates and provides healthcare services (including public health) at all levels of care (International Institute for Communication and Development, IICD Report, 2014). In terms of managing health services, GHS has a National Governing Council and retains relatively centralized control over its regions, districts, and management of health services is semi-decentralized. That grants greater financial and management autonomy to local units within the health system (Bossert et al., 2002). The healthcare sector has three levels nation, regional, and district, and five levels of care providers; community-based health facilities, sub-district, district and regional, and national level. The sub-district level has health centres, health posts, clinics, and community-based health planning and service facilities. These facilities provide immediate and urgent care to patients before referring them, should the need arise. At the sub-district level, healthcare providers serve as the first point of referral. The regional hospitals serve as the second referral points and refer complex cases to the national level care providers (Nyonator et al., 2005).

Like in most LMICs, access to healthcare services varies as the urban centres are well served and have sophisticated hospitals and clinics, while the rural areas often has no modern healthcare facilities. The population either relies on traditional medicines or travels long distances to have access to healthcare services. To improve access and quality of care, in the rural areas, the initiative "Community-based Health Planning and Services" was introduced in 1999. This led to the division of rural areas into zones served by community health workers (CHPS) (Nyonator et al., 2005). The CHPS zones provide primary health services and they serve as the first point of contact between the population and the health system. Presently, all Ghanaians have access to PHC services supported by the National Health Insurance Scheme (NHIS), which has been described as one of the most successful on the continent (Nyonator et al., 2005).

3.3.2 Access to and use of ICT

Like in South Africa, Ghana is one of the countries in West Africa that has fully embraced ICT and developed and implemented ICT policies (GHS, n.d.). In terms of access to ICT services, in 2019, there was about 41.2 million mobile subscribers; 14.767.818 about 46.5% of the population had access to the Internet. It has 9.3 million Ghanaians use a mobile device to access the Internet and only 284 000 fixed-line telephone subscribers (Ghana ICT Report 2020). In

education, for example, ICT is mostly used in tertiary education. Presently, all the major universities have their ICT policy, including an ICT levy for students to enable their access to computer labs and broadband connection while on campus. However, the situation is different in some private tertiary institutions where students make use of cyber cafés on campuses which are privately owned (Mangesi, 2007).

3.3.3 HIS/IS Management

Ghana is gradually revolutionizing its healthcare system to include ICTs applications to improve access to and quality of health care services. In 2012, Ghana rolled out a nationwide health information system called District Health Management Information System (DHMIS2), used at all levels of the health sector based on the DHIS2 platform. DHIMS2 is a comprehensive web-based HMIS platform for the reporting and analysis needs of district health administration and health facilities at every level of the healthcare sector. DHMIS2 is oriented towards the capturing of aggregate data from health programs. The software also has a specific module, the e-Tracker, configured to allow data to be recorded in the most granular way possible and facilitates automated compilation. The Tracker is almost playing the role of an electronic patient record (Ghana Health Service n.d.).

On e-health, Ghana is ranked 98/134 according to the Network Readiness Index in 2020. In July 2010, the country launched its national e-health strategy to provide a framework for designing and rolling out e-health projects in the Ghanaian health sector. Presently, the MoH is gradually rolling out biometric identification cards, which can store medical information such as blood groups and allergies, while computerized records are slowly replacing the antiquated paper filing systems (Ghana e-Health Strategy, 2010).

Health facilities have computing equipment, multimedia devices, imaging, printing systems, communication, and internet systems. Few health facilities have fully functional LAN (Local Area Networks) but are most often used to support the automation of the front office services such as the pharmacy department. E-learning and telemedicine are practiced on a very small scale. Medical schools and training centres have been very slow in changing their traditional teaching techniques. No training institution has an e-learning enabled-training curriculum with interactive features (Achampong, 2012).

However, the MoH and some NGOs are developing applications. For example, the Mobile Midwife application is a maternal and child health educational application for pregnant women. Healthcare providers use it to send automated messages to pregnant women to remind them of their appointments. It also sends out individually tailored messages on vaccinations, nutrition, and other pregnancy-related issues. The GHS-DHIMS2 has introduced an e-Tracker to digitalize routine data collection and management. Additional packets of initiatives do exist also in the private sector. For example, private developers are developing mobile applications that will aid Ghanaians to interact with the healthcare system. Moja app offers incentives to individuals to donate blood by rewarding them with free access to qualified medical practitioners via live chats and virtual clinics. Dakota App gives its members access to a large network of doctors who can answer their questions and the ability to subscribe for information on health topics relevant to their needs. Users can also schedule hospital appointments through this app. ClaimSync is an electronic medical records platform that can link various hospital visits and insurance providers (The Ghana Report, 2016).

E-health in Ghana is not challenge-free. Some challenges include:

- The lack of interoperability due to the many ICT manufacturers and vendors providing health facilities. The lack of regulatory bodies to monitor the progress and development of various e-health applications makes it even difficult to achieve interoperability (Ghana e-Health Strategy, 2010).
- The lack of guidelines for electronic data interchange and patient-identifiable information in the health sector (Achampong, 2012).
- Like most African countries, Ghana's healthcare sector suffers a shortage of ICT skilled personnel required to deliver large-scale e-health projects (Kesse-Tachi et al., 2019).

3.3.4 Management of Routine Health Data

Routine data is collected manually. At the health facilities, nurses fill out several copies of the register before attending to patients. Thereafter, the reports are sent to the sub-districts, where data is compiled. From the sub-districts, both the compiled data and the individual reports are sent to the district level, where routine data is compiled. At the districts, some data is sent to the national level and some to the regions. At the national level, the Centre for Health Information Management (CHIM) is responsible for data collection and management.

3.3.5 Empirical Case in Ghana

Routine data is generated at the peripheral level and managed by nurses. Due to the high volume of patients to attend to and the administrative processes such as filling paper-based records, managing data has become cumbersome, often resulting in late submission of data, which adversely affects monitoring of health services, delays in patients' follow-up, hence, managers' inability to take timely action. To ameliorate this situation, GHS decided to digitalize the processes of manual data collection by introducing mobile technology named e-Tracker. My research focused on the usability of e-Tracker. Data was collected from fifty-two health districts (two-health districts Awutu Senya and Ho Municipality in Ghana) focusing on nurses at the point-of-care. The case serves as an approach that could mitigate challenges of implementing standard health indicators.

3.4 South Africa: A Brief Overview

The third site (case) is South Africa (SA) with a population of over 59 million. SA has a rich colonial history and infamous for its racial segregation (apartheid). Apartheid was a political and social system dominated by white minority rule. During the apartheid era, some ethnic people were denied their basic human rights, people were divided by their race, and forced to live separately. The different races had different healthcare services leading to a fragmented and dysfunctional health system. This was the norm until 10 May 1994 when apartheid was abolished (Naylor, 2015).

SA is often referred to as the "rainbow nation" to describe its rich multicultural diversity. It is divided into 9 provinces, 52 districts, 8 metropolitan and 44 district municipalities. It has a parliamentary republic with a three-tier system of government and an independent judiciary, operating in a parliamentary system. The national government is composed of three inter-connected branches, legislative, executive, and judiciary. Considered as a developing country, it ranks 141/189 globally on the Human Development Index of 2020. Each province is managed by a unicameral legislature, which is elected every five years. The legislature elects a Premier as head of the government, and the Premier appoints an Executive Council as the provincial cabinet. The Metropolitan Areas are governed by municipal councilors, who are also elected every five years. It has a multiethnic society encompassing a wide variety of cultures, languages, and religions. Its pluralistic makeup is reflected in its constitution.

According to section 27 of the bill of rights, the constitution guarantees every citizen access to health services (Mahlathi et al., 2015). Everyone can access either public or private health services; however, access to private health services depends on an individual's ability to pay. Although access to health services is a constitutional right, most of the population has inadequate access to essential health services, including clean water, and basic sanitation.

3.4.1 Healthcare System

The health sector has three levels; national, provincial, and district. The National Department of Health (NDoH) provides leadership in the formulation of health policies and legislation through the national health system development (SA NDoH, 1997). The provinces promote and monitors people's health and develops a caring and effective provincial health system by establishing a province-wide DHS base on the principle of Primary Healthcare (PHC) approach. The district is the vehicle for delivering integrated district health services, headed by a district manager. It provides universal access to essential health care and follows rational planning and appropriate use of resources (SA NDoH, 1997). In addition, the district is responsible for the overall management and control of its health budget and the provision of a full range of comprehensive PHC services within its area of jurisdiction (Hendricks et al., 2014). Having a decentralized management health system with an emphasis on the DHS and increased access to services has strengthened PHC available to all.

3.4.2 Access to and Use of ICTs

Unlike Cameroon, which is still gradually embracing access to and the use of ICT related-services, SA is among the countries on the continent that has developed and implemented ICT policies. According to the ICASA report of 2020, on the state of the country's ICT sector, 89.5% of households have a cellular phone and 64.7% have access to the Internet. Fixed telephone line subscriptions decreased from 4.4 million in 2018 to 2.7 million in 2019, and broadband subscriptions to 19.6% in 2019. Paid TV subscribers increased from 7.3 million in 2018 to 7.6 million in 2019. SA has fully embraced the potential of ICTs; for example in the educational and healthcare sectors, 6,949 schools have internet access, and all health facilities have access to the Internet (ICASA Report, 2020).

3.4.3 HIS/IS Management

The provision and management of HMIS/IS are engraved in the country's White Paper (SA-NDoH, 1997). In 2019, the country reviewed its national digital health strategy to strengthen the digital health governance structure. This gave room for the development and implementation of numerous mHealth programs to improve access to and to support the delivery of priority health programs. In the public sector, some services have been automated, for example ehealth programs are the MomConnect program[7], Health Patient Register System (HPRS)[8], and the Stock Visibility System (SVS)[9]. In addition, the NDoH has developed a Knowledge Hub as an open-access learning management system, with a central electronic interface that provides easy access to professional development information and services. Other electronic systems are the TIER.net; an electronic Tuberculosis Register, is used for the capturing of patient-level TB/HIV data at the facility level (SA-NDoH, 2019). Some universities have started developing digital health short courses and supervising Masters and Ph.D. students exploring digital health topics (SA-NDoH, 2019).

Being the first country to implement a national information system, presently, it has created IS management committees and have implemented policies and guidelines for managing routine data at all levels of the health sector. For example, NHISSA (National Health Information System South Africa) committee is a national task team responsible for coordinating, implementing, and maintaining a comprehensive HIS. The NHISSA membership comprises of officials responsible for managing the country's HIS. Similar committees have been established at the provincial, district, and community levels. The committee also deals with operational issues regarding the implementation of the National Indicator Data Set (NIDS) to guide program development, planning, monitoring, and evaluation of routine information.

Each level of the health sector has its own Standard Operation Procedures such as the District Health Management Information Systems (DHMIS) to ensure uniformity in implementing the DHMIS. SOPs have streamlined data management and data flows from the point of care to the national level. SA is the first country in Africa to develop and implement standardized health indicators (i.e., a uniform and minimal set of datasets with clear definitions to be reported by

7. MomConnect is a health promotion program used for educating and encouraging women to take care of themselves using available antenatal and post-natal services during and after pregnancy. By March 2019, more than 2.5 million mothers were registered on the program.
8. HPRS aimed at creating a patient and Service Provider Registration System in preparation for National Health Insurance (NHI). HPRS has been implemented to provide a patient registry and Master Patient Index (MPI) using the South Africa Identification Number.
9. SVS is an electronic stock management system designed to increase access to accurate, timeous medicine availability information from health facilities. The program is implemented in clinics and hospitals

all health facilities), using a bottom-up participatory approach and the principle of the hierarchy of standards (Braa et al., 2007a). This approach is considered a benchmark emulated by many other LMICs.

Unlike Cameroon, in SA there is the political will and has invested extensively in ICT activities (ICASA Report, 2020). Access to and use of digital health services is relatively high. In terms of network readiness, SA is rated 75 among 143 countries. It has an effective policy and regulatory, business and innovative environment but in terms of affordability, the case of accessing internet is relatively high (ICASA Report 2020). However, a notable achievement is the development of the National Health Normative Standards Framework for Interoperability in eHealth. Compared to Ghana and Cameroon, SA has impressive cell-phone penetration, more fixed lines, and mobile broadband. Health facilities, mostly those in urban areas, have functional LANs (Locate Area Network) to support the automation of health services. Most health facilities have e-patient health record systems, e-consultation, e-prescription, e-referral and e-training systems, internet connection is reliable in terms of connectivity and speed in urban hospitals.

Unlike in Cameroon and Ghana, where telemedicine and e-learning services in health are practiced in a rudimentary way, in South Africa, telemedicine is practiced on a large scale. Health facilities have computing equipment, multimedia devices, imaging and printing systems and a robust internet system. Although SA has fully embraced ICTs and all health facilities have telemedicine services, however, some challenges are identified, including:

- The lack of skilled staff to maintain the system in the healthcare sector.
- Unequal distribution of access to ICT services. For example, in rural hospitals the speed of internet is often affected by poor telephone services and continuous interruption of electricity (Ruxwana et al., 2010).
- The existence of old and unreliable state of computer equipment particularly at rural areas (Ruxwana et al., 2010).

3.4.4 Management of Routine Health Data

As in Cameroon and Ghana, data flows upward from PHC health services. Routine data is collected and captured electronically daily. At the end of the month, the data is validated and forwarded to the district level. In addition to developing policy and documents, there is a unit in charge of activities related to information management at each level of the health sector. For example, at the NDoH, a directorate of the national health information system (NHIS) is

responsible for developing and maintaining the national HMIS. At each PHC health facility, beginning at the community level, has a HIS unit with dedicated staff (depending on the size of the clinic) to manage routine data. These staff have access to computers, internet, printers, and other resources. The PHC information unit feeds into the district, provincial and national levels. The district has a district information team comprising of data managers strengthening information management related-services at that level (SA-NDoH, 2019).

3.4.5 Empirical Case in South Africa

Mbingo PHC, a rural area clinic in KwaZulu-Natal province won several awards[10] and was the best performing clinic in the district to achieve the district's targets on priority health indicators in 2017 and 2018 consecutively. Given the uniqueness of the clinic, repeatedly obtaining accolades presented a unique opportunity to investigate the situation and to understand how this was achieved. Table 3 presents the similarities and differences of IS/HIS in the three sites.

[10] In 2017, the clinic earned the position of Ideal Clinic. In 2018, it received the Ministerial award as a model clinic.

Table 3: Comparison of IS status in all three countries

Program Characteristics	Management of health systems & HIS	Using DHIS 2 platform	Political will / access to /use of IS in health care	Management of Standard Health Indicators	IS challenges
Cameroon Pop: 25 million	Authoritarian Management with a centralized structure, decision-making of HIS	DHIS2 is institutionalized. But information is still considered a powerful resource to be managed by those at the central level.	No political will. Telemedicine and e-Learning are practiced rudimental. Only health facilities in Yaoundé have access to the internet and it is not available to personal used. Health facilities in the other part of the country have no access to the Internet. Information/facility managers have internet dongle and a certain amount of data is loaded on the dongle monthly so that they can submit data.	The national department of information systems (CIS) institutionalized a list of health indicators. At the peripheral level, routine data for the indicators is collected manually and then summarized in the MAR booklet. The booklets are forwarded to the district level where the data is supposed to be analyzed and captured on DHIS2. At the peripheral level, routine data is not validated. Health facilities lack the skilled staff, financial, and infrastructure to support information-related activities. No dedicated post for information/data managers at the peripheral level.	No digital nation strategy plan. No regulatory framework for the implementation of digital health interventions. Poor coordination of action between MoPH and MINPOSTEL, corruption, and lack of democratic practices. No appropriate system for the maintenance of infrastructure. Lack of e-health financial plan.

Ghana Pop: 30 million	Decentralized Management of health services, with the local unit having to grant greater financial and Management autonomy	DHIS 2 platform institutionalized. Information is a major building block used to improve the effectiveness of services at all levels of the health system.	Telemedicine & e-Learning are practiced rudimental. Health facilities have computing equipment, multimedia devices, imaging, printing systems, communication, and internet systems. Few health facilities have fully functional LAN (Local Area Networks) but are most often used to support the automation of the front office services and the pharmacy department.	In the first instance, routine data capture at the facility level on paper-based or electronic devise using registers, forms and notebooks. Data is subsequently collated and summarized onto nationally designed standard forms and thereafter electronically captured in the DHIMS-II at district level. This makes data accessible at the reporting health facilities and all levels of the health system simultaneously and in real time. There are Standard Operating Procedure (SOPs) or Data Dictionary containing the definition of all data elements, indicators, datasets. Health facilities that lack internet facilities to upload data on to DHIMS-2 continue to forward data to the district office for uploading.	Lack of interoperability. Lack of regulatory bodies to monitor the progress and development of various e-health applications. No policy guidelines for electronic data interchange and patient-identifiable information in the health sector. Shortage of ICT skilled personnel required to deliver large-scale e-health projects

South Africa Pop. 59 million	Decentralized Management of health services with the district responsible for the overall management and control of its health budget and the provision of a full range of comprehensive PHC services within its area of jurisdiction	DHIS 2 platform institutionalized. Information is a major building block used to improve the effectiveness of services at all levels of the health system.	Has fully embraced IS, and Telemedicine is practiced on a large scale.	Routine data is captured on Tick registers. At the end of each working day, the Data Manager collates extracted from the data and captured on DHIS2. At the end of the month, facility managers validate the data & forwards it to the district level where it has to be analyzed and forwarded to the next level. Health facilities have computing equipment, multimedia device, imaging, printing system, communication, and internet system. Health facilities have priority indicators and set targets. At the end of the month, the manager assess the facility's progress towards the set target. If set targets are not achieved, action-plans are developed and implemented.	Lack of interoperability. Staff lack ICT-related skills. Lack of access to it. The situation is not the same in rural hospitals, connectivity and speed of Internet services are often affected by poor telephone lines and interruption of electric power supply

CHAPTER FOUR

4. Research Methods

Exploring challenges associated with implementing standard health indicators requires a methodology to explain why the challenges occur in the first place. To understand the phenomenon, I chose an interpretive epistemology. Although, I have detailed the methodological sections in the papers presented in the thesis, I will elaborate on the integrated approach in this chapter. I begin this chapter with an account of how I entered the field and rearranged my approach according to my initial findings. Next, I provide an overview of my research design and a chronology of the fieldwork. This is followed by further details of how I collected, organized, and analyzed my empirical material.

4.1 Entering the Field

During my second semester (summer of 2016) at the department of informatics (IFI), I was elated listening to my colleagues in our research group from Malawi, Uganda, Ghana, Tanzania, Nigeria, and their involvement in developing HMIS in their respective countries. It was only a couple of years after Cameroon had adopted the DHIS2 software as the main database of the national HMIS. In addition, they had developed and implemented standard information systems, i.e., a national health indicators and standard data collection tools named the Monthly Activity Report. The Ph.D. at IFI is a project of the global HISP, affiliated with many countries, including Cameroon. Based on this, I contacted the CIS and introduced myself to the director. After a couple of skype meetings with the head of CIS and its staff, I got an invitation from CIS inviting me to Yaoundé. The CIS team was preparing to organize DHIS2 training workshops for staff at the district level. My visit to Yaoundé was thus a suitable moment because it was opportune to join the CIS team as a facilitator for some of the DHIS2 training sessions.

Upon my arrival in Yaoundé, the director introduced me to the CIS team. I attended a couple of planning meetings with the CIS staff and also at the MoPH, and at the WHO country office in Yaounde. As a trained DHIS2 facilitator who had been conducting DHIS2 training

workshops at UiO, it was easy to get myself integrated. At the end of the workshops, one of the facility information officers (FIO) asked the CIS facilitator what is the way forward and the reply was, I quote "we have given you the new MAR registers and internet dongle. We want you to start sending data without any more complaints or excuses".

A week later, one of the district information officers (DIO) invited me to the district meeting, and I was excited that it was the district data review meeting. However, it turned out that the meeting was to resolve a complaint about why two Integrated Health Centers (IHC) had not submitted the previous month's data. The manager of the IHC was asked why her facility had not submitted for the previous months. The manager responded, I quote:

> *I am the only trained nurse at my facility; every day, I receive forms from projects asking for this and that data. In addition, I have an average of four deliveries daily, children to vaccinate, and other patients who visit the facility. Projects ask for new data daily. I was given the new MAR booklet containing a new list new element, yet project managers ask for more data, and they tell us the data they need is not in the MAR booklet. Filling the form from projects and the MAR is time-consuming. By 2:00 pm, electricity goes off in my area, so I have to take care of patients first.*

The quotation from the facility manager and the response from the CIS facilitator, got me to want to understand more about Cameroon's HMIS. I asked myself that if staff at the peripheral level, the point of data generation could face such challenges, what would be the data quality and how will the data be used to support decision-making. While reflecting on these remarks, I contrasted them with my experiences on implementing standard indicators from other countries and the reading of associated literature. For example, Braa et al. 2004 on the implementation of HIS in LMICs explained that it should “guarantee the sustainability in the entire system and the sustainability of the entire HIS is highly dependent on achieving a local sustainability” (p. 226) at the peripheral levels. Furthermore, Avgerou & Walsham (2000) stressed the need to broaden the conceptualization of IS implementation to address not only the technical aspects but also the social processes involved in developing and using IS, particularly in LMIC contexts.

This brief account might not appear to be about health indicators but it highlighted the dilemmas that healthcare providers at peripheral levels encounter daily while processing routine data for indicators and more broadly for routine data management. Understanding how staff at the peripheral level lived this experience would help the study to propose approaches that potentially could contribute to improving HIS in Cameroon and the region in general. This required having in-depth conversations with the staff involved and to observe how they carried out their everyday work. More importantly, the account highlights some methodological points

about defining the research site – which should not be taken for granted (Blomberg & Karasti, 2013) and the subject of inquiry, which in interpretive approaches can be shaped through iterative processes of data collection and analysis.

4.2 Research Approach

This study utilized a qualitative approach that was informed by the research questions:

- **Main**: What challenges are associated with implementing standard health indicators in hierarchical organizations, and which approaches can be employed to mitigate these challenges?

- **Sub-RQ1**: What are the challenges associated with implementing standard health indicators in hierarchical organizations?

- **Sub-RQ2:** What approaches could be employed to mitigate the challenges of implementing standard health in indicators hierarchical organizations?

These questions were exploratory and qualitative in nature, which was supplemented with some quantitative data to answer sub-RQ2.

4.2.1 Rationale for using a qualitative design

Qualitative research takes their point of departure in philosophical theories, many of them in humanistic approaches (Polkinghorne, 1989). Qualitative research begins with the assumptions and the use of an interpretive framework that informs the research problems by addressing the meaning individuals ascribe to a social or human problem (Creswell 2007, p. 44). Qualitative research does not seek to describe a particular norm, but rather to discover the richness and complexity of a situation, which may be different from the norm resulting in contextually framed perspectives (Manning, 1992). Qualitative research is a situated activity that locates the observer in the world of inquiry (Creswell 2007, p.44).

Qualitative approaches are sensitive to natural settings in which people live, are more exploratory and descriptive, and are based on the participants' lived experiences rather than measuring facts or truths (Creswell, 2007). In this sense, the researcher is not detached from the participants but attempts to understand the phenomena from the participants' own

perspectives (Smith et al., 2003). This is in contrast to quantitative research that aims to eliminate the researcher from the research process, so that the data can be analyzed in a bias-free and objective manner in order to discover a single truth (Lee and Baskerville, 2003). According to Willig (2001), qualitative research is concerned with the meaning and the lived experience rooted in the individuals' socio-cultural context. Creswell (2007) explains that qualitative research takes the researcher out of the laboratory and into a context where the phenomena can be studied. Qualitative research involves an interpretive, naturalist, holistic, and inductive approach to the world. This means that qualitative researchers study things in their natural settings, attempting to make sense of or interpret phenomena in terms of meanings people bring (Denzin & Lincoln 2000). Qualitative research generally explores, describes, and analyzes participants' personal and social experiences (Smith et al., 2003). The purpose of an inductive, natural, and holistic approach is to study the phenomena without manipulating the context in which they occur but to explore the phenomena as they occur in people's lives.

Furthermore, the exploratory nature of my research questions and the assumption that knowledge is obtained through our daily practices and interactions within communities where we belong (Ashworth, 2003). Therefore, using a qualitative research approach would provide an in-depth understanding of the phenomena within the health sector and allows for the unfolding of events to be directly observed. Although the increase in evidence-based decision-making encourages a quantitative approach to research (Darling and Scott, 2002), the main benefit of doing qualitative research is the patience, skill, creativity, and commitment needed in undertaking a research process that is continually evolving and the value it places on subjective viewpoints in exploring the phenomenon more holistically (Irvine and Gaffikin, 2006).

Like, De Vos and Fouche, (1998) and Creswell, (2007) explained qualitative researchers have at their disposal different research designs including phenomenology, interpretative, grounded theory, and ethnography. Data analysis encompasses both inductive and deductive approached and establishes patterns or themes. Finally, qualitative research allows the researcher to increase understanding of the phenomenon within a particular context and to examine it from the participants' perspective, using emerging qualitative methods to collect data in a natural setting.

The aim of this research is to understand the challenges associated with implementing standard health indicators and which approaches can be employed to mitigate these challenges. For me, this was so that I could answer my research questions in detail while relying on the rich

description of experiences from staff at the peripheral level to form the arguments in my findings. Since the focus of this study was to understand the challenges of implementing and and using health standard indicators (phenomenon), this design would allow me to use multiple data collection methods including interviews and observations (Creswell, 2007). In addition, adopting an interpretative stance allows for methods that are compatible with the primary aim of this study.

When conducting a research be it qualitative or quantitative, there are some underlying assumptions about what constitutes a valid research and which research methods are appropriate (Myers, 2019). The most pertinent ones are those that relate to the underlying epistemology, which guides the research. Epistemology refers to the assumption about knowledge and how it can be obtained (Myers 2019; Gonzalez and Dahanayake, 2007; Saunders et al., 2009). Epistemology "provides a philosophical background for deciding what kinds of knowledge are legitimate and accurate (Gray, 2014, p. 19). As Orlikowski and Baroudi, (1991) put it, the empirical world can be objective, treated as independent of humans, or subjective being created and recreated by humans. This research was guided by the philosophical assumptions, which relate to the underlying epistemology that health indicators, as part of an IS is composed of both technical and social elements. IS cannot be independent of people around them because, for example, peoples' individual practices, values, and interests influence the use of standard health indicators. Therefore, understanding and using IS including standard health indicators in the organization requires the use of a socio-technical perspective (Eriksson and Kovalainen, 2008).

Research can be classified as positivist, interpretive, and critical (Myers, 2019; Gonzalez and Dahanayake, 2007; Creswell 2007). Positivists, having its roots in the natural sciences, assumes that reality is objectively given and can be described by measurable properties, which are independent of the researcher (Myers & Avison 2002). In positivist studies, the main argument is that the reality is objectively given and exists independent of humans (Gray 2014). In this context, the researcher is seen to be external to the process of data collection, that is, s/he is expected not to intervene in the phenomenon under study. Positivism may not offer powerful insights to IS related study. However, Klein & Myers, (1999) noted that most quantitative studies follow a positivist approach. IS research can be classified as positivist if there is evidence of formal propositions, hypotheses, testing and the drawing of inferences. Since the purpose of this research is to understand the challenges of associated with implementing standard health indicators in the healthcare setting which involves interaction between the HIS

and the organization and apply the produced knowledge to inform the implementation IS, a positivist approach was found to be not appropriate.

For better understanding of the challenges of implementing IS including standard health indicators, it is important to analyze the social practices and organizational culture through which people engage (Mukama et al., 2005). In the past two decades, IS researchers and practitioners advocate interpretivism as the most appropriate approach for studying IS implementation and interventions (Walsham 2006). The third epistemology is the critical perspective, which aims at commenting on existing social systems and revealing any contradictions and conflicts that may be inherent within their structure (Orlikowski & Baroudi, 1991). Gray (2014), explained that critical research questions currently hold values and assumptions that challenge conventional social structures. My research was guided by both interpretive and critical research based the on their underlying philosophical assumptions.

4.2.2 The Interpretive Framework

The interpretive framework is a theoretical approach that involves the systematic analysis of socially meaningful action in order to arrive at an understanding of how people create and maintain their social worlds (Djamba 2002). The phenomenon under study has an organizational and social focus and therefore, an interpretive stance was seen appropriate.

Interpretive studies start with the assumption that people create their own subjective and intersubjective meanings as they interact with the world around them (Eriksson and Kovalainen 2008). Unlike positivist studies, that encourages deterministic explanation of a phenomenon; interpretive studies attempt to understand a certain phenomenon through the meaning people assign to it by getting inside the world of those generating the phenomenon. As such, interpretive researchers do not predefine dependent and independent variables; however, they are concerned with the full complexity of human sense making as the circumstances appear through accessing the meanings participants assign to them (Kaplan and Maxwell, 1994).

Interpretive research in the IS field is concerned with understanding the social context of ISs and does not aim to prove a hypothesis but acknowledges that social phenomena must be understood in the social contexts in which they are constructed and are guided by how people interpret and understand situations (Angen, 2000; Oates 2005). This research aims to

understand what happens in that setting from the participants' perspectives without imposing the researcher's previous understanding. To understand my research question, the study adopted an interpretative stance.

By adopting the interpretative stance, I accept that reality is socially constructed and humans build meanings as they engage with the world. Based on this stance, people give me (the researcher) accounts of their active interpretations and constructions of their situation. The data I collect through this approach is thus an account of the interpretations made by the people and my interpretation of their interpretations. My role has been to report my interpretations of their social reality as truthfully as possible and to improve the trustworthiness of the research as explained in section 4.9.1. The explanatory and analytical approaches and concepts used to make sense of this reality varies.

In addressing my research purpose, I endeavored to understand the various perspectives of people's subjective and intersubjective meanings (Groenewald, 2004; Laverty, 2003). Klein & Meyers (1999) work has had a significant impact on IS research, offering solutions to methodological rigor and the importance of understanding the social and historical aspects of the phenomena under investigation. In each paper, I have attempted to provide details of the context of each case as extensively as possible.

So far, this research has justified the adoption of a qualitative methodology and the interpretive paradigm. The next section focuses on the selection of an appropriate research strategy.

4.3 Research Strategy

Having justified the use of a qualitative approach and interpretivism as the epistemological stance, this section focuses on selecting a research strategy. Remeniy et al. (2002) differentiate between strategy and tactics. While the first refers to the overall approach adopted, the second one is about the specific details of data collection and analysis. The research strategy refers to organized principles that provide the procedure for guiding the research design and process. It describes how a given issue can be studied (Henn et al., 2006). In this research, I recognize that while knowledge can be acquired from different forms of text, the most critical knowledge is what is obtained through our daily practices and interactions within communities where we belong. It was necessary therefore to adopt a research strategy that would provide an in-depth

understanding of the phenomena under study and allows the unfolding events to be directly observed, hence, a case study was adopted as the research strategy.

Case study research allows for the exploration and understanding of complex issues. It can be considered a robust research method particularly when a holistic in-depth investigation is required. Case studies, in their true essence, explore and investigate contemporary real-life phenomena through detailed contextual analysis of event and their relationships. Yin (2013) added that case study research strategy investigates a contemporary phenomenon within its real-life context.

The main characteristics of case study strategy have been identified by many authors (e.g. Cavaye 1996; Orlikowski and Baroudi 1991; Eriksson and Kovalainen 2008) as follows. It does not explicitly control variables. It focuses on understanding the dynamics present within single settings. It studies the phenomenon at one or a few sites; data are collected by multiple means; it uses qualitative methods to collect and analyze data, its focuses on up-to-date events, and multiple sources of evidence.

In IS research, the case study strategy is effective as it enables better understanding of the interactions between the IS and organizational context (Orlikowski and Baroudi 1991). Case study is well suited because not only does it focus on in-depth understanding of the phenomenon, it also concentrates on developing an understanding of the context (Cavaye 1996). As noted by Orlikowski and Baroudi (1991), case study strategy has confirmed its appropriateness to produce a sound interpretive understanding of human-IS interaction in the real social setting. In this study, the selection of a case study strategy is based on some considerations. These are to seek an in-depth understanding and uses of standard health indicators to meet the nature of the research question and to investigate and develop a mature understanding of the contextual aspects of the phenomenon.

Case study strategy is versatile and can investigate single or multiple cases, depending upon the philosophical assumptions of the researcher (Myers and Avison 2002). A single case is often selected when the case is both an exemplar, containing unique circumstances and being revelatory as one of the first examinations of the phenomenon (Yin 2002). A single-case study design could be criticized for its inability to provide a generalizing conclusion, in particular

when the events are rare. However, one way of overcoming this is by triangulating different sources of information (Creswell, 2007) so that diverse viewpoints can cast light upon a topic and enhance the credibility of the findings (Creswell, 2007).

This research used multiple cases. Miles and Huberman (1994) explained that using multiple cases makes it possible to build a logical chain of evidence. Additionally, Benbasat et al., (1987) stated that multiple-case studies provides more general results than a single case study does. Yin (2002) noted that the analytical conclusions derived from a multiple-case study is more robust, as it moves the investigation from one context to another, thus isolating idiosyncrasies that contribute to exploring the phenomenon. Doolin, (1996) explained that interpretive studies use more than one case without loss of depth and rely on the richness of their descriptions to support their validity. Similarly, Eisenhardt, (1991) added that a multiple-case study allows comparisons, which can show that the research results are not idiosyncratic to a single case but are consistently replicated by several cases. In addition, constructs and relationships can be more accurately explained since it is easier to find out precise definitions and appropriate levels of construct abstraction from multiple cases (Eisenhardt and Graebner 2007). Eisenhardt, (1991) added that when a research adopts several cases, the purpose is to gain a broader exploration and allow comparisons because the cases have some similarities. However, this was not the case in this research. Although this study has three cases, as illustrated in the figure 4, each case had a separate unit of analysis, hence there was no comparison. Adopting multiple cases was informed by the findings of case one and each case was independent in nature. Therefore, instead of describing this study as having multiple-case design, I called it "multi-sited" study.

"Multi-sited" is a term used by ethnographers to describe how they move from one site to another as developments unfold in search of news. It is a fitting approach to a rapidly changing society and, accordingly, ever more involve complicated research objects that do not confine themselves to a single location (Hannerz 2003). Relating to my research, although it was not complex, but access to the site became complicated and not accessible to conduct my fieldwork. Using the multi-sited approach allowed me to answer the research questions rather than enabling me to gain broader perspective of the phenomenon studied.

4.3.1 Basic conceptualization of the cases

As already indicated above, this study was supposed to involve a single case (Cameroon). Due to the war that erupted in the Southern regions of the country (where I had to do my fieldwork), I had to redesign the research project. Hansen (2018) suggests that "researchers should be flexible during fieldwork" (p. 11) and Chambers (2020) added that conducting fieldwork necessitates an adaptive and flexible approach when impacted by political turmoil, as in my situation. The study moved from a single case to multiple case design but each case was independent and the purpose was to answer the research questions.

Ragin and Becker (1992) emphasize the need to have empirical units of analysis. The unit of analysis is the level at which the research is conducted and which objects are researched (Blumberg et al., 2011). In this study, each case had a separate unit of analysis and the unit of analysis was HISP's activities going on at the different sites. Conducting multiple case that are independent enabled me to explore different aspects of the research questions at other locations with separate units of analysis. Figure 4 illustrates how the research was redesigned to answer the research questions.

The research started in Cameroon (case 1) and the purpose was to understand the challenges associated with implementing standard health indicators at the central level while at the peripheral level, I focused on understanding challenges frontline data managers face in managing routine data. I made two field trips to Cameroon, where I conducted interviews with staff at the central and peripheral levels. At the peripheral level, I interviewed 25 staff (9 programs managers and 16 nurses). I started by analyzing data from 16 nurses because this cadre are directly involved with data management-related activities and the main findings are summarized and presented on table 4.

Table 4: Main factors that hinder data management at the peripheral level

N=16

	#	%
Lack of support	2	13
Lack of capacity & capability	5	31
Data management processes are cumbersome	9	56
Total	**16**	**100**

The findings were summarized into two main challenges; lack of support, capacity and capability 44% while 56% indicated data management processes are cumbersome. The findings were further discussed with my supervisors. Since I could not continue the research in Cameroon, the next step was to look elsewhere for approaches that could mitigate these challenges. During this period, Ghana was implementing mobile technology to enhance routine data management at the point-of-care. I took that approach to mitigate the challenge that data management processes were cumbersome, which serves as case 2. Finally, to South Africa where I explored the process and impact of developing data management capacity and capabilities among nurses at the peripheral level, which constituted case 3.

Case 1 (Cameroon) served as the foundation of the research study and the findings from this case answered research question sub-RQ1. Case 1 looked at the challenges of understanding and using health indicators in the healthcare sector. While cases 2 (Ghana) and 3 (South Africa) could become a source of learning for case 1. Hence, they (cases 2 and 3) helped to mitigate some challenges arising from case 1 (sub-RQ1) and were complemented with literature on the boundary phenomenon; which enabled me to answer sub-RQ2, as illustrated in the figure 4.

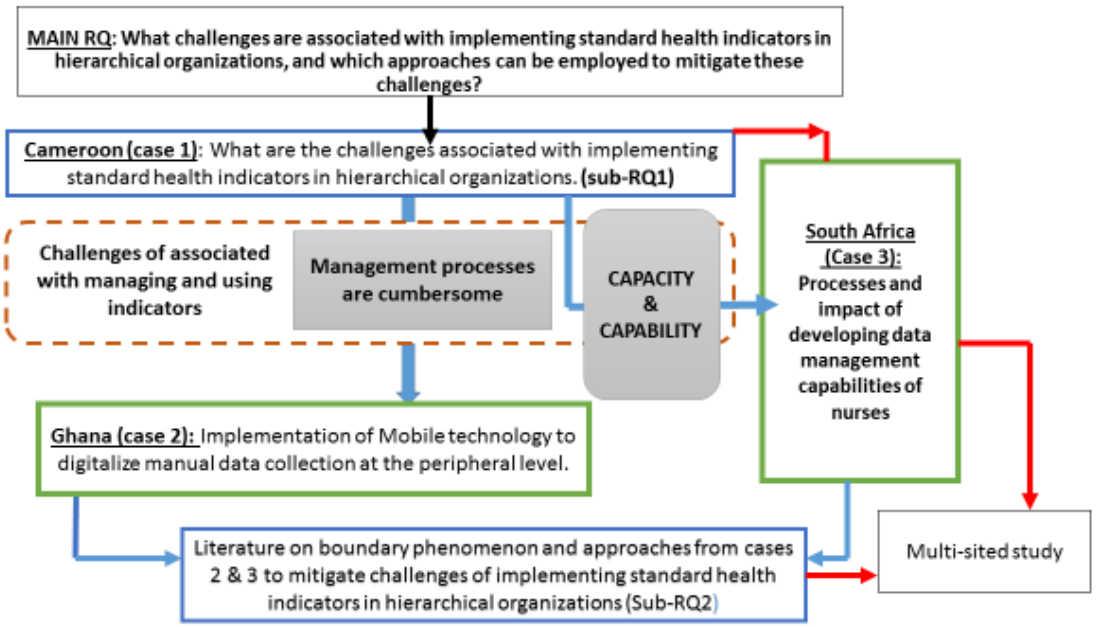


Figure 4: Basic conceptualization of the cases and their contribution to RQs

4.4 Accessing the Sites

Gaining and maintaining access to a research site when conducting research could be challenging, let alone conducting a research study involving multi-sites (Hannerz, 2003). Riese (2019) explained that how a researcher accesses the field or research site could influence the research process and results either negative or positively. While Walsham (2006) added that good social skills coupled with self-reflection are essential in gaining and maintaining access to the research sites. As indicated at the beginning of this chapter, I entered Cameroon through the CIS, MoPH. Maintaining continuous access on the field involved negotiation with the district and facility information officers, parallel program coordinators, and managers of integrated health centres. Since I left the fieldwork, I have tried to stay in touch with some district and facility information officers, often making phone calls to them and project coordinators for follow-up questions, and in some cases, to give feedback regarding my findings.

4.4.1 Entry to Cameroon: Case 1

Being affiliated with the HISP research group at the Department of Informatics, University of Oslo (UiO) helped extended my contacts to CIS-MoPH in Cameroon, HISP Ghana, and South Africa respectively. My first contact with CIS was through UiO and after a series of skype meetings with the CIS team, I received an invitation to visit the CIS-MoPH team in Yaoundé, Cameroon, which served as an opportunity to build a better understanding of HIS management. While in Yaoundé, I asked for permission to conduct my research and was advised by CIS director that instead I should write to the Ministry of Public Health (MoPH), which was immediately done. It will be surprising to note that I still have not received a response to my letter sent to the minister, reflecting the difficulties in conducting an academic research study in Cameroon and the nature of decision-making at the MoPH. During the same period, the CIS team had planned a series of DHIS2 training workshops with the district and facility information officers (D/FIO) and coordinators of PHP from the Littoral, North West, and South West, regions, and I was asked to act as a training facilitator alongside the CIS team.

While facilitating the DHIS2 training workshops, I made acquaintances with participates, told them about my study, and exchanged contacts. Seeing that the response from the minister was

not forthcoming, after the DHIS2 training sessions, I wrote to each of the Regional Delegate of Health instead, requesting permission, which was granted. With the acceptance letters from the Regional Delegates, I then went ahead to seek for gatekeeper permission from managers of health facilities. However, being able to contact staff responsible for managing data and getting them to participate in the study was challenging.

While doing my fieldwork, I maintained close contact with the D/FIOs and received support from them. For example, to visit a health centre, either the DIO or FIO accompanied me for security reasons but also, I realized that their presence facilitated me meeting with staff at the health facilities. I also realized that traveling with either the D/FIO was a win-win situation. To me, the presence of the FIO facilitated access to staff at the health facilities. That is, while at the health facility, I observed that immediately the staff identified the FIO, a familiar face, quickly accepted my request to be interviewed. On the other hand, to the D/FIO, going to the health facility was an opportunity to visit since districts have no finance for D/FIOs to make such visits. In addition to conducting data, at some facilities, I provided some support such as providing on-site training to managers who had problems using data collection registers and how to calculate and analyze health indicators. For example, at one health facility, the nurse on service was alone attending to patients. Children were crying and the elders were getting agitated because they had been waiting for too long. I stepped in by assisting in the recording of the bio-data of patients. By doing this, the staff was able to complete her duties and had time to discuss with me before the end of the day. Helping with some administrative tasks gave me the opportunity to better understand what was happening on the ground. Most importantly, it helped me to create acquaintances and build trust with facility staff who were not part of the DHIS2 training (Lincoln and Guba 1985). Similarly, Chaudhry (2018) added that it is important to gain participants' confidence when conducting qualitative research as it ensures credibility of the study and allows the researcher to receive a free flow of information. This process continued until the end of the data collection phase in Cameroon.

4.4.2 Entry to Ghana: Case 2

Since I was certain on what to do in Ghana, I contacted one HISP researcher in Ghana, who guided me on what to do and stressed on the need to contact the Ghana Health Service (GHS) to obtain ethics approval. I contacted GHS and since the University of Oslo does not offer ethics clearance, I had to go through the normal process of obtaining this approval. The normal process

means I was considered as a Ghanaian student seeking ethical clearance for a research study. This implies having a local supervisor and some research assistance before the Ethics Committee will accept the research proposal. I used my ex-colleagues as local supervisors and research assistants. Their responsibilities were to ensure I upheld ethics principles throughout the fieldwork.

The process was not only cumbersome but also costly. Unlike other ethic committees where one could submit the application via email, the GHS Ethics Committee accepts only hardcopies of the application. In this context, it is the responsibility of the researcher to ensure that the application and attachments are printed and handed to administrator of the Ethics Committee. The local supervisor and research assistant facilitated these processes.

After obtaining the ethics approval letter ref. # 017/11/17, it was easy to obtain gatekeeper permission. I realized that having obtained ethics approval, booking appointments was faster and having access to district managers went smoothly which was the focus of my study. For example, the local supervisor contacted the director of DHIMS II (District Health Information Management System II) and booked an appointment on my behalf. For example, during a meeting with one of the directors of DHIMS, after presenting a brief overview of my research objective, the director was relatively helpful. He explained the strategy plan of GHS regarding the implementation of mobile technology, gave me a list of health districts where e-Tracker had been installed and went ahead to introduce me to the district manager and district information officers in the two districts Awutu Senya and Ho municipality. These were districts where mobile technology was already implemented. In addition, I was fortunate to attend some meetings at the districts where I was introduced to facility managers and community-based health planning and service (CHPS) managers. Being a pilot study, data collection was conducted in two districts; Awutu Senya (urban) and Ho municipality (rural). At Ho municipality, I worked with a public health officer who introduced me to the nurses attending the public health meeting at the district. Creating contacts with staff at GHS helped me to have a better understanding of the health system. The presence of the local supervisor and research assistant was quite helpful because potential research participants wanted to identify a familiar person. Attending meetings, interacting with nurses increased participants' confidences and facilitated the flow of free information throughout my fieldwork (Lincoln and Guba 1985; Chaudhry 2018). Eide (in Eide and Allen 2005:5) explained that it is important to know the

person when conducting a research and Eide et al. (2005) added that "not only must the researcher know about the group being studied, but at least some group members must also know him or her to gain access that allows for trust-building" (p. 5).

4.4.3 Entry to South Africa: Case 3

In South Africa (SA), I had to go through a similar procedure as Ghana to obtain ethics approval before commencing my fieldwork. Unlike Ghana, where the GHS Ethics Committee grants ethics approval in SA, only academic institutions will grant ethics approval and the government departments issue ethical clearance. This means that in SA, I started by applying for ethical approval from one of the educational institutions of higher learning. After obtaining ethical approval, I then applied for ethical clearance from the provincial department of the Health Ethics Committee and to the district office of the health facilities involved in my study to obtain gatekeeper permission.

In Ghana and SA, I was not as involved as was the case in Cameroon. However, before I started collecting data, I tried to build rapport with the participants, which I maintained during and after my fieldwork. Creating these relationships helped me to have a better grasp of the health sector and to build confidence between the researcher and research participants (Lincoln and Guba 1985; Chaudhry 2018).

4.5 Data Collection methods

In this research, mixed methods of data collection were employed to seek, describe, and translate the phenomena in the social context they lived in (Myers and Avison 2002). Qualitative and quantitative data was collected through interviews, participant observation, field notes, analysis of documents across the cases, focus group discussions (FGD), and questionnaires. In addition, I revised some data collection tools to collect data on usability. Evidence from several sources is collected to support the research results, which is a strategy to enhance data credibility (Yin 2013). The target is to obtain a rich set of data about the research issue and to capture the contextual complexity (Creswell, (2007). Table 4 presents the sources of data collection used and the number of interviews and hours spent conducting interviews.

Table 5: Sources of data collection used

Case	No. of interviews	No. of hours interview	No. of FGD	No. of hours FGD	No. of hours observation	Questionnaire	Document Evidence
Cameroon	47	38			13		Yes
Ghana	22	10	5	5	18	62	Yes
South Africa	11	8	4	4	14		Yes
Total	**80**	**56**	**9**	**9**	**45**	**62**	

Collecting data from multiple sources facilitates triangulation, which helps develop a comprehensive understanding of the phenomenon (Patton 1999). In qualitative research, triangulation is viewed as a strategy to test validity through the convergence of information from different sources. It is important in a case study because findings from multiple sources are more likely to be convincing and accurate (Yin 200), i.e. increase the validity of the results. There are several different types of triangulation method/data, investigator, theory, and data source triangulation (Denzin 1978; Patton 2005). According Flick (2008), data triangulation helps in verifying facts through multiple-data sources. Moreover, data triangulation improves the quality of data and consequently the robustness of the findings (Olsen, 2004; Myers 2019). In this study, multiple data sources were used, which is highly recommended when conducting qualitative research (Miles and Huberman 1994) as a mechanism for increasing both the reliability and validity of the research.

4.5.2 Semi-structured interviews

Given the research's aim, interviews were considered the most useful data source for gathering the interviewee's (healthcare professionals) interpretations of standard health indicators. Data and information are used throughout the healthcare system, thus, interviews were conducted at different levels of the system to cover healthcare providers, PHP coordinators with stake in information management including standard health indicators.

Based on the objectives of the research, a semi-structured interview guide using open-ended questions was necessary. In conducting IS research, unstructured or semi-structured interviews are the most common source of data (Myers and Newman 2007; Walsham 1995) as it is

considered to bring a closer understanding of people and their social worlds (Hermanowicz 2002). Interviews offer researchers the chance to explore topics in-depth and to understand the context within which the interview is conducted (Silverman, 2013). Interviews were the dominant source of data in this study and were conducted by the researcher using interview guides.

Participants interviewed in all three cases were selected purposively by using the maximum variation sampling technique. Maximum variation sampling is a purposive sampling technique used to capture a wide range of perspectives relating to the phenomenon being studied (Creswell 2007). In this study, different participants were selected from different levels of the healthcare sector and were purposively selected based on their job descriptions, i.e. participants involved in data management or HIS activities in their respective health facilities. In qualitative research, the goal is to be enriched by the phenomenon being studied. Therefore, I selected fertile participants from which I could substantially learn more about their experiences. Patton (2005) explained that it is important to select information-rich participants for research studies, from whom one can learn a great deal about the issues of central importance to the purpose of the research. In addition to selecting information-rich staff, another aspect I considered was to have representation from different stakeholders involved in data management.

Those interviewed comprises of, for example, DHIS2 implementers, D/FIO, M&E, and data managers data/information managers/officers, PHP coordinators, and healthcare providers involved in data management related activities. Health program coordinators were interviewed to establish how they interact with each other by sharing data between health programs, how they use the DHIS2 platform, and their participation during the implementation of the standard health indicators. At the health facility level, it was important to know about the relationship between staff at the district and those at the central level regarding support, communication, training (frequency), and the management and use of data by staff at different levels. Interviewing staff from different health sector levels helped me understand meanings, beliefs, experiences, and the social context and provide rich descriptions and explanations of processes within the organization. The sample size was not predetermined; instead, data collection ended when I realized saturation, i.e., repeated themes. In addition, interviewing different people within an organization aimed at triangulation of subjects (Myers and Newman 2007) and also

helped to reduce the bias of interviewing only prominent individuals (Miles and Huberman 1994).

The interviews were conducted at the interviewee's workplace and were mainly semi-structured. Semi-structured interviews helped the researcher and participants to engage in a dialogue whereby initial questions are modified in the light of the participant's responses and the researcher can probe interesting and important areas which arise (Smith et al., 2003). The interviews averaged 45 minutes in length. Relying on what participants say alone may deny the research insights of what they do in their social practices, therefore, observations was used to verify what they say they did.

4.5.2 Participant observations

In addition to the interview, data were gathered through observations of healthcare providers in their interaction with data and analyzing standard indicators at their respective health facilities. Observation is the systematic recording of observable phenomena or behavior in the natural settings (Gorman and Clayton, 2005) during data collection-related activities. In this research, natural settings were health facilities, such as clinics, community health centres, hospitals, and district information meetings. Participant observation was used to complement the interviews and was done at various stages during my fieldwork. For example, in Ghana, I observed nurses using e-Tracker; in SA, it was during data validation meetings. In Cameroon, I watched the DIOs and data managers validate data before it is captured electronically. Observing participants in their natural settings, first, gave me a deeper understanding of what is happening on the ground. Second, observing nurses at meetings gave me the advantage of seeing and understanding the study phenomenon firsthand. It also presented an excellent opportunity for me as the researcher to build a relationship with the participants. Lincoln and Guba (1985) emphasized building rapport or creating acquaintances with participants before conducting qualitative research as it increases the credibility of the study.

During observations, I made notes, which were transcribed at the end of the day. Transcribing notes daily helped me identify gaps in my data, reflect on participants' comments, and adjust the interview guides. In addition, I attended data management-related meetings in the districts and health centres visited and had informal conversations with staff at different levels of the health sector. Attending workshops and meetings broadened my perspective and understanding

of the health sector and the phenomenon studied. Furthermore, observations helped to maximize the triangulation, which resulted in enriching the collected data and enhancing the research reliability and validity.

4.5.3 Focus Group Discussions (FGDs)

Focus group is a form of group interview that explicitly utilizes the interaction between research participants as part of the method to generate data (Kitzinger 1995). It is a useful source of data to explore how participants describe their thoughts and to uncover important factors (Kitzinger 1995). In this research, FGDs were conducted at two (SA and Ghana) sites. In Ghana it was used to get nurses' views about using mobile technology to collect data while in SA, it was used to get the nurses' views on the data validation meetings introduced by the health facility manager. During FGDs, participants shared their collective experiences about using e-Tracker in the case of Ghana, and in SA, it was about understanding nurses' views about having daily data validation meetings. At the FGDs, I acted as a moderator, and started the discussion by explaining the aim of the study. During the discussion, I ensured that all participants got an opportunity to speak and to avoid the situation of a few participants dominating the discussion. I encouraged the quiet nurses to share their views, as everybody's opinion is important. However, a challenge experienced was taking notes or capturing expressions that stood out during the group discussion. Each FGD lasted between 45 minutes to an hour. During the FGDs the main points raised were summarized on the whiteboard and were later transcribed to assist in data analysis.

4.5.4 Questionnaires

Another source of data used was through questionnaires. A questionnaire is a research instrument consisting of a series of questions to gather information from respondents. Questionnaire is a well-established tool to acquire information and perceptions on public knowledge. It enables respondents to consider their responses carefully without interference from, for example, the interviewer and is helpful to access a large audience within a short period and to compare the data (Bird, 2009). The questionnaire is handy when participants wish to remain anonymous and is a more comfortable way for participants to reveal information, that would make them uncomfortable in a face-to-face setting (Bird, 2009). Using a questionnaire provides a relatively cheap, quick, and efficient way of obtaining large amounts of data from a

large sample of people (Jones et al., 2013). In this study, a questionnaire was used at one site, Ghana. These districts were selected because at the time of data collection, they had implemented e-Tracker, nurses had been trained, and had started using the device. Questionnaire was useful to assess nurses' usability of mobile technology in two health districts comprising of 62 health centres and Community-based Health Planning and Services (CHPS) zones. I adopted a psychometric questionnaire on usability (Gao et al., 2018) to explore healthcare providers' perception of using mobile technology to collect routine data. The questionnaire consists of close-ended questions, but space was provided for participants to comment after each question. In addition, it was relevant to compare data from the two districts to establish any differences in using e-Tracker at Awutu Senya (urban) and Ho municipality (rural).

4.6 Documentary evidence

Documentary evidence is useful for making inferences about events. Yin (2002, p. 103) states, "because of their overall value, documents play an explicit role in any data collection in doing case studies and in qualitative studies. In this research, there were many types of documents, which were found to be helpful, interesting, and added value to the data collected. This included published reports for example, at all three sites; I analyzed official reports written by different bodies involved in health system and HIS. Examples are MoPH Health Strategic Plan; digital health plans. Particularly, in Cameroon, I assessed the Monthly Activity Report (MAR) registers for availability and uniformity of data at the health center, while in Ghana, I studied the SoPs for data management, data collection registers/forms. Since my focus was on digitalizing routine data collection, I looked at the manual process and compared it with the digital process. In South Africa, I reviewed the tally sheets, monthly reports, Road to Health Card, and Tick registers. These documents were helpful to learn about major events, historical decisions made, key actors in the health system, and their roles. Besides, it gave me background information about the research sites. Most of the documents were reviewed before I started conducting interviews, which proved helpful in the preparation of the interviews. In addition, the information gathered from these sources helped in providing rich information about the phenomenon under study. Table 5 provides an overview of the documentary evidence studied.

Table 6: Document studied and insights from them

Site	Document Type	Insight from the document
Cameroon	Health Analytical Profile	Provide an overview of the state of HIS and performance of health indicators
	MoPH Strategic Plan	
	MAR	Access the user-friendliness of the register
Ghana	SoP for data management	Data management procedure and guidelines
	Immunization manual	Number of nurses have to fill before offering the vaccine to a child
South Africa	SoP for data management	Overview of the tasks & responsibilities of the clinic manager
	Tally Sheet & Tick Register	Access the user-friendliness of the register

4.7 Data Collection

I conducted all the interviews in the English language. Before starting each interview, time was dedicated to building trust and rapport, which helped set the tone for the discussion. The interview proceeded as a "professional conversation" (Kvale, 1996, p2) which consists of a give-and-take dialectic in which the interviewer follows the conversational threads opened up by the participant and then guided the conversation toward producing a more complete account of the phenomenon under investigation. Kvale (1996) equated conducting research as an interchange of views between two persons conversing about a theme of mutual interest where the researcher attempts to "understand the world from the interviewees' point of view, to unfold the meaning of peoples' experiences" (pp. 1-2). During the interviewing, I allowed the interviewee to describe his or her personal and subjective experience as freely as possible in their own words, and where necessary; I asked additional questions for elaboration purposes. This allowed the interviewee to describe the lived experience by the person herself and allows the essence to emerge naturally (Kvale, 2006).

While conducting the interviews, I tried making notes, but it was challenging because I had to multitask (i.e., asking the question, trying to listen to the interviewee, and at the same time making notes). Rapley (2004) explained that multitasking may cause the researcher to fail to maintain a normal conversation and may come off as being passive or uninteresting. Therefore, the researcher must have good social skills and be sensitive to access participant's views (Rapley, 2004). I observed that during the discussion, whenever I started writing a comment, the participant pauses, which interrupted the flow of the discussion. In Ghana, I made some

field notes and recorded the discussions on my mobile phone, which I had to constantly check to ensure that the device is recording. Using a mobile device to record an interview makes the process more accurate, effective, and transparent, however, Burke et al., (2001) cautioned that it is imperative to conduct a pre-test of mobile device to ensure that the speaker on the phone is functioning correctly so that one is not caught off guard. Paulus et al. (2017) also added some words of caution to researchers that equipment failure and environmental conditions might seriously threaten a research. Therefore, it is imperative that the researcher should ensure that the recording device functions well and that spare batteries are available. The interview setting must be as free as possible from background noise and interruptions.

During observations, I often sit at the back of the room observing nurses' interactions and taking notes, which helped understand some of the "unspoken signs" of the participants that the recorder cannot capture. For example, in Ghana, at one of the community-based Health Planning and Services (CHPS zones), I observed a nurse using a mobile device to capture the patient's information. While standing at one corner of the room, I observed the nurse moving back and forth with the device in her hand. She seemed so uncertain whether to use the mobile device or the paper register. After going back and forth so many times, she finally decided to use the paper register instead of the mobile device. During the data analysis, while s reading the comments and reasons nurses gave for not wanting to use mobile device was the lack of confidence, as expressed by one nurse in the following verbatim quote:

> *"...though nurses are happy with the mobile device, most of them are still reluctant to use [it] because they do not have the confidence. They prefer to capture data on the paper registers, and when the facility is less busy, they transfer the data on the device..."*

This quote, captured in the comment section of the questionnaire, corroborates my observation of the nurse's body language. This highlights the importance of using multiple data sources as it increases the credibility and validity of data and leads to a more robust research design (Kvale, 1996). In addition, using a recorder complemented my findings. For example, during FGDs and interviews, although I made some summaries at the end of the day, I used my field notes and recorded interviews to complement the findings as illustrated in table 6 below.

Table 7: Illustrating how data sources complement each other

Notes taking during Interview	Recorder
"CIS makes all the decisions concerning HIS and data management	*…the CIS people sit in Yaoundé and design tools to be used by someone working in Limbe, for example, without them knowing how the work is like on the ground…[he added]. When it comes to information, the central level seems to impose tools." We on the ground using these booklets should at least have a say*
Inadequate training received by staff at the peripheral level during the implementation of standard indicators	*…the training focused mainly on operational aspects of the new data collection tools; and how to capture data, report generation on the DHIS2 platform. They did not focus on areas or issues relevant to program managers, such as data analysis (FIO).*

The usability questionnaire adopted comprised of closed-ended questions scored on a 5-point Likert-type scale ranging from strongly agree to strongly disagree. Space was provided after each question for respondents to add comments and express their views on using the mobile technology. The questionnaire was distributed to 62 health centres in two health districts in Ghana. Prior to administering the questionnaire, it was pre-tested to determine if the respondents understand the questions. Feedback from the pre-test led to some questions being modified and clarified. Pre-test questionnaire provided the most direct evidence of the validity of the questionnaire data (Marshall et al., 2014). The questionnaire was paper-based, one questionnaire was administered per facility, and facilities had one and half months to return the questionnaire. To increase the response rate, two reminders were sent in the space of two weeks. Upon receiving the questionnaires, they were cleaned and captured into the Statistical Package for the Social Sciences (SPSS).

4.8 Data Analysis

This is the technique used to analyze empirical data collected through multiple data sources. This study applied both qualitative and quantitative data analysis methods to address the research questions (Myers & Avison, 2002; Yin, 2013) because it was not possible to use only one approach. As Kaplan (1988) explained, no single data analysis approach is adequate to provide the richness required in IS research as presented in the subsequent sections. In this study, data collection and analysis were done concurrently and the overlap between both processes allowed flexibility in data collection procedures (Drake et al., 1998) since new

insights are found during analysis (Runeson and Host, 2009) and could be further probed. In addition to reviewing field notes and tapes after each interview, data analysis was done at different stages of the research.

First, while individual paper writing, data was analyzed in order to answer the specific research question addressed in those papers. In addition, I participated in conferences (e.g. IFIP 2017 and 2021) and workshops (e.g. DHIS2 Academy 2017 and PhD Days at IFI), where I presented some of my work. Feedbacks from reviewers of articles submitted in the peer review journals, participants at the conferences, PhD Days, and from my supervisors sharpened my understanding of the phenomenon under study. Second, while writing the thesis, data was analyzed to address the research questions.

4.8.1 Quantitative Data Analysis (QDA)

In this study, QDA was used to analysis quantitative data collected from participants who responded to the questionnaire on the mobile technology usability study. According to Babbie (2015), quantitative research must ask questions that can be measured and answered numerically and analyzing such data would involve the researcher to convert data from numerical values to statistical analyses. The numerical representation helps describe and explain the phenomenon that those observations reflect (Babbie, 2015). Common outputs of quantitative analysis include percentages, frequency, and means. In performing the quantitative data analysis, I referred to my theoretical perspective, seeking measures to mitigate challenges encountered by staff after implementing standard indicators. Quantitative analysis was instrumental in measuring e-Tracker usability outcomes, satisfaction rate, learnability, and errors.

In this case, QDA was used to assess the five concepts of mobile technology usability; efficiency, satisfaction, learnability, memorability, and error (Lin, 2013). The primary data came from the study conducted in Ghana to ascertain nurses' mobile technology usability. This is because mobile technology is influenced by contextual factors and unanticipated challenges (Banda et al., 2012). Therefore, understanding usability is critical for analyzing continuity of use (Kaplan, 2006). To analyze the data collected, I used descriptive analyses, e.g., measures of frequency, to summarize the deductive results based on the different usability concepts. QDA also helped me to compare the results data from the two districts (Awutu Senya and Ho

municipality). That is, to compare the differences in experiences in using the mobile application.

4.8.2 Qualitative Data Analysis

In conducting qualitative analysis, one drawback is that the technique used to analyze data are often not well formulated (Miles and Huberman 1994) and results depend on the researchers' skills to observe themes within data (Oates 2005). In this study, qualitative data analysis was conducted in several iterative cycles within each case, paper, and finally when writing the thesis. To assist in analyzing the significant large amount of qualitative data collected, qualitative content analysis was considered appropriate.

Content analysis is a systematic, replicable technique for compressing many words of text into fewer content categories based on obvious rules of coding (Krippendorff 2004). Content analysis is used to interpret meaning from the content of text data. Qualitative content analysis has been defined as "any qualitative data reduction and sense-making effort that takes a volume of qualitative material and attempts to identify core consistency and meanings" (Patton 2005, p. 453). Qualitative content analysis extracts objective content from text data to examine themes, which are manifest. This type of analysis allows researchers to understand social reality in a subjective but scientific manner (Zhang and Wildermuth 2009).

Content analysis may be used qualitatively or quantitatively; furthermore, it may be used in an inductive or deductive way (Erlingsson & Brysiewicz 2017). Which of these is used is determined by the purpose of the study. If there is not enough former knowledge about the phenomenon or if this knowledge is fragmented, the inductive approach is recommended. In this case, the categories derived from the data is inductive content analysis. While deductive content analysis is used when the structure of analysis is operationalized on the basis of previous knowledge and the purpose of the study is theory testing (Patton, 2005; Elo & Kyngas, 2008). Both inductive and deductive analysis processes are represented in three main phases: preparation, organization, and reporting. Despite this, there are no systematic rules for analyzing data as the key feature of all content analysis is that the many words of the text are classified into much smaller content categories (Elo & Kyngas, 2008; Erlingsson & Brysiewicz 2017).

In this study, qualitative content analysis technique was deemed desirable to gain a holistic view of the phenomenon under study, interpret the themes, while at the same time help in preserving the meanings and perspective of the respondents. Furthermore, it enables the interpretation of all transcribed interviews, documents and observations. In this study, whether while writing the individual papers or the thesis, content analysis was used in an inductive and deductive ways, guided by the purpose of the research. While performing my content analysis, the following steps were followed: preliminary data analysis; preparing the data; familiarizing oneself with the text; formulating codes; developing categories and themes, and finally applying the themes.

- **Preliminary Data Analysis**

This was done concurrently during fieldwork. That is, at the end of each interview, I summarized the key points and validated them with participants. Then, at the end of each day, I listened to the recordings, made notes, and transcribed keywords and statements to allow the voices of the participants to speak. This was useful in developing impressions, themes, and issues from the field. The preliminary themes identified were discussed with the district and information officers. Most often, the issues raised by the participants were very similar, but when a participant raised a new idea, it was included in the interview guide and probed for more clarity. For example, in Cameroon, while listening to the interviews and reading the notes on how nurses use health indicators, I realized that most participants (nurses) reported inadequate training and lack of data management skills as reasons for not being able to calculate indicators. However, at one facility, the participants raised a different reason that they have no access to data. This point was a new angle, which was included in the interview schedule and probed in the next interview among other participants.

Generally, data analysis is iterative and recursive (Elo & Kyngäs, 2008), that is to say I kept going back and forth, from the data to the analysis and from the analysis back to the data to refine the interpretations and broaden my understanding of the phenomenon. For example, at the end of each day, I transcribed my field notes and listened to the recorded interviews to gain an in-depth understanding of what the participants were saying. This continued after my fieldwork and when I returned to Oslo.

I applied both inductive and deductive approaches to familiarize myself with the data, coding, creating categories, and identifying themes. However, these steps were not done in a linear fashion. I moved back and forth through the processes in order to make sense of the whole dataset. This allowed me to systematically integrate new data into the analysis and assess the relevance of previously selected theoretical concepts as the data analyses proceeded (Green et al., 2007).

- **Preparing and familiarizing oneself with the data**

I started preparing and familiarizing myself with my data very early during the stage of data collection. I brought together data from all the sources; transcripts of interviews, field notes from the participant observations. Each data source contributed to understanding of the entire phenomenon and strengthened the findings. To start my data analysis, I prepared and made sure that the data were in the same format. All the audio (tapes) of the interviews were transcribed and each interview was saved on separate files.

I read and re-read the text repeatedly to understand what the respondents were saying while keeping the aim of my study in mind. While reading the text, I wrote down my impressions and tried to understand the message the text left me with. I also broke down the text into smaller parts, which I went back and forth so many times to compare if my initial impression has changed and to check for different perspectives. Sometimes I read the interview transcripts to identify relevant data, and then tagged them with meaningful phrases that captured the meaning of the data segment. By doing this, I gained a sense of the text as a whole.

- **Coding**

Having familiarized myself with the text, I started creating codes that are descriptive of the text. In qualitative data analysis, codes are used to describe the meaning of a segment of the text and are tools to help researchers reflect on the text. During analysis, coding is the process of reduction and abstraction, allowing for exploring patterns (Elo & Kyngäs, 2008). When codes are given to a segment of data, they are easier to identify connections between the texts. In this study, I started by creating descriptive labels to segments of the text. I discussed the codes with my co-authors, supervisors, and sometimes with my colleagues. While discussing with my colleagues they asked questions and brought in new ideas. I went back to my data added new

codes and refined the meaning of others. This process continued until I got to a point that I was satisfied that the codes were reasonable.

- **Creating Categories**

A category consists of codes that appear to deal with the same issue (Erlingsson & Brysiewicz 2017). After having provided codes, I started by comparing, combining several codes, and appraising them to search for patterns among them. Some codes were either to irrelevant or vague and were discarded. An example of creating codes and categories is presented on table 7. For example, codes were combined to create categories like the lack of skills and lack of support.

- **Identifying Themes**

At this final step, from the categories, themes were created as illustrated in figure 5. Some categories (lack of finance, centralized decision-making) became themes in their own right. After defining a list of themes, I made sure that they were valuable and had accurate meaning or explanation of the text. The themes were refined for analysis with broader meanings and implications in relation to the literature on IS implementation including the use of indicators. Here, I used broader themes that helped me understand the challenges that end-users encountered with implementing standard indicators.

Since my research had adopted a socio-technical approach as explained by (Lorenzi & Riley, 2000; Sheikh, 2016), it provided me with valuable ways of mapping the different partners, their views, concerns, how they understood and used standard health indicators. Since my initial impressions was to identify challenges that stakeholders with diverse interests and concerns experienced when implementing standard indicators, in creating the themes, the emphasis was on identification of relevant challenges. This inspired me to look for a theoretical approach to address issues of interaction and negotiation when different actors are working together.

Adopting the socio-technical perspective as my analytical lens to understand my phenomenon helped in framing the analytical focus in different ways. First, it helped in identifying the diverse actors who interact and negotiate during HIS implementation. Second, it helped to understand in-depth, the empirical findings regarding tensions and conflicts among different stakeholders within and between different social worlds. The notion of negotiation has been

used in IS research in relation to boundary objects. These steps were applied during data analysis, writing the articles, developing content, and writing this thesis.

4.9 Positionality

Researchers doing qualitative studies are usually required to identify and articulate their positions. Researcher positionality describes an individual's worldview, position about a research task, and its social and political context (Ritchie et al., 2009). The researcher worldview could be influenced by many factors; beliefs about the nature, what they know about the world, their beliefs about the nature of knowledge, the way they interact, and relate with the environment (Ritchie et al., 2009). Positionality reflects the position that the researcher has chosen to adopt within a given research study. In this research, I played the role of a researcher and a HISP facilitator.

As earlier explained, before my fieldwork, I was invited by CIS to Yaoundé. This invitation gave me the opportunity to join the CIS team as a facilitator for some of the DHIS2 training sessions at the regional and district levels and to attend data management meetings. This was my role during the training sessions and it changed to a researcher immediately after I obtained permission to conduct fieldwork, which happened to be after the DHIS2 workshops. Nevertheless, during the periods as a CIS facilitator, I interacted and created acquaintances with participants, some of whom happened to be respondents in my research. The acquaintance helped me to engage with the district/information officers, program coordinators and built expectations on my role as a researcher.

When conducting qualitative research, one of the disadvantages of an existing acquaintance between the researcher and research participants is that it might influence the interaction and may result to interviewer bias (Baskerville, 1999). To deal with any pre-conceived ideas and assumptions, the following measures were applied:

First, I employed the technique of reflexivity after each interview. Second, I used memoing and notes taking about participants' comments. Writing down my thoughts at the end of each day and reflecting on how I conducted the interviews, communicating the problems encountered with participants during data collection, helped me to reflect on the process and hence minimize

bias. It also gave me the opportunity to establish an intense relationship with my data, to engage with my research to a greater degree (Birks et al., 2008). Third, I collected data from multiple sources which helped me to probe issues that were not clear. According to Priede et al., (2014), probing is used to generate further explanation, to get the participants to elaborate on the response, and promotes critical thinking.

4.9.1 Trustworthiness of research

Trustworthiness or rigor of a study refers to the degree of confidence in data, interpretation, and methods used to ensure the quality of a study (Pilot & Beck, 2014). Challenges to rigor in qualitative inquiry paralleled the blossoming of statistical packages and the development of computing systems in quantitative research. A great deal of attention is applied to reliability and validity in all research methods (Guba and Lincoln 1994). Some have tried using the same criteria as for positivist research, which includes objectivity, reliability, internal and external validity (Yin 2002). However, they are not appropriate for interpretive research (Guba and Lincoln 1994; Diaz Andrade 2009). Thus, different criteria are needed for interpretive research (Morse et al., 2002). Unfortunately, there are not an agreed set of criteria for interpretive research. However, Guba and Lincoln (1994) propose a set of criteria for interpretative research which include trustworthiness (validity), confirmability (objectivity), dependability (reliability), credibility (internal validity), and transferability (external validity). Morse (1999) suggests that it is a *myth* to claim that validity is not a relevant criteria in qualitative research. Regardless of the naming debate, trustworthiness in this study stems from establishing specific techniques and practices as explained in the following subsections:

Credibility in qualitative research parallels validity in quantitative research and refers to the degree to which the findings are convincing. According to Guba and Lincoln (1994), it is the extent of accuracy of results, matching reality, and measuring it correctly. It is determined during the research problem and can be achieved by employing a series of activities including but not limited to member validation and peer evaluation. Member validation involves presenting the themes to the participants, as this will allow them to assess the themes that emerged from the data (Polit & Beck, 2014). To ensure the credibility of my research, a number of techniques were adopted. All efforts were made to have a well-designed research that examined the right things and collect the right data from the right source, to increase credibility. The research depended on qualitative data that is helpful for understanding the phenomenon

and the reason why staff experience challenges in understanding and using health indicators. Using interviews to understand the challenges encountered by staff, gave me the possibility to probe exciting and important areas that arose. Moreover, prior to the fieldwork, the questionnaire was reviewed, checked by the authors and senior IS staff in the department of IS. These measures were essential to increase the credibility of the research (Eisenhardt 1991*)*.

Moreover, using semi-structured interviews to elucidate respondents'' experiences helped both the researcher and participants to engage in a dialogue or conversation during interviewing. Audiotaping the discussions and transcribing them shortly after conducting the interviews ensured that any sentiments and emotions contained in the discussions were reported accurately Likewise, in the result sections, I included verbatim quotations to show that the study's discursive approach to inquiry was taken. Presenting some raw data collected from the fieldwork "allows the reader to get a better picture of the respondents' own perspective, without relying solely on the interpretation of the researcher" (Lee and Lings 2008, p. 237).

Another way to increase credibility was purposively selecting participants who were information-rich and whom one could learn more about the phenomenon studied. Also, I used member checking to get participants' comments. Bryman and Bell (2007) suggest that members checking is a supportive tool to confirm collected data, which in turn increased research credibility. Another technique used was triangulation i.e. multiple sources, interviewing different level of participants, and using semi-structured interviews as explained in Section 4.5. These measures allowed viewing research points from more than one perspective (Morse et al., 2002).

This study also used peer debriefing process involving colleagues in the research as external reviewers. Sharing data with colleagues to gain alternative perspectives helped in broadening the interpretation of the data and in overcoming biased explanation by challenging the primary assumptions by qualified peers (Lincoln and Guba 1994). Throughout the study, I attended workshops where I presented some of my works and published three articles in peer review journals. Feedback from external reviewers sharpened my understanding of the phenomenon studied, which increased the credibility of the study.

Generalisability is concerned with the application of research results to cases or situations beyond those examined in the study (Collis and Hussey 2009, p. 59). Yin (2013) argued that this could be a criticism directed to the statistical and not the analytical generalization that is basis of case studies. Often, it is suggested that case results cannot be statistically generalized. Interpretive research does not seek statistical generalization, instead, it seeks a deeper understanding of the phenomenon, which can then be used later on to inform other settings (Orlikowski and Baroudi 1991). From an interpretive stance, Walsham (1995) explained that the validity of doing this relies on the plausibility of the logical reasoning used in describing the findings and in drawing conclusions from them. Walsham (1995) suggested four types of generalization from interpretive case studies, which are the development of concepts, the generation of theory, the drawing of specific implications, and the contribution of rich insight.

In this study, although each case is unique, it could still be an example of broader classes of things and a degree of generalization is still possible. The study provided sufficient detailed and thick descriptions so that judgement can be made on whether other situations have similar features so that the findings could be relevant there too (Lincoln and Guba 1994; Bryman and Bell 2007). In addition, both the thesis and the articles attached have developed specific concepts, drawn specific implications, and contributions as explained in Chapter 7, which could be relevant to other circumstances.

Transferability refers to the degree to which the findings derived from the research process can be applied to other contexts and by other participants (Babbi & Mouton, 2001). In qualitative research, this concerns only case-to-case transfer (Lincoln & Guba, 1985). Since I do not know the site that one may wish to transfer my findings to; however, I have provided thick and rich descriptions so that those who want to transfer the findings to their site could judge for themselves. That notwithstanding, with the limitations of ethical considerations, the participants and the context in this study have been described as extensively as possible.

Dependability in positivist research means whether the study can be replicated with similar results (Lincoln and Guba 1994). It's objective is to demonstrate that the research instruments are accurate and reliable (Oates 2005). In this study, measures to ensure dependability of the research were as follows. In addition to providing rich, thick, and thorough account of the events and situations, in the data analysis sections, I have clearly described the processes of data

analyses. Furthermore, I explained how data analyses were done at different levels and feedback were obtained from external reviewers who brought in different perspectives, asked questions, and provided valuable input, which confirmed the trustworthiness of the information presented in my thesis.

Conformability refers to the extent to which the findings reflect the focus of the research process and is free of researcher's bias. According to Lincoln & Guba (1985), conformability is achieved when issues of truth-value, consistency, and applicability have been addressed. In this study, I have provided a transparent and a precise description of the research process from the beginning through the development of the methods, reported the findings as accurately, and consistently as possible. Qualitative research acknowledges the researcher's ongoing role in the research process. Throughout this research process, I have had continuous supervision and have constantly been reflecting on my contributions. Moreover, to achieve confirmability multiple data sources, methods, participants' checking, and interpretations have been used (Doolin 1996). The research tells enough to judge whether the findings do flow from the data in the setting. Presenting the chain of evidence contributes to the trustworthiness of the analysis.

4.10 Ethical considerations

Ethical issues are critically important in social research in general and in qualitative research in particular (Tilley and Woodthorpe 2011; Myers 2019). According to Wassenaar (2006), research ethics should protect the participants' rights and welfare at all times. Specific principles must be adhered to, to ensure that the research is carried out according to ethical guidelines. This study is registered on the Norwegian Centre for Research Data, Reference #: 45883. I obtained ethical approval and gatekeeper permission from the local research authorities; see sections 4.4 – 4.4.3. I considered the data obtained for this research project to be private; consequently, consent was obtained from the participants and I undertake to keep the text safe at all times.

During fieldwork, before conducting any interview, I ensured that each participant received the information sheet including the informed consent form, the nature of the interview, and the structure of the interviews. The information sheet was as straightforward as possible, and participants were informed that they were free to ask questions. Before the start of each

interview, I explained participant(s) that their participation was voluntary and that they were free to withdraw at any time during the conversation. Anonymity is an important ethical consideration (Durrheim, 2006). Pseudonyms were used to protect the participants' identities. All material derived from the research process will be stored safely. The interviews were conducted in a safe space where participants felt secure and comfortable.

To summarize, this chapter has explained the research design and the methods. The researcher explicitly articulated the nature of the research problem, explained the epistemological, and methodological stances. The study took an interpretive paradigm, which enabled the researcher to interact closely with research participants and to explore the phenomenon in-depth.

The richness of data produced through using multiple data sources helped to better investigate the phenomenon. Triangulation of methods was achieved across multiple data sources. The qualitative content analysis was found to be the appropriate technique for analyzing data. A qualitative content analysis was deemed more desirable for this study as it preserves as much as possible the deep meaning of the qualitative data. Furthermore, it enabled the interpretation of all transcribed interviews, documents, and notes of observation relating each one of the whole in order to gain a holistic picture of the phenomenon. The trustworthiness strategies used in this research, related procedures, and techniques were found to be interlinked which in tend fostered the coherence and validity of the research.

Table 8: Excerpt of transcript from the interview

Parts of transcripts from the Interviews	Codes
What I have noticed in terms of data is that most of the time data is collected by staff who have no experience and do not understand data. Sometimes data is not recorded correctly, which makes it very difficult to compile the data and submit on time. The staff managing data have no experience because they have not been trained but also because they were forced. Clinicians working in the information unit are sent there because they have a physical disability, suffering from some chronic illness, they are elderly staff waiting to go on retirement, or the staff are considered uncooperative by management. The director sends clinician with disability because managing data is less stressful.	DC Lack of experience. Do not understand data. Data is not recorded correctly. Clinicians are forced to work as data managers. Data managers have a disability, suffering from chronic illness. Managing information is less stressful.
The other issue is that we have the MAR booklet that the Mr Lukong give us at the end of the month to complete. When Mr Lukong gave use the MAR booklet he told us that we have to record all data in the MAR but most often other programs come with their own register which we have to also fill. It is too much to fill those registers and attend to patients. Do you know that last month one of my colleagues was insulted by a patient? She insulted my colleague because she was trying to fill the registers before attending to the patient. So the patient said the nurses is wasting her time. She insulted the nurse, carried her baby and left without us attending to the child.	Health program come with other registers to fill. Too much to fill.
Since we had the two-day workshop in Douala, I was given some MAR booklets. At the end of every month, it is my responsibility to photocopy the booklets and distributed to nurses at the different consultation points so that they can fill and then send to me to capture the data on DHIS. Submitting data has become my responsibility and not that of the health facility. I have to look for photocopy papers for the machine to photocopy the booklets. Buying papers to photocopy the booklet has now become my responsibility because at my facility, there is no budget allocated for information services. The submission of data has become my responsibility as the facility information officer. I have to get paper for the photocopying machine to photocopy the MRA booklet and distribute it to nurses. There are times that we will go for 2-3 days without electricity although the hospital has a generator, the issue is that the generator is connected to basic units only. Unfortunately, the statistics unit is not considered a basic unit, so I have to use my mobile phone to send data.	My responsibility to look for photocopying papers. No budget allocated for information services. No electricity.
I have to use my cellphone to capture data and submit. The internet dongle that I was given is not working. I do not know what is happening. I have tried so many times to call the CIS office in Yaoundé, all to no avail. Now I use my personal data on my mobile phone to submit data. And you know our salary is not paid regularly. Talking about activities to support data management at the district level there is absolutely nothing. Look at office, there are no shelves to place the MAR Booklets. As you experienced for yourself, I cannot go to the health centres to provide support because there is no fund to support information activities at the district level. I do not have any telephone I rely on my cell phone and I have to pay for the data. I get no support from our facility or the district	I have called CIS office in Yaoundé all to not avail. At the district, there is absolutely nothing. No shelves to place the MAR booklets. No fund to support information activities. No forum either here or at the district where partners come to review data

office. Due to lack of fund whenever data is collected it is send to the district office there is no forum either here or at the district where partners come to review data.	
Talking about the list of indicators and the MAR booklets. Everything and decision about data comes from above. For example look at the MAR booklet it was designed by the guys in Yaoundé and we saw it the first time at the DHIS training which you were also there. How can the CIS people sit in Yaoundé and design tools to be used by someone working in Limbe, for example, without knowing how the work is like on the ground. When it comes to information, the central level seems to impose tools. We on the ground using these booklets should at least have a say. About indicator, we do not know anything. That is whether the target is achieved or not because most often that is done at the central level.	Everything and decision about data comes from above. When it comes to information, the central level seems to impose tools. Whether the target is achieved or not because most often that is done at the central level.

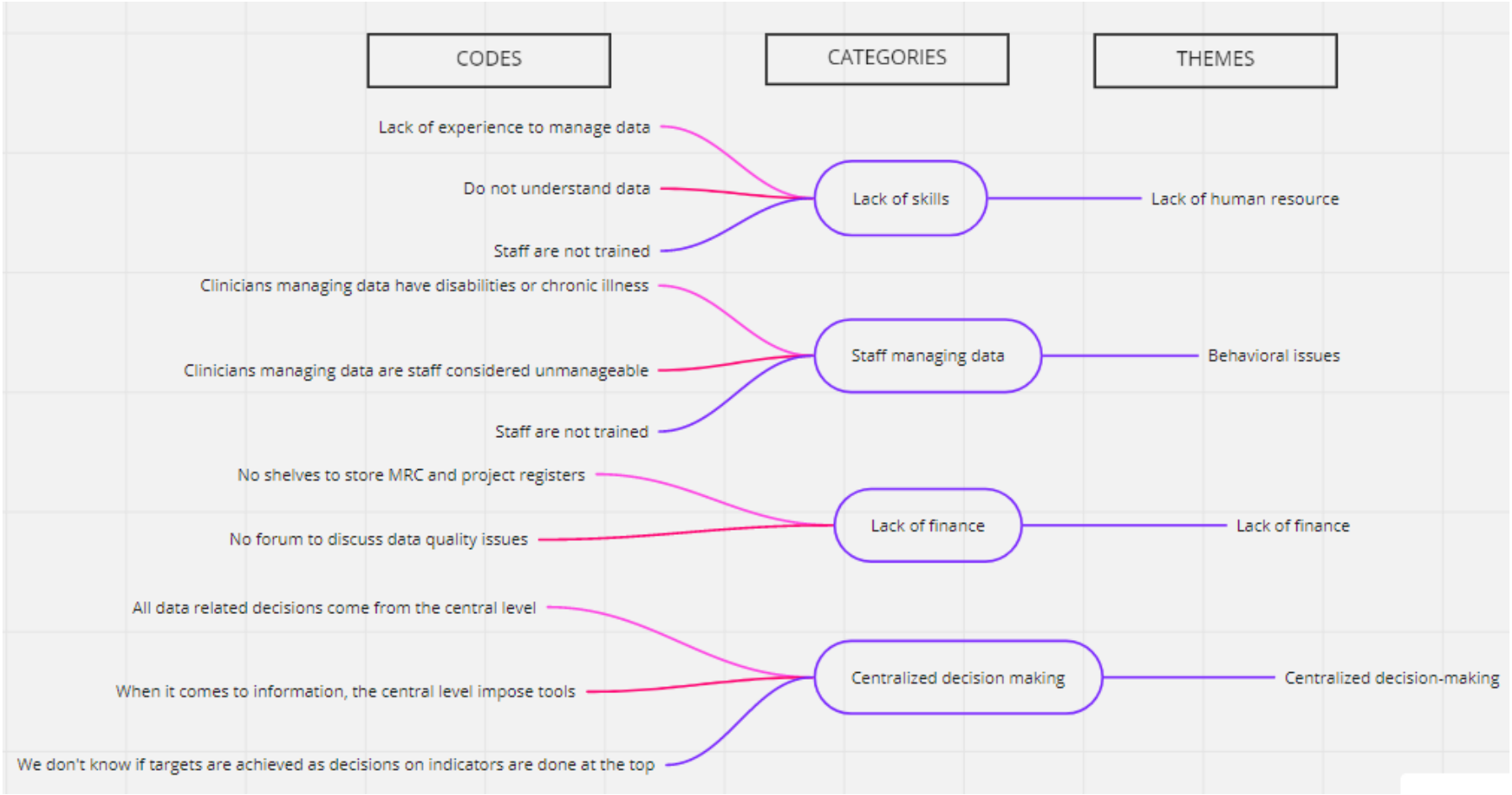


Figure 5: Examples of how Categories & Identifying Themes

CHAPTER FIVE

5. RESEARCH FINDINGS

This chapter presents the findings of this study. It draws from five papers; three published in peer-reviewed journals and two conference proceedings. This chapter is structured in two parts. Firstly, I present a complete reference list of papers (as presented in the appendix of this thesis) and then summarizes each of the paper in the subsequent sections. Finally, I endeavored to synthesize the findings and then linked them to the research questions.

5.1 List of Papers

Table 9: List of papers in this thesis

Paper	Author(s), date, title, publication
Paper 1:	Asah, F. N., Nielsen, P., & Sæbø, J. I. (2017, May). Challenges for health indicators in developing countries: misconceptions and lack of population data. In *International Conference on Social Implications of Computers in Developing Countries* (pp. 593-604). Springer, Cham.
Paper 2:	Asah, F.N. (2019). Creating a 'Community of Information Practice' in Resource Constraint Setting: The Case of Mbingo Primary Health care Facility, *Electronic Journal of Information Systems in Developing Countries*, 2021;e12178.
Paper 3:	Asah F. N, Kanjo C., Msebdema M.B., Addo H., Logo D.D (2020). The Implementation of Mobile Technology to Support Health Management Information Systems at Point-Of-Care: a case study, *Journal of Health Informatics in Africa* 2020:7(2):18-28
Paper 4:	Asah, F.N., Nielsen P., Kaasbøll J., Seukap R. (2021). Organizations failing to learn: Roadblocks to the Implementation of Standardized Information Systems, *Journal of Health Informatics in Developing Countries* Vol. 15 No.1 (2021).

Paper 5: Asah, F.N., Kaasbøll, J. (2021). Deconstructing the Dichotomous relationship between "IS Professionals and End-users": A Case of implementing Standard Indicators in Cameroon. *Proceedings of the First Virtual Conference on Implications of Information and Digital Technologies for Development, 2021*

5.2. Summaries of the Papers

The papers presented were written at different stages of my Ph.D. trajectory. Each paper provides a different empirical example and conceptual insight pertinent to my research aim. In the following sections, I present a summary of the findings and finally, discuss how they contribute to the research questions.

Paper 1:

Asah, F. N., Nielsen, P., & Sæbø, J. I. (2017, May). Challenges for health indicators in developing countries: misconceptions and lack of population data. In *International Conference on Social Implications of Computers in Developing Countries* (pp. 593-604). Springer, Cham.

Background and Purpose: Empirically, this paper discussed program managers' understanding and use of health indicators for decision-making within the health care sector of Cameroon. With the emergence of Millennium Development Goals (MDG), the country introduced an electronic information platform (DHIS2). DHIS2 is the primary tool used for managing routine health information systems. In this system, health indicators are the core elements of data analysis.

The purpose of this paper is twofold. First, the paper empirically explores the understanding and use of health indicators by health programs and facility managers for decision-making. Second, it draws implications from this situation related to local practices and global initiatives such as universal health coverage.

Research Approach: Qualitative and interpretive approach. The primary data collection methods were interview, FGDs, and document review were used as a supplementary method. Data was collected from staff involved in data management-related activities at the health facility. Data collection took place at multiple levels of the healthcare system. The interviews were unstructured, giving more room for discussions on indicators, how routine data is

collected, analyzed, and used. The interviews were transcribed and content analysis was used to analyze data.

Findings: The general perspective in this study was that facility and program managers at different levels of the health system do not share the same understanding of health indicators, which has implications on how coverage indicators (for example) were calculated and reported. The study highlights the following; a widespread absence of population data within the healthcare sector and the inability of the facility and program managers to analyze and interpret health indicators owing to insufficient data management skills. This has an implication on how health indicators are calculated. The study also shows that managers had little or no interaction with health indicators.

Furthermore, the study shows that HIS is characterized by fragmented health programs and multiple data collection tools. It also highlights the need to develop staff capacity on data management, particularly those at the peripheral levels. This paper was the foundation for this thesis and contributed to my understanding of the research context.

This paper extends the debate on health information, in general, and the use of health indicators at the peripheral level. Though this study was limited to facility and program managers at the peripheral level, the findings raise broader applicability in implementing electronic health information platforms (DHIS2) in the country. The paper provides a rich understanding of how health indicators are collected, analyzed, and used by facility managers at the peripheral level.

My role in this paper: I made the most significant intellectual contributions. This includes designing the study, acquiring and analyzing data from the field, and writing the actual manuscript.

Paper 2:

Asah, F.N. (2021). Creating a 'Community of Information Practice' in Resource Constraint Setting: The Case of Mbingo Primary Health care Facility, *Electronic Journal of Information Systems in Developing Countries*. Electron j inf syst dev ctries. 2021;e12178.

Background and Purpose: Providing continuous training is a strategy to develop the skills and competencies of healthcare providers at the peripheral level. Intrigued by the achievements at Mbingo primary health care facility, a rural health facility in northern KwaZulu-Province of

South Africa, and eager to explore what was outstanding about this health facility and, most importantly, to understand how the clinic manager and colleagues work together.

Research Approach: This study applied an interpretative approach. Data was collected from staff involved in data management-related activities through interviews, observation, and documentary review. Data from the interviews provided subjective accounts of how nurses understand data review meetings and the role of the clinic manager during the meetings. The interviews were taped, transcribed, and were analyzed using the content analysis. Thematic coding was used to organize the content of the interviews and to identify categories and themes. The study draws on the community of practice to understand how nurses and their managers participate within the community.

Findings: This paper presents a case in a rural health facility on how a clinic manager collaborated with colleagues to improve their understanding of data management. It highlights an innovative and practical way of building staff skills in data management in a rural healthcare facility. The paper, in its theorization, brought to the forefront the role of the clinic manager as pivotal in building the skills of staff in rural healthcare settings.

This paper highlights the importance of informal learning and the creation of local networks as critical strategies in developing staff skills at the peripheral level. An observation from the case is that mutual engagement and trust foster mutual learning (exchange and sharing of information), collaboration, and teamwork, which in tend motivate staff to work better. The paper demonstrates the abilities of community of practice (CoP) as a strategy to facilitate the continuous development of staff skills on data management and use at the peripheral level. Also, if well-managed, CoP could serve as a vehicle to harness skills and competencies, hence building social capital in resource constraint settings. It also highlights the importance of delegating tasks to one's subordinates and the effect it has on staff performances.

This paper makes theoretical and practical contributions. Theoretically, the article extends the role of the facilitator within CoP from administrator to the champion of CoP, particularly in resource-constraint settings. Practically, the paper provides a practical approach to improve nurses' skills in data management and use in resource constraint settings in the absence of formal training. The study made the following conclusions. (i) The clinic manager plays an essential role in implementing indicators in resource constraint settings where formal education

is not available. (ii). Using the CoP concept could encourage the use of contextual solutions to resolve problems instead of importing external solutions that might be difficult to implement in their specific context. (iii) Activities such as information sharing, delegation of tasks, and teamwork could increase mutual engagement and trust between staff and management, motivate staff to work better, all of which could improve staff performances.

My role in this paper: I made the most significant intellectual contributions. This includes designing the study, acquiring and analyzing data from the field, and writing the actual manuscript.

Paper 3:

Asah F. N, Kanjo C., Msebdema M.B., Addo H., Logo D.D (2020). The Digitalization of Routine Data Management at the Point-Of-Care: The case of Ghana. *Journal of Health Informatics in Africa* 2020:7(2):18-28.

Background and Purpose: Rapid progress in the mobile industry and the penetration of mobile technologies in the healthcare sector hold tremendous potentials to address some data collection and processing challenges. Organizations implement mobile technology to increase efficiency. However, the full potential of the technology and thus the benefits can only be exploited if used. Since mhealth technologies are designed to be used while on the move, evaluating its usability is critical to continuity of use. The purpose of the study was to assess usability of mhealth technology among nurses and to explore contextual factors that influence usability at the point-of-care.

Research Approach: An interpretive approach was used, applying inductive and deductive data analyses. The study is based on the implementation of a mobile technology named e-tracker used for managing aggregated routine data from the health centres to the district level. The study was conducted in two health districts; Awutu Senya in the Central Region and Ho Municipality in the Volta Region. The study targeted healthcare providers working at health centres and community-based health planning services (CHPS) zones. The study adopted a usability questionnaire and assessed four attributes of usability; efficiency, satisfaction, learnability, and memorability. The study was not able to measure the error concept. The

questionnaire was cross-checked and the content validated by academics and staff of the department of information technology. Interviews were conducted to allow the researcher to probe why the nurses held the opinions alluded to in the questionnaire data. The study benefitted from qualitative and quantitative analysis to establish the nurses' views about the technology.

Findings: The revealed that using e-Tracker made nurses more efficient and productive in delivery their daily activities. The nurses added that they were satisfied with the device because the digitalization of data collection registers and forms have rationalized routine data management processes making it easy to learn and use. More importantly, the nurses added that the offline feature of e-Tracker enabled them to capture data in areas where there no internet coverage. The DIO added that the introduction of e-Tracker has reduced the cost and the physical effort required to collect and process data and has improved data quality.

However, using e-Tracker was not challenge free. The nurses reported of lack of skills, which led to lack of confidence. The results showed that due to a lack of skills, nurses lacked the confidence to stand in front of patients and use the device. There was also the issue of trust on the part of the patients. The nurses explained that patients did not take them seriously whenever they held the device and wanted to attend to them; According to the patients when nurses have the device on them, they were chatting with friends instead of attending to them. Other challenges identified were; poor internet connectivity at health facilities in deep rural areas, and the lack of finance to buy data bundles for the device. While mobile technologies are pivotal in enhancing manual data collection, in this study, the challenges nurses encountered, although inevitable, needs to be attended to because they could affect the usability and nurses might stop using the device if challenges persist.

The paper concludes that frontline nurses find e-Tracker easy to manipulate faster to generate reports. They were satisfied using e-Tracker as it made them more productive and easy to use. The DIO concurs that e-Tracker reduced cost and physical efforts required collecting routine data. However, some contextual factors were identified that might hinder its usability. An important lesson from this study is that the implementation of new technology among healthcare staff, particularly those at the peripheral level, requires continuous training and support. The study contributes to the discourse on the digitalization of routine data management processes at the point-of-care.

My role in this paper: I made the most significant intellectual contributions. This includes designing the study, acquiring and analyzing data from the field, and writing the actual manuscript.

Paper 4:

Asah, F.N., Kaasbøll J., Nielsen, P. Seukap R. (2021). Organizations failing to learn: Roadblocks to the Implementation of Standardized Information Systems**.** *Journal of Health Informatics in Developing Countries* Vol. 15 No.1 2021.

One would think that due to technological advances, there are few technical reasons for organizations to experience the challenges that plagued IS implementation some 20 years ago. Reasons being that continuous use of HIS in this era would typically indicate successful implementation. Unfortunately, in LMIC, implementing HIS have continued to be challenging, and hence failed to meet its objective. One reason for this failure is that organizations fail to learn from their own experiences. In the IS domain, the implementation of standard health indicators is a strategy to harmonize the IS. However, ensuring that the partners and stakeholders continuously use standard indicators has proved challenging. Therefore, the paper explores challenges that end-users encounter after the implementation of standard health indicators. The article focused explicitly on why organizations failed to learn from their experiences.

Research Approach: We used an interpretive approach with qualitative data collection methods. The study was conducted among staff involved in data management related activities from three regions (South West, North West, and Littoral) of Cameroon. The staff were involved in data management-related activities at their respective health facility and data was collected at multiple levels of the healthcare system. Semi-structure interviews were used with open-ended questions relating to the challenges they encountered in using health indicators, their participation before and after the implementation of standard indicators, and support they received from the central level, and their relationship with staff at the central level. The interviews were transcribed, and content analysis was used for data analysis.

Findings: The findings revealed that staff at the peripheral level encountered multi-level of challenges after standard health indicators were implemented. These challenges were

summarized in the following broad themes: financial issues, centralized decision-making, communication and infrastructural issues, lack of human resources, and behavioral issues. Drawing from organizational learning, to analyze the challenges, we attributed these challenges to the prevailing organizational structure by arguing that the organization has failed to learn from its mistakes. This is because when an organization fails to learn its mistakes, it is blinded from seeing reasonable alternatives, and its members are prevented from having reflective discourse despite visible negative outcomes. Linking the challenges to the organizational structure, the paper discusses barriers to effective learning in an organization, reasons why organizations fail to learn, and proposes approaches to mitigate the barriers to organizational learning.

The main contributions in this paper lie in how the different concepts were theorized. Linking the challenges that staff encountered to the organizational structure makes the study unique. As reasons for not learning, the study identified three myths-in-use, namely, technological fix, silver bullets, and emperors of the same empire. These myths are embedded in the organizational structure that hinder organizational learning. In Cameroon, HIS is centralized, making it a significant barrier to implement standard indicators because centralized decision-making structures do not support some IS principles. Therefore, this paper contributes to IS literature by demonstrating the effects of centralized decision-making on the implementation of IS in centralized organizational structure. Linking the failure in IS implementation to failure to learn, this article extends the IS literature on the effects of the lack of learning in the organization. Finally, the study processed approaches to mitigate these challenges both at the central and peripheral levels.

The study concludes that organizations often misplace their attention on what and how they should learn. Organizations are often good to learn from external sources and often eager to accommodate new technologies but often fail to provide a conducive atmosphere where their own experience could thrive. Learning from experiences is not valued, while they have few processes and routines that help the organization promote learning.

My role in this paper: I made the most significant intellectual contributions. This includes designing the study, acquiring and analyzing data from the field, and writing the actual manuscript.

Paper 5:

Asah, F.N., Kaasbøll, J. (2021). Deconstructing the Dichotomous relationship between "IS Professionals and End-users": A Case of implementing Standard Indicators in Cameroon. *Proceedings of the First Virtual Conference on Implications of Information and Digital Technologies for Development*, *2021*

The aim of this paper is to examine the relationship between IS staff at the central level and data managers at the peripheral level during and after the implementation of standard indicators. Focusing on the end-users, the study seeks to explore the relationship between IS professionals and end-users and bring to the fore the meaning of their relationship. This is a follow-up from a study conducted in Cameroon, after the implementation of standard indicators. The results revealed that staff, particularly those at the peripheral level encountered multiple challenges, including a lack of skills to analyze data and non-involvement, rendering them incapable of using the system.

To explore the relationship, we used the concepts of différance and supplément. The findings revealed that IS professionals and end-users are embedded in a relationship managed by dominance and are sustained by the particular structures of power and norms that constitute the organizational structure. The IS professionals have more authority than staff at the peripheral level. Also that, the IS professional exercise dominance through actions and behaviors similar to that of différance and supplément. In this context, IS professionals are equated as différance from end-users, and end-users are supplément of IS professionals. The study revealed that although end-users are portrayed as supplement, they are supposed to manage the IS at the peripheral level; which is contradictory. The study conclude that the IS professionals and end-users are in a dichotomous relationship which is a derivative of the organizational structure. The notion of portraying IS professionals in-charge and having more authority than end-users is creating tension in the collection and use of health indicators.

The main contribution of this paper lies in how the problem has been theorized; the use of différance and supplément to theorize the relationship between IS professionals and end-users. This study contributes to the discourse on IS implementation and ICT4D by illustrating a novel way of examining the relationship within IS management and brings to light a new factor that could explain the non-use of IS including health indicators at the peripheral level. The paper concludes that a HIS organizational structure where decision-making is centralized is a ground

for tension and a major roadblock of building local capacity and providing infrastructural support at the peripheral level.

My role in this paper: I made the most significant intellectual contributions. This includes designing the study, acquiring and analyzing data from the field, and writing the actual manuscript.

5.3. Contributions of Papers to Research Questions

The five articles presented in this thesis each provide different empirical aspects contribute to answering the research questions.

Contribution to sub-Research Question 2

Paper 1 provides a brief overview of the empirical setting, explicitly highlighting program and facility managers' understanding and using of health indicators. The findings revealed that managers at the peripheral level do not share the same understanding of health indicators. They lack data management skills to calculate and analyze indicators. At the peripheral level there are multiple data collection tools causing fragmentation of information. Collecting data from multiple data sources increase the burden of the already overloaded staff, risking quality of data and health services provided.

Paper 4 is a strategy to strengthen Cameroon's national HIS, CIS, under the supervision of the MoPH, decided to implement standardized information systems (SIS). Although the aim was to harmonize HIS, however, after implementing SIS, the findings revealed that end-users experienced multiple levels of challenges that hindered them from fully utilizing the new IS.

The findings further revealed that in the implementation of SIS there are many stakeholders with diverse interests and concerns and that the centralized structure of decision-making hinder stakeholders including coordinators of PHP from participating in the process of implementing SIS, causing conflict between the partners and CIS.

Paper 5 - In addition to the challenges staff at the peripheral level encountered and the conflicts between the multiple stakeholders and CIS, the findings of the study also revealed that there exist a dichotomous relationship between IS staff at the central level and end-users at the peripheral level. The findings revealed that IS professionals and end-users are embedded in a relationship managed by dominance, which is a derivative of the organizational structure. The finding revealed that IS professionals (i.e. staff at the central level), exercise dominance through actions and behaviors similar to that of différance and supplément. That is, IS professionals are différance from end-users, and end-users are supplément of IS professionals. Although end-users are, supplement but at the same time are expected to manage the system and train staff at the peripheral all, which is contradictory**.**

Since the focus of this research was at the peripheral level, the findings from staff at this level were further analyzed and summarized to two main factors or challenges; (i) lack of support, capacity, and capability and (ii) data management processes are cumbersome. The second phase was to propose approaches that could mitigate challenges arising from implementing standard health indicators. No single approach can address such challenges. Papers 1, part of 4, and 5 described the challenges and contributed to sub-RQ1.

Contribution to sub-Research Question 2

Paper 4 Theorizing the findings that challenges of implementing IS are deeply rooted in the organizational structure prevailing in the country. The study went further to use organizational learning as the lens and identified three beliefs (i.e. technological fix, silver bullet, and emperors of the same empire) embedded in the organizational structure that hinder organizational learning. In addition, the study provided extensive recommendation to mitigate the challenges. Firstly, the study recommended the creation of a National Health Information Committee by the MoPH. Members of this committee will be representative of stakeholders, coordinators of PHP and end-users. Such a committee will create a platform for equal collaboration with all partners and stakeholders to discuss on health indicators and develop a comprehensive list of health indicators, hereby creating boundary object. When partners with different concerns and interest come together they create a platform to strengthen IS domain by institutionalizing structures, mobilizing resources and creating networks.

Paper 3 is an approach to mitigate challenge of data management processes. I explored the use of mobile technology to enhance manual data collection. Lack of user acceptance is a barrier to the successful implementation of new IS. Therefore, user acceptance is often a pivotal factor determining the success or failure of the introduction of information technology. This paper assesses the usability of mobile technology for collecting routine data at the point-of-care.

The study revealed that digitalizing data collection registers and forms has streamlined data management processes. The nurses reported that they were satisfied using mobile technology named e-Tracker. They reported that using the technology has made them more efficient and productive while performing their jobs. They added that the offline feature on the device enabled them to capture data in areas with no internet coverage. In addition, the district information officer explained that using mobile technology has reduced that cost and physical effort required to collect, process data, and above all has tremendously improved the quality of routine data. Of interest, the study also revealed that nurses lack the confidence to use the device in front of clients. While theorizing the findings, study further found that nurses had difficulty mastery the content.

Paper 2 serves as an approach to mitigate challenges associated to the lack of support, capacity, and capability. The paper explores the process and impact of developing data management capabilities of nurses. Using the concept of community of practice (CoP), this paper presents an innovative learning approach to enhance nurses' skills in data management at the peripheral level. The paper illustrates how data management related-activities were contextualized in the daily activities of nurses through daily meetings. The nurses reported that meeting daily and working together on data-related issues has brought staff and management together as a team. It has helped them to build a good working relationship. More than building staff skills on data management related activities; the study revealed that CoP acted as a source of knowledge creative within the health facility.

This approach highlights the role of the clinic managers as pivotal in championing this approach, nurturing and motivating her colleagues. The study highlights the healthcare manager as pivotal in strengthening a data use culture in resource-constrained healthcare settings. This paper presents a practical approach of operationalizing health indicators in resource-constrained settings. This paper contributes to CoP by extending the role of the facilitator beyond the usual role as organizer of meetings to champions of the CoP.

Table **10** summarizes the papers and their contributions toward answering the research questions. Although the focus of the research is at the peripheral level, it is worth noting that having a sustainable peripheral level depends on solving the conflicts between multiple partners and stakeholders at the central level.

Table 10: Summary of Papers and Contribution to Research Questions

Main RQ: What challenges are associated with implementing standard health indicators in hierarchical organizations, and which approaches can be employed to mitigate these challenges?	
Sub-RQ1: What are the challenges associated with implementing standard health indicators in hierarchical organizations?	**Sub-RQ2:** What approaches could be employed to mitigate the challenges of implementing standard health indicators in hierarchical organizations?
Paper 1: Presents challenges that hinder facility and program managers to manage and use health indicators, which has implication on how coverage indicators are calculated and analyzed. Challenges identified were the lack of basic data management skills, the lack of population-based data, and fragmented IS The paper concludes that although managers at the peripheral level collect and submit data monthly, they rudimentary use indicators to support decision-making. Therefore, it contributed to sub-RQ1 by highlighting challenges program managers face when using health indicators.	**Paper 1:** This paper serves as the foundation for the study and to some extend helped me to understand Cameroon's HIS context.
Paper 4: Described challenges end-users encountered after implementing standardized information systems (SIS) in the healthcare sector. The purpose of this paper is twofold. The first fold links to sub-RQ1; which explores the challenges of that end-users encounter after the implementation of SIS. The findings revealed in-depth the conflict that exist between stakeholders, partners and CIS-MoPH as far as selecting and implementing SIS.	**Paper 4:** In paper 4, in addition to highlighting the challenges of implementing SIS, the paper went ahead to propose solutions to mitigate challenges. Therefore, the paper contributes to answering sub-RQ2 by proposing solutions.

The paper contributes to answering sub-RQ1.	
NA	**<u>Paper 3</u>: Usability of Mobility Technology (e-Tracker)** This paper assesses the usability of mobile technology named e-Tracker to enhance routine data management at the point-of-care. The paper illustrates the advantages of using mhealth technology at the point-of-care by evaluating the usability of e-Tracker augment the processes of managing routine data at the point-of-care. Paper three; implementing mobile technology served as an approach to mitigate the challenge that data management processes are cumbersome, therefore, contributes to answer sub-RQ2.
NA	**<u>Paper 2</u>: Creating a community of information practice (CoIP)** This paper highlights the process and impact of developing data management capacity and capabilities of nurses at the peripheral level. Using the concept of community of practice (CoP), the papers demonstrates how the processes of data management can be contextualized and integrated into nurses' daily activities. Creating CoIP is an approach used to demonstrate how capacity, capability, and support related to data management can be developed and institutionalized. Therefore, this paper contributes to answering sub-RQ2 by proposing a strategy for developing staff capacity through cultivating a community of practice.
<u>Paper 5</u>: Deconstructing the dichotomous relationship between "IS Professional and end-users."	

Paper 5 is a follow-up to paper 4 but focuses on exploring the relationship between IS staff at the central level and IS data managers (end-users) at the peripheral level. The findings contributes to answering sub-RQ1 by highlighting the type of relationships there is between IS professionals and IS end-users at the peripheral level. The findings also revealed that there exist a dichotomous relationship which is managed by dominance on the part of IS professionals at the central level. Also that IS professionals being at the top of the organization structure tend to have more authority than staff at the peripheral level. Such relationships hinder the free flow of information including the use of IS. The paper contributes to answer sub-RQ1by highlight challenges.	**NA**
To summarizes, **papers 1** and **4** provided an overview of HIS background in Cameroon and served as the foundation my research study. **Paper 5,** is a follow-up to paper 4 but focused on the working relationship between IS staff at the central level and end-users at the peripheral level regarding decision-making and management of resources when implementing health indicators. It highlighted a different type of challenge associated with information management within a hierarchical organization. Papers 2 and 3 are approaches and 4 provided recommendations that could be implemented. Therefore, papers 1, 4, and 5 provided challenges, papers 2, 3, and 4 approaches and served as approaches to mitigate challenges associated with implementing standard health indicators. Papers 1, 4, and 5 contribute to answering sub-RQ1, which 2, 3, and 4 contribute to answer sub-RQ2. Papers 1, 4, and 5 are challenges to answer RQ1. To answer RQ2, I draw from the literature on boundary phenomenon and approaches that have been implemented (papers 2 and 3). Therefore, the main findings are CoP, mobile technology, hierarchical organizational culture (empirical) and boundary object (literature).	

CHAPTER SIX

6 Analysis and Discussion

The aim of this study is to understand the challenges of implementing standard health indicators in a public health sector. The study is guided by the following research questions (RQ):

- **Main RQ**: What challenges are associated with implementing standard health indicators in hierarchical organizations, and which approaches can be employed to mitigate these challenges?
- **Sub-RQ1**: What are the challenges associated with implementing standard health indicators in hierarchical organizations?
- **Sub-RQ2**: What approaches could be employed to mitigate the challenges of implementing standard health indicators in hierarchical organizations?

6.1 Challenges associated with implementing standard health indicators

To answer sub-RQ1, I draw from empirical experiences on implementing standard health indicators in Cameroon's public health sector. My findings are grouped and presented in figure 6.

6.1.1 Hierarchical Organizational Culture

The findings revealed that implementing standard health indicators in a public sector setting such as Cameroon is complex, leading to multiple challenges. These challenges, I argue, are attributed to the hierarchical organizational structure. This is because HIS, including standard health indicators, is not implemented in isolation (Van Gigch, 1991), instead it is integrated into the existing organizational norms and working practices. This implies that HIS requires a conductive organization culture for it to be successfully implemented (Clegg et al., 1997; Malmsjo et al., 2003). In this context, the environment is the Ministry of Public Health (MoPH) and the prevailing organizational culture is a hierarchical organizational structure. The literature points to various issues that result in the underperformance of HIS in a hierarchical organization and the findings from this study reveal nothing different.

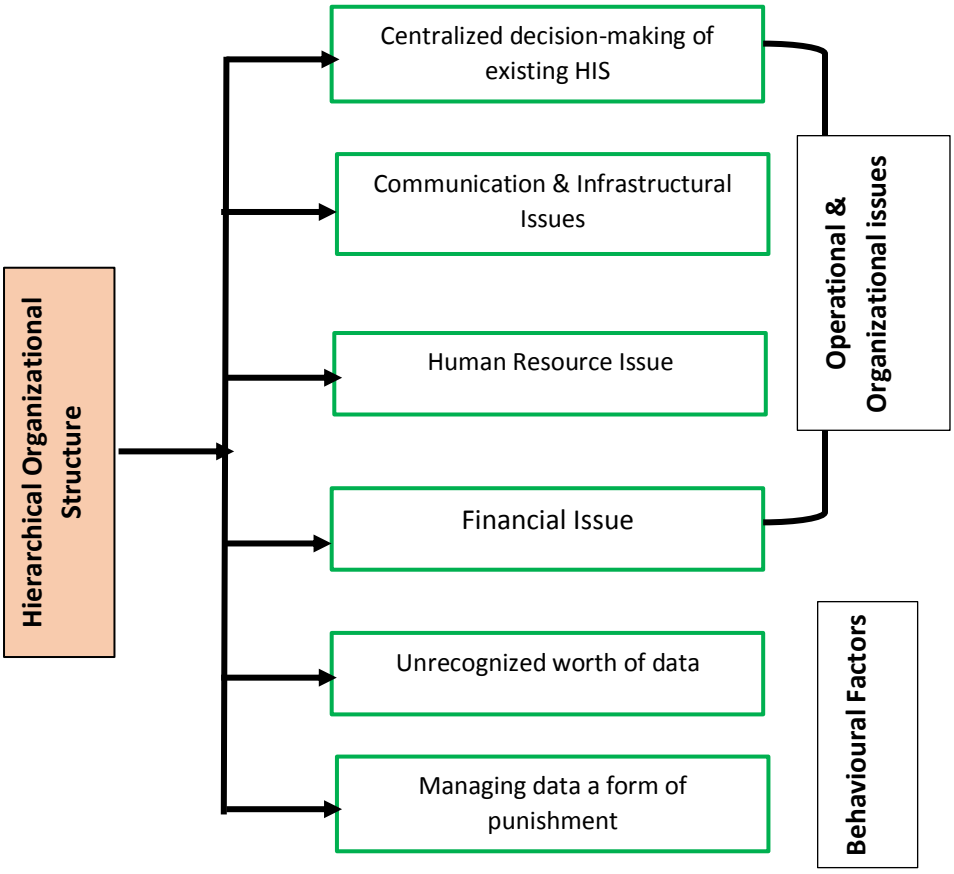


Figure 6: Summary of Findings

The factors identified are summarized in the following broad themes: Centralized management of existing HIS, human and financial issues, infrastructural and communication issues, and behavioral factors. Unlike table 4 (page 59), that was specifically looking at the peripheral level and how indicators are managed, the findings presented here looks at challenges associated with implementing standard health indicators in the entire country. In the following sections, I will analyze and discuss the findings.

6.1.2 Centralized Decision-Making of existing HIS

The study revealed that the existing HIS is centralized; i.e., decisions regarding planning and implementing standard health indicators and other issues relating to IS are made by senior managers or a single organization at the top of the organizational structure alone, without involving other partners and staff at the peripheral level.

For example, as in this case, a single organization, CIS, makes all the decisions. The healthcare domain comprises multiple partners and stakeholders with different interests and agendas involved in IS. When CIS, for example, selects and defines the list of standard health indicators, the list is not comprehensive because they will select indicators to meet their information needs and that of the international partners, while the indicators of PHP are not included. Such an IS is said to be inflexible because it does not accommodate the information needs of partners and stakeholders. The study further revealed that when the information needs of PHP are not met, it could lead to tension, which could affect the entire HIS.

An example of such tension is that PHP coordinators and district managers introduce additional data collection forms to collect new indicators, which fragments the IS even further. Uhl-Bien et al. (2009) noted that centralized decision-making turns decision-makers to become autocratic leaders and could lead to tension between CIS and PHP. Knudsen (2018) noted that when senior managers are politically appointed, they often lack subject matter expertise, and consequently, they make poor decisions, which could negatively affect the performances of their subordinates.

The findings revealed that centralized structures are sources of power. Since those at the central level make the decisions in addition, they exercise authority and dominance in terms of decision-making, resource allocation, and information sharing relating to IS; over those at the peripheral level. This creates power divide between IS staff at the central level and those at the peripheral level. In this study, it is observed that CIS staff at the central level, in addition to making decisions, exhibit behaviors of difference, a behavior trend that hinders management and use of health indicators.

Barriff et al. (1978), Markus (1983), and Bloomfield et al. (1992) explained that centralized decision-making in a hierarchical organization and the issue of power divide could be linked to the school of thought that computer and IS are sources of power, which go back to the era when computers were first introduced in organizations. In that era, only senior managers and directors at the top of the organization were those who had access to computers, when even some of them did not know how to switch them on. Unfortunately, the same school of thought still prevails, particularly in a hierarchical organizational culture.

For example, most public organizations such as the MoPH are hierarchical and bureaucratic in nature, characterized by centralized decision-making; where senior managers make decisions, including formulating policies, defining interventions on standard health indicators, designing data collection tools to be implemented and used at the district level. According to Barriff et al.

(1978), in this information age, coupled by the proliferation of information and communication technologies including computers, such managers and decision-makers feel that giving computers to the staff at the peripheral level is taking away their powers. As Bloomfield et al. (1992) noted, "the distribution of computers and information technologies is creating a conundrum in respect of power and control in centralized organizational structures" (p. 460). Similarly, Barriff et al. (1978) added that such managers believe that having computers is an indicator to decentralized power.

According to the literature, HIS, including standard indicators, should be implemented at the district level and should require the active involvement of all the stakeholders, particularly the district managers (Grudin, 1991; Berg et al., 2003). As explained by Unger et al. (2000), in the healthcare sector, district managers are placed closer to where standard indicators are implemented, and used because they can facilitate lower-level responsiveness to the local needs and would require a management style with some level of discretion over their work. When decisions are made without their (district managers') involvement, they undermine their management authority and limit their ability to adopt HIS in their local context (Uhl-Bien et al. 2009).

Furthermore, centralized decision-making discourages the staff from unleashing their creativity and hinder their personal development. In such an environment, learning does not take place and the staff are expected to implement what the senior management has designed -- they tend to work as robots without engaging with their jobs and when faced with challenges, they cannot interact with their job (Kawonga et al. 2015). The findings revealed that because the staff do not have the opportunity to learn, they lack the skill to interact with the participants (staff at the peripheral level) during training workshops.

Kawonga et al. (2015) noted that in formalized organizations such as MoPH with defined job roles, it dampens staff creativity, and creates a non-participatory environment, which could lead to lack of staff motivation and, hence, a decline in staff performances (Sivadas et al., 2000).

Similarly, Lambert et al. (2006) added that when the staff have no opportunity to unleash their skills, they might not perform to the minimum due to lack of skills. In a similar vein, Stevens et al. (2010) explained that when an organization does not promote staff creativity, the staff do not produce new information, which limit their ability to train or teach others. Kamadjeu et al. (2005) found that limited knowledge on the usefulness of standard indicators is a significant factor in low data quality and information use.

Likewise, when HIS is centrally managed, information flows upward and there is no feedback and communication to those at the peripheral level, leaving them information-less. The lack of communication, the study found, gives little value to the data collected, and as a consequence, data collection is perceived as a supplementary task to healthcare delivery.

Therefore, to create a conducive and participatory environment where IS, including health indicators, could be used accurately, all the stakeholder should be involved, be able to interact and exchange ideas with one another, and pursue solutions to new problems as they arise, which in turn stimulate creativity and learning (Sivadas et al., 2000).

These results support other studies that highlight the importance of working in teams. For example, Pyrko et al. (2017) explained that when the staff work in groups, they learn and discover new ways to approach their tasks, thereby developing new skills. Similarly, Qureshi et al. (2013) added that knowledge is power, and education is the premise of progress in every society. If the staff do not produce information, they are not progressing, which could affect their personal and professional skill development. These findings concur with that of the previous authors (see Vredenburgh et al., 1998; Pichault 1995; Chiasson et al., 2012; Clegg, 2010), describing IS and power within an organization. According to Vredenburgh et al., (1998), centralized decision-making plays a vital role in creating power structures within the healthcare domain, and are sustained by the particular structures of power and norms that constitute the organizational structure.

6.1.3 Human Resources Issues

Information systems relate people, processes and technology to support operations and management of healthcare services (Berg et al., 2003). The study revealed that there is an acute shortage of trained staff in Cameroon, particularly in the healthcare sector. The human resource issue in LMIC is chronic and could be associated to the following -- low salaries, health worker shortage, particularly in the rural and remote areas, mal-distribution of specialists, negative working environment, and inadequate investment in the health sector (Essomba et al., 1993; Işık et al. 2013; Wright et al., 2016).

The findings of this study revealed a lack of staff, basic skills and competency on IS and data management related activities. The study also revealed that despite several capacity-building initiatives provided, the staff at the peripheral level sometimes fail to grasp the training given to them, because HIS/IS content are too generic and training workshops are one-off.

In contrast, staff, particularly nurses, need target-oriented and integrated activities into daily routines. Since HIS/IS training content and style do not meet their needs, there is a breakdown in skill development and in the use of information, as indicated by the dotted area in red ink (figure 7). This has led to the lack of skills at the peripheral level.

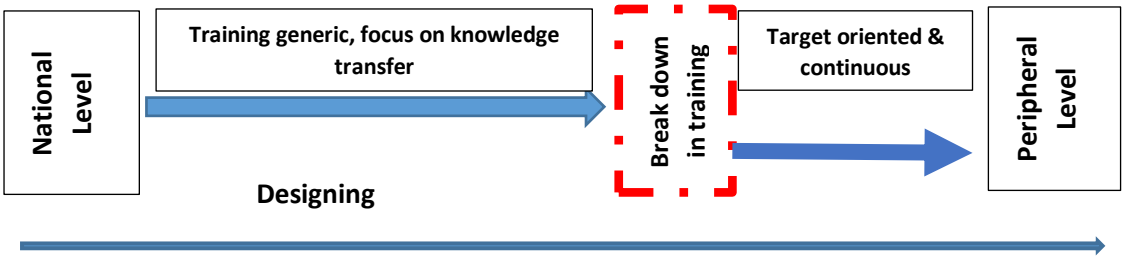


Figure 7: Illustrating a breakdown in capacity building

This study found a lack of skill in terms of quantity and quality at all levels of the health sector. The study found that the lack of human resource has been exacerbated by high staff mobility, caused by low salary and degradable working conditions. As a consequence, the staff leave public service to seek employment with international organizations that offer better remuneration packages and working conditions. Managing HIS/IS require skilled staff to devise, execute and maintain it (Kabene et al., 2006), which increase staff performances (Blau 1996); without which it becomes practically impossible to understand and use IS, including standard indicators (Mengiste 2010).

Human resource crisis seems to be a global challenge in LMIC due to poor economies, and according to Bangdiwala et al. (2010), countries with centralized structures are more likely to have inadequate human resources because they tend to have difficulty in developing the work force. The study found that lack of human resource could be attributed to the following:

Structural Adjustment Policies imposed by the International Monetary Fund (IMF). The SAP is a policy imposed by IMF to many African countries around the 1990s (Verhoeven et al., 2007). This policy contained drastic measures, which African countries, including Cameroon, must abide by, to be legible for financial support from IMF. One of such drastic conditions includes downsizing public enterprises, reducing the staffing, and instituting wage bill cap

(Marphatia, 2010; Verhoeven et al., 2007). The wage bill cap is an agreement that places a limited amount of money to be spent as salaries to public servants (Geo-Jaja et al., 2001; Verhoeven et al., 2007). Unfortunately, in most LMICs, the public servant is the largest employer.

In Cameroon, for example, about 80 per cent of the workforce are public servants (i.e. people employed by the Ministry of Public Service). With the wage bill cap, civil servants saw their salaries sliced down to about 50 per cent. As a result, public servants were forced to either leave the public service, some were forced to take an early retirement package, while others resigned and joined the private sector, leaving the public service with very few staff. The wage bill, although implemented in the 80s, is still in application until date. In Cameroon, the public service trains, but cannot retain staff because of low salaries. Staff resign in search of better pay and working condition in private organizations. The wage cap imposed by IMF on African countries, including Cameroon, is a significant limitation for the scaling up of the health system (Marphatia, 2010).

In addition, in Cameroon, the lack of human resource has been exacerbated by centralized decision-making because managers at the peripheral level cannot recruit an external staff without going through the central level. In this context, those at the central level are not only informed, but they are also those who make the final decision as to who is hired. This process is unnecessarily long, and could lead to staff hired not compatible as those recruiting are not the same persons they are going to work with, and this could lead to conflict of personality (Kabene et al., 2006).

Another factor, particularly among IS staff, is the lack of educational institutions offering IS-related courses. In addition, the lack of educational institutions focusing on postgraduate, professional education, leadership and research, has resulted in serious limitations in IS professional work force.

6.1.4 Communication and Infrastructural Issues

Infrastructure for HIS can be as simple as a pen and paper or as complex as fully integrated ICT. Cameroon lacks communication infrastructure to support HIS. The study revealed that health facilities have limited internet access and staff experience constant power cuts, particularly in the Northwest and Southwest regions, which affect data collection and submission. In addition, since the outbreak of war in 2015, the infrastructural issues have

worsened. The findings also revealed that there is no communication channel between the different administrative structures and there have been rampant internet shutdowns. The D/FIOs reported that they find it very difficult to communicate with the CIS staff, except when the CIS has a workshop at the regional or district levels. The same was the situation between the DIO and the IHC as MIHC explains.

> …we send data to those at the district office monthly, and they will not call to acknowledge receipt or give us feedback except when data is submitted late.

Studies have shown that emerging technologies can help countries to dramatically increase their storage and performance capacities, and accelerate data processing time than previously required (WHO 2008). Cameroon does not only lack skilled employees, but also lacks IT infrastructure. For example, the country has one main internet service provider -- CAMTEL -- which is the national telecommunications organization. The services provided to customers are poor, often exploited and defrauded. This has resulted in very expensive cost of bandwidth internet access, only 6 per cent of Cameroonian use broadband because of the high cost. Health facilities have no access to information, books are outdated, and no access to journals. At the peripheral level, staff have no access to the internet. The lack of access to internet has aggravated since the breakout of the war in 2016. Thijmen (2017) reported that internet was shut down in the North-West and South West regions for over 240 days.

Add to that, inadequate electricity supply. An FIO shared his experience capturing and sending data on his mobile phone when there is no electricity.

> *…although hospitals have a generator, the issue is that the generator is connected to essential units only. Unfortunately, the statistic unit is not considered an essential unit, so I have to use my mobile phone to send data…*

The issue of electricity supply has become a national emergency that needs to be addressed. It was observed that Cameroon has been having difficulty providing stable and reliable electricity to every nook and cranny of the country. Currently there is no part of the country, which can boast of electricity supply for 24 hours a day without interruption.

Generally, the lack of communication and infrastructural facilities are barriers to economic development. For example, poor physical and digital infrastructure such as access to the internet, telephones, roads, and reliable electricity are factors that hinder access to and use of

information (Mengiste 2010). The lack of road infrastructure affects health services; for example, in distributing goods and services, and the flow of information to the peripheral level. The lack of infrastructure and communication facilities could be attributed to the lack of finance, but most importantly to the fact that information is not considered as an important resource.

6.1.5 Financial Resource

Finance is an essential resource in the implementation of IS. Lippeveld et al. (2000) explained that the success of implementing any information system is heavily dependent upon the availability of financial resources, because finances are needed to manage the system, buy computers, build servers, install and maintain software and hardware, conduct training workshops, and in some cases, hire the services of experts. During implementation, donors will finance the initial development cost of the system. However, future funding of recurrent costs will ultimately determine the system's financial viability.

Tossy (2014) noted that the challenges of increased operational and maintenance costs of IS are frequently cited obstacles and barriers to the successful implementation of IS, especially in the LMIC. In Cameroon, for example, the amount of finance required would be even higher because massive attendance at meetings or workshops is dependent on giving the participants some financial incentive, such as outstation allowances.

The study found a lack of finance to support IS related activities at the peripheral level. As a result, D/FIOs are unable to carry out information-related activities such as traveling to health centres to provide on-site support. One FIO reported that information management activities are perceived as the responsibility of the FIO alone, and that the institution does not have any budget line for information-related activities, such as holding data review meetings and traveling to health centres. I had first-hand experience during my field trip when I asked one of the FIOs to accompany me to the health centres and she responded, I quote:

> *"I can only accompany you to the health centre if you are going to take care of my transportation fare. The officer added that they do not visit to provide support to health centres due to lack of means of transportation."*

In Cameroon, in addition to the effects of SAP, lack of finance to support information-related activities has been exacerbated by the country's method of allocating its national budget. For example, the national budget is assigned based on the needs of the decision-makers. Farnham (1990) explained that in a centralized organizational structure, decision-makers are politicians whose needs are informed by their individual beliefs and values, and are guided by their personal or self-interest. Mintzberg et al. (1976) and Akdere (2011) explained that in a public organization, the decision-makers, who in this case are politicians, make rational decisions. Regardless of the shortcomings of rational decision-making (Simon, 1945; Cyert & March, 1963; Patel et al., 2002; Calabretta et al., 2017), politicians tend to monopolize their decisions and would allocate finance where they will benefit the most (Farnham, 1990).

Unfortunately, IS related-activities are not one of those areas because IS supports accountability and transparency, which in Cameroon are contrary to the beliefs of political decision-makers who are guided by bureaucratic and autocratic principles (WFP, 2018) and corruption[11] (Bechem, 2018). It should be noted that Cameroon has twice topped the chart of most corrupt states in the world -- 1998 – 1999 -- as per Transparency International indices (GERDDES-Cameroon, 1999). I will argue that these beliefs have hindered the decision-makers in Cameroon from allocating finance towards IS-related services despite the much-prophesized statement that health data is the backbone of every healthcare system (Chan 2007). This confirms why not much is done to support data and information-related activities.

6.1.6 Behavioral Factors

Behavioral factors have direct influence on how routine data is accessed and used in an organization (Aquil et al., 2009). In this study, two behavioral factors where identified -- unrecognized worth of data and managing data is an act of punishment by health facility managers.

Unrecognized Worth of Data - The study revealed that information managers at the peripheral levels are not recognized, which implies that the MoPH does not value the worth of data/information. For example, the organigrams of MoPH, health facilities, district and sub-district hospitals, and integrated health centres have no designated post or position for information manager/officer. The staff explained that it is challenging to grow in the profession

[11] Corruption is manifested in several forms: bribery, nepotism, graft, fraud, speed money, theft, pilferage, embezzlement, falsification of records, and influence peddling.

as in other careers when working as an information officer, as explained in the following quotation.

> *As a statistician by profession, I was recruited by the Ministry of Public Services to work as a DIO. Here I am, my boss. I have been working as the DIO for the past six years without any promotion. Working as a DIO information manager is challenging to develop. For example, in nursing, one starts as a staff nurse and moves from a professional nurse to a chief professional nurse. In information management, it is not like that because the profession does not exist on the organigram.*

Managing data is a punitive tool by facility managers – The findings revealed that the manager or the director of the health facility assigns clinicians who either have a physical disability, suffering from a chronic illness, or are elderly staff waiting to go on retirement to work as information manager at the statistics unit. These staff cannot cope with the stress of managing patients in the ward; accordingly, working in the information/statistics unit is less stressful.

Another reason is that when a staff becomes unmanageable, he or she is sent to the information unit. It was revealed that the statistics unit has been nicknamed the "garage" because it is an office where there is little or no interaction happening. The issue is what will be the quality of data collected by a staff who is unmanageable? Will the manager be willing to trust the quality of data collected by an unmanageable staff member? Nkoa et al. [n.d.] explained that the absence of managerial support does not give credence to both the information managers and data, and when those involved in managing data are not supported, falsifying data becomes easy.

Today, data can no longer be treated as a source of competitive advantage but a necessity, the reason why most organizations have admitted that they manage data the same way they manage their staff (Nyamtema, 2010). Even more important in the healthcare system, data is the backbone of the health system (Chan 2007). But surprisingly, the findings proof otherwise. Behavior, i.e., confidence, motivation, and competence, influences the way one understands and uses data (Hackman & Oldham, 1980; Buckland & Florian, 1991). Limited knowledge on the usefulness of standard indicators is detrimental to data quality and use (Kamadjeu et al., 2005). Therefore, to motivate IS users, particularly the staff at the peripheral level, training is pivotal. Data managers are influenced by the organizational culture they work in. Aquil et al. (2009) noted that when the management exhibits negative attitudes toward data and information related activities, it affects data quality, and hence, the value of collecting data may be questioned.

In conclusion, the hierarchical organizational structure and centralized decision-making prevailing in Cameroon's public health sector contributed immensely to the challenges associated to implemented IS, including standard health indicators as described above. Seemingly, the culture prevailing in the healthcare sector does not promote an information culture. An information culture is when an organization has the capacity and control to promote the values and benefits among its members, to collect, analyze, and use information to accomplish its goals and mission (Lippeveld 2019).

To summarize the answer to RQ1, challenges of implementing standard health indicators are: Centralized management of HIS, infrastructural and communication issues, human resources, financial resources, and behavioral factors. These challenges are attributed to the hierarchical organization culture prevailing in the public health sector of the country.

Sub-RQ2: What approaches could be employed to mitigate the challenges of implementing standard health indicators in hierarchical organizations?

6.2 Approach that could be employed to mitigate challenges

In the first part of this chapter, I have presented the challenges and in discussing the challenges, I argue that they are attributed to the organizational culture prevailing in the MoPH and are deeply rooted in the entire system. To address these challenges, the literature on organizational management recommends drastic measures such as overhauling the system (Lytinen & Robey 1999). Although it is the ideal route, revamping the entire IS would require changing the whole organization which is beyond the scope of this study. The phenomenon under study has organizational and social focus, so I applied a socio-technical perspective (Silva & Hirschheim, 2007) as a lens to theorize and to understand these challenges. The socio-technical perspective provides the opportunity to mitigate challenges and tensions between the different stakeholders (Elkjaer & Huysman, 2008).

In the healthcare domain, the diversity of perspectives, heterogeneity of stakeholders, and the challenges and tensions emanating from these different perspectives create epistemic barriers, which compromise successful collaboration (Brown & Duguid 2001). How then do we navigate across these boundaries?

The challenges associated with implementing standard health indicators in LMIC settings such as Cameroon is complex and various approaches in combination are needed. To answer sub-

RQ2, I drew on a combination of approaches, two examples from two empirical cases and the concept of boundary objects. In the following sections, I shall describe how I applied these approaches and how they could be used to mitigate the challenges.

6.2.1 Mobile technology (e-Tracker): dealing with infrastructural issues

As indicated on table 4, one of the main challenges nurses faced was that data management processes are cumbersome because of the multiplicity of data sources, particularly at the peripheral level where routine data is generated. In the LMIC, health facilities at this level are constrained with poor infrastructure, scarce financial, skilled human resources, and are limited or no access to the internet (Ngoma, 2014). The findings from this study revealed that coping with collecting routine data from multiple sources is one of the challenges the staff at the peripheral level encounter daily. For example, a health facility staff reported as quoted:

> *"Mothers come very early to the clinic to have their babies vaccinated before starting their day's activities. At the clinic, we have to examine both mother and child, weigh and check the baby's vital signs. If the mother is still breastfeeding the child, we have to verify … [that] the baby is eating properly. All information is written down. Also, one has to fill in about five registers. Mothers are getting angry, complaining that we are wasting their time" (HO-2).*

Manual data collection often results in high potential of human errors such as incomplete records, problems of poor recording, underreporting of data, time-consuming, hence increases the burden of the already overloaded staff at the peripheral level. In addition, collecting data from multiple sources could lead to data quality as data collected from different sources often fail to be consistent and could lead to inadequate monitoring of services, delay in patients' follow-up, and the inability to make timely action (Lippeveld et al., 2000; Lippeveld, 2019).

Mobile technology could enhance the processes of managing data and if connected to the internet, could facilitate data analysis, use, and reduce some data quality challenges (Asangansi et al., 2013). Although mobile technologies have the capability to revolutionize data collection processes at the point of care, however, Titlestad et al. (2009) warn that in LMIC settings, the lack of skills and competency on computerized IS among potential users in the healthcare sector is a major limitation.

The findings from this study revealed that using mobile technology significantly improved the processes of managing data and analyzing standard indicators at the point-of-care. The use of mobile technology reduced the amount of effort previously required to perform the same activities manually, which intend, reduces some data quality challenges. In addition, the

digitalized interface e-tracker made data collection faster, easier to collect, to analyze, and to use. Asked about the perception of the nurses, a nurse had this to say:

> *"…using e-Tracker is user-friendly and the offline feature which allows us to capture, save data and then send it later. One does not need to have access to the Internet during data capturing."*

The healthcare providers added that using e-Tracker gave them the freedom to perform their activities, which means that they have more time to validate data before submitting them to the district level. The findings revealed that using e-Tracker enabled them to generate clients' schedules instantly, send text messages to remain clients of their appointment. The offline feature of device gave them the opportunity to use the device without necessarily being connected to the internet. The information manager corroborated this by explaining that the introduction of mHealth technology has increased data transparency and accountability, thereby facilitating the use of indicators for decision-making by staff at the peripheral level. It has also improved data timeliness and data quality. Although the healthcare providers were quite excited about using mhealth technology, the study found that some healthcare providers were unable to grasp the training due to lack of skills. The study revealed that limited internet access in deep rural health facilities and lack of finance to buy data bundles for the e-Tracker device were factors that hinder usability.

Essentially, the case here suggests that mobile technology (e-tracker) has the potential to improve the processes of managing data, analyzing, and understanding health indicators at the point-of-care. This is similar to reports by Kaonga et al., (2013); Mengesha et al., (2018) that mobile technologies facilitate open communication and empower staff at the lower level something that is not available in hierarchical organizations. Furthermore, Josserand et al., (2006) added that a decentralized organization would be efficient than a bureaucratic hierarchical organization if the management of MoPH is decentralized and embraced IS. This study concludes that the use of mobile technology has the potential to mitigate infrastructural challenges while at the same time building capacity on computerize IS devices. Therefore, this could be a lesson.

6.2.2 CoP: Dealing with human resource and developing local skill

Lack of skilled human resource, particularly at the peripheral level is a common finding revealed in this study. The situation is even worse in terms of IS training, the findings revealed that despite the capacity-building initiative provided, the staff at the peripheral level sometimes fail to understand the training offered them. Reasons being that HIS training is too generic while the staff need target-oriented and continuous training (Nutley, 2012). The findings from this study revealed that there is a breakdown in skill development at the peripheral level and that non-use of indicators is due to a lack of skill and knowledge.

People are the most incredible resource because better skilled staff means increase in productivity (Blau 1996). Therefore, equipping staff with the necessary skills to do their job is not a luxury, but a necessary (Nutley, 2012). According to the literature, training on data management to the staff at the peripheral level should be practice-based and learner-centered (Nutley et al., 2013). Inadequate skills and knowledge could contribute to the failure and unsustainable IS in LMIC (Heeks, 2002), which in turn threatens the introduction of standard health indicators (Mengiste, 2010).

The concept Community of practice (CoP) is an approach that could be used to develop internal skills, thereby mitigating the human resource crises. The findings revealed that a clinic manager used CoP as the vehicle to operationalize and integrate IS content into nurses' work practices, while nurses acted as knowledge broker. The findings revealed that when IS content is contextualized, it can be easily institutionalized, leading to continuous skill development. More than building staff skills, the findings revealed that CoP is a source of knowledge creation within an organization, which in turn contributes to organizational learning.

To the organization (healthcare facility), these findings revealed that CoP served as a vehicle to harness skills and competencies, hence building social capital. According to the literature, resource-constrained health facilities find it extremely difficult to recruit and retain skilled staff and have limited access to reliable information. This study revealed that cultivating CoP could harness skills and competencies of staff internally where formal training is limited, hence building social capital in the following three ways: (i) It offers staff with similar interests and opportunities to network and collaborate. (ii) It encourages interpersonal relation, which is essential to building trust among members. (iii) It enables its members to maintain and sustain shared knowledge exclusive within the community

While to the staff, the findings revealed that social interactions within CoP gave them a sense of support, motivation, improved teamwork, and trust among staff, which, in turn, improved

the overall performance of the health facility. While working together, the staff were motivated to achieve their goals, and the synergy in the group gave them the support needed not only to complete their tasks successfully but also to learn more. As they work together, they search for solutions to problems from within instead of relying on outside interventions, which is not context-based. The staff also added that interacting with their peers gave them more confidence to learn without fear of making mistakes and the feeling that they belong to a community inspired staff to be proactive. Kimble et al., (2001) explained that relational attribute such as confidence is critical to boosting staff performances within a CoP.

This could not have been successful, without the leadership role of the operation/clinic manager, who was instrumental in operationalizing and ensuring continuity in developing the skills of her subordinates. The actions and behaviors of the manager concur with the assessment by Buick et al., (2018) and Handley et al., (2006) that low level managers are change agents who make sense of changes with their colleagues. Peterson et al. (1994) added that leadership is required for IS to be successful and that good leadership (the saint) is crucial to manage the (demons). In this context, the managers who supported the use of health indicators and are willing to shoulder the efforts are the saint while "demons" are those managers who resist the use of indicators.

The CoP case described shows the importance of operationalizing and integrating data management related-activities into the nurses' daily activities at the peripheral level. This finding supports those by several authors (see Nutley, 2012; Nutley et al., 2013) that training at the peripheral level should be integrated and offered as in-service training instead of having once-off training section. In addition, the study highlights CoP as a vehicle to harness internal skills of staff on data management in resources-constrained healthcare settings.

6.2.3 Boundary Objects

Having presented the empirical approaches, in these sections, I present the third approach, boundary objects, which I drew from the literature and included experiences from implementing the two empirical approaches presented above.

In the healthcare domain, the diversity of perspectives, heterogeneity of partners and stakeholders all involved in IS related activities have different concerns, viewpoints, and systems acting as barriers, which compromise the successful resolution of conflicts while working together (Brown and Duguid 2001). To mitigate such barriers and conflicts, I propose solutions encouraging collaborative work; which involves incrementally breaking boundaries and developing shared understanding through mutual learnings among the different partners and stakeholders (social worlds) (Star and Griesemer 1989). An example is the concept of boundary objects.

The concept of boundary objects was first introduced by Star and Griesemer (1989). The authors described its attributes that they serve as translation devices, inhabit several intersecting social worlds, and satisfy the informational requirements of each. Boundary objects reside with those boundaries, allowing for productive communication among social worlds. They have different meaning in different social worlds but their structure is common enough to more than one world to make them recognizable and provide a shared format for solving problems among different functional settings (Star and Griesemer 1989; Carlile 2002), such as the hierarchical setting of the MoPH.

Since the original formulation of boundary objects, the definition has expanded to encompass not only technologies, but also ideas and processes. It has been applied in various context such as design teams (Subrahmanian et al., 2003), new product development (Carlile 2002), the implementation of IS (Yakura 2002), and standardized packages (Fujimura 1992). For example, Fujimura (1992) used the notion of boundary objects to develop a conceptual and technical workspace, which is less abstract, more structured, less ambiguous, and more concrete. According to Fujimura, standardized packages facilitate "both collective work by members of different social worlds" (p. 176). Thus, boundary objects sit in the middle of a group of partners with divergent viewpoints. The creation and management of boundary objects is a key process in developing and maintaining coherence across intersecting communities (Bowker & Star, 1999).

Based on the explanation on boundary objects, I argue that the process implementing standard indicators is similar to conceptualizing boundary objects. As they could help to mitigate the conflicts and challenges, break knowledge barriers between practices, and facilitate shared understanding among the multiple partners and stakeholders and across multiple environments (Carlile 2002). In addition, boundary objects facilitate knowledge sharing between practices to

facilitate collaborative work, and to break the epistemic barriers that hinder the successful transition of practices from fragmented to integrated work (Fujimura, 1992; Carlile, 2002).

6.3.2 Developing Standard Health Indicators as creating Boundary Objects

The concept of boundary objects to bridge knowledge gaps between practices stems from the empirical works of situated action theorists (Lave & Wenger, 1991; Suchman, 1978). Boundary objects could serve as mediating tools to facilitate the interaction, negotiation, and collaboration of different partners and stakeholders across different social worlds. Moving from fragmented practices to collaborative work is a matter of evolving existing practices (Blackler et al., 1999; Engestrom, 2004). As Wenger (2000) indicated, boundary objects could serve as essential collaboration and learning tools for two reasons. They connect different partners and stakeholders from multiple social worlds and they offer learning opportunities in their own right (Wenger 2000).

Developing and implementing standard health indicators and their corresponding data elements as creating boundary objects could facilitate coordination and integration of routine tasks at the different levels of the healthcare sector (Koskinen & Makinen, 2009). This will require bringing together all partners and stakeholders to discuss their concerns and views. Bringing all those involved together to brainstorm on equal terms, where no single organization or individual has more decision-making powers encourages teamwork and promotes buy-in. In Cameroon, the present approach of implementing standard indicators is top-bottom where CIS makes all the decision. Star and Griesemer (1989) criticized this approach, as it looks CIS like an imperialist who seeks to control other actors via the creation of an obligatory passage point. The authors further suggested that using the boundary objects is an ecological approach, which takes into account the coexistences of multiple partners' viewpoints and standard indicators are developed through gradual negotiation, interaction and collaboration, while incorporating the concerns and views of different partners and stakeholders (social worlds) (Jacucci et al., 2006; Nyella & Kimaro 2015).

Dahlbom & Janlert (1996) added that the negotiation with partners implies that the process requires incrementally breaking boundaries and interests, which in turn would gradually change their behaviors and routines and new once are adopted. In addition, negotiation provides a useful analytical insight to understand ongoing exploration between different partners and

shows how social orders emerge through the give-and-take interactions that take place (Clarke et al., 2008). It also helps us to recognize that social structures are conditioning factors for the interplay between different social actors with overlapping and competing interest (Strauss, 1978). Implementing standard health indicators in this manner, different partners and stakeholders are bound to communicate with others and those with different perspective and perhaps different views and ideas (Koskinen & Makinen 2009). This approach promotes transparency and facilitates participation, features, which are missing in how indicators were previously implemented.

By applying the concepts boundary objects will imply that they serve both at the initial stage and at the final stage. At the initial stages, boundary objects will facilitate planning, selecting, and defining different indicators by different stakeholders. At the final stage, they will enhance negotiation, interactions and collaboration; hence assist in developing and implementing a comprehensive list of standard health indicators at different levels of the healthcare system. By working and collaborating with different partners and stakeholders offers a platform for networking, learning, and resource mobilization of resources (Nyella & Kimaro, 2015). Therefore, in this context, boundary objects are tools situated at the interface between multiple social worlds and facilitate negotiation, flow of information, skill and materials development between diverse actors and partners. Since boundary objects are effective ways to incorporate diverse stakeholders and partners views, Elzinga (2008) warns that care must be taken that participation does not become token, but that those involved should be empowered and their views accurately represented. This study identified three roles that boundary objects could play in addressing the challenges of implementing standard health indicators in a hierarchal centralized organization.

Facilitates organizational learning and skills development

When different partners work together, creates a platform for negotiation, collaboration, and facilitates learning and skills development (Benn et al., 2013). Koskinen & Makinen (2009) explained by different stakeholders communicating and learning from each other, which in tend, could lead to skill development. This is because boundary objects are "plastic enough to adapt to local needs and the constraints of the different stakeholders employing them, yet robust enough to maintain a common identity across sites" (Star and Griesemer, 1989, p. 393). This is true when partners have different needs, for example, when partners disagree on the definition

of indicators, they would discuss and agree to use flexible standards (Braa et al., 2007b). For example, Cameroon has more than 145 local languages some words are pronounced differently depending on which part of the country one is located; making it difficult for health care providers to perform health services. Using boundary objects could facilitates the creation of a common language to translate standard health indicators from explicit knowledge into personalized understanding. This facilitates the production of new knowledge and shared understanding, allowing for collective learning, among different partners; such knowledge could lead to skills development (Trompette & Vinck, 2009), one of the challenges experienced by staff in the centralized structure. Therefore, BO could improve internal skill development.

Source of Resource Mobilization

Normally, when different partners and stakeholder work together, they pull synergies from individual programs to multiple program initiatives, thereby encouraging collaborative investment and resource sharing. The findings from this study revealed the lack of communication and infrastructural equipment to support information-related activities. Edi and Setianingtias (2007) explained that partners are often unwilling to coordinate with one another due to their different procedures and agendas, which could complicate their collaborative efforts. Meanwhile on the other hand, some partners want to work together in a meaningful way but are hindered by the absence of standards and standardized processes to facilitate information sharing between them (Trompette & Vinck, 2009).

When multiple partners collaborate as in this context, in addition, they develop other documents such as standard operation procedures (SOPs), put in place clear set of operating guidelines for programs, budget, and pooling funds (Disch, 2002; Ashoff, 2004). For example, in Tanzania, Nyella & Kimaro (2015) observed that using the boundary objects approach while implementing HIS in the country encouraged collaborative investment and resource sharing among parallel programs, which in turn facilitated the rollout of DHIS2 software. In addition, partners supported the national government to equip the provincial and district level offices with computers, supported the rollout of DHIS2 training for clerks and HIS managers, and provided regular on-site support at different sites (ibid). Therefore, standard indicators, if well implemented, could improve infrastructural and communication challenges in Cameroon as well.

Avenue for networking.

Developing standard health indicators could encourage networking. When different partners and stakeholders come together and collaborate mutually in a transparent environment, could serve as a platform for networking. Network for skill development and resource mobilization are based on the assumption that could provide the possibilities for two-way flow of knowledge (Braa et al., 2004). For example, the traditional alliance with health partners such as WHO and Global Funds has provided financial support to programs in LMIC. Experiences from other countries, Tanzania, Ghana, and South Africa, show that establishing a new partnership with HISP has led to capacity-building opportunities such as providing technical assistance (TA) through knowledge transfer and education (Crisp et al., 2000). The finding of this study revealed a lack of qualified staff to manage and maintain IS in Cameroon. This implies that developing and implementing standard indicators creates a platform for TA through HISP regional academics for example.

Furthermore, for sustainability and eventually becoming self-reliant on HISP technically, Cameroon's MoPH, could leverage TA from HISP to build skills of its core technical team. The relationship could be extended to a memorandum of understanding with other institutions of learning. For example, UiO could provide higher education in information sciences, operational research, and program evaluations. Therefore, networking facilitates mobilization of resources, which in addition, could lead to changing people's perception about IS including managing standard health indicators. In addition, having good attitude towards IS in general, includes allocating the country's national budget to support information-related activities.

To summarize, as approaches that could be applied to mitigate conflicts and challenges among different partners, I proposed developing of creating boundary objects, CoP, and mobile technology.

CHAPTER SEVEN

7. Contributions and Conclusions

This chapter provides a summary of the theoretical and practical contributions of the thesis. As such, section 7.1 presents the contribution and implications, whereas section 7.2 describes the implications for IS in developing and implementing IS in LMIC. Finally, section 7.3 presents the limitations of this study and the areas for future research.

7.1 Contribution to sub-RQ1

This study identified several factors as challenges associated with implementing standard health indicators in the public health sector. While theorizing the challenges, we attributed them to the hierarchical organizational structure. Attributing the challenges to the hierarchical organizational structure, the study concurs with previous studies (e.g. see Bloomfield et al. 1992; Bariff et al., 1978; Markus 1983; Mengiste 2010; Sheikh 2015). Hierarchical organizations are prone to bureaucracy, which in turn lead to the lack of collaboration with staff at the peripheral level, thereby causing roadblocks for successfully implementing and using standard health indicators (Mengiste 2010). The challenges identified are summarized and presented on figure 8.

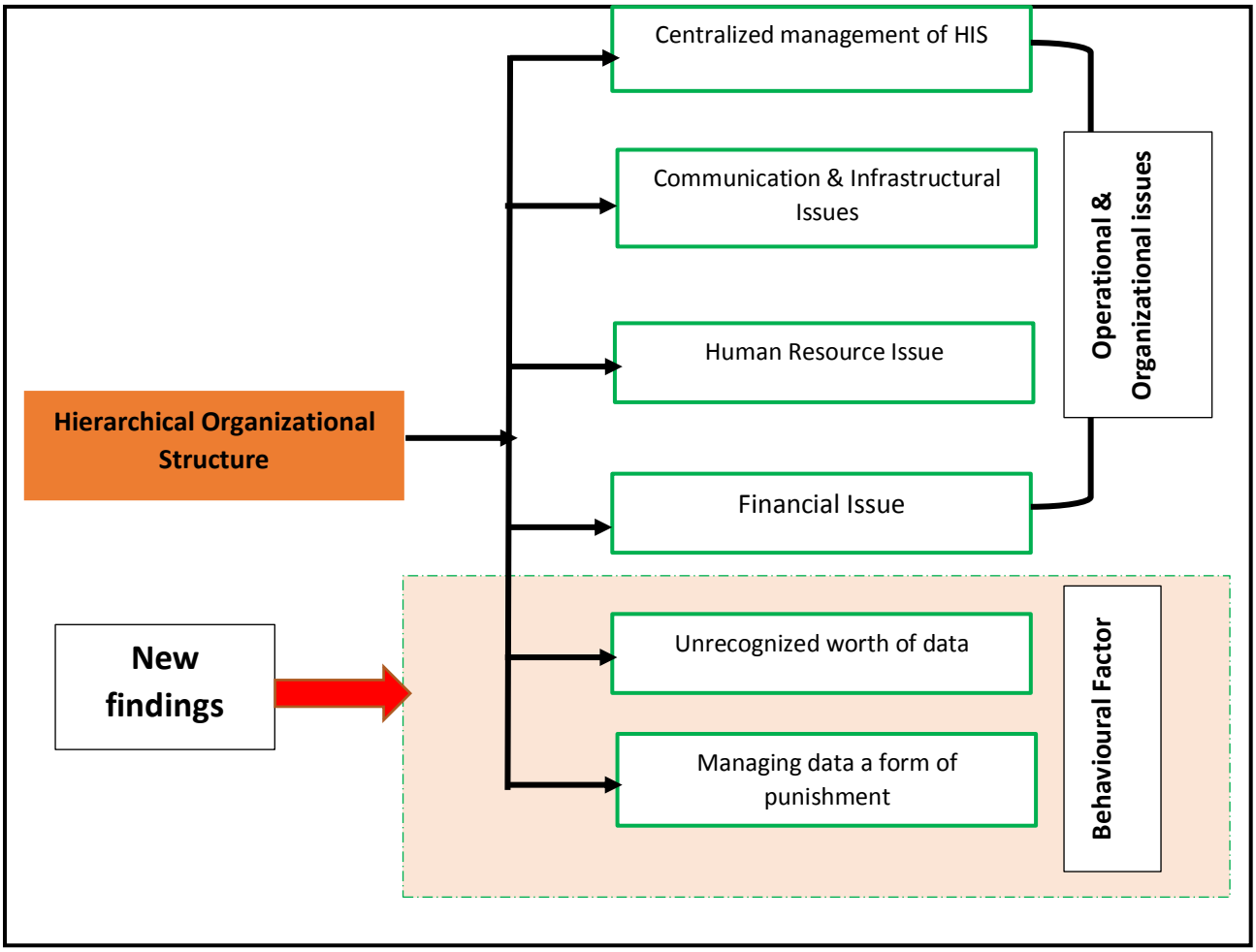


Figure 8: Summary of Findings

This study attributed the challenges identified to centralized decision-making style prevailing in the healthcare sector. Studies have pointed to various challenges that result in the underperforming of centralized decision-making (Giddens, 1984; Mengiste 2010; Sheikh 2015), where managers at the top of the organizational hierarchy have exclusive decision-making powers over distribution of resources. In this context, managers at the top of the organizational hierarchy equate computer and IS as sources of power inheres in official position, which in turn creates a working relationship of dominance between staff at the central

level and those at the peripheral level. Dwivedi et al., (2015) warn that non-involvement of staff during IS implementation could lead to resistance and non-compliance among IS users. Giddens (1984) noted that the dominant relationship exhibited by staff at the central level are derivatives of the organizational structure. These findings concur with the previous study by Bariff et al., 1978; Bloomfield et al. 1992; Flyvbjerg 1998 cited in Clegg., 2010, linking power to centralized management of IS. Bariff et al., (1978) explained that existing hierarchical structures play vital roles in creating power structures within the existing healthcare bureaucracy. This implies that well-established structures such as the MoPH and CIS help in shaping decisions on IS, including the implementation of standard health indicators. Linking the challenges to hierarchical organizational structure prevailing in the country, this thesis extends the notion by emphasizing that hierarchical organizational structure and centralized management of HIS are impediments to IS innovations.

Another important contribution made by this study is the six themes (figure 8) identified as challenges associated in implementing standard health. Starting from the top of the figure, the first four factors (centralized management of health indicators, communication and infrastructural issues, human resources, and financial issues) are factors that have been identified by previous studies (e.g. see Bloomfield et al. 1992; Mengiste 2010; Tossy 2014; Sheikh 2015). However, this study identified a new, exciting, and unexpected finding -- behavioral factor. Introducing the behavioral factor on the list, of challenges particularly in the implementation of standard health indicators in a hierarchical organizational context where multiple players are in continuous conflict, is a contribution by itself.

Behavioral factor is the new finding found in this study. Behaviors are the actions and mannerisms made by individuals in conjunctions with themselves, the environment, which have direct influence on how standard indicators are understood and used in the organization (Aquil et al 2009; Lippeveld 2017). In managing health indicators, managers as well as users need to understand the importance of data, feel confident, and have the competence in performing information-related activities (Hackman & Oldman 1980; Buckland & Florian 1991). This study shows that beyond the technological and organizational determinants, which hinder the implementation of standard health indicators, in this context, behavioral factors are imperative and need to be attended to. Therefore, this thesis contributes theoretically by developing a new analytical framework to understanding challenges associated with implementing standard health indicators in hierarchical organizations.

The culture of information in the organization influences the behavior of the organization to support IS, including standard health indicators. Lippeveld et al. (1992) noted that IS follows the existing communication channels of the organization. An organization that has established IS support services, such as planning, supervision, human resources, logistics and finance, promote an information culture (Scheider et al. 2013) and the reverse is true. The findings from this study revealed that Cameroon's organizational structure, which is hierarchical, does not promote a culture of information. Thus, this finding aligns well with the previous study Scheider et al. (2013) and Glazer et al. (2014) on organizational structure and the influence on IS, including standard health indicators. By highlighting the behavioral factors as a new challenge associated with implementing standard health indicators, this research brings to the fore new factors that have hitherto been ignored in the previous IS research in LMIC settings.

Furthermore, this thesis conceptualized implementing IS, including standard health indicators, as a socio-technical perspective. A socio-technical process of implementing standard indicators considers the broader socio-technical configuration process, which together determine the outcome of IS development (Bostrom and Heinen, 1977). By adopting the socio-technical approach, this thesis affirms the importance of understanding the existing routines and procedures and their role in forming the environment, in the processes leading to implementing standard indicators.

7.2 Contribution to sub-RQ2

Sub-research question two focused on approaches that could be employed to mitigate the challenges from sub-RQ1. In responding to sub-RQ2, I used multiple approaches, empirical interventions and drew from the literature on boundary objects. I start with contributions from the empirical approaches.

Exploring the use of mobile technology to address data management processes

In this study, the use of mobile technology (e-Tracker) improved manual data collection at the point-of-care. Mobile technology facilitates data collection from multiple sources, challenges faced by data managers when collecting data from standard health indicators. The study

revealed that using e-Tracker gave nurses the freedom to perform data management-related activities more quickly, giving them more time to validate data before submitting them to the next level. The findings also revealed that the device's mobility and the availability of the offline feature facilitated data capture and analysis even when there is no connectivity. This implies that digitalization of manual data collection processes using mobile technologies reduced the time spent on managing data and improved data quality and use. With good quality data, accurate decisions may come out and the quality for indicators, such as national health indicators and those of SDG, will potentially be improved. The findings are in line with the views of Xiong (2015), Macanze (2007), and Asangansi et al. (2013) that mobile technologies have the potential of improving the processes of routine data collection. Beyond the contribution of digitalizing manual data processes and improving the quality of routine data, this research contributed to building nurses' skills in mobile technology. The study also contributed towards improving digital infrastructure and access to communication technologies used at the peripheral level.

In addition, the study revealed a limitation in IS training to nurses at the point-of-care. The study revealed that despite the advantages of using mobile technology, during training, nurses had difficulties understanding the content. This is because the IS training content targeting healthcare providers are too generic and are offered over a very short period (Nyamtema 2010; Nutley 2012; Nutley et al., 2013; Nicol et al., 2017; Boadu et al. 2019). On the contrary, IS training for nurses should be content specific and integrated into nurses' work practices (Nutley, 2012), with the goal of building capacity. The study extends this notion by emphasizing that the present IS content for nurses at the peripheral level hinders IS skills development, which in turn deters healthcare providers from fully using health indicators as the lack of IS skill could link to limited use (Boadu et al., 2019).

The process and impact of developing data management capabilities of nurses

The second approach explored the processes and impact of developing data management capabilities of nurses. Lack of skills and lack of qualified staff to manage and maintain IS, including standard health indicators, is a chronic challenge facing most countries in LMIC (Boadu et al., 2019), including Cameroon. Recent changes in healthcare delivery and practices have added to the capacity shortfall, which means that more responsibilities have been shifted to the staff at the district level, yet they are not adequately trained (AbouZahr & Boerma 2005).

This study described the case in a rural health facility where the clinic manager worked relentlessly with her colleagues and subordinates by having daily meetings on data. Consequently, the staff acquired more skills and competencies on data management related-activities. The daily interactions, which I named creating CoP, contributed to the following:

Building skills of healthcare providers in data management activities: The findings from this study revealed that frequent interactions and collaboration on routine data related issues amongst healthcare professionals increased their understanding and knowledge on data management related activities. The findings of this study are in line with an argument by Pyrko et al., (2017) that as the bodies of individuals in a group fuse to attend to the same concerns, personal growth and learning take place. This revealed that frequent interactions added values to individual lives daily as they pursued their professional development through mutual engagement. Chua (2006) noted that when members collaborate in a group, they can create solution to their problems, which, in turn, lead to building knowledge and possible contextual solutions to solve their problems, instead of relying on outside interventions. This thesis adopts and extends the concept of CoP by practically providing steps to develop local capacity amongst the staff at the peripheral level.

In addition, the study revealed that in the CoP, nurses were able to know each other, built close and positive relationship, enjoyed mutual support from colleagues in areas they required help, and improved their skills in data management. Through continuous collaboration with each other, the nurses built trust for themselves, and felt safe to work together as they engaged in and embraced a sense of common purpose. Ellinger (2005) noted that when the staff feel supported by their colleagues, there is the possibility to learn freely without fear of being criticized for making mistakes. Similarly, Kimble et al. (2001) added that relational attributes such as feeling confident, trust and feeling safe are critical to boosting staff skill in data management-related activities. The findings are in line with the view of Fontaine & Millen (2004) and Bate & Robert in Rashman et al., (2009) that social interaction approaches to learning are relevant in public organization because they are sources to develop local skills and capacities. This strategy of building human capacity foster sustainability of HIS and use of health indicators, in a setting where both IT and data experts are difficult to build and retain, and where support for data management is usually through short-term projects (Kimaro & Nhampossa 2005). This thesis affirms that CoP is a vehicle to build social capital in resource-

constrained settings, where it is not easy to recruit and retain staff. Therefore, this research contributes to IS training literature by demonstrating the capabilities of CoP in building local capacity, thereby contributing to creating a sustainable local context for continuous skill development after implementing standard health indicators. CoP encourages staff to collaborate on a mutual basis, and build interpersonal relations internally and externally, which in turn lead to building their skills individually besides creating organizational knowledge (Chua 2006).

Facilitates learner-centered learning: Learner-centered teaching approach used by the clinic manager in this approach focused on the nurses and their development, rather than on the transmission of content. The findings from this study revealed that the staff learnt how to solve problems, think critically on the daily activities, and apply information efficiently when making a decision. By so doing, they acquired skills and grew through participating in the CoP, which helped them develop as professionals. The study found that the relationship that existed among the staff in the CoP was a good and supportive one. This implies that nurses enjoyed mutual relationship with one another. The findings of the study are in line with the view of Nutley, (2012), Nutley et al., (2013), and Nyamtema (2010), that the training of nurses at the peripheral level should be context-specific and learner-centered.

Repositioning the role of the operation managers to ensure continuity in learning: In CoP, the role of the facilitator has been limited to performing administrative tasks. However, in this context, the role of the operation manager, who in this case is the clinic manager, was more than that of a facilitator. The clinic manager wore many hats:

First, the clinic manager was the facilitator; the clinic manager trained and mentored her subordinates on data management activities. The findings of this study are consistent with that of Gold et al., (2010) and Olfman et al., (2014). Olfman et al., (2014), who noted that an important strategy to enhance training is to give learners a firm grounding in conceptual understanding, and that operation managers are able to bring significant changes among their colleagues in CoP by engaging and empowering them.

Second, the clinic manager is the champion as she "took the bull by the horns" to solve the facility's challenges by cultivating a community of information practice. She transformed the priority indicator, operationalized and integrated it into the nurses' daily activities; i.e., she was

the context expert, which facilitated the linking of context and content when operationalizing the training content. Since some nurses were novices, the facilitator's role became relevant as both content and context expert, instilling confidence among her subordinates. The findings concur with Handley et al., (2006) and Buick et al., (2018) by explaining that operation managers are change agents, who make sense of changes with their colleagues, in sharing knowledge and experiences in a way that allows continuous learning to take place. Therefore, this research contributes to CoP by extending the role of the facilitator from performing administrative tasks to being the champion and the commander-in-chief of CoP.

Another observation was leadership of the clinic manager, which sustained the CoP. The findings revealed that the manager's dedication and experience in both context and content motivated the staff and increased their participation in the community. Leadership is a key factor in strengthening and developing an IS, including implementing standard health indicators (WHO 2008). The finding is in line with Olfman et al., (2014), who explained that in providing professional training, when the facilitator is more experienced than the learners, she not only facilitates transfer of knowledge but also the process of engaging with and motivating the staff.

Similarly, Rourke & Kanuka (2009) added that in a CoP, having a more experienced facilitator with better knowledge and understanding of the subject matter than the learners help provide clarity and guidance within the group. This thesis argues that such performances need to be emulated. Approaches to encourage more clinic managers to creating CoP include providing some form of incentives which is a way of encouraging and supporting outstanding performances of healthcare facilities.

Intended contributions for proposing standard health indicators as boundary objects.

The third approach in this thesis was drawn from the literature, which is implementing standard health indicators equates creating boundary objects. As already explained above, developing standard health indicators involves collaborating on an equal basis and building a shared understanding with multiple partners. The multi-faceted nature of boundary objects, if well implemented, facilitate interaction, negotiation and collaboration, thereby creating a conducive platform for information and resource sharing, resource mobilization, networking, and building capacity. The intended contributions in these sections are directed towards explaining the

importance of adopting the boundary objects in developing standard health indicators in a hierarchical organizational structure characterized by centralized decision-making.

The findings revealed that a common source of disputes between PHP and CIS, for example, is the variation in the definition of indicators. Taking the Family Planning (FP) program, CIS is interested in knowing "Acceptors of modern FP methods new" (A). PHP B "New acceptors of modern FP methods". PHP C "New FP Acceptors >20". When partners collaborate and understand the needs and concerns of others, an agreement (boundary object) is arrived at, which will accommodate the concerns of all those involved. The agreement might be to broaden the existing definition for example. When collecting data, data on FP is collected by ages. In this example, I have broadened the definition, which is "Females 15-49 years of age who are current users of modern methods of contraception". A decision (definition) that will accommodate (intersection) the needs of all partners will be adopted instead; boundary object as depicted in figure 9.

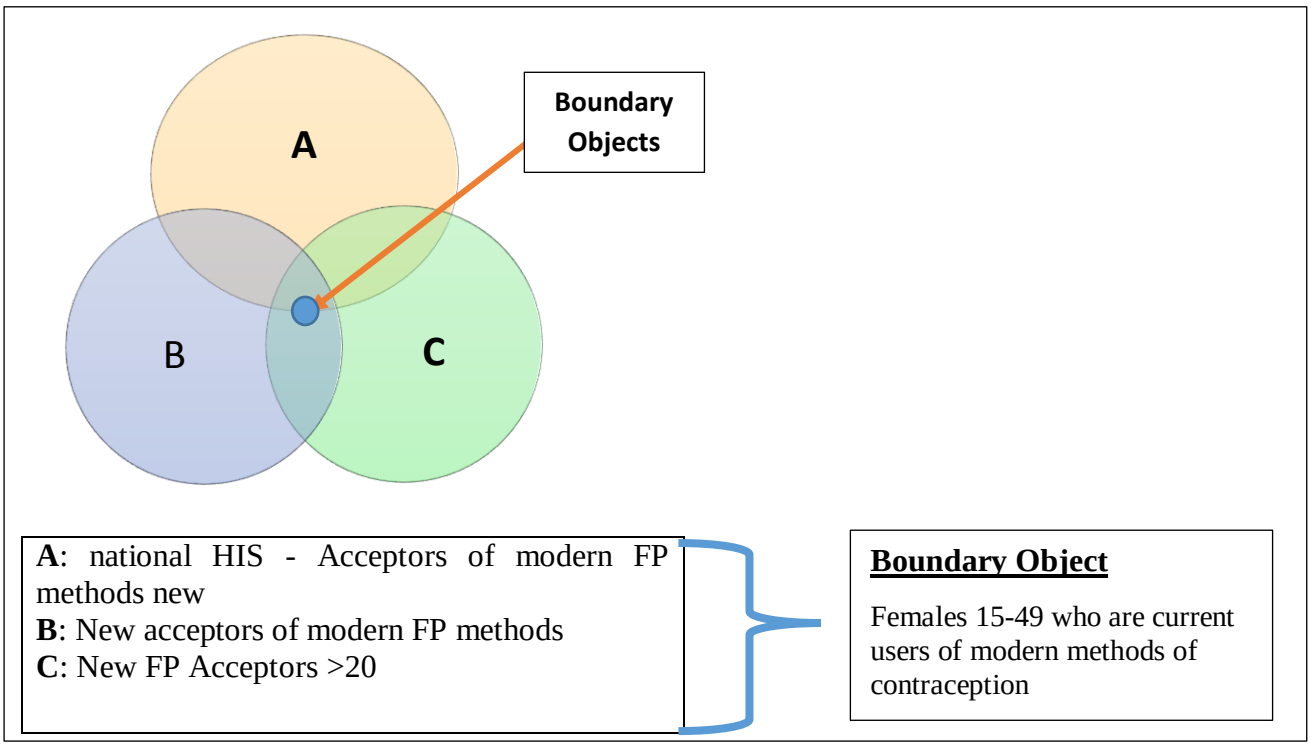


Figure 9: Boundary Objects at the intersection of different PHPs

The multi-faceted nature boundary objects, if well implemented, would facilitate the process, thereby creating a conducive environment for information and resource sharing, networking,

and building capacity. This is consistent with the previous findings from Mengiste (2010) and Nyella & Mndeme (2010), where they found that boundary objects mitigate conflicts and tensions among multiple partners from different social worlds.

As already indicated above, this thesis assumed that implementing standard health indicators is a socio technical perspective. Therefore, it contributes to this discourse by discussing the challenges and relating to the findings, as discussed in papers 1, 4 and 5. In doing so, the study contributes to developing practical approaches that promote sustainability of standard health indicators in the healthcare domain.

Implementing standard health indicators is a complex process because of the heterogeneous nature of the process charged with complexity related to identifying and implementing the right technological solutions that will provide standard tools for data collection and processing, as well as procedures. This process of defining standard health indicators needs to be well-planned in order to serve the needs and concerns of the different partners within the healthcare domain. The dynamic and flexible nature of boundary objects would serve the needs of the evolving healthcare sector. Thus, the thesis contributes to this discourse by outlining the approaches that could help resolve the differences in views and opinions among different partners and stakeholders, and consequently working towards a common vision that will help achieve successful implementation of HIS, including standard health indicators, while taking into consideration both policies and technological issues.

The study affirms that boundary objects could serve the following roles, as a source of collective/personalized learning and skills development, a source of resource mobilization, and as an avenue for networking (see sections 6.3.2). Thus, this study confirms the versatility of boundary objects as intermediary interfaces and a key process in developing and maintaining coherence between multiple stakeholders from different social worlds (Fujimura 1992). Most importantly, negotiation by means of creating boundary objects is a valuable strategy because it could align various political concerns and interests of multiple partners. Thereby, this thesis proposes gradual negotiation with different stakeholders from multiple social worlds, a relevant approach when implementing standard health indicators in a hierarchical organizational structure. In the process of negotiation, partners and stakeholders deal with problems and challenges, co-develop strategies to tackle issues, or break alliances if the partners cannot compromise their interests. Thus, the research intends to contribute to the discourse around

conceptualizing boundary objects as the intermediaries that help different partners negotiate during the implementation of standard health indicators. By proposing the process of developing standard health indicators as creating boundary objects, this thesis intends to contribute to policy and practices on IS implementation.

Finally, creativity provides a way to explore messy problems and find new ways to resolve them. The way I conceptualized the research problem and applied different approaches to answer my research questions contributes to the uniqueness and richness of the study. In answering the research questions, combined empirical approaches from two different countries, combined with literature review on boundary objects, I would say it is a new framework to conclude research in times of crises. In addition, the individual papers that are part of this thesis also contributed to literature on organizational learning (papers 4 & 2), CoP (paper 2), mobile technology (paper 3), and power in IS (paper 5), either by proposing new theoretical perspective or extending on the existing ones.

7.2.1 Practical Implications

Implementing standard indicators by creating boundary objects improves broad-based and inclusive collaboration

According to Olson (2009) the increasing need for different disciplinary perspectives on HIS is an indication that different skills and knowledge sets are needed to manage and maintain the IS, particularly LMIC. The study has explicitly illustrated that implementing standard indicators in a complex environment requires broad-based and inclusive collaboration. The thesis proposed implementing standard health indicators as creating boundary objects. The study has demonstrated the advantages of adopting the concept of boundary objects.

Managing challenges through context-specific strategies

As presented in the findings from the different research papers attached to this thesis, one significant practical contribution of this study is an analysis of context-specific challenges that users encountered after implementing standard indicators in the hierarchical organizational structure. Throughout the research, I have identified challenges related to fragmented IS, poor

infrastructure as well as inadequate and limited human resources. The findings from the approached identified context-specific approaches to cope with some of the challenges faced in different settings. These strategies would have practical implications for those engaged in implementing IS in LMIC.

Advocating for the decentralization of the process of implementing standard indicators through negotiations with boundary objects

The challenges of implementing standard indicators identified have been attributed to the hierarchical organizational structure and centralized management style prevailing in the MoPH. As a Cameroonian, I want to join my peers to advocate for decentralizing the process of implementing standard health indicators by negotiating with boundary objects. With this thesis, I want to call on decision and policy-makers, donors, aid agencies, and HISP at the University of Oslo (UiO) to quickly start the discussion. HISP at UiO, for example, often acts as a mediator between the health ministries and donors or funding agencies. The HISP UiO/DHIS2 as a research network operates in more than 50 African countries, used by various health programs and many international organizations. This means that when a country successfully implements a new IS, the credit goes not to the country alone, but to the HISP UiO network.

7.3 Implication for HIS Training

HIS training to staff at the peripheral level should be context specific and integrated into their work practices. Nyamtema (2010) and Nutley et al., (2013) noted that when IS training content to nurses at the peripheral level is generic, they have difficulties in understanding the content. Also, IS implementers lack practical context and content experience. According to Kang and Santhanam, (2003), one of the means of addressing this gap is training users to engage in practical activities. This thesis argues that no better person can engage nurses in practical activities than nurses themselves. Unfortunately, when implementing standard health indicators, the staff at the peripheral level are considered supplementary. However, to ensure continuity in training, this thesis proposes that HISP needs to develop specific IS training content targeting healthcare providers at the peripheral level. However, a practical approach is

to recruit content experts (Ali et al., 2017), who could assist operation managers in developing content-specific training material for staff at the peripheral level.

HIS has four key functions: Data generation, compilation, analysis and synthesis, and communication and use (Health Metrics Network 2008). Data generation, the first function, happens at the point-of-care or the peripheral level. Those managing data at this level encountered many challenges such as insufficient staff (quantity), lack of staff with adequate skills (quality), and limited access to financial resources. In addition, health facilities have poor infrastructure (inadequate availability of transport, electricity and internet connection), which compromise data management processes (Lippeveld 2001; Hozumi et al., 2002). Redman (2020) explained that if data quality fails at this point, it is challenging and costly to restore it later on. Despite all the challenges on data quality, most interventions on HIS have focused on strengthening or improving the functions of compilation, analysis and synthesis, and communication and use, the point of data generation, the most important function of HIS, has been neglected. It seems as if we are struggling to build a house without a solid foundation. If we have to achieve this purpose of HISP, HISP/UiO as one of the mother organizations developing and implementing HIS, needs to revisit it objectives.

7.4 Limitation of the Study

The phenomenon studied in this thesis was to understand the challenges are associated with implementing standard health indicators in hierarchical organizations, and which approaches can be employed to mitigate these challenges? Having worked as a knowledge broker, I have identified critical issues related to data management at the peripheral level. The peripheral level is the point of data generation. I argue that staff managing data must be well-equipped, have the necessary infrastructural support, skills and competencies manage data. Even though I acknowledge that mitigating challenges and creating stability at the peripheral level must be matched by having stability at the central level, the material presented in this thesis is not exclusively from the peripheral level. However, I confess that understanding the peripheral level is crucial in obtaining stability at the national level; the material presented here would

provide some critical insight to mitigate the challenges of managing IS throughout an entire health system.

Although I did not interview the staff at the central level, there is extensive literature on mitigating information management-related challenges at the national level. Reviewing the literature provided insight that helped inform me on what is required at the national level. For example, some of the challenges associated with implementing standard health indicators identified were the lack of adequate data-management skills, centralized decision-making, and conflict between parallel program coordinators and CIS, in terms of which indicators should go the list of indicators. These challenges cannot be addressed without support from the national level. While focusing on this work, a few issues have come to mind. The first one is the call for a more detailed analysis of the information needs of staff at the peripheral level involved in data management activities. The finding of such a study could help create target training content workshops. The peripheral is vast, with many cadres of healthcare staff involved in data management activities. The need is to develop context specific IS content for nurses at the peripheral level. Furthermore, this research was conducted in two of the 10 provinces in Cameroon. The focus was on the peripheral level; further research is needed to understand staff's perspectives at the central level to have a broader view of the country's situation. The use of boundary objects, in this case, is a proposition. Further research is needed to explore the concept practically in Cameroon.

8. REFERENCES

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9. APPENDICES

Paper One

Asah, F. N., Nielsen, P., & Sæbø, J. I. (2017, May). Challenges for health indicators in developing countries: misconceptions and lack of population data. *In International Conference on Social Implications of Computers in Developing Countries* (pp. 593-604). Springer, Cham.

Challenges for Health Indicators in Developing Countries: Misconceptions and Lack of Population Data

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Abstract. Indicators are foundational for planning, monitoring and evaluating of health services in developing countries. Most health indicators use population-based data, to enable comparison across geographical areas and over time. This paper is based on an interpretative case study on health indicators and how they are calculated and used at health facilities in Cameroon. We found that health managers at different levels of health systems do not share the same understanding of health indicators and we observed a wide-spread absence of population data. We further observed that health managers derive alternative ways of calculating indicators in the absence of population data. This paper contributes by discussing the implications of a lack of a common understanding of health indicators and the absence of population data to calculate health coverage indicators. Though this study was limited to data and program managers at district and regional levels, the findings raise issues that have wider applicability in the implementation of electronic health information system as well as how indicators such as UHC goals are calculated.

Keywords: Health indicators · Population-based data · Health management information system · Cameroon

1 Introduction

A key goal of a health system is to provide the necessary healthcare services to all those who are in need; thereby improving the health status of the population. International organisations such as WHO and United Nations, in partnership with governments of countries, have developed global initiatives to monitor performances of the health system. One concrete example is the United Nations' Sustainable Development Goals (SDGs) which target major health problems alongside other related problems alongside other related issues and constitutes a coordinating framework for these efforts (WHO 2010). Universal Health Coverage (UHC) is one of the goals of this initiative. UHC has been defined as the ability of all people who need health services to receive them without incurring financial hardship (WHO 2010; Kieny and Evans 2013). To monitor countries' health progress and performances towards supporting UHC, a range of health determinants' indicators have been developed. These indicators are measurable and time-bound.

J. Choudrie et al. (Eds.): ICT4D 2017, IFIP AICT 504, pp. 1–12, 2017.
DOI: 10.1007/978-3-319-59111-7_48

Examples of these health indicators include; *children under 5 sleeping under insecticide Treated Nets (ITNs)* and *births delivered in a birth facility*.

Health indicators are powerful tools used at all levels of the health system, for monitoring and evaluating and communicating information about the population's health (Mant 2001; Klazinga et al. 2001; Maniz 2003). They could be used to track how well (quality) and how far (quantity) countries' health system are performing (Klazinga et al. 2001; Maniz 2003).

An indicator has two parts; numerator and denominator that go into the formula for calculating them (Klazinga et al. 2001; Maniz 2003). Numerators are the things we count, i.e. *infants immunized* or *new cases of TB*. Denominators are the group with which the things we count are compared, i.e. *total population* or *all births in a year*. In the health system, indicators could also be used to measure a variety of dimensions concerning the health situation of the population; mortality, morbidity, health status.

There exist different types of indicators which could be used to monitor health progress, namely; health status, health systems, risk factors and health service coverage. Of important to this paper are health service coverage indicators.

These indicators reflect the extent to which people in need actually receive the health service they need (Tanahashi 1978; WHO 2009). This group of indicators measure the effectiveness of health programs. They help service providers to understand how effective an intervention is, and whether one target group is reached more effectively than another. They also help to identify underserved areas or regions which need more attention (Boerma et al. 2014). Most UHC indicators fall in this group.

Indicators in this group use population data as denominator, as it facilitates comparison of health status or health service provision over time and space. Coverage indicators are equally specific and valid for small and large geographic entities, and for any given time interval (WHO 2009). Examples of such indicators are; *immunization coverage*, *HIV testing coverage*, and *delivery in facility rate*. A common challenge is that there is lack of reliable population data to calculate them.

Population data is usually not accessible for smaller areas such as communities or districts (WHO 2009; Linard et al. 2012). Often, available population data is either outdated, not available for current administrative entities, not available for certain target populations (such as women of child-bearing age), or they may be duplicated sources of population data that do not necessarily provide the same figure (Linard et al. 2012; Leegwater et al. 2015; Bharti et al. 2016). The purpose of this paper is twofold. First, we are empirically exploring the understanding and use of health indicators by health program managers for decision-making. Second, we draw implications from this situation related to local practices and global initiatives such as UHC.

This study is derived from an ongoing implementation of an electronic system as a measure to strengthen Health Management Information system (HMIS) in Cameroon. This system is the main tool used for the management of health information nationwide. In this system, indicators are core element of data analysis, used to measure healthcare services.

2 Related Literature

In this section, we present relevant literature on health indicators to establish an understanding of what they are, what makes a good or poor indicator, and how they are used in health management.

Indicator(s) is developed by international organizations, reference groups and inter-agency groups, countries, academics, advocacy groups and others. From a performance management perspective, Flowers et al. (2005) describe indicator as a measure used to express the behavior of a system. In the public health context, indicators are specific tools for programme management, including the analysis and diagnosis of problems, and for taking correctives actions (Sahay et al. 2009).

Indicators are key statistical measure used to describe a situation, track progress and performance over time and to compare entities doing similar work. They could be used as a guide to decision making and set priorities (Donabedian 1966). They help to inform policy and policy-makers and can be used to improve quality of care and promote accountability (Donabedian 1966; Mainz 2003).

The literature explains that the process of selecting indicators should be systematic and based on facts rather than on feelings (Mant 2001). The process should involve all stakeholders and be based on "who wants the indicator", "how it is used" and "by whom" (Mant 2001; Klazinga et al. 2001). Heywood et al. (2001) explains that the process should employ understanding, discipline, teamwork and negotiation. Therefore, an ideal indicator should: (i) be based on agreed definitions; (ii) measure what it is intended to measure; (iii) give the same results if used by different people in different places; (iv) be simple to calculate using readily available data; (v) fit local needs, capacity and culture and the decisions to be made; (vi) be highly sensitive to changes in the situation concerned; (vii) permit useful comparison; (viii) be evidence-based (Heywood et al. 2001; Mainz 2003; Larson and Mercer 2004).

Indicators can be classified as: input, process, output, outcome and impact. Input indicators are the resources needed to implement work. Input indicators measure resources, both human and financial, allocated to a particular program. Process indicators measure whether planned activities did take place. For example, in antenatal care, process indicators can be *antenatal 1st visit before 20 weeks rate*, *antenatal client re-test rate*, and *post-natal visit with 2 weeks rate*. Output indicators measure first level results associated to an intervention. They are defined as what we produce. Some examples include; I*nfant 1st PCR test around 6 week uptake* or *delivery by caesarean section rate*. Outcome indicators measure what we have achieved and should be linked to concrete goals. Examples include; *delivery at facility for women under 18 year*s and *live birth under 250 grams in facility rate*. Finally, impact indicators are the cumulative effect of the overall program (Mainz 2003; Heywood et al. 2001).

Indicators can be calculated in different ways; ratios, proportions, or rate (Worning et al. 1992; Mainz 2003). Ratios are numbers expressed in relation to another by dividing one number by the other. Here, the numerator is not part of the denominator. Proportion measures a part or amount that is part of a whole. The numerator is part of the denominator. Rate represents the frequency of an event in a specified period. In calculating a rate indicator, the numerator is the number of occurrences of an event during a period

of time. The denominator is the number of person exposed to that event in the time period. These indicators are illustrated in Table 1 below.

Table 1. Different types of indicators

Indicator type	Description	Example
Ratio	Numerator is not included in the denominator	Ratio of male TB deaths to female TB deaths
Proportion	Numerator is contained in the denominator	Proportion of children one year old immunized against measles
Rate	Frequency of the event during a specific time in a given population	Deaths of children less than one year of age per 1000 live births

Population data is required as denominator to calculate these types of indicators. Since these are integral for health management, the lack of population data poses a challenge.

3 Research Context

The empirical setting within which the study was conducted is Cameroon. It is a low-income country, situated in the sub-Saharan Africa (SSA) region. It has an estimated population of 20.6 million (Chen et al. 2004). In Cameroon, basic public and social amenities for the vulnerable are either absent or inadequate. Nationally, 29.7% of the population does not have access to safe drinking water and 66.9% lack adequate sanitation, resulting in regular outbreaks of cholera and other water-related diseases (UNICEF 2015). The burden of healthcare financing is born largely by households through out-of-pocket payments (OOP). The government of Cameroon spends an average of USD 61 as per capita per person on health. Out of this amount, only USD 17 paid by the state, USD 8 comes from international donors, and USD 36 is OOP (Cameroon Economic Update 2013). Over the past two decades, health indicators have remained poor, and in some cases even worsened. Cameroon is struggling with high mortality and morbidity especially in rural communities. Mortality rate for children under 5 is 148 per 1000 live births, ranking Cameroon as 18th amongst 20 countries in the world with the highest mortality rate. Only 13% of children under the age of five sleep under insecticide-treated nets, in a country where malaria accounts for more than 40% of all deaths in this age group. Maternal mortality rate is alarmingly high, 670 per 100,000 births as compared to 546 per 100,000 live births in SSA. In addition, many women and girls have limited access to, and utilization of, prevention-of-mother-to-child transmission (PMTCT) services, resulting in HIV infection transfer to children (UNICEF 2015).

The healthcare system adheres to the district health approach, organised in three levels: the operational level, corresponding to district health care; hub of all health interventions; the intermediate level which is responsible for technical support, while the central level deals with the development of health policies. Different programmes operate at all three levels, engaged in the provision of specialised services such as maternal and child health, malaria,

HIV/AIDS, TB, and are supported by different donor agencies. The health system suffers from qualitative and quantitative shortage of human resources, and lack of technical and managerial expertise (Cameroon Economic Update 2013).

The health management information system (HMIS) in Cameroon is fragmented and characterised by vertical and fragmented information system and non-standardized data collection methods. DHIS2, the electronic tool used is housed at "Cellular National d'Informations Sanitaires" (CNIS), the department responsible for the management of health information in the country.

4 Research Design and Methods

The study is drawn from an interpretative strand (Walsham 1995). Interpretive research in Information Systems (IS) is useful as it helps researchers understand the problem in the contextual nature (Klein and Myers 1999).

Data was collected by the first author using qualitative methods. It included interviews, group discussion, and a document review. A total of 2 focus group discussions and 7 interviews were conducted in January and in July 2016, with Maternal and child health Programme Managers at district and national levels; data managers at district healthcare facilities, Matron in-charge of data management in wards, and Sister-in-charge of health facilities. 22 health and program managers participated in the study, of which 13 were females. Ten had no access to a computer and only 6 had Internet access. The document review included annual reports, strategy documents, and program reports.

Purposive sampling technique was used to select interviewees (Creswell 2007). This technique is used to achieve a homogeneous sample; that is sample of cases who share the same characteristics e.g. background or occupation. In this study, the interviewees shared a similar occupation; i.e. involved in data management at their respective facilities. An interview guide with broad themes around data management was used, focusing on understanding and use of health indicators. Permission to conduct the study was obtained from the Office of Regional Health delegate of each region and signed informed consent was obtained from each interviewee. The principle of data saturation was applied; i.e. interviews were ended when further probing were not adding new information. Permission to audio record interviews was obtained from interviewees at the start of every discussion and interviews were transcribed.

Data analysis was driven by the interpretive process and a descriptive approach with content analysis was used to analyse the data (Elo and Kyngas 2008). The interviews were transcribed verbatim. The interviews were read through several times to obtain a sense of the whole. The text was then divided into condensed meaning units. Open codes were used to group headings into categories to formulate a general description of the research questions. The interviews revealed themes which are interrelated. During this process, the data, themes and topics was discussed among the authors and based on these discussions the data was revisited.

5 Analysis

The analyses of the interviews and review of documents revealed the following:

A general observation in Cameroon is that population data is either outdated or not available. In the absence of reliable census data, the National Bureau of Statistics issues population figures per province and district to the Ministry of Public Health annually. However, for areas below the districts, it provides percentage per population group and annual projected growth rate per age group that has to be calculated by those who want to use population data. Usually, healthcare managers lack the necessary numeracy skills to perform such calculations. Also, these figures are not publicly available.

Data is collected at health facilities, and reported upward through health districts to the national level. At health facilities, daily registers are used to record activities from various units of the facility; outpatient, antenatal unit, labour and delivery, immunization and in-patient. At the end of each month, data from these registers are collated manually in to the Monthly Reporting Activity[1] (MRA) and also on Program Template forms. Thereafter, these forms are forwarded to the district office where data is captured electronically and their respective databases. MRA is captured into DHIS2 while program-specific data is captured on pre-designed Excel templates, hence forwarded to the regional level. At the regional level, data is also aggregated and synchronized to get the profile of the entire region before it is forwarded to the national level where analyses is done. We observed that the MRA is not comprehensive, as it does not contain all the data elements of health programs, as explained by one district manager:

> *"Previously, programs manage have their own reporting system but since the new CNIS director was appointed, he is trying to put some order in the system; starting by standardizing data collection tools. The data elements in MRA were selected based on the 100 indicator datasets as stipulated by WHO."*

Theme 1: Issues relating to Data Quality

Data Quality - Data review and giving feedback

It is essential to perform data quality checks. Exploring issues of data quality, we observed that data reviews and feedbacks are not standardized processes of data management. They are often done haphazardly and not frequently conducted at most facilities. District managers explain that due to lack of feedback, data clerks have cultivated the habit of falsifying data:

> *"When data clerks submit data and receive no feedback, they believe nobody checks the data submitted. Thus, they have cultivated the habit of cooking data and submitting."*

Despite being aware that neither data quality reviews are done nor feedbacks provided, district managers said they trust the quality of data: *"I only type and submit I do not use data. I cannot say anything about the quality of data. But I trust the data submitted by the matron in-charge"*

[1] The MRA does not have certain data elements which programs have to report on. Consequently, individual program have created their own data collection tools to collect program specific data.

Theme 2: Understanding of and use of health indicators

Understanding indicators : Nurse Managers at District & Regional Health facilities

We observed that health managers at operational levels seldom discuss about indicators and do not share the same level of understanding of indicators. In particular, facility level managers interviewed were not aware that there is a difference between an indicator and data element. They were neither able to understand what makes up an indicator nor how an indicator is calculated. They were also not able to differentiate a data element from an indicator. During the discussions, they would refer to "indicators" but when probing it became apparent that what they meant were "data elements". When asked to present a list of monthly priority indicators, a matron in-charge showed a list of monthly summary data element forms, noting: *"these are all our indicators that we report monthly. I write everything here on these forms and submit to them."* A similar situation was observed among district program managers. When asked to give example of some of the SDGs indicators in the program she manages she noted:

> *"Last week I went to the hospital for a visit. As I was walking out of the hospital, I caught sight of this beautiful picture with the following caption "breastfeeding is a sustainable development goal as will reduce infant mortality". That was the very first time I heard about sustainable development goals. I was so happy."*

While attending a monthly district meeting, Program managers were presenting monthly reports on facility visits conducted in their sub-districts. In the course of presenting these reports, they use phrases such as "low ANC coverage, low immunization coverage" as outcome of their visits. It was not clear from the presentations how they arrived at the decisions.

Use of indicators: Nurse Managers at Healthcare Facilities.

We also observed that health managers' use of indicators was minimal. A nurse manager explained that she uses indicators when preparing her performance-based business plan to help allocate targets (excerpt of plan presented on table below). A general complaint was the difficulties to do the calculations as illustrated in Table 2 below. For example, column 2 depicts how population data are presented to managers at health facilities.

A matron in-charge explains how she uses indicators:

> *"At the beginning of the year we have priority activities and also set which are reviewed annually. For example I know in this hospital, our consultation at the end of last year was 40,000. For this year, we should move up to about 45,000. If that is not achieved, we will know that we have not performed well and need to do something so that we can achieve more consultations. Two years ago, our consultations moved from 20,000 to 30,000. As a result of this increase, the director saw that the consultation area has become small. He expanded the waiting area, bought more chairs so that patients should sit down while waiting to be seen by a doctor."*

In the explanation above, the manager talked of "indicators" but what she is referring to are "data elements". She added that to calculate indicators, they would use the performance of the previous year or quarter to evaluate their facility's performance against set targets. To set indicator targets, it was observed that there are no clearly

Table 2. Level of achievement of the objectives of the last quarter business plan

Indicators	Monthly target calculation	Objective for the previous quarter (A)	Objective planned for the quarter (B)
Out Patient Consultations (new cases): Nurse	Total pop. of catchment area/ 12 × 80% × 90%	4025	4026 + 660
Referral received in the hospital	Pop × 1/12 × 1%	55	55 + 18
Cases of STIs treated	Total pop. of catchment area × 3%/ 12 × 80%	134	134 + 30
Children completely vaccinated	Total pop. of catchment area/ 12 × 4%	223	223 + 70
Normal Assisted Delivery	Total pop. of catchment area × 4%/ 12 × 80% × 70% × 90%	112	112 + 50

defined criteria to use. With reference to the Table 2 above, Columns 3 and 4, the nurse manager from another facility shared her experience:

"As we prepare the business plan for PBF, we have working sessions with the PBF team. They will say for example, on the indicator: "Outpatient consultations (new cases): nurse", since we achieved 4025 in the last quarter, what do you think if we shift your objective for next quarter to 660 that is 4025 +660 = 4685. What do we do, we just have to accept? They do not take into consideration any other factor. It is our responsibility to ensure that the number cases are achieved at the end of the quarter. If we do not achieve it, we shall not benefit a single franc on this particular indicator."

Another facility manager added:

"To set a target, we merely take the performance for the previous quarter, and add at least 5%. Five percentages is just an amount we decide to use. The idea is to encourage them to perform better than the previous quarter. However, there is a challenge because most often those targets sets are not achieved."

Use of Indicators at District Level

District managers use indicators to compile quarterly reports as explained by one of them:

"Programs have specific indicator targets. Take for example, the indicator "immunization coverage." I am a statistician so when data arrives my office, after capturing, I do my calculation base on the targets and population projection I have. Hence, I compare the results (figures) with what was submitted for the previous months to know when I have achieved the target or not."

Another Program manager shared her experiences:

"For example, as a HIV/AIDS program manager, this program is a priority program. I have monthly targets that were set and sent to me from Yaoundé [the capital in Cameroon] *at the beginning of the year. Consider, for example, the indicator, "Treatment coverage among HIV/*

AIDS positive pregnant women". Based on the data submitted, at the end of each month, I calculate the indicator and send the report to the national office in Yaoundé."

Furthermore, the district program manager explains:

"If for examples the targets are not met, I will have to wait for instructions from Yaoundé before going out or planning for an intervention because Yaoundé makes all the decisions."

Use of Indicators at the National Level

A director at the national explained that all decisions are made at the central level, the reason why data analyses are done there; at the national level. He added that indicators are used to evaluate program, but lamented on the quality of data. For example, he mentioned that most of the indicators routinely collected for his program are irrelevant. He also added that district managers are not involved in decision-making as this is the responsibility of those at the central level:

"Districts are not involved in decision-making. Except for the HIV/AIDS program, where program managers at district level have targets. Reasons being it is a priority program, with lots of international funding from PEPFAR. However, about which SDGs my program is reporting against, SDGs have not yet been made published. They are still waiting for the indicators and targets."

Further, he added, indicators are often discussed only when preparing annual reports. This is the responsibility of the national program manager for monitoring and evaluation.

6 Discussion

The study provides tangible examples of health managers' understanding and use of indicators in healthcare settings. So how transferable are the findings? We found that these behavior were similar to other countries reported by Silvia et al. (2013), Thaizy et al. (2015).

The world's political agenda for the next 15 years (2016–2030) on health systems' strengthening is to reduce poverty through SDGs in general and UHC goals in particular. These are global initiative to monitor countries health performance. UHC are time-bound and measurable indicators to be monitored and reported against, annually by each country. Though internationally developed, most of the indicators are similar to those in a country's operational plans. Thus, decision and interventions made by policy makers and healthcare providers should be based on these indicators.

At the operational level, data to generate these indicators come from various health interventions done at district and communities levels. Therefore, it is important that healthcare professionals understand indicators and also know how they are calculated, as it might help them to monitor and evaluate their performances, and in the event of an outbreak, they intervene immediately.

While managers are should understand health indicators, it is important the government provides reliable population-based data. In Cameroon, population-data is available for the regions, and for administrative units below the district, projected population estimates are provided instead, and it is the responsibility of the district or facility

managers to calculate these estimates, who in most cases lack the necessary numeracy skills.

A reliable source of population data is through census, but census is not frequently conducted. Data available is either outdated or does not exist in administrative unit below the district. However, there are other reliable sources of population-data. Citing an example from the developed countries, in Norway, the civil registration and vital statistics (CRVS) systems are reliable sources of population data. The government has introduced a method whereby these systems are maintained through incentives given to bother public and private entities and citizens to engage in proper and timely registration of vital events (Nielsen et al. 2015). Thus, the saying goes "population-data is the true denominator for development" (Purcell 2016).

Population-based provide an important piece of mosaic of evidence for decision-makers as well as healthcare providers. It can be used to assess the magnitude of health problems of which population are most vulnerable, such as to track and evaluate the effectiveness of health intervention for UHC.

Furthermore, health care providers dealing with indicators need to understand their meanings and what goes into calculating it (Sahay et al. 2009). In addition, indicators should be standardized as it improves data quality (Maniz 2003; Flower et al. 2005).

7 Conclusion

The study found that healthcare managers have difficulties understanding data elements and indicators. In the absence of population data, they use alternative method to calculate indicators. Although managers have priority indicators they report on monthly, coverage indicators are not calculated using population as denominator. This study extends research on how health information is used by healthcare providers based on a case study in Cameroon. Though this study was limited to data and program managers at district and regional levels of the health systems, the findings raise issues that have wider applicability in the implementation of electronic health information system as well as how health indicators such as UHC goals are calculated.

The primary concerns of case study research centers around validity and reliability (Merriam 1985). To address these concerns; for validity, we employed the process of triangulation, i.e. the use of a variety of data sources (interviews, focus group discussions and documents review) as opposed to relying solely upon one source. We have also included verbatim quotations (Johnson 1997) in the analysis section, consulted with senior directors at the ministry of health. To ensure reliability, the following measures were employed; interviews were recorded and transcribed, and during data analysis themes identified were discussed and agreed among the authors, before it was included in the paper (Roberts et al. 2006).

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Paper Two

Asah, F. N. (2021). Creating a "Community of Information Practice" for improved routine health data management in Resource-Constrained Setting: The case of Mbingo Primary Healthcare facility, South Africa. *The Electronic Journal of Information Systems in Developing Countries*, e12178.

Received: 23 June 2019 | Revised: 21 March 2021 | Accepted: 4 April 2021

DOI: 10.1002/isd2.12178

RESEARCH ARTICLE

WILEY

Creating a "Community of Information Practice" for improved routine health data management in Resource Constrained Setting: The case of Mbingo Primary Healthcare facility, South Africa

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Funding information
Norwegian Centre for International Cooperation in Education, Grant/Award Number: UTF-2016-longterm/10032

Abstract

Intrigued by the outstanding performances of a rural health care facility in relation to data management and use, recognized by the KwaZulu-Natal Ministerial Award in 2017 and 2018, respectively, we draw on an interpretive case study to further our understanding of the role of the healthcare managers in this and the context in which they operated. The performance of the healthcare facility in relation to data management and use could be traced to the cultivation of a "Community of Information Practice" around data management and the leadership style of the healthcare manager and the commitment of the staff. The study highlights the healthcare manager as pivotal in strengthening a data use culture in resource-constrained healthcare settings. This paper presents a practical approach in operationalizing health indicators in resource-constrained settings. This paper contributes to CoP by extending the role of the facilitator beyond the usual role as organizer of meetings to champions of the CoP. The paper concludes that healthcare managers are change agents, who make sense of changes with their colleagues, by sharing knowledge and experiences in a way that allows continuous learning to take place, creating a sustainable context for continuous use of health data.

KEYWORDS
clinic manager, Community of Practice, data management processes, health indicators, KwaZulu-Natal Province, Primary Healthcare facility

1 | INTRODUCTION

The use of information, in this era of the information age, is a central factor in improving efficiency and effectiveness in the delivery of services. Decision-makers such as healthcare providers need reliable information to plan activities and to assess the performance of health services (Worku,

Abbreviations: CM, Clinic Manager; COP, Community of Practice; CPN, Chief Professional Nurse; DHIS2, District Health Information System 2; DO, Data Officer; HISP, Health Information System Program; HMIS, Health Management Information system; HPRS, Health Patient Registration System; IM, Information management; IS, Information System; KZN, KwaZulu-Natal; LMIC, Lower and Middle Income Countries; NDoH, National Department of Health; NSD, Norwegian Center for Research Data; PHC, Primary Healthcare; RHIS, Routine Health Information System; SA, South Africa.

The actual names of the PHC facility and district office used in this paper have been concealed for confidentiality reasons.

2012). Generally, raw data does not facilitate decision-making or action taking and hence the need for using relevant health indicators. In public health, indicators are important measures of the health status of a population (von Schirnding, 2002) and for taking corrective actions and are measures for evaluating health service delivery (Merry, 2016).

In the management of health information, health indicators are selected at the national level and frontline managers collect and report the data to the higher levels. Studies within South Africa (Mate et al., 2009; Nicol et al., 2017) and from other African countries such as Kenya (Nyamtema, 2010), Ethiopia (Shiferaw et al., 2017), Ghana (Boadu et al., 2019), show that frontline managers have insufficient skills to analyze and use indicators. The lack of skills to manage data is partially associated with a lack of trust in the data (Nicol et al., 2017) but also be affected by workload, limited skills, and knowledge around data use (Gimbel et al., 2017; Njuguna et al., 2019).

The frontline health managers including nurses are primary data managers and should be able to understand the importance of data, have the skill to calculate, and analyze indicators, because if the quality of data is poor at the point of collection, it is difficult and costly to restore it later on (Redman, 2020). According to relevant literature, continuous training is one of the best methods of developing frontline health managers' capacity on data management. In South Africa, the National Department of Health has over the years, organized training programs on data management. However, due to national healthcare shortages from rural health facilities are especially impacted as they are often the only professional staffing the PHC facilities and cannot avail of the training (Mate et al., 2009; Nutley & Reynolds, 2013). The content of the training is also important (Nutley & Reynolds, 2013). Research on data management and use for staff at the peripheral level has stressed that for training to bring about change in practice, it should be content and context-specific (Nutley & Reynolds, 2013; Taylor, 2009). That is, the training should be operationalized to include how to develop locally relevant health indicators, report generation, and be built-into the work practices of healthcare workers. This is to ensure that the training meets the information needs of the staff and will instill in them the skills to be able to collect, analyze, and use data to make better decisions, hence creating a data use culture (Arenth et al., 2017). A participatory and learner-centered approach is also advisable. Since the present training programs fall short of these criteria (Nutley & Reynolds, 2013), there is a need for alternative methods of training.

Mbingo clinic is a primary healthcare facility (PHC) in the Bali health district[1] of the KwaZulu-Natal province has won several awards[2] and was the best performing PHC facility in relation to achieving the district's targets on priority health indicators in 2017 (MEC Service Excellence Award, 2018). Given the uniqueness of a rural PHC facility, repeatedly obtaining these *accolade*s presented a unique opportunity to investigate the situation and understand how this was achieved. This research was guided by the following research question: "how do healthcare managers assist in developing the use of data in a rural healthcare facility?"

The empirical finding is from the Mbingo PHC facility in the northern KZN province of South Africa where routine data is collected manually from patients who seek care and thereafter, the data is analyzed. We draw on the concepts of Community of Practice (CoP) as the analytical lens and practical guide to analyze how staff participate and interact, whilst developing collective learning and building capacity (Brown & Duguid, 2001). This paper contributes to the ongoing discussion in information system (IS) around creating a data use culture where routine data is collected, analyzed, and used, to inform decisions. The rest of the paper is structured as follows: Section 2 reviews relevant literature and theoretical frameworks; Section 3 presents the settings, approach, and methods used in the study; Section 4 presents data management and analysis used in this study; Section 5 presents the findings and analyses; Section 6 discusses the findings, and Section 7 concludes the study.

2 | RELATED LITERATURE AND THEORETICAL FRAMEWORK

2.1 | Definition of concepts

2.1.1 | Data management process

Data management is the process of collecting, analyzing, and presenting routine data for action (Heywood & Rhode, 2001). Data collection takes place at the periphery and includes capturing data from the different forms, registers, and consultation points. Next, the data is collated and validated, that is, cleaned to ensure that there are no errors. Thereafter, the data is assessed towards set goals and targets to support decision-making, hence developing a data use culture (Arenth et al., 2017). Generally, the processes of analyzing and presenting data are often computerized. However, in rural health facilities characterized by poor infrastructure and shortage of staff, the processes are largely manual.

2.1.2 | The healthcare manager in a primary healthcare facility

The manager of a primary healthcare (PHC) facility can be either a chief professional nurse (CPN) or a professional nurse (PN) and in the rest of the paper, the manager will be referred to as the facility manager. In a PHC facility, healthcare providers work in teams to achieve clinical objectives. The role of a facility manager is to set the stage for excellence by exhibiting leadership and cultivating good working relations that would make the facility conducive for staff to work (Maragh, 2011). The facility manager is also an operations manager; they are viewed as approachable,

accessible to engage with, and motivate their subordinates so that they can work together (Buick et al., 2018; Nisbet et al., 2013). Eraut (2004) adds that operation managers are influential, nurturing, and act as mentors to their subordinates. Ellinger (2005) concludes that managers at operational levels who exhibit these qualities create a conducive environment where employees work together in achieving their objectives including solving data management-related challenges.

A PHC facility is the first point of entry for most people seeking health care in South Africa. PHC facilities serve as hubs and are a critical interface between the population and health care sector (Munyewende & Rispel, 2014). Thousands of South African citizens visit PHC facilities daily and rely on the services[3] offered (Gilson et al., 2014). PHC facilities collect data from multiple sources; either routinely (continuously at various times, mostly monthly), or non-routinely (through surveys). The focus of this article is on routine data collection captured manually on registers, forms, and tally sheets. While healthcare providers collectively perform healthcare services to patients, from my experience working with nurses in African countries, nurses are often reluctant to capture routine data, on the basis that it is the responsibility of the facility manager. This assumption may be because data management is time-consuming and the nurses do not have the time to do this, but could also be attributed to the fact that most nurses lack basic data management skills to perform the task (Njuguna et al., 2019). To change this assumption and to get nurses involved in data management-related activities would require managers and nurses working collaboratively and sharing their skill sets (Ellinger, 2005; Gilson et al., 2014).

2.2 | Theoretical perspective: Community of Practice

In LMIC, the lack of adequate competencies to analyze data is a major challenge affecting health information systems, particularly among staff at the peripheral levels (Gimbel et al., 2017; Njuguna et al., 2019). Building the competencies of these staff can be achieved through collective learning (Eraut, 2004) in a Community of Practice (CoP).

The term CoP, coined in 1991 by Lave and Wenger (1991), is achieved when a group of people "who share a concern or a passion interact on an ongoing basis and in the process, do it better as they interact regularly" (Wenger-Trayner & Wenger-Trayner, 2015, p. 1). A CoP has three main features; a shared domain of interest, a sense of community, and a shared practice. The *domain* provides a common identity for the members, which guides their thoughts and actions while providing members with a sense of purpose and value. An example, in this case, is routine health data. The *community* is where interactions and relationships are built through mutual understanding and trust (Wenger et al., 2002). An example being staff involved in data management-related activities at Mbingo PHC. Finally, the *practice* is what members do in the domain, that is, the defined ways or procedures of doing things in a specific domain. An example is the data review and validation meetings organized around data management and the defined procedures and practices.

In a CoP, members can create solutions to their problems through interactions and participation, thereby harnessing and building knowledge within the group as opposed to relying on outside interventions (Chua, 2006). At the same time, members can develop their own professional identity and build a professional working team where they can share information and experiences (Fontaine & Millen, 2004). In a rural district like Bali, KZN, where it is difficult to recruit and retain skilled staff, cultivating CoP could harness skills and competencies of staff internally, something that Leadbeater (2000) suggests as a solution in resource-constrained settings in the absence of formal training.

Cultivating a CoP could be intentional, that is, to meet the needs of the organization (Dubé et al., 2006), or could be developed spontaneously in response to members' needs (McDermott, 1999). Small communities have few specialists, while larger ones can have hundreds of people within an organization or across organizational departments. However, to ensure sustainability, CoPs should have a core of experienced members.

Another concept used is knowledge broker. Knowledge brokers are intermediaries between CoPs; facilitating information and knowledge transfer within CoPs (Wenger, 1998). Brokering helps to spread and make sense of the knowledge in the context where it is used (Hearn & White, 2009). To do this, knowledge brokers need to be members of two or more CoPs. At Mbingo PHC, these are staff who belong to the community of information practice and are members of the District Health Information Community.

The CoP concept has been used extensively in IS. For example, CoP was used to characterize the link between traditional and modern practices for improving data quality in health information systems (Kanjo, 2012). Similarly, in Sri Lanka, the concept was used to describe collaboration among HIS staff, the global HIS expert community, and other stakeholders in the development of the web-based District Health Information Software (Siribaddana & Hewapathirana, 2016).

3 | RESEARCH SETTINGS, APPROACH, AND METHODS

3.1 | Research setting

The empirical setting for this research is Mbingo PHC in the Bali health district. The health district is ranked among the poorest in the province. The facility has 15 staff members and runs an outreach team for family and school health, and is involved in mobile outreach activities. It has 10 community caregivers working in the community who report daily to the health facility.

3.2 | Data management activities at Mbingo Healthcare Facility

At Mbingo PHC, routine data collection begins at the reception of the facility that is managed by a staff nurse. When a person visits the facility to seek healthcare for the first time, the demographic data (name, address, date of birth, and phone number) is captured on the Health Patient Registration System (HPRS) and a unique identifier (UID) is created. Then, the patient's folder is created and handed to the person, who is sent to the waiting area to be consulted. If the patient is already registered, his/her demographic data is retrieved and updated in the HPRS. Then, the patient's file is retrieved from the shelf and handed to the patient and the patient is sent to the waiting area to be consulted. However, a patient's demographic data is retrieved from the HPRS only when there is an internet connection. Without an internet connection, the patient's demographic data is written in a register and later captured on HPRS. Other routine data is generated at the consultation points; where patients are consulted either by the nurse or by the doctor. After the consultation, patients who need medications go to the pharmacy to collect their medicines. Each consultation point has a Tick register, which is the mandated paper-based booklet used for recording patients' information and interaction between the healthcare provider and the patient. The register does not leave the consultation room.

3.3 | Research approach and methods

The paper is based on an interpretive case study approach, which was chosen as the most appropriate for the study's purpose. This is because the study aimed at descriptively understanding the data management practices of staff at Mbingo PHC that led to learning and how learning is transferred within the group. Walsham (2006) has described that interpretive case studies in IS research help to develop thick descriptions of human (staff) interactions with health indicators at Mbingo's PHC facility that led to learning. The researcher visited Mbingo PHC for 3 months during data collection involving a combination of qualitative data collection methods such as open-ended semi-structured interviews; document analysis (Data Management Standard Operational Procedures [SOP], Tick registers, Immunization registers, and Road to Health card[4]) and observations. The interviews were used as the primary source of data as it offers the most direct approach to collecting detailed data on the phenomenon (Myers & Newman, 2007) and allows the researcher to probe for more information as deemed necessary.

Eight semi-structured interviews were conducted between May and July 2018 with the following staff members (two Professional Nurses, a Chief Professional Nurse, a PHC supervisor, a staff nurse, a Data Officer [DO], a nutritional advisor, and a Pharmacist Assistant) in the facility. The interviewees were purposely selected because they were directly involved with data management-related activities as defined in the District Health Management Information System (DHMIS) Facility level SOP (SA-DHMIS, 2012). The interviews were held in the afternoon because then, the staff is usually less busy and more relaxed compared to the morning periods. Before conducting each interview, the researcher took about 10 min to share with the interviewee the purpose of the discussion and to give him/her time to read and sign the consent document.

In semi-structured interviews, the researcher invited staff to describe their daily activities in relation to data management. The researcher conducted all the interviews in the English language as this is the common work language, using an interview guide, which comprised broad questions on data management processes, the roles of the manager in supporting data management processes, how the manager facilitates data review meetings, and the challenges encountered. Each interview lasted for about 45 min and was audio-recorded with permission from interviewees. The data from interviews helped the researcher to understand the processes of data management and to be able to obtain a rich set of data about the research issue and capture the contextual complexity within which the staff work.

Data collection was also done through observation. The observations were conducted by observing the staff in their everyday environment, which enriched and broadened the researcher's knowledge and understanding of data management processes at the facility. Likewise, attending data review and validation meetings allowed the researcher to observe the interactions in the natural settings. Observations were made on how the staff use the Tick register,[5] how they make a summary at the end of the day, how the data officer compiles and collates data at the end of the day, and the interactions among the staff and the manager during data review meetings. Another source of data collection used was document analysis. Analysis of existing documents (both printed and electronic) provided contextual information regarding data management practices and procedures adopted.

4 | DATA MANAGEMENT AND ANALYSIS

After transcribing the interviews, the researcher read the transcripts to remove any identifying information and to familiarize herself with the broader sense of what was reported by the participants. While reading the transcripts, participants tended to highlight and focus mainly on their regular data review meetings, interactions, discussions that took place, and the manager's presence and participation during meetings. This was the starting point of analyzing the data and highlighting challenges and key data management. On challenges, phrases identified such as “issues data manager encountered”; “nurses' writings are illegible.” Other terms that explain activities after the manager

introduced day data review meeting and the manager's roles such as: "manager creating time," "manager teaching and demonstrating how to use the tick register," "manager designed data validation tool," "manager showed how to calculate priority health indicators," and "manager allowed us to attend and present data at district information meetings." Thus, an inductive approach to thematic analysis was adopted.

After identifying the phrases, the researcher reviewed the transcripts again and started developing interpretive codes. The coding process was done manually with the researcher using various colored pens to highlight key themes while writing comments in the margins to record her thoughts. Thereafter, the themes were charted to link key phrases from the respondents and identify patterns of phrases. As an inductive process of coding and categorizing was adopted, the themes that emerged are rooted in the participants' own words.

5 | FINDINGS AND ANALYSES

5.1 | Challenges in managing data at Mbingo leading to the cultivation of CoP

The Data Officer (DO) is the administrative staff in charge of data management activities at the facility. At the end of each month, the DO goes from one consultation point to another collating data. While collating data, the DO had difficulty extracting data from the Tick registers because the writings of nurses were illegible. The process of verifying and validating data was time-consuming because the DO spends time running behind nurses to verify values they had written in the register. Sometimes, it was difficult for nurses to recall what they had written in the Tick register. Consequently, routine data collected was either incomplete or submitted late to the national IS and at the end of the month. Additional, it was difficult for the facility manager to evaluate the facility's performances due to the lack of accurate data. Arising from these difficulties a "Community of Information Practice (CoIP)" was cultivated at Mbingo PHC by the facility manager. In the following sections, we present the activities that happened after the cultivation of the CoIP.

5.2 | Cultivating a "Community of Information Practice"

The CoIP comprised one Chief Professional Nurse (CPN), two Professional Nurses (PNs), one staff nurse, a Data Officer, a Nutritional Advisor, a Pharmacist Assistant, and the facility manager. The staff was directly involved in managing routine data. The facility manager and her colleague agreed to change the frequency of data review meetings from monthly to daily and spend an hour each day to reflect and discuss data-related issues. In the following sections, we present the activities that happened at these meetings.

5.2.1 | Teaching how to use Tick register in the consultation room

Since managing routine data is not part of the nursing curriculum (Personal Communication, June 30, 2018), nurses do not know how to record information in the Tick register. Combined with the fact that the DO has little or no background in healthcare, they could find it difficult to understand what the staff had written in the Tick Register. In addition, the Tick register is a very broad book, the size is approximately 80 by 130 cm, and can cover an entire table. The register has many columns and the font size is small, giving the staff very little space to write in. Being aware of these challenges, the facility manager offered brief explanations to her staff on how to use the Tick register properly; that is, to record data in the register and to summarize activities at the end of each consultation day. In explaining the purpose of summarizing the activities, a Nurse had this to say:

> …we need to write a summary and comment to explain the data if there are any discrepancies in the figures. For example, if a mother comes with a child who is ill and also due for a vaccine; if the vaccine was not given to the child because of one reason or another, the nurse has to explain the reason (Nurse).

5.2.2 | Presenting and discussing data and indicators

The facility manager decided to operationalize some of the terminologies. For example, explaining an indicator as a road sign on your journey to optimal healthcare delivery. The staff also added that whenever there were changes such as a new data collection tool introduced or an indicator added to the list, the facility manager ensured that the staff were informed and were taught how to use either the tool or the new indicator. This helped the staff to be informed, within and beyond the district, as far as data management is concerned.

5.2.3 | Facilitating data validation through round-robin

Data validation is an important function to ensure data quality. At Mbingo PHC, the facility manager designed a spreadsheet, which is a duplicate of the Tick register. The DO use this spreadsheet to extract data from the Tick register. That is, data is extracted from the Tick register and captured onto the spreadsheet, and then, the data is collated and entered into a computerized system. The DO then prints out the data and distributes it to the staff in preparation for the validation meeting. Before the commencement of the next day's activities, the staff meets to verify and validate the data.

During data verification and validation meetings, the DO reads out the name and value of each data element as per the consultation point and the staff verifies and validates the value. If a value is incorrect, it is immediately verified from the source and the correct value is written on the form. The staff reported that it was also the time for them to reflect on their day's activities, as the facility manager will probe them on what they did during a consultation with patients. This was also means by which the facility manager could check whether proper procedures and guidelines are followed during consultations. The staff also reported that they find the process of probing useful as it allowed them to recall and reflect on the previous day's activities and make corrections if required and discuss issues they were not quite clear on. The staff acknowledged that when attending to patients they are multitasking and could easily overlook or omit something as expressed in the following statement:

> …because we are so busy during the consultation and it is easy to forget an important activity such as vaccinate a child, fill the Road to Health card but forget to write the type of vaccine in the Tick register so these discussions we have with the manager help us to reflect on our day's activities… (Staff).

Therefore, the verification of data and interactions that emerged increased their understanding of data management and their performances in healthcare delivery.

On the other hand, the facility manager added that to make their meetings interactive, she rotates the task of chairing the meeting among the staff. The staff explained that it motivated them to work harder because whenever it was one's turn to chair the meeting, s/he has to be well prepared, that is, to look at the data and to prepare questions. The staff added that the discussions and interactions among them increase their trust in data because they have been involved in all the steps; collecting, analyzing, and reporting of data.

5.2.4 | Delegating responsibilities and information sharing

In nursing, positions are ranked by their level of education as well as years of experience so too in practice. That is, each position has its tasks and responsibilities and it is a common practice for nurses to keep to their tasks and responsibilities. At Mbingo PHC, this was not the case as the staff explained that at the end of each month after the staff has analyzed and assessed each priority indicator, the outcome is compared to the monthly target. Then, the group generates a report and selects two staff to present the report at the District Information meeting. The staff explained that presenting the facility's data report at the district was one of the tasks of the facility manager but she delegates the task to her colleagues. The facility manager explained that the reason for delegating her subordinates to present the facility's data was to allow her subordinates to experience first-hand what happens when they present poor or inaccurate data, as explained in the following statement.

> …previously, whenever I attend this meeting and bring feedback to my colleagues some think that I am demanding too much. So, I decided to delegate my staff to attend the meeting so that they can have a first-hand experience of what happens at the district meeting. Allowing them to attend the meeting has been quite helpful in that now they take the initiative to ensure that data is complete and correct before data is submitted (Manager).

However, according to the staff, attending the district information meeting gave them a sense of recognition but also added that it made them work harder as expressed by one of the staff:

> …when one is designated to attend the information meeting at the district, it makes one feel more important but also pushes one to work hard to ensure that he or she has a better understanding of data to be presented. Being part of data management from start to end gives one the confidence when presenting data at the district meetings… (Staff).

A staff who had attended and presented the facility's data at the District Information meeting said:

> …it was an honor to be delegated to represent our manager at the district meeting and to participate in those meetings. It makes me feel valued as being part of the decision-making process but you must go there well prepared because if you present something

> that is not clear you will have so many questions to answer and the discussions and other people you interact with at the meetings are helpful… (Staff).

More than building staff confidence to present data and motivated them to work harder, attending the district information meetings allowed staff to interact with staff from other health facilities on data management-related issues which were quite beneficial to them in building their skills.

On the indicators whose monthly targets were not achieved, the team develops an action plan. The staff reported that it was always faster to develop an action plan during the meetings because it is easier and faster to get member's input and commitment. To ensure a continuous flow of information within the facility, the facility manager reported that, it was a common practice that whenever a staff member attends either a meeting or a workshop outside the facility, s/he must prepare a brief report on either the discussion, outcomes, or actions arising from the meeting and share with other staff.

5.2.5 | Nurses perception about daily data review meetings

The staff explained their perception about changing the data review meeting from monthly to daily. For example, on submitting data, the DO explained that since the cultivation of CoIP and data is validated daily, the submission was easier and faster as all that was remaining to be done was to compile the data and get the facility manager to sign-off. While comparing the amount of time spent in compiling data before and after the inception of the CoIP, the DO had this to say:

> …previously, I [DO] and the clinic manager were the only two dealing with data. The process took a full two days and working late hours because we have to go through all those huge, Tick registers. Now, since the team has already validated the data, the process takes about two hours and it is less stressful… (DO).

More than the fact that staff understanding of and ability to collect, analyze and present data has improved, what was also beneficial was that having regular meeting has brought the staff and management together as a term, has helped them to build a good working relationship. Another staff added that by working together they can support one another, while another added that because they are now involved in data management activities from state to end, their trust and confidence in data has increased. These factors led to the facility's outstanding performances in relation to data management and use which led to the facility winning the awards.

6 | DISCUSSION

This study describes how nurses worked together to build their skills and competencies in data management and use. While analyzing the case it was evident that a CoIP existed in the facility. The evidence presented below supports this assumption.

6.1 | The Community of Practice identified

The original concept of CoP was based on volunteer participation and informality. However, CoP has evolved as being more formalized and purposeful (McDermott & Archibald, 2010) as shown in this study. At the Mbingo PHC, the community was created to meet the needs of the facility. A CoP has three main features: domain, community, and practice (Lave & Wenger, 1991). In this case, we identified the *domain* as routine health data, *community* as the core group of staff involved in data management-related activities, and the *practice* as CoIP. The CoIP specifically provided an opportunity for staff at Mbingo PHC to participate and contribute to how best to handle data management-related issues. The staff were concerned about data quality and wanted to improve the data-related issues. In a CoP, a common domain creates the ground for members to affirm their purpose and establish relationships through mutual engagement (Wenger et al., 2002) with diverse members.

As evident in this case, although the staff was from the same PHC facility, they had different professional backgrounds comprising the Chief Professional Nurse (CPN), Staff Nurse (SN), Data Officer (DO), and Pharmacy Assistant. This representation of diversified professionals brings in divergent ideas and experiences in the community and provides a robust strategy for professional learning. Members in a CoP need to become aware of their working context through insights from people to whom they can relate to. The feeling that they belong to a community encourages members to be proactive in learning from experiences in similar contexts (Wenger et al., 1991).

Within a CoP, learning takes place through participation, interaction, and the exchange of information (Wenger et al., 2002). As Mbingo, participation was evident through interaction at meetings, when drawing action plans, and presenting the facility's report at the district meetings.

These social interactions with a CoP are important opportunities for learning and in developing new ideas and solutions. As Pyrko et al. explained, "when members are involved in discussing common concerns, as their bodies fuse to attend to the same concerns, personal growth and learning take place" (Pyrko et al., 2017 p. 393). Additionally, when staff works in groups, they may discover new ways to approach a particular task that is more effective and have the advantage of shared knowledge and experiences, which tend, give them a sense of ownership (Kozlowski & Ilgen, 2006). At Mbingo PHC, since information sharing was a common practice as staff of CoIP were also members of other professional communities, they acted as knowledge brokers (Carlile, 2004) to keep the staff informed and connected with other colleagues within the district and beyond on issues related to data management and use.

6.2 | Sustaining the CoP

When dealing with people with diversified professionals with divergent ideas and experiences as in CoP, effective coordination is critical to thriving (Napier et al., 2014). Although organizing data review meetings is not new to PHC facilities in SA because according to the Standard Operation Procedure, they are supposed to have at least one data review meeting per month. However, what was peculiar at Mbingo PHC was the frequency of these meetings, the dedication of the facility management, and the commitment of staff.

The facility manager was the initiator, facilitator, and champion. Her presence in the meetings gave relevance and commitment that encouraged other staff. Also, the facility manager provided a conducive environment where mutual trust and teamwork motivated other staff to attend as well. These aspects say a lot about the leadership of the facility manager and the staff. Van Mierlo et al. (2005) explained that the presence of the manager and the resources provided, created a sense of collectiveness, and generated synergies among staff, which increased teamwork. Gold et al. (2010) added that managers at operational levels are at the center of change in any organization because they can easily engage and exhibit behaviors to empower their colleagues and subordinates. This is because managers are "learning committed leaders" (Ellinger, 2005) as they strive to support their colleagues and subordinates by granting them the possibility to learn without castigating them for making mistakes. Kimble et al. (2001) explained that relational attribute such as confidence is critical to boosting staff performances within a CoP. CoPs are typically more effective when they have a high level of empowered and interdependent members, and active and involved leaders (Kirkman et al., 2012).

In addition to the leadership style of the facility manager, another important aspect was the fact that the manager acted as both a content and context expert. This eases the linking of context and content in operationalizing the program; this boosts trust between staff, and management, hence, facilitates learning. Context experts refer to facilitators who are aware of the resources available to the learners and aware of the work situation of the learners That is, helpful in situations where learners are novices and the role of the facilitator becomes significant both as content and context expert. As seen in this case, the facility manager was both the content and context expert.

6.3 | CoP: Source of new knowledge

More than building staff skills, CoP can act as a source of knowledge creation within an organization. As new knowledge developed can contribute to organizational knowledge. However, local knowledge developed in CoPs becomes organization knowledge after it has been institutionalized (Von Krough et al. 2000 quoted in Jakubik, 2008). As was evident from this case, the monthly data review meeting changed to a daily data review meeting, the facility incorporated the writing of daily summaries in their daily routine, and the spreadsheet used by the DO to extract data from the Tick registers became one of the tools used to validate data. These tools facilitated the processes of data management within the community, thus CoP is a source of knowledge creation.

Similarly, for a CoP to thrive, it should be able to connect its values between the organization and its members. Chua (2006) explained that a CoP can maintain its relevance only if it can effectively address the needs of the organization. The organization has to achieve a balance between meeting the needs of the members and serving the goals of the organization by aligning the members' values with that of the facility and integrate them into staff's day-to-day activities, which are significant to the organization. At Mbingo, the staff's primary objective was to improve data quality. Having accurate data improves decision-making, which in turn improves health services. Since these activities are relevant to both the organization and staff, they were easily integrated into the staff work practices, hence attracting participation. These activities facilitated information sharing and learning, contributed to the development of staff competencies in data management-related activities at Mbingo PHC.

7 | CONCLUSION AND RECOMMENDATIONS

The purpose of this article was to understand how facility managers assist in developing a data use culture in a rural health facility. In addition to using the concept of CoP as the lens and practical guide, the findings of this study revealed that the facility manager played a vital role in championing the use of indicators and improving the competencies of her colleagues on data management-related activities. Similarly, the study

highlights the role of the facility manager, as pivotal in building, directing, and sustaining a CoP in the facility. The CoP would not have been successful without the "critical mass of committed, like-minded staff" (Chua, 2006, p. 125), who were passionate about solving the data management challenges they encountered. The facility manager's frequent interactions with members on a mutual basis, not only stimulated teamwork but also built confidence in them to take up the challenges of data management, knowing that support is always available. Although creating a CoP emerges as an essential approach to improving the facility's data use and management, to sustain it, the facility manager must lead and champion the agenda of the group. The study also highlights the CoP as a vehicle to harness the internal skills of staff on data management in resource-constrained healthcare settings.

This paper contributes to the field of IS practitioners by expanding the discourse on data management training for staff in resource-constrained settings. Several researchers (Gimbel et al., 2017; Njuguna et al., 2019) argued that training on data management for healthcare staff at the peripheral level needs to be focused, content, and context specified. This study has contributed by illustrating a practical approach to operationalize and integrate data management-related activities in the work practices of staff in resource-constraint health facilities, consequently, facilitating continuity in learning and skill development. As explained by Buick et al., (2018) operations managers are change agents who make sense of changes with their colleagues. The findings from this study give insight into and guidance on how facility managers can achieve this. Similarly, this paper contributes to CoP by extending the role of the facilitator beyond the usual role as organizer of meetings to champions of the CoP. Such performances need to be emulated, therefore this study recommends that providing some form of incentives is a way of encouraging or supporting outstanding performances of healthcare facilities.

ACKNOWLEDGMENTS

My gratitude to the management of the Bali district office and to the staff and management of the Mbingo PHC for accepting to participate in the study.

CONFLICT OF INTEREST

None.

ENDNOTES

[1] The name of the clinic and district used in this article are pseudonyms.

[2] In 2017, the clinic earned the position of Ideal Clinic. In 2018, it received the Ministerial award as a model clinic.

[3] The package of services offered by PHC are: immunization, control of communicable diseases, treatment of minor illnesses and injuries, the supply of essential drugs, control of non-communicable diseases, mental and oral health, rehabilitation, sexual and transmittable infections, and HIV/AIDS, provision of adequate food and nutrition, clean water and sanitation, provide health education, and, maternal and child health and family planning, including midwifery and obstetrics care to mothers.

[4] This is a simple card used for monitoring a child's health. It has a list of all the immunization a child is expected to take, and space for when vaccination was administered, supplementary Information, and appointments.

[5] The Tick register is a huge booklet used by nurses when doing consultation to write all interactions with the patient. This is the only booklet nurses are supposed to write in when doing consultation.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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How to cite this article: Asah FN. Creating a "Community of Information Practice" for improved routine health data management in Resource Constrained Setting: The case of Mbingo Primary Healthcare facility, South Africa. *Electron j inf syst dev ctries*. 2021;e12178. https://doi.org/10.1002/isd2.12178

Paper Three

Asah, F. N., Kanjo, C., Msendema, M. B., & Addo, H. (2020). The Digitalization of Routine Data Management at the Point-Of-Care: The case of Ghana. *Journal of Health Informatics in Africa*, 7(2), 18-28.

Journal of Health Informatics in Africa

The Digitalization of Routine Data Management Processes at the Point-Of-Care: The case of e-Tracker in Ghana

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Purpose: This study explored the usability factors that influence the use of mobile technologies among healthcare staff at the point-of-care.
Methods: The study adopted an interpretive approach and employed a combination of qualitative and quantitative data collection methods, and inductive and deductive analysis. A questionnaire was adapted, and data was collected from 52 health facilities, with four interviews conducted between April and June 2018.
Results: The study found that the digitalization of data collection registers and forms has streamlined data management processes. The nurses were satisfied with e-Tracker as it has made them more efficient and productive. More importantly, the offline feature enabled them to capture data in areas with no Internet coverage. Using e-Tracker has reduced the cost and the physical effort required to collect and process data and has improved data quality. Lack of confidence in using the tablet in front of clients and poor Internet connectivity were among the challenges identified. While inevitable, these need to be addressed as they could influence the usability and continuity of use of the technology.
Conclusions: While the device has the potential to improve routine data collection, some contextual factors might hinder its usability. An important lesson from this study is that the implementation of new technology among healthcare staff, particularly those at the peripheral level, requires continuous training and support. The study contributes to the discourse on digitalization of routine data management processes at the point-of-care.

Keywords: *Usability, e-Tracker, mHealth Technology, Routine health information management, Digitalization, Ghana*

1 Introduction and Background

Manual data collection has traditionally been the mainstay of collecting and managing routine data in the healthcare sector, especially at the peripheral levels in low and middle-income countries (LMIC). However, it has high potential for human error such as incomplete records, poor recording, and underreporting of data. Manual data collection procedures can also be cumbersome and time-consuming, thus increasing the burden on already overloaded staff, and risking the quality of both the data collected and the services provided [1,2]. Poor quality data and its limited use to support decision-making characterize health management information systems (HMIS) in many LMIC, including Ghana, which was the focus of this study.

Ghana is a developing country with a population of 28,102,471 (July 2018 est.) [3]. In the country's healthcare sector, routine data is collected manually, with nurses completing several registers before attending to patients. Due to the high volume of clients, paper-based registers can be cumbersome and time-

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 J Health Inform Afr. 2020;7(2):18-28. DOI: 10.12856/JHIA-2020-v7-i2-285

consuming and could result in late submission of data. In turn, this results in poor monitoring of, and delays in patient follow-up, and inability to take timely action, which could affect the delivery of primary healthcare services. To address this situation, the Ghana Health Service (GHS) decided to digitalize data management related activities by implementing mobile technology (e-Tracker). E-Tracker is used by front-line healthcare providers such as community-based Health Planning and Services (CHPS) for the management of routine data [3] at the point-of-care.

The introduction and implementation of mobile technology in the healthcare sector in general and for managing data collection related activities hold tremendous potential [4]. Features such as GPS navigation, web-browser, instant messaging, and high-speed wireless network [5] have opened up a vast space for mobile interactions in the healthcare sector. Studies have shown that mHealth can improve health systems in areas such as maternal, child, and reproductive health [6]. Mobile applications including the use of mobile devices can improve medical data collection, service delivery, and patient-doctor communication, and facilitate real-time monitoring of patients. In HMIS, mobile technology can be employed to address data collection challenges [7,8], especially in LMIC.

Using mHealth technology for data management has significantly reduced the effort expended. For example, it can be used in HMIS to track and monitor the reporting of health indicators, while the use of Personal Digital Assistant (PDAs) has increased access to data, improved accuracy (timeliness and feedback), reduced time and costs, and improved data quality [9]. In Mozambican health centers, staff who use handheld phones to send routine data to district offices reported up to 50% improvement in data quality [10].

Despite the advantages of mobile technologies, studies conducted in Nigeria and South Africa have cited poor network infrastructure as a predominant barrier to their use, especially in rural areas where there is poor network coverage [11]. The high cost of Internet access in landlocked countries hinders full implementation of mobile technology. For example, a World Bank report showed that on average, the cost of Internet access is US$206.6 per Mbit/s per month in coastal countries in Africa, compared to US$438.82 per Mbit/s per month in landlocked ones. Chad, Cameroon, Equatorial Guinea, Lesotho, Mali, and Niger have some of the highest access costs [12]. Another challenge is the lack of a regulatory framework; there is also a need to review and update existing ones to address emerging issues and new technologies. The lack of or poor implementation of laws on cybersecurity, data protection, and privacy, could slow the momentum of the growth of the African digital economy [13]. A lack of skilled human resources such as ICT professionals and electronic content developers hinders the implementation of mobile technology, especially in rural areas [14]. Other factors that can affect usability include limited Internet connectivity, high levels of power consumption, small screen sizes, limited input modalities [8], low Internet penetration, and poor mobile connectivity [15,16], which, for example, hamper the use of SMS and voice call reminders to take medication [12] and negatively impact perspectives of usability [8].

Organizations implement mobile technology in order to increase efficiency. However, the full potential of the system and thus the benefits can only be exploited if they are used. Nielsen [17] explains that as the prevalence of mobile technology with Internet connectivity increases, so too, does the need to pay attention to the usability of these devices. Usability refers to how easy it is to use a device, or how easily it can be used to accomplish a given task. A system that is difficult to operate is likely to fail; therefore, acceptance and ease of use are factors in the successful implementation of mHealth in LMIC[12]. For example, a major challenge faced by mHealth users is lack of use acceptance of the technologies [18,19] as they are designed to be used while on the move. Therefore, ascertaining mobile technology's usability is critical for continuity of use [12,20].

Furthermore, routine data is generated at the-point-of-care (peripheral level). Studies have revealed that the use of mobile technologies at this level is influenced by multifaceted contextual factors and unanticipated challenges [18]. Ghana has a large rural healthcare sector that is nurse-driven and studies have revealed that frontline care providers lack basic IT skills [13]. The fact that users in rural healthcare settings are reluctant to accept mHealth technologies [17] motivated the study. The main objective was to understand the contextual factors that influence the usability of these technologies among frontline nurses at the point-of-care in primary healthcare facilities. The findings could serve as an important component of the pilot phase of mHealth implementation.

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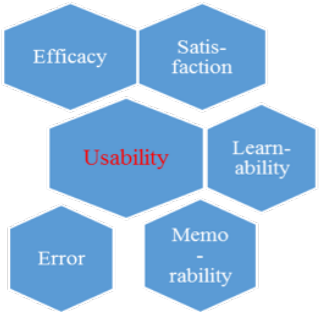

Figure 1 Usability Framework (Lin, 2013)

Definition of Concepts

The concept of usability emanates from the field of human-computer interactions (HCI) and is concerned with the relationship between humans and computers. Usability is a quality attribute that measures the ease-of-use of a user interface. It concerns the quality of a user's experience when interacting with an application, website, or mobile within a specific context [21]. Measuring usability involves a combination of factors. The International Standardization Organization (ISO) 9241-11 defines usability as "the extent to which a device can be used by a specific user to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use" [21]. In this case, the device is the e-Tracker, the users are community health nurses (CHNs), the tasks involve managing data related activities and the context of use is primary healthcare. Data related activities include data collection, analysis, interpretation, and dissemination. Figure 1 above shows the five constructs that have been used to measure usability [21]. The key constructs which guided this study were: Efficiency – a measure that assesses whether users have learned to use the device and how quickly they can perform tasks that is considered a quantitative measurement; Satisfaction – a qualitative measurement that measures how pleasant it is to use a device; Learnability – a quantitative measurement to assess how easy it is to learn the system and quickly begin to use it for work; Memorability – a measure of how well the user can re-establish proficiency after a period of not using the system; and Error – a measure that assesses how many errors users make when using a mobile device and how easy it is to recover from the error[21]. Our study did not use the error rate as a separate measurement because it can be incorporated into the learnability attributes [22]. The remainder of the article is arranged as follows: Section 2 presents the research setting and methods employed, section 3 discusses the results, section 4 presents the discussion, and section 5 concludes the article.

2 Research Setting and Methods

2.1 Research Setting

The study was conducted in two districts (Central Region Awutu Senya and the Volta Region, Ho Municipality), across 52 health facilities. These districts were selected because at the time of data collection, they had implemented e-Tracker, and nurses had been trained and had started using the mobile device. These health facilities are the first point-of-entry for most people seeking healthcare and data processing is done manually. They are under-resourced in terms of both human resources and technological and other infrastructure. The staff has limited skills, and few opportunities for further training. They also lack access to technology, experience sporadic power cuts, and have limited or no access to the Internet. This is the level where data is generated and the source of many data quality issues. Redman [23] explains that poor quality data at this level affects the entire system, and cleaning data at another level is difficult and expensive.

At CHPS, routine data is gathered from patients who seek different healthcare like outpatient, immunization, and maternal care and recorded on different registers and forms. Next, the data is manually compiled and aggregated weekly, monthly or quarterly, and forwarded to the next level of reporting. At the highest level, the data is analyzed using the District Health Management Information System (DHMIS2),

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an open source software platform for reporting, analysis and dissemination of routine data. Each district has a district health directorate, with a district information manager. At the health centers, nurses have poor access to information because the books are out of date, there is no access to journals and the Internet, and the information available is not appropriate for the local situation.

2.2 Methods

This qualitative study adopted an interpretive stance to understand the phenomenon of digitalization of routine data management at the point-of-care through the meaning that people ascribe to it [24]. Behaviors that stem from experiences help to describe realty. The interpretive stance was chosen because the study aimed to descriptively understand the contextual factors that influence frontline healthcare staff's use of mobile technology in delivering healthcare services from their own perspective. Interpretive studies aim to produce "an understanding of the context of IS, and the process whereby the information system influences and is influenced by the context" [24, pp.4-5]. Walsham [24] notes that interpretive studies in information systems (IS) research incorporate thick descriptions of human interactions in the use of IS. Data was collected from 52 health facilities using a combination of data collection techniques including questionnaires, interviews, and document analysis [25].

A questionnaire was the primary source of data collection. This is a well-established tool to acquire information on public knowledge and perceptions. It enables respondents to consider their responses carefully without interference from, for example, an interviewer and it is possible to access a large audience within a short period of time and to compare the data [26]. In addition, questionnaire is particularly useful when participants wish to remain anonymous and more comfortable way for participants to divulge information that would make them uncomfortable in a face-to-face setting. In this case, the purpose is to understand nurses' perception of e-Tracker (mobile health) and to rate how they feel about using the device. In addition, we sought to compare the data from the two districts to establish any differences in experiences of using e-Tracker at Awutu Senya (urban) and Ho municipality (rural).

The team adapted a usability questionnaire to meet the needs of the study. The questions were closed-ended and were scored on a 5 point Likert-type scale ranging from strongly agree to strongly disagree. Space was provided for nurses to add their comments after each question and to express their views on using e-Tracker. For validating and administering of the questionnaire, it was cross-checked by IT students at Lucas College in Accra, under the supervision of the fourth author and senior health information department staff to validate the content. It was pre-tested with five surveillance officers at Ho municipality. Pre-testing a questionnaire helps to determine if the respondents understand the questions and provides the most direct evidence of the validity of the questionnaire data [27]. Feedback from the pre-test led to the modification and clarification of some questions. The questionnaire was paper-based and one questionnaire was administered per facility.

2.3 Data collection

This study focused on the e-Tracker on the tablet, with the nurse in charge of the tablet at each health facility responding to the questionnaire. Data was collected between April and June 2018. The questionnaires were handed to the CHNs in charge at the district office while they were attending the monthly data management review meeting. At the meeting, the district manager introduced the researchers to the CHNs in charge and the researchers were given ten minutes to present the study's aims and purpose. At the end of the meeting, an envelope containing a questionnaire, a covering letter that explained the study's objectives, and a consent form for the CHN in charge to sign was handed to the CHNs in charge. Envelopes for CHNs in charge who were absent from the meeting were later given to the Health Information Officer (HIO) at Awutu Senya and the Public Health Officer at Ho to deliver at the health facility, as they visit facilities in the district on a weekly basis. Sixty-two questionnaires were distributed, 40 to Ho Municipality and 22 in Awutu-Senya. The facilities were given approximately a month and-a-half to complete the questionnaire and two reminders were sent in the space of two weeks to increase the response rate.

While a questionnaire is an effective data collection tool, it is not always comprehensive. Hence, the questionnaire was supplemented with interviews and document analysis. Interviews were conducted after the health facilities had returned the questionnaires. They probed why the nurses held the opinions recorded on the questionnaires. Interviews were conducted with four individuals charged with overseeing the implementation and use of e-Tracker in these districts, namely, the district health director, two information

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managers, and a public health officer. The interviews were semi-structured with broad and open-ended questions to allow the respondents to explain the issues they encountered in trying to get the nurses to use e-Tracker. Before the start of each interview, time was dedicated to building trust that helped to set the tone for the rest of the discussion and for the respondents to read the information sheet and sign the consent form. The interviews were conducted at the respondents' offices and lasted 30 minutes. They were auto-taped, and transcribed verbatim. Printed and electronic documents were also analyzed. These included strategic plans, project reports, quarterly reviews, and bulletins. They provided contextual information on health care practices and strategies in Ghana. Collecting data from multiple sources increased the study's internal validity [28]. Written informed consent was obtained from those interviewed after they had read the covering letter explaining the study's objectives. Ethical approval was obtained from the Ghana Health Services Review Committee, Reference 017/11/17 and permission was obtained from the relevant authorities.

2.4 Quantitative and Qualitative Data Analysis

Data analysis for this study was twofold. Firstly, the questionnaires were sorted and entered on the Statistical Package for the Social Sciences (SPSS), with descriptive analyses employed to summarize the deductive results. The data was analyzed based on usability concepts. Secondly, the interviews (qualitative analysis) were transcribed and analyzed. Analysis of the data from the interviews was cyclic [27], with the researcher going back and forth from the data to the analysis and from the analysis back to the data to gain a good understanding of what the participants were saying. An inductive approach to thematic analysis was adopted based on Braun and Clarke's [29] process. The transcripts were read and codes that gathered similar data together were developed. Phrases were written in the transcripts that placed similar data together. After identifying the phrases, the researchers reviewed the transcripts and started developing interpretive codes. The coding process was done manually using colored pens to highlight key themes while inserting comments in the margins to record the researchers' thoughts. Thereafter, the themes were charted to link key phrases from the respondents and identify patterns of phrases. As an inductive process of coding and categorizing was adopted, the themes that emerged are rooted in the participants' own words.

3 Results and Analysis

This section presents the results from the qualitative and quantitative analysis. Where appropriate, comments and verbatim quotes are inserted.

3.1 Characteristics of Study Participants

Of the 62 questionnaires administered, Awutu-Senya returned all 22 while Ho municipality returned 30. In total, 52 health centers returned the questionnaires. Of the 52 nurses who participated in the study, 43 (83%) were female and 9 (17%) were male. This affirms that nursing is still regarded as "the quintessential" female profession [30]. Most (96%) of the nurses were CHNs with more than three years' work experience. The majority (63%) of the participants were in the age bracket 31 to 40 years, while 23% were aged 15 to 30. Approximately 75% of the participants had worked at the facility for more than two years. There was no significant difference between nurses' use of e-Tracker in the rural and urban districts.

3.2 e-Tracker Usage

Each health facility has a desktop computer and one tablet and both have e-Tracker installed. The tablet is used by the CHN in charge. E-Tracker is used to collect routine data and to track clients on different health programs such as family planning, immunization, child health, maternal health, and post-natal health services, and to send SMSs to remind mothers of their appointments. It is also used to manage data; i.e., to capture, calculate coverage, analyze trends, compile data, and submit data to the DHMIS2 platform, where facility reports are generated.

Comparing the data collection process before and after the implementation of e-Tracker

The nurses reported that before the implementation of e-Tracker, a nurse, for example, was required to manually complete an average of five registers or forms before attending to a patient. S/he had to juggle between examining the mother and the baby, and completing the forms. A nurse explained the challenges they encountered on a daily basis:

> *"Mothers come very early to the clinic to have their babies vaccinated before starting their day's activities. At the clinic, we have to examine both mother and child, weigh and check the baby's vital signs. If the mother is still breastfeeding the child, we have to verify …* [that] *the baby is eating properly. All information is written down. Also, one has to fill in about five registers. Mothers are getting angry, complaining that we are wasting their time." (HO_2)*

Another nurse added that at month end, when data has to be submitted, they had to flip through tens of pages of the registers and the tally sheet to verify and validate the data, then capture it on an excel file, and perform the necessary validation, before the data was sent to the next level. This participant described manual data collection as cumbersome and time consuming. Using e-Tracker and the digitalization of registers, including the use of the Unique Patient Identifier (UPI) has reduced duplication of processes, enabling nurses to perform their tasks more quickly. A feature of e-Tracker that facilitates ease of use is the device's interface. Around 75% of the participants agreed that the e-Tracker interface is pleasant to work with. They explained that the organization of information on the device is very clear and easy to grasp. The HIO added that data management was easier and faster as nurses submitted data almost daily, making it easy to manage and validate and provide timeous feedback. This resulted in improved efficiency. Although most of the nurses said that they were happy with using the device, around 30% said that they did not feel comfortable using it in front of patients.

3.3 Satisfaction

More than half (59%) of the nurses expressed satisfaction with using the device and 64% agreed that it made them more productive. The participants noted that digitalization increased the speed with which data was processed, because e-Tracker enables reports to be generated instantly. This function was previously done at the district office, and took a couple of days after the data had been submitted.

One participant compared using e-Tracker on a desk-top computer to using it on the mobile device. It was noted that the mobile device offered mobility and an offline feature enables nurses to capture data without necessarily being connected to the Internet. This feature is not possible with a laptop. The Information Manager concurred:

> "…using e-Tracker on the desktop was difficult as compared to the one on the tablet. This version on the tablet is user-friendly. But an additional advantage is the offline feature which allows nurses to capture, save data and then send it later. One does not need to have access to the Internet during data capturing" (AS_4)

Another nurse added that e-Tracker enables instant generation of clients' schedules and they are able to send text messages from the device as reminders to clients anywhere at any time. The participants expressed satisfaction with the device as they can do everything on it. Similarly, the HIO noted that the introduction of e-Tracker had reduced the cost and the physical effort required to collect and process data. For example, the amount spent on paper, printing reports and phone calls has decreased significantly. The HIO added that data timeliness and submission rates have improved and because data is submitted daily, so too is the quality of data because nurses have more time to look at the data before it is submitted.

However, it was interesting to note that, 40% of the nurses expressed reluctance to use e-Tracker because it was time-consuming. A further reason was that they had to do double data capturing, i.e., on paper-based registers and the device. However, the HIO explained that the MoH requested this as the digitalization process is in its initial stages and that, in order to ensure that no data is missed, CHNs should continue capturing data manually. This will ensure a smooth transition. Once the system is stable, the CHNs will only use the e-Tracker.

3.4 Learnability and Error

Before nurses started using e-Tracker, they attended a two-day training course on how to use the tablet. Fifty-two percent of the nurses reported that it was easy to learn how to use the e-Tracker and 50% added

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that it was easy to rectify an error. The HIO added that the MoH is aware that the training was brief; however, health centers are visited on a regular basis by HIOs who provide on-site support and supervision to ensure that the device is used properly and functioning well. Furthermore, the fact that the nurses found the interface easy to use and were able to navigate the various features easily implies that the e-Tracker was memorable.

3.5 Factors that Influence Nurses' Use of e-Tracker

Inadequate Skills and Lack of Support

The nurses were of the view that they required more training and support on how to use the device and to ensure that it is functioning. For example, three health facilities in Ho municipality did not complete the questionnaire because the device was not functional. From the deductive results presented above, it would seem that e-Tracker offers exciting new opportunities to nurses to satisfy high demand for healthcare delivery, and to be able to work faster, and be more flexible and effective. However, a lack of adequate skills and support to use the device effectively can cause frustration, with negative impacts on their motivation. Training is an important component when implementing new IS and at the rural health facilities, continuous training and support is even more crucial due to the dearth of skills [1,2].

Lack of Resources

Lack of mobile device - as noted previously, there is only one device per facility. The nurses expressed the need for more devices, as having one tablet per facility with many consulting points does not reduce the workload. There is also a lack of finance for fuel and to purchase data for the device. The HIOs and nurses need fuel for the vehicles and motorcycles they use to travel to health facilities for supervision and to provide on-site support and the device need mobile data. A lack of resources such as finance and equipment, are among the biggest challenges hindering the implementation of a new IS in low and middle-income countries (LMIC) [1].

Lack of Confidence to Use e-Tracker Device

The nurses reported that they lacked confidence to use the device on a daily basis. One explained:

> *"When we stand in front of the clients talking to them with this device in our hand, some of them feel that instead of attending to them instead we are chatting so I do not feel confident"(HO_1).*

Another commented:

> *"…though nurses are happy with the device, most of them are still reluctant to use [it]. … They prefer to capture data on the paper registers and when the facility is less busy, they transfer the data on the device…" (AS_5).*

Limited Internet Coverage

Furthermore, the nurses reported poor Internet coverage at some health facilities, especially those in deep rural areas. They noted that after capturing routine data they have to drive long distances to obtain Internet coverage to send it, meaning that they spend more on fuel.

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4 Discussion

The study aimed to understand the contextual factors that influence the usability of e-Tracker (mHealth technologies) among frontline nurses at the point-of-care. Quantitative and qualitative data collection methods were employed. To measure usability, we used Lin's [21] concepts, namely, efficiency, satisfaction, learnability, error, and memorability. Our quantitative analysis to measure the concepts of usability revealed that four concepts (efficiency, satisfaction, learnability, and error) were evident in this study. Due to lack of data, we were unable to measure the concept memorability.

The study found that the digitalization of numerous paper-based registers and forms has reduced the time spent on data management processes. The user-friendliness of the e-Tracker interface facilitates easy access to different components and data management has become flexible and faster. Using e-Tracker gave nurses the freedom to perform their duties (to collect routine data) easier and faster, hence giving them more time to validate data before it is submitted, consequently improving data quality (data timeliness and submission rates have improved). The mobility of the device and availability of the offline feature facilitate data capture and analysis even when there is no connectivity, which improves performance. While using e-Tracker has made nurses more productive and efficient, from a management perspective, it has reduced the cost and the physical effort required to collect and process data.

Apart from establishing whether e-Tracker is usable or not, the study also aimed to identify the challenges encountered by nurses in using it. This is important as challenges can affect usability. The findings show that nurses lacked confidence to use the device daily to complete their tasks. They also point to the challenge of undermining clients' trust, as some clients assume that nurses are using the e-Tracker device for fun. This finding is consistent with Velez et al.'s [31] study that found that because nurses were not confident about using the device, they reverted to paper-based registers and forms to collect routine data.

Self-confidence is related to uncertainty [32]. Bearden [32] notes that when individuals are confronted with an intricate situation, self-confidence plays a significant role in backing their actions or decisions, and can determine their attitude. There are two types of self-confidence; general self-confidence and specific self-confidence. Specific self-confidence implies that the individual has ample information and knowledge that makes them confident about handling the specific device. General self-confidence involves negative and positive attitudes towards a particular object or individual. Bearden [32] contends that general self-confidence is associated with a person's decisions and behavior, and is often associated with non-users with little or no experience of a particular product. In this study, the nurses lack general self-confidence. Individuals with high levels of general self-confidence are accustomed to using new technologies and willing to take risks [33]. In contrast, those with low levels of general self-confidence feel that they are insignificant and their fallibilities make them uncomfortable, and uncertain that they can successfully manipulate a new technology.

A lack of general self-confidence to use a technology in an organization could have a serious impact on the workforce [34]. As noted above, a lack of self-confidence is the result of a lack of skills. In the IS domain, an important objective of the implementation of a new technology is to ensure that its users are equipped with the skills required to properly use it [35]. However, building staff confidence to use technology, particularly among staff at the peripheral level [36], requires continuous and contextual training because it empowers staff by giving them the confidence they need to keep abreast of the new technology, and pushes them to perform better.

Although the managers acknowledged that the two-day initial training given to nurses was not sufficient and noted the need for on-going on-site support and supervision, performing these services might be challenged due to the lack of financial resources to cover items such as fuel to travel to health facilities to provide such. Lack of finance and poor Internet connectivity hamper the development and sustainability of IS in LMIC. While IS implementation is complex and challenges are inevitable [37], it is important to manage them because they are key to continuity of use of the technology[38].

5 Conclusion

The study found that the implementation of mobile technology has enhanced and improved the processes of data collection and use at the point-of-care. The digitalization of data collection registers and forms significantly reduced the data management processes. These findings are consistent with those of

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[9,10,13,19]. However, the implementation of mobile technology was not without challenges. While these are unavoidable, they need to be attended to because if they persist, they might affect usability; that is, nurses might abandon the device. An important lesson from this study is that the implementation of new technology among healthcare staff, particularly those at the peripheral level requires continuous training and support. The traditional two-day HIS training is inadequate because it does not provide staff with the necessary skills to adequately use the technology. In order to develop staff skills and self-confidence to use the new technology properly, the two-day training should be complemented with on-site support and supervision. Overall, the positive effects of e-Tracker outweigh the challenges. However, to gain the full benefits, it is important to focus more resources on building staff capacity.

This study contributes to the discourse on digitalization of routine data management processes at the point-of-care. While it was conducted in two health districts, its findings raise issues that have wider applicability to the implementation of information technology in resource-constrained settings. The primary concerns relating to qualitative research revolve around validity and reliability [27]. To address these concerns, in terms of validity, we employed triangulation; that is, a variety of data sources (questionnaires, interviews, and documents analysis) as opposed to relying solely on one source. We also included verbatim quotations [39] in the analysis section. To ensure reliability, the interviews were recorded and transcribed, and at the end of data collection, a preliminary report was written and presented at the district information meeting [40]. In terms of future research, while there is a rich body of literature on data management in health facilities, very little attention has been paid to nurses at the peripheral level who generate this data. We recommend that further study is conducted to check the validity and quality of the data since data quality problems arise at the point-of-care.

Acknowledgements

We wish to thank all the nurses who participated in this project. We would like to express my sincere gratitude to Madame Patricia Antwi, Messrs Christian Gohoho, Adams Agbeko, Frederick Ofosu-Ababio, Fredie Amponsah, Dominic Atweam, Adu Geegee Kwame, and Vadis Adesi for orienting us towards relevant information on the project. Special gratitude to my department, IFI at the University of Oslo for the financial support.

Statement on Conflicts of interest

No conflict of interest

Funding:

No funding

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 J Health Inform Afr. 2020;7(1):18-28. DOI: 10.12856/JHIA-2020-v7-i2-285

Paper Four

Asah, F.N., Kaasbøll J., Seukap R. (2021). Organizations failing to learn: Roadblocks to the Implementation of Standardized Information Systems. *Journal of Health Informatics in Developing Countries*, Vol. 15 No. 1 (2021).

Journal of Health Informatics in Developing Countries
http://www.jhidc.org/
Vol. 15 No. 1, 2021

Submitted: Feb 20th , 2021 Accepted: June 6th, 2021

Organizations failing to learn: Roadblocks to the Implementation of Standardized Information Systems

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Abstract

Purpose: Implementing standard health indicators aims at harmonizing fragmented information systems. However, they have not always met this expectation. This article argues that standard information systems fail because organizations fail to learn effective ways of solving problems.

Design: Using an interpretive phenomenological approach, we draw examples from the implementation of standard health indicators in Cameroon to explore why organizations fail to learn. We collected data from April and September 2017 from 25 staff in healthcare facilities and district offices.

Findings: Staff at the peripheral level encountered multiple levels of organizational challenges. We argue that these challenges are deeply rooted in the organizational structure. Using organizational learning as a lens, we theorize the factors (i.e., a disincentive for learning, educational barriers, and organizational culture) that hinder learning. Then identify three beliefs (i.e., technological fix, silver bullet, and emperors of the same empire) embedded in organizational structure that hinder organizational learning. Finally, we propose practical measures to mitigate the challenges that impede the implementation of standard health indicators in Cameroon and beyond.

Conclusion: Organizations often misplace their attention on what and how they should learn. While they are fast to learn from external sources and are often eager to accommodate information systems, they fail to provide a conducive atmosphere where local experiences thrive, do not value learning from experiences, and adopt few processes to promote learning.

Originality: Linking the challenges encountered by staff at the peripheral level after implementing standard health indicators to poor organizational learning opportunities offers a novel perspective to conceptualize the challenges of implementing information systems in low and middle-income countries.

Keywords: Standard health indicators; Standardized Information Systems; Health Information System; Implementation of Health Information Systems; Organizational learning; Organizational culture; Cameroon; Centralized Decision-Making.

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1. Introduction

This article explores the challenges of implementing standard health indicators within a healthcare sector to strengthen to harmonize fragmented information systems. It uses an example of implementing national (standard) health indicators and standardized data collection tools to shed light on the challenges encountered by staff at the peripheral level of the healthcare sector in low- and middle-income countries (LMIC).

1.1 Background

In the Health Information systems (HIS) domain, standard health indicators are used to harmonize information systems (IS), hence improving the quality of the information available to policy and decision-makers at all levels of the health system [1; 2]. Decision-makers, including health professionals, rely on accurate information to monitor and evaluate the performance of health services [3]. However, the outcomes of implementing standardized information systems (SIS) have not met expectations. One would expect that the massive advances in computerization and information technologies to enable HIS [4] in today's world, would facilitate the implementation of SIS and that there would be fewer technical reasons for organizations to experience the same challenges that plagued IS implementation some 20 years ago [5]. The continuous use of HIS in this era would indicate successful implementation and better use of health indicators to support decision-making. However, in LMIC, the implementation of IS remains a challenge [6;7] and a significant number have failed or are unsuccessful [8]. An information system fails when it does not meet users' expectations [9] and the growing number of IS projects that have failed in LMIC is an indication that more than advances in technology is required to improve the rate of successful implementation. In this article, we argue that Cameroon's implementation of standard indicators failed because the IS department (the CIS) fail to learn effective means to solve problems. Consequently, ineffective practices have persisted within the organization, and the employees have become resistant to change.

In the healthcare sector, the implementation of SIS aims to harmonize a country's HIS. For this reason, in the following sections, we draw from the IS literature in general to describe our case. Although there are a plethora of studies on why IS implementation fails [8,10], there is little insight on how to overcome these challenges, particularly in public organizations. Our study was guided by the following research questions: "What issues did users experience after the implementation of health indicators?" "Which challenges did they confront during the implementation process and how can these be mitigated"

We hope that the study's results would help us understand, however, partly, why some IS projects in LMIC fall short of expectations.

The empirical basis for this study was the implementation of SIS in Cameroon's health sector. In Cameroon, SIS implementation is influenced by the prevailing decision-making style, which is hierarchical and centralized. This article contributes to the ongoing discussion on the implementation of SIS in LMIC by better conceptualizing the role of the peripheral level in the implementation process. We draw from the organizational learning literature to scrutinize the phenomenon of failing to learn.

The remainder of the article is structured as follows: Section 2 focuses on the related literature and theoretical framework; Section 3 describes the research setting and the approach and methods employed; Section 4 describes the data analysis; Section 5 presents the results; Section 6 presents the discussion and analysis, and Section 7 concludes the article.

2. Related Literature And Theoretical Framework

2.1 Definition of Concepts

Indicator and health indicators

An indicator, which is the central concept in this article, is a pointer that shows something. It involves numbers and quantification and is 'seductive' as it can provide knowledge of a complex and murky world [11 p. 1]. In public health, an indicator is a measurement that reflects a given situation. In monitoring and evaluation, an indicator is a quantitative metric that provides information to monitor performance, measure achievement, and determine accountability [12]. Within the context of HIS, health indicators are core elements of the data analysis used to measure the performance of healthcare services [13]. Thus, while there are many meanings of the term indicator, for this article, an indicator is defined as:

> *"A named collection of rank-ordered data that purports to represent the past or projected performance of different units. The data are generated through a process that simplifies raw data about a complex social phenomenon. The data in this simplified and processed form are capable of being used to compare particular units of analysis such as countries, institutions, over time, and to evaluate their performance by reference to one or more standards* [14, p. 74]*."*

This definition highlights some characteristics of indicators, including: (i) The name of an indicator is usually a simplification of what it intends to measure and changes over time. (ii) Indicators usually enable the comparison of different units. (iii) Indicators are often a numerical representation of complex phenomena intended to render them simpler (easy to understand and use) and compare with other phenomena that have been represented numerically. (iv) One of the characteristics that distinguish an indicator from other data is that it is based on its potential to evaluate performance.

Indicators are attractive to decision-makers and decision-making processes. In healthcare, they are the backbone of decision-making, and they act as standard-setting instruments which to measure performances [15]. Porter [16] explained that when decision-making processes include indicators, the result is considered efficient, consistent, transparent, and impartial. Similarly, Espeland et al. [17] noted that embedded within indicators is an ideology of how to achieve the best performance. The generation of indicators results in the production of specific goals and targets against which health performance, for example, is measured. The indicators of the Sustainable Development Goals, Universal Health Coverage, UNGASS on HIV/AIDS[1]And the Global Reference List of 100 core health indicators are examples of indicators used in the healthcare sector to measure health service delivery [12;11].

In IS, indicators are the primary tools used to manage health information and are the core elements of data analysis employed to measure different attributes and dimensions of health status. In designing a country's national healthcare system, it is imperative to develop a comprehensive list of core indicators that provide concise information on its health situation and trends. Health indicators are selected and produced at the central level, while data for the indicators are collected and analyzed at the peripheral level. The World Health Organization (WHO) notes that, once standard health indicators and standardized data collection tools have been developed, it is imperative to implement them throughout the health sector. [18].

2.2 Implementing standard health indicators in LMIC

Implementing an IS, particularly health indicators, is the process of putting a plan into effect. Klein & Sorra [19] explained that this process should ensure that systems are adapted and used routinely, particularly at the peripheral levels. Similarly, Jacucci et al. [20] and confirmed by Braa et al. [21] that implementing IS should guarantee the entire system's sustainability, and that depends on adapting the system to a given context. The reason is that a successful implementation relies on the availability of local capacity to understand, manage, and make sense of the data. Therefore, we argue that, in addition to installing hardware and software, IS implementation should build local capacity to make sense of the data at the peripheral level.

Research on LMIC reveals that while some countries have successfully implemented SIS, others have not. The factors identified as challenges that hinder the implementation of SIS in LMIC include the limited duration of donor support, inadequate focus on local expertise, and narrow conceptualization [22;

[1] The United Nations General Assembly Special Session indicators on AIDS are the most widely used set of indicators for HIV. Their purpose is to measure progress toward implementing the Declaration of Commitment on HIV/AIDS adopted by 189 UN Members States in 2001.

23]. Avgerou et al. [24] observed that, generally, the implementation of IS in LMIC tends to be sensitive if the goal is to use the same indicators in many different contexts, then the challenge of implementing is twofold. In the first instance, there should be a consensus on the list of indicators at the national and international levels to attract funding and support. Secondly, the indicators need to be routinized and adopted at the peripheral level [20; 23]. In addition, achieving this balance is a source of tension between the national level and parallel health programs (PHP) [25], which is highly influenced by the organizational structure [6;26].

2.3 Organizational Learning

Organizational learning (OL) is part of a field of study, including organizational communication, creativity and innovation, individual accountability and motivation, management and leadership development, systems thinking, mental models, and organizational structure [27]. However, most OL concepts focus on establishing and maintaining a learning organization or overcoming barriers to learning. In contrast, our study aimed to understand why organizations fail to learn from their own experiences. To answer the question, we need to identify the factors that hinder learning.

In general, OL refers to the process of developing new knowledge and insights derived from the '*everyday experiences of people within the organization which has the potential to influence behaviors and improve the organization's capabilities*' [28, p. 409]. An organization is said to learn when it identifies and corrects its errors. Therefore, learning occurs when, on behalf of the organization, individuals gain new knowledge and insights and modify their behaviors and actions [27], resulting in action that influences individual and organizational behaviors. Given that our focus was on learning and inter-organizational learning, we relied on social learning approaches.

Social learning includes social interactions and engagement within a specific organizational context and should be an integrated component of the individual's everyday organizational life and work practice [29]. This approach to learning enables practitioners to form communities of practice (CoPs), which can be a source of collective learning and information sharing and can stimulate organizational change [30]. Bate & Robert (2002) in [31] added that social learning approaches are of particular relevance to public service organizations (the focus of this case) and are characterized by professional communities that span organizational boundaries. Within a CoP, collective learning enables practitioners to build professional judgment, make sense of their experiences at work, and increase intra- and inter-organizational collaboration (Knight and Pye 2005) in [31]. Thus, OL is learning, which involves social activities undertaken among staff within a specific work environment [30].

2.4 Barriers to Effective Learning within an Organization

The social approach to learning emphasizes the context where learning takes place [31]. Therefore, understanding the organizational context becomes relevant to the understanding of OL.

2.4.1 Organizational Structure

The organizational structure defines how activities such as task allocation, coordination, and supervision, are directed towards the achievement of organizational goals [32]. Chen & Huang [33] described it as the formal scheme of relationships, communication, and decision-making processes that influence the distribution and coordination of resources and social interaction among staff. Martinez-Leon [27] added that the structure of an organization could positively or negatively impact knowledge creation and information sharing [34]. While there are many different organizational structures, of interest, in this case, is the bureaucratic structure with centralized decision-making.

A bureaucratic structure has a centralized decision-making process and a high level of formalization. It has a hierarchical structure where managers at the highest level make all decisions. The highly specialized nature of these organizations impedes the creation of new competencies [28] and is counterproductive to creating new knowledge, thereby inhibiting staff's personal development [27]. Thus, it can be argued that bureaucratic structures, particularly public organizations, impede knowledge creation and learning, while the opposite is true for decentralized organizational structures (see Tsai 2002; Newell et al. 2003) in [31].

2.4.2 Social barriers

The social barriers to learning from failure are linked to the psychological reaction most people experience when they fail. Many people, especially those in positions of power, believe that revealing one's failure, particularly to one's circle of friends, could jeopardize one's status. As a result, managers at higher levels of organizations tend to project an image of perfection by resorting to blanket excuses [35].

2.4.3 The vicious cycle

While there are numerous theoretical approaches to OL, in this case, there was little learning to explain. On the contrary, the dominant findings pointed to a lack of knowledge. Thus, we selected a theoretical approach, which explains why organizations fail to learn. As illustrated in Figure 1, Lyytinen and Robey [5 p. 91] summed up organizations' inability to learn as a vicious cycle. Failure to learn results from recurrent loss, which eventually becomes a typical situation when sustained over a long period. Thus, adherence to invalid theories leads to continued failures to learn because relevant information from experiences is filtered out.

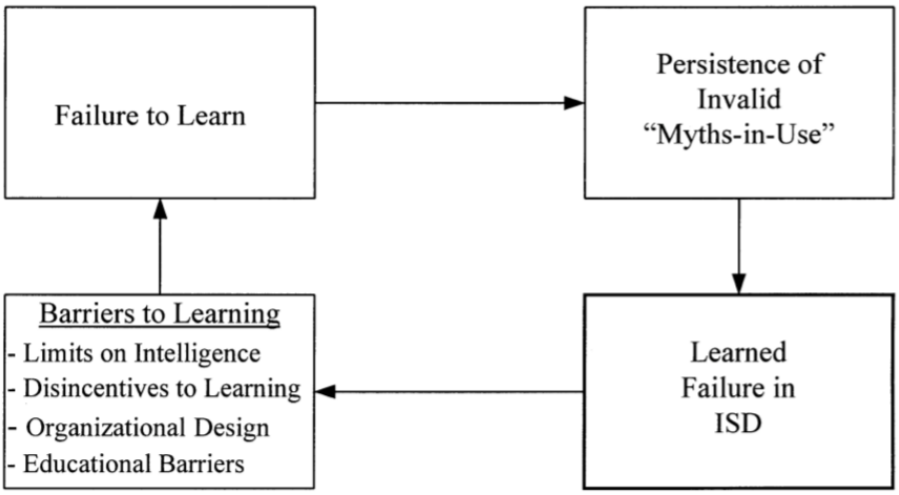

Figure (1) Model of learning failure in information system development. Adapted from [5].

Myths-in-use is beliefs embedded in organizational routines and IS practices that have assumed mythical status and are insulated from blame for IS failures. When organizations rely on myths-in-use, they learn to live with inadequate performance and attribute failure to external causes rather than processes. Challenges to standard development practices are received defensively rather than viewed as opportunities for organizational inquiry. For example, organizational myths place faith in the power of organizational designs to repair what is wrong. Organizations prefer to fix problems by reshuffling managers [5]. The barriers to learning (to be explained in section 6.1) and the organization's failure to learn from experiences reinforce beliefs in myths within the organization.

3. Research Setting, Approach, and Methods

3.1 Research Setting

The empirical setting for this research was Cameroon, a low-income Central African country with about 24 million in 2018. Cameroon has a youthful population, with more than 60% of its citizens under 25. Forty percent of the population lives below the poverty line, and human development indicators remain low [36]. Cameroon has a hierarchical organizational structure characterized by centralized decision-making, bureaucracy, and poor communication channels. The challenges confronting its citizens include stagnant per capita income, relatively inequitable distribution of income, and a lack of basic amenities such as potable water and sanitation, as well as a top-heavy civil service, endemic corruption, and a generally unfavorable business climate [37]. These characteristics are likely to have contributed to the country's poor priority health indicators. For example, Cameroon has achieved the slightest reduction in the under-five mortality rate in the region, and life expectancy has declined in the past two decades. The under-five mortality rate is 103 deaths per 1,000 live births, exceeding the average in sub-Saharan Africa

of 78 deaths per 1,000 live births. Pneumonia, Tuberculosis (TB), and HIV/AIDS remain persistent problems, while malaria is the central public health issue that is responsible for 22.4% of annual deaths [38; 39].

Cameroon's health system comprises the Ministry of Public Health (MoPH) and regional and district offices. The primary healthcare providers are government health facilities, public enterprise health clinics, faith-based, and private health facilities. Administratively, policies are developed at the national level, with regional structures tasked with implementing them, performing quality control, and coordinating and supporting health districts. The district level represents the operational unit for implementing primary healthcare services. The level is the hub and embraces all the facilities and individuals in the community involved in providing healthcare at various levels of intervention [40]. The district office is also responsible for providing data to the national level.

Health Information System

Before 1995, Cameroon did not have a national HIS; routine data was collected haphazardly, i.e., every health program had its information system [41]. Health information-related activities were spearheaded by the various international aid and donor agencies operating in the country. For example, the North-West and the South-West regions had two projects, SESA[2] and OCEAC[3]. Each health program has its own HIS tools to gathers its data [41].

From 1995 to 2013, the MoPH made an initial attempt to harmonize the HIS by creating a national Department of Health Information Systems [39], known by the French acronym CIS (Cellule d'Information Sanitaire). The CIS was charged with managing the production of health information throughout the country at national, provincial, and district levels, with a director appointed at head office. However, no funds were allocated to the department, rendering it unable to operate, and international aid agencies continued to create silo IS. In Cameroon, routine IS consists of formalized paper-based tools at health facilities and a computer-based system at the district level. However, many studies described the IS as dysfunctional [42;43] and fragmented [39].

The adoption of the Millennium Development Goals (MDGs) in 2014 and the need for comparable data led to the overhauling of Cameroon's national HIS. The MoPH received significant financial support from the Global Fund and the Center for Disease Control (CDC) to restructure the CIS and the national IS. For example, the platform for data management changed from a paper-based system to DHIS2 (District

[2] Child Health in the South and Adamaoua

[3] Organization of Coordination for the Control of Endemic Diseases in Central Africa

Health Information Software version 2), an electronic medium for data analysis. With technical support from the WHO, the MoPH-CIS SIS (i.e., a list of standard indicators and redesigned the data collection tools) implemented them throughout the health sector. However, this has not solved the problem of fragmentation of IS and double data collection.

The flow of routine data

Routine data is generated at the periphery level comprising the integrated primary healthcare facilities and district hospitals. It is gathered from patients who seek care such as immunization, maternal, and childcare services at the lowest level reporting facilities. Patients' data is recorded on different program registers and forms. Depending on the program, data is compiled weekly, monthly, or quarterly, aggregated, and recorded in the Monthly Report Activity (MRA) booklet. The booklets are sent to the office of the district information officer, where they are validated by the district information team and captured electronically on DHIS2. Those with access to the platform can use the data. DHIS2 is a web-based platform where routine data is managed. Besides routine data reports, health facilities compile independent reports to each parallel health program (PHP).

3.2 Research Approach and Methods

The study adopted an interpretive phenomenological approach. Phenomenology aims to understand human experiences by providing a thick and rich description of lived experiences [44]. Acquiring knowledge ultimately depends on understanding the lived experience, which presupposes a focus on subjectivity [45]. Phenomenologists are thus concerned with understanding the phenomena from the perspective of those involved [46;47]. This approach best fits the study as it involves "exploring the lived experiences of the participants and understanding how they make sense of the social world" [48, p. 3]. The phenomenon in this study is the challenge. We sought to understand the challenges that staff at the peripheral level experienced following the implementation of standard health indicators. We also aimed to unveil the existential empirical meaning as they lived this experience [47]. The approach enables researchers to put themselves into the participants' shoes to understand their subjective experience [49] and to describe the phenomenon as accurately as possible, refraining from considering pre-given facts but remaining true to the facts. The interpretive stance assists in understanding the phenomenon through the meaning that staff ascribe to it. Moustakas [44] noted that phenomenological studies incorporate thick descriptions of people's interpretation of their lived experiences. To achieve this, we drew on interviews, participant observation, and a review of documents (strategic plans, project reports, quarterly reviews, and bulletins) to explain how staff at the peripheral level lived this experience. We used interview guides to conduct semi-structured interviews with open-ended questions to allow the participants to narrate their

accounts and interpretations of their experiences. Interviews were the primary source of data as they are the most direct approach to collect detailed data on a phenomenon [50] and allow the researcher to probe for more details. Collecting data from multiple sources increased the study's internal validity [51].

3.3 Data Collection

This research was conducted within the Global Health Information System Programme (HISP) framework, which involves many African countries (including Cameroon), Asia, and Europe. The first author, a Cameroonian, collected the empirical material as part of her Ph.D. research. The first author was invited to join the CIS as a facilitator during the implementation of the SIS. The CIS at the MoPH in Yaoundé was her first contact point, and the CIS director introduced her to CIS staff. Before the implementation started, the CIS team held a couple of meetings, mainly focused on logistical issues at the regional level. Before the implementation, the first author participated in the training workshops of program managers, district information officers, and facility information officers from three regions (Littoral, North, and South West) on the DHIS2 platform. At the facility level in the South West region, she assisted the district information officer in providing training on data collection and validation processes. Although she was introduced by the CIS director, before entering each region to collect data, the first author obtained permission from the regional director of public health and a gatekeeper's letter from the health facility director. She was accompanied by either the district or the facility information officer on her visits to health facilities.

Data collection took place between April and September 2017 and covered three district health offices, two regional and sub-district hospitals, and seven integrated health centers (IHC). These sites were selected as the researcher had easy access to them [52]. We used the maximum variation sampling technique to select 25 staff at various levels of the health sector and were later interviewed (see Table 1 below). This method was employed to ensure variation among the participants [49].

Table (1) List of health staff interviewed

Staff interviewed	**Code**	**No.**	**Brief description of Tasks**
District information officer	DIO	3	DIO manages information at the district level
Facility information officer	FIO	6	FIO manages information either at a General/regional hospital
Manager of IHC	M-IHC	7	M-IHC & MDH collect data at a health facility
Manager of District Hospital	M-DH	2	
Monitoring and evaluation officer	M&E O	4	Information manager from parallel programs
Program Manager	PM	3	

Phenomenologists approach interviews with a casual attitude with the researcher and the participant perceived as peers [44]. A semi-structured interview schedule was developed with broad and open-ended questions. Before starting each interview, the researcher dedicated some time to building trust and rapport, which helped set the tone for the discussion. The researcher read out the aim of the study, clarified the interviewee about their rights, and the interviewee's read and signed the informed consent form. For the researcher to understand their lived experience and to promote profound engagement, the participants were encouraged to talk freely [44]. Van Manen [47] noted that the participants are not simply informants in phenomenological research but become co-researchers. For example, program managers were asked to explain what it was like to be trained to capture data on DHIS2 instead of analyzing and using indicators. The district/facility information officers were asked to recount their experience of receiving support from CIS staff. These questions helped the researcher to understand how they experienced working with CIS staff. A specific question asked was how they experienced the implementation of health indicators, and the training received. The interviews were audiotaped, and notes were taken.

In terms of participant observation, the first author was invited to a quarterly review meeting with the DIOs and FIOs. The meeting addressed different data-management-related issues encountered by DIOs and FIOs, their impression about the new tools, training, support, and communication between the district and the CIS. This helped the researcher better understand what was happening on the ground and understand the impediments and challenges confronting staff. The first author also participated in a district workshop with managers of integrated health facilities and held informal discussions with IHC managers. In one instance, the FIO and were supposed to visit two IHCs on the city's outskirts. The visit was canceled due to rioting caused by the civil unrest in the two English-speaking regions of the country. Hence, instead of visiting rural health facilities, we visited one urban health facility where we examined the different data collection tools, i.e., from PHP, and interacted with M&E staff from the PHP collecting data at the facility. Observing nurses in their daily setting enabled the first author to get closer to the participants, and by participating in their worlds, she gained access to their experience [44]. The review of documents (both printed and electronic) provided contextual information on healthcare practices and procedures in Cameroon.

4. Data Analysis

Data analysis began during data collection. During qualitative research, it is almost inevitable that it is impossible not to start thinking about the data collected when one is collecting data.

Notes taken during the interviews were transcribed after each interview. Data analysis continued after fieldwork. The field notes and audio recordings were transcribed. The taped interviews and hand-written notes were secured to ensure confidentiality. The transcripts were read through to gain a broader sense of what was reported by the participants also to remove any sensitive information. The researcher employed Braun and Clarke's [53] thematic analysis. Data analysis was a back and forth process, from the text to the analysis and back to the text to refine the interpretations. Increasing familiarization with the text revealed its meaning through reflection. Where necessary, the researcher returned to the text for verification. As the researcher read through the text, she identified themes. Van Manen [47] explained that during data analysis, themes are not conceptual formulations; instead, they are "more like knots in the webs of our experiences around which certain lived experiences are spun and thus lived through as meaningful wholes" [p. 90]. As the researcher read through the text, she identified themes that described the lived experience. The themes identified and explored are not absolute, as another researcher may draw attention to different or additional themes.

The themes were further analyzed to generate similar text descriptions that would help answer the research questions. The text was examined for ways in which the challenges encountered by the staff were related to the management style of HIS and then linked to Cameroon's organizational culture. This constructionist approach in thematic analysis posits that events, meanings, and experiences result from a range of discourse within society [53]. The following themes, decision-making issues, infrastructural and communication issues, etc., were identified inductively from the text. The researcher continued to move back and forth between the transcribed text, the codes, and the themes to make sense of the text and create links. She then related these themes to the study's theoretical framework to uncover issues relating to centralized management of HIS and link the challenges staff encountered after implementing SIS as a result of poor learning opportunities.

5. Findings And Analyses

The following sections present and discuss the main themes that emerged from the narratives. The themes do not represent the participants' only truth; instead, they are possible interpretations emerging from the researcher's perspective. The findings relate to issues that end-users encountered after the implementation of standardized tools. The themes are grouped in the following categories: decision-making issues, infrastructural issues, and communication issues. In presenting the findings, where

appropriate, we have inserted verbatim quotations and photographs, while impressions during observations are shown in text boxes.

5.3.1 Decision-making Issues

Centralization of HIS management: The WHO recommends that developing and implementing standard health indicators be consultative [1], involving all partners and stakeholders. Cameroon's organizational structure is bureaucratic with centralized decision-making, as is the HIS management structure. Managers reported that decisions to select indicators and to design data collection tools were made centrally by the CIS, with little participation from lower-level staff:

> *…the CIS people sit in Yaoundé and design tools to be used by someone working in Limbe, for example, without knowing how the work is like on the ground… When it comes to information, the central level seems to impose tools. We on the ground using these booklets should at least have a say*.

In an organization where top managers make all decisions regarding data without involving staff at the peripheral level, there is likely to be little commitment to using the new IS at the local level [54]. Studies in Africa show that involving stakeholders at all levels during the implementation of SIS allows for discussion and interaction, opening avenues for partners to raise concerns and share experiences and resources. It also creates opportunities for inter-disciplinary and inter-organizational collaboration [29], which could lead to learning.

The tension between the CIS and Parallel Health Programs (PHP): The healthcare sector has multiple partners with different voices and information needs. The fact that decisions are made exclusively by the CIS creates tensions. The PHP managers reported that the list of indicators represents the information needs of managers at the central level only. They added that the HIS is rigid and does not allow them to either change or add new indicators, creating tensions between CIS and PHP indicators.

Figure 2 below illustrates an example of such tensions. The right side of the figure represents an example of national indicators, and the left is variations of indicators from PHP. Take, for example, the section on the Family Planning program. The MoPH wants to know "Acceptor of modern family planning (FP) methods new," while Program B[4] want to collect data on "Acceptor of modern FP of youths by age and gender," and Program C wants "New acceptor of FP less than 20 years", etc., which led to non-use of data collected via the MRA booklet. The situation has been exacerbated by the weak enforcement of data-use measures at the peripheral level. For example, there are no data validation meetings; as such, the quality of data becomes questionable. This led to PHP introducing new data collection forms at the

[4]. We decide to name the programs, for example, Program A, Program B, etc., instead of using their names

peripheral level to collect their data, thus creating more fragmentation in the IS. Multiple data collection efforts also increase the burden of the already overloaded staff, risking the quality of both the data collected and the services provided.

Lack of human resources: The lack of knowledgeable personnel with capabilities to implement HIS is a critical challenge facing HIS in LMIC. The interviews revealed a shortage of skilled and trained staff with sound knowledge and competence in data collection, analysis, and use, particularly at the peripheral level. It is worth mentioning that the CIS had six staff, including the director, at the time of fieldwork. Of these, two held a basic degree in computer sciences and two in public health, while there was two administrative staff.

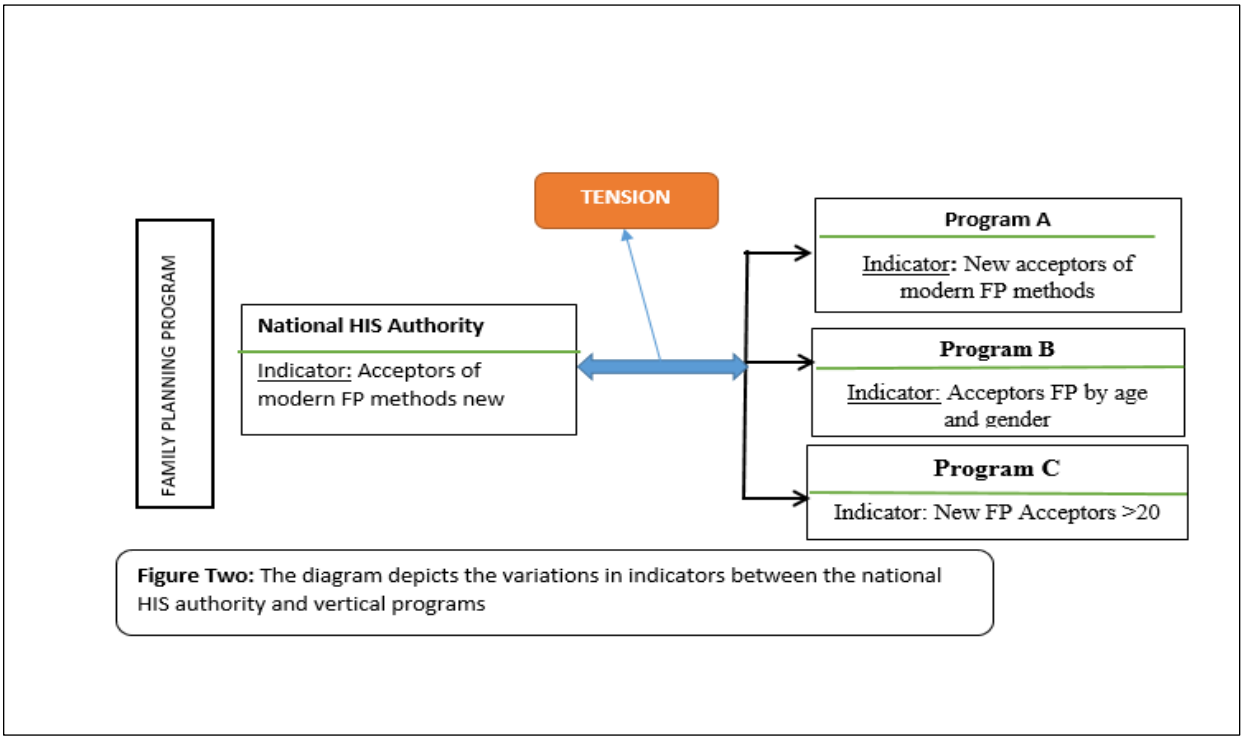

Figure Two: The diagram depicts the variations in indicators between the national HIS authority and vertical programs

The findings reveal that most DIOs are statisticians who do not have any background or computer training. For example, the head of the strategic planning unit, tasked with coordinating HIS activities in the region, explained that he is a medical doctor with no training in computing. In terms of data management, we observed a dire need for skilled staff with knowledge of public health, monitoring, and evaluation. The lack of experienced personnel in these areas could have contributed to the poor performance of HIS and the non-use of indicators.

The human resource challenge (particularly at the peripheral level) is deeply rooted in centralized decision-making. The data revealed, for example, that the district is headed by the District Medical Officer (DMO), supported by a Health Management Team (HMT), and is responsible for the planning and management of health services in the district. The DMO and the HMT report to the MoPH at the central level, where planning and allocation of funds occur. Another observation is that when the district wants to recruit new staff, it advertises the vacancy, shortlists applicants, and interviews those shortlisted. However, the final decision (i.e., who is recruited) is made at the central level, which takes a while.

Another issue is that HIS is perceived as a "technical craft." People believe that to undertake activities related to HIS, they need to learn new or additional technical skills. Such conceptualization discourages people from seeking employment in this domain. The low salaries in the public service have exacerbated the situation. The findings reveal that staff resigns from the ministry daily to work with non-governmental organizations (NGOs) who offer better salaries and working conditions.

Inadequate HIS training: Training is essential when implementing a new IS and is the most effective way to develop users' skills [55;56]. Training is even more crucial at the peripheral level due to the shortage of skills and competencies in data management. The analysis revealed that the two-day HISP workshop that was offered focused on operational aspects of the new IS (i.e., how to capture data, report generation on the DHIS2) and did not cover how to analyze and use information. These topics were not what program managers had requested. In addition, the respondents, particularly nurses at the health centre, reported that the training was too generic, short-term with limited follow-up. As a result, the skills acquired becomes redundant. Staff at the peripheral level require training that is focused on data use, learner-focused, and in-service [57]. The lack of adequate training could result in inadequate skills to analyze and use data. As illustrated in the excerpt below, managers' inability to calculate and analyze data implies that decisions concerning service delivery were based on raw data.

The excerpt illustrates how a facility manager makes decisions using raw data. It is clear that some facility managers do not know the difference between a data element and an indicator, lack population data, or lack the skills to analyze data. When indicators are not calculated correctly, as illustrated in figure 3, the result is a false representation of the facility's performance. It creates the impression that the health facility is performing well when in reality, it is not. Making decisions based on false representation (wrongly calculated indicators) could have devastating consequences for the community. For example, the use of inaccurate data could lead to an epidemic being discovered too late. Poor planning of the supply of essential drugs could endanger the lives of children or pregnant women.

Inconsistencies in defining indicators: Providing clear definitions of indicators promotes consistency in their collection, interpretation, and use [58]. The analysis revealed that some indicators were not clearly defined and, in some cases, they were not linked to program activity. A DIO reported that although data is collected and submitted monthly, most often, the data collected cannot be used to calculate priority health indicators such as measles, polio, and BCG coverage.

Researcher: Tell me more about the EPI data. Tell me more about these figures.

Manager: As you can see, the number of children immunized is increasing almost monthly.

Jan:	BCG dose	50 out of 50 = 100%
	Measles 1st dose under	1 yr 35 out of 50 = 70%
	PCV 3rd dose under	1 yr 40 out of 50 = 80%

Researcher: If 50 children had BCG, what happened that only 35 came for Measles 1st done?

Manager: This facility is in the city and has a midwife, and many mothers come from neighboring villages to deliver. After delivering, they return to their villages, and their children will continue taking their vaccines from health centers.

Researcher: What is your population of children under one year in your catchment?

Manager: In January, it was 50 and 65 in February,

Researcher: What do you do with this data?

Manager: At the end of the month, we compile and submit to the district office.

Researcher: Apart from sending data to the district office, what else do you use this information to do?

Manager: Not much, except when there is a problem, we shall be informed by various program managers.

Figure (3) Illustrations of how indicators are calculated

5.3.2 Infrastructural Issues

No platform to discuss data-related issues at the district level: Manual data collection has more potential for human error; therefore, data must be validated at the source before being captured on DHIS2. The district should have a platform to discuss data-related issues [59], instead of allowing the DIO to validate data alone. The findings show that routine data is not regularly validated either at the facility or at the district level. Data-related issues are not discussed at the district level; thus, the quality of the data becomes questionable. We observed that due to the quality of data, coordinators of some PHP send data

managers directly to the health centres to collect data instead of using the data collected by the DIO and published on the DHIS2 platform. Braa and others [59] argue that validating data is an essential process in data management. Only by validating and making sense of data can one provide feedback to data capturers on improving data quality. Similarly, Redman [60] added that the peripheral level should have a platform to validate data because if the quality is lacking at the point of collection, it is difficult and costly to fix the problem at a later stage.

Poor record keeping: Program registers and forms are the primary tools to collect routine data. These tools should be appropriately handled and maintained in good condition as good quality records are an essential component of safe and effective healthcare [61]. We observed the inferior status of the registers, with some pages torn. This increases the risks of collecting poor data quality.

Figure 4: Physical state of registers at a health facility

Researcher Observation: During our visits to the IHC, the pages of the registers were torn and twisted.

5.3.3 Lack of Resources

Lack of information-related resources: The study found that the state has not allocated sufficient funds to health facilities' data and information-related services. Furthermore, these facilities lack computers, printers, printing paper, and ink. At some health facilities, MRA booklets were scattered on the floor because there is no shelving. An FIO noted that:

... in my facility, there is no budget allocated to information services. The submission of data has become my responsibility as the facility information officer. I have to get paper for the photocopying machine to photocopy the MRA booklet and distribute it to nurses...

Lippeveld [62] also found that the lack of resources as factors hindering HIS implementation.

***Information managers not valued*:** In today's world, information is no longer considered as a source of competitive advantage, but a competitive necessity [63]. Information is an integral part of all organizations and is the backbone of healthcare systems. Thus, it is not surprising that organizations now manage information in the same way they manage their staff [63]. Recognizing the importance and value of information lends credence to information and those involved in managing health data. It was observed from the MoPH, health facilities, district and sub-district hospitals, and IHC's organigrams that there was no designated post for information manager or data officer. Staff that occupies this position reported that, unlike in other professions, it is challenging to grow in this position:

As a statistician by profession, I was recruited by the Ministry of Public Services to work as a DIO. Here I am, my boss. I have been working as the DIO for the past six years without any promotion. Working as a DIO information manager is challenging to develop. For example, in nursing, one starts as a staff nurse and moves from a professional nurse to a chief professional nurse. In information management, it is not like that because the profession does not exist on the organigram.

There are no formal criteria to hire, appoint or recruit staff to work in the information management unit. The findings reveal that clinicians suffering from chronic illness are assigned to work in the information unit because working in the ward was too stressful. The results also show that being assigned to work in the "*statistics department*" is a form of punishment because staff in that department have little or no interaction with other staff. We argue that if data management and those involved in managing data are not respected, managers will attach little confidence to the data collected [42], affecting its quality and use.

Researcher Observation: During fieldwork, it was observed that the area where the FIO office is located is deserted, with no movement or activity.

5.3.4 Communication Issues

Inadequate infrastructure such as electricity supply, telephone, internet access, and transportation significantly affected communication and submission of data. For example, poor Internet access and

constant power outages in the Northwest and Southwest regions hamper these activities. An FIO shared his experience:

> *…although hospitals have a generator, the issue is that the generator is connected to basic units only. Unfortunately, the statistics unit is not considered a basic unit, so I have to use my mobile phone to send data…*

***Lack of communication*:** The analysis revealed a lack of communication between the different administrative structures. For example, the only time the FIO and DIOs communicate with CIS staff is when the CIS holds a workshop at the district level. As a MIHC explained, the same applied to communication between the DIO and the IHC:

> *…we send data to those at the district office monthly, and they will not call to acknowledge receipt or give us feedback except when data is submitted late.*

Staff at the health centers have poor or limited access to information because the books are out of date. They have no access to journals and the Internet, and the available information is not appropriate to the local situation. The lack of communication and feedback also devalues the data collected, and consequently, data collection is perceived as a supplementary task in healthcare delivery [26]. Feedback is an essential process for identifying problems for resolution, for regulating and improving performance at individual and system levels, and for identifying opportunities for learning (see Knight 1995) in [64]. However, giving feedback remains inefficient in HIS in many LMIC (see Hozumi et al. 2002) [64]. According to Nutley [65], the lack of communication and support between those developing the system and those using it could negatively affect the information system itself.

6. Discussion

The study aimed to identify the challenges encountered by users following the implementation of SIS in Cameroon. One would expect that the frequency of implementing and using HIS would reduce the challenges because IS experts should have learned from their mistakes. However, the empirical findings showed otherwise as staff at the peripheral level encountered multiple challenges. We argue that these challenges cannot only be attributed to a lack of adequate training, skills, and resources. Instead, they are deeply embedded in the existing organizational structure. When an organization fails to learn from its mistakes, its staff are unable to identify feasible alternatives. We drew on theories of organizational learning to understand why organizations fail to learn.

6.1 The Reasons Why Organizations Fail to Learn

Lyytinen & Robey [5] identified four barriers to learning in IS, of which three were relevant in this study. The three barriers are disincentives for learning, organizational culture, and educational barriers.

6.1.1 Disincentives for learning

The organizational culture and management's decision-making behavior are shared values and beliefs that govern how people behave in organizations. These shared values form the basis for communication and mutual understanding and affect how staff act and perform their jobs [66], which could either encourage or discourage innovative behaviors [67]. In Cameroon, the prevailing organizational culture is hierarchical with centralized decision-making. Centralization refers to how the locus of decision-making authority is concentrated at the organization [67]. It allows for tiny delegation of decision-making, creating a non-participatory environment and reducing communication, motivation, social interaction, and staff's involvement in tasks [68], which could impede workplace learning. In contrast, standard health indicators promote evidence-based decision-making and transparency [64]. However, these attributes are not encouraged in an organization where decisions are made at the central level [69; 70] and there are many red tapes. In terms of implementing health indicators, IS experts require sufficient autonomy and freedom to pursue solutions to new problems as they arise, reflect and exchange ideas; these activities stimulate creativity and learning. An environment where personal initiative or invention is not encouraged does not promote the production of new information and hence no learning and personal skill development [68]. Furthermore, since managers/heads of departments are political appointees and might lack subject matter expertise, they are likely to make poor decisions, negatively affect their subordinates' job performance [71]. The disincentives identified by Lyytinen & Robey [5] included punishment instead of trying to learn from experience, which could occur in a rigid hierarchy.

6.1.2 Organizational Culture

The complexity of the delivery of healthcare services calls for stakeholder collaboration. However, Cameroon's organizational structure hinders open communication and cooperation, undermining cooperation, especially with partners and staff at the peripheral level. A case in point is that the workshop's content during HIS implementation did not focus on users' information needs but on what the IS experts deemed necessary. This point aligns with Lyytinen & Robey's study, where both vertical and horizontal divisions exacerbate poor communication within the organization, which hinders information and knowledge sharing. The separation of doing at the operational level from possible learning at the central level implies that the organizational design is a barrier to change [5].

6.1.3 Educational barriers

The educational barrier identified by Lyytinen & Robey [5] was between computer scientists who held a technical view of IS and business people who did not understand the technical challenges. In Cameroon, a professional barrier was identified between CIS IT staff at the national level, familiar with healthcare providers, whose knowledge focused on patients and treatments, and less on data management, population, percentages, and indicators. In this study, we found that the two-day HIS training workshop offered during implementation was insufficient to transform healthcare providers into health managers who could act on indicator values. This is similar to Lyytinen & Robey's study [5], the myths of a technological fix. The silver bullet was found in this case, although in somewhat different forms.

6.2 Myths-in Use

Myths-in-use is beliefs embedded in organizational routines and IS practices that have assumed mythical status and are insulated from blame for IS failures. In this study, we identified three myths-in-use. They are technological fixes, silver bullet, and emperors of the same empire.

Technological fix – The CIS seemed to have limited the implementation of standard indicators to "providing computers and Internet dongle." For example, at the end of the two-day HIS training workshop, an FIO asked one of the directors, "what is the way forward" and the director responded:

> *"…you have computers, Internet dongle, and some copies of MRA. I do not want to hear any further complaints again. Go ahead and start sending data. We hope all your concerns have been attended to".*

Reducing the implementation of HIS to the installation of software and hardware and disregarding the context within which the system operates is an extremely narrow approach to SIS [24;72] that has been associated with the failure of many HIS initiatives.

The notion of a ***'silver bullet'*** is based on the belief that there is a single solution to resolve all information-related problems. In this case, we consider the '*silver bullet'* to be the new list of standard indicators developed and implemented. The use of the term '*silver bullet*' reveals a fascination with magical weapons possessed by heroes fighting the forces of evil. Although such an analogy may be considered a simple embellishment of language, in this case, it highlights an essential assumption about solutions to HIS problems. For example, given that the WHO recommended implementing SIS as a strategy to strengthen IS, the MoPH-CIS thought that it would solve all the data management-related challenges the staff was facing once that is done. Belief in a 'silver bullet' is an inaccurate reflection of reality and may prevent deeper examination of why the staff at the peripheral level still encounter numerous challenges following the implementation of SIS.

Emperors of the Same Empire: This is an additional (new) myth we found in this case, and it is relevant among CIS and donors. When more than one emperor rules the same empire, conflict is bound to occur. The term "emperors of the same empire" describes the tension between the MoPH-CIS and PHP, the main actor and partners involved in information management in Cameroon. These bodies need to identify an amicable way to discuss and resolve their differences and concerns as far as SIS uses concerned. They must be able to collaborate and work together, without which there is bound to be conflicts.

6.3 Strategies to overcome Learning Failure

Having described the barriers to effective learning and why the MoPH-CIS failed to learn, we propose approaches to overcome learning failure. There is no silver bullet. The proposed strategies are redesigning the structure, including institutionalizing systems, mobilizing resources, making the MoPH-CIS Inclusive, networking, and creating a community of practice (CoP).

6.3.1 Redesigning the MoPH-CIS

The challenges identified are attributed to the organizational structure and culture. Overcoming them would require a complete *makeover* of the entire health sector. Although it is a radical measure, it would lead to better management of the entire healthcare sector. However, such a measure is feasible in private organizations and beyond the scope of this article. However, a viable approach could be to create an independent body or committee, which would collaborate with the MoPH and other partners and stakeholders in the country. For example, the creation of a "National Health Information Committee for Cameroon" (NHICC). This committee should be located within the MoPH, perhaps in the planning or monitoring and evaluation department. The committee should be independent and apolitical, with representatives from all stakeholders. An independent body in charge of HIS development would create a platform for collaboration and enable the pooling of both human and financial resources [73]. This NHICC and the MoPH would work together to strengthen institutional structures, mobilize resources, and network.

Institutionalize Structures: Institutions are said to be cognitive, normative, and regulative structures and activities that provide stability and meanings to social behavior [74]. Organizations and the organizational fields such as the MoPH-CIS and its partners constitute an institutional life [74]. Institutions are, therefore, the regulative frameworks, managerial practices, and norms that enable organizations to function and endure [74]. Regarding MoPH-CIS and DHIS2 software, would rejuvenate the e-health policy that was introduced in 2008 but cannot be implemented due to poor coordination between the MoPH and Ministry of Post and Telecommunication (MINPOSTEL) [75]. They would ensure that the

policy is implemented and that all programs/projects in-country comply. The CIS would develop the Enterprise Architecture with e-health components that govern all its e-health projects.

At the operational level, it would support Standard Operating Procedures (SOP) for data management. The SOPs provide a formalized system for evaluating the technical adequacy of data management-related activities. These activities start before data collection, continue after analysis is complete, and require continuous coordination [76]. These documents outline how to keep records and obtain accurate, complete, and thorough documentation of all activities related to data management. They also specify the minimum data quality and the procedures used to analyze and report the indicators. The main objectives of the SOPs are to maintain a reliable data quality system for CIS, provide accurate data required by the service, donors, and other stakeholders. It also provides a record-keeping system that will help evaluate and monitor for effective resolution of concerns on ongoing programs [76]. Other institutional strengthening mechanisms are to institutionalize district and facility data review meetings. At all these meetings, presentations should be based on standard health indicators, which health facilities track monthly. In addition, these meetings should include discussions on the challenges (communication, on-site supervision/support) that facilities at the peripheral level encounter in managing and using standard indicators by strengthening institutional structures, hence, creating a conducive environment for information-related activities to thrive.

Mobilize Resource: This is at the heart of a successful implementation of IS is the availability of human and material resources. The provision of material resources is correlated to access to financial help [10]. Cameroon is a developing country and depends heavily on foreign grants and loans to implement national development initiatives, including health programs [41]. Pursuing a viable and efficient HIS has been a significant challenge concerning acquiring the necessary financial support for its implementation. Mobilizing resources through networking with health partners would secure additional finance to support CIS to implement the national health indicators.

Networking: In a resource-constrained context like Cameroon, its sustainability of HIS invariably depends on building networks both locally and internationally. Such networks could be used to create opportunities to strengthen the capacity of staff at MoPH-CIS [25;77]. Networking is based on the assumption that providing possibilities for the two-way flow of knowledge between nodes in the network would lead to sharing available resources for planning and implementing health projects [25]. The traditional alliance with health partners such as WHO, the United Nation Bodies, Global Fund, etc. have been providing financial support to programs in many developing countries. However, experience from

other countries, Tanzania, South Africa, Mozambique, etc., show that establishing a new partnership with HISP has opened new capacity-building opportunities in technical assistance (TA) through knowledge transfer and education.

In addition to providing TA for customizing the DHIS2 software for the countries using the software, the HISP group is also providing training on advanced features of the DHIS2 software through the HISP regional academics in West and South Africa. For sustainability and eventually becoming self-reliant and less dependent on HISP technically, the CIS can take the initiative by leveraging on the TA from HISP to build the skills of its core technical team. In addition, MoPH-CIS could extend the existing memorandum of understanding (MOU) with the University of Oslo to that of fellowship to provide higher education in information science and research [25]. It could be seen as a strategic plan to build the skills of Cameroonians.

Experience from other countries shows that networking with health partners could assist in refurbishing and replacing broken down ICT equipment, support end-user training, provision of logistics for monitoring and evaluation of activities, and payment of server hosting [78].

Making the MoPH-CIS Inclusive **-** The HIS profession is considered a technical craft for the "technically inclined." This narrow conception discourages prospective staff from joining the profession. The proposed national HIS committee should motivate the expansion of the CIS unit to include research and development, monitoring and evaluation, and public health. This could broaden HIS perspective and encourage more research, consequently attracting people with diverse professional and educational backgrounds to join the IS sector.

6.3.2 Cultivating Communities of Practice (CoPs)

Once the proposed committee has been stabilized at the central level, ensuring continuity in capacity building at the peripheral level and cultivating CoPs around data management activities could achieve this purpose.

A CoP is a group of people who share a concern or passion for something they do and learn how to do it better as they regularly interact [29; 30]. Cultivating CoPs, especially at the peripheral level, with assistance from the operation managers (health facility managers), could support and motivate their subordinates to work together [79]. If well supported, an operations manager would contextualize data management and integrate it into staff's work practices to become in-service training. A study conducted in a rural health facility in northern KwaZulu-Natal, South Africa, found that the creation of a CoP

stimulated discussion and interactions and consequently developed staff skills in data management-related activities [57].

Table (2) Strategies to improve learning

Reasons for the CIS learning failure	Strategies to overcome learning failure
• Organizational structure • Educational barriers • No platform to interact	• Redesign the MoPH-CIS, including institutionalizing structures, mobilizing resources, networking, making the MoPH-CIS Inclusive • Cultivating CoPs

In summary, the MoPH-CIS can learn from its mistakes by applying the proposed approaches discussed above and summarized in Table 2 that are in line with many calls for awareness of organizational issues in HIS [80]. According to [57], widespread awareness of these issues has failed to influence practice. However, the authors added that the difficulty would lie in implementing the proposed recommendations, which will influence course based on learning from experience, an apt illustration of the need for improved approaches to organizational learning. The challenge is to move beyond the habit *of accepting instructions* to the critical step of asking questions and getting more involved.

7. Conclusion

The study set out to understand the challenges encountered by users following SIS implementation and suggest ways to mitigate these challenges. Using the case of Cameroon, we found that, following the implementation of SIS, staff at the peripheral level encounter many challenges such as inconsistencies in the definition of indicators, a lack of resources, etc. We argued that these challenges are partly because the MoPH-CIS failed to learn from its experiences. As a result, HIS has remained susceptible to failure, and ineffective practices persist. These results concur with the findings of several previous studies [81]. Theorizing the reasons for learning failure, we concluded that the causes primarily stemmed from the MoPH-CIS organizational structure. Based on this, we proposed ways to overcome the learning failure. A study on why organizations fail identified three organizational myths [5], while those three myths Lyytinen & Robey [5] identified may be applicable in private organizations, in this study, we identified a new myth, "*Emperors of the Same Empire*," relevant in public organizations; among CIS with donors and partners.

The core contributions of this article lie in how the different concepts are theorized. Linking the challenges staff at the peripheral level encounter after the implementation of SIS to the failure to learn and the organizational structure makes the study unique. The MoPH-CIS structure in Cameroon is centralized, rendering it a significant barrier to successfully implementing an IS because centralized decision-making

does not support the principle of DHIS2 [26;43]. The article contributes to the literature on an organizational structure by demonstrating the consequences of centralized decision-making for the implementation of SIS. Linking the failure in IS implementation to the inability to learn contributes to the IS literature by illustrating the effects of a lack of learning. The recommendation to introduce CoPs emphasizes the need for continuity and more focused and integrated training, particularly for staff at the peripheral level. Implementing a new SIS should be considered an opportunity to review and modify the traditional way of doing things, influenced by bureaucratic and hierarchical structures. The article concludes that organizations often misplace their attention on what and how they should learn. As explained by Attewell [82], organizations are adept at learning from external sources and are often eager to accommodate new technologies but often fail to provide a conducive atmosphere where their own experience can thrive. Learning from experiences is not valued, while few processes and routines are in place to help the organization to promote learning. Finally, we argue that while the implementation of SIS is cardinal for coordinating between multiple partners, the organizational culture can hamper the implementation process.

This study had several limitations. Firstly, it focused on the two English-speaking regions (formerly known as Southern Cameroon). These regions have lower levels of socio-economic development than other regions in the country. Secondly, the fieldwork was conducted amidst political unrest in the English-speaking regions. Thirdly, we did not consider alternative conceptualizations of the theoretical linkage between the failure to learn and HIS implementation, choosing instead to employ the lens of organizational learning. While this is one possible approach to theorize the causes, further research is required on alternative paths.

8. Declarations

8.1.Author's Perspective:

FNA conducted the interviews, transcribed and analyzed the transcribes, and maintained a reflective diary throughout the process. FNA is a Cameroonian and a knowledge broker by profession. FNA has worked with healthcare providers at the peripheral level in many African countries. The impact of an existing professional relationship between the interviewer and interviewees was taken into account during data analysis through the researcher's reflexive diary. First, FNA and RS read and analyzed the text to identify codes. Later, FNA, JK, and PN discussed the themes. JK and PN provided critical input on the manuscript.

8.2.Acknowledgments:

We would like to thank the DIOs, FIOs, Program managers, Data managers, and health facilities managers from the North and South West and the Littoral regions interviewed, particularly Mss. Bridget Kah, Munge Hellen, and Mr. Lukong of Limbe Regional Hospital.

8.3.Declaration of Conflicting Interests:

The authors declare no potential conflicts of interest.

8.4.Funding:

No financial support was received for the research, authorship, or publication of this article.

8.5.Ethical approval and consent to participate:

This study was approved by the Norwegian Center for Research Data (Reference #: 45883). Ethical approval was sought from the Regional Delegations of Health from the three regions. All the participants signed individual consent forms.

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Paper Five

Asah, F.N., Kaasbøll J. (2021). Deconstructing the Dichotomous Relation between Information System Analysts and End-Users: A Case of Implementing Standard Health Indicators in Cameroon. *IFIP Conference 2021*

DECONSTRUCTING THE DICHOTOMOUS RELATION BETWEEN "IS PROFESSIONALS AND END-USERS": A CASE OF IMPLEMENTING STANDARD INDICATORS IN CAMEROON

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ABSTRACT: *Différance* and *supplément* are post-structuralist concepts for analyzing language in text and are most often associated with the work of Jacque Derrida. After implementing standard health indicators in Cameroon, the findings show that staff at the peripheral level encounter multiple challenges, including lack of participation during the implementation process and tension between staff at the peripheral level and IT staff at the central level, resulting in non-use of the system. We use deconstruction to understand the root cause and the findings reveal that IT professionals and end-users are embedded in a relation of domination. That is, IT professionals are différance from end-users, and end-users are supplément of IT professionals. Although end-users are portrayed as supplementary, they are supposed to manage the system, which is contradictory. This led to IT professionals having more privilege and authority over end-users. This dichotomous relation is a derivative of the organizational structure. The notion of portraying IT professionals in charge and having more power over end-users is an avenue for conflict. The paper concludes that a HIS organizational structure where decision-making is centralized is a ground for conflict and a major roadblock of building local capacity and providing infrastructural support at the peripheral.

Keywords: interpretive phenomenological approach, différance, supplément, standard health indicators, health information systems, Cameroon, deconstruction

1. INTRODUCTION AND BACKGROUND

The need to provide comparable and accurate data to report on the Millennium Development Goals (MDGs) indicators compelled Cameroon to adopt and implement strategies to harmonize the national health information system (HIS) (MINSANTE-WHO, 2018). An example is the

adoption of the District Health Information Software version 2 (DHIS2)[1] and the design and implementation of standard information tools. These are the list of standard health indicators and Monthly Reporting Activity (MRA); data collection tools (MINSANTE-WHO, 2018). Standard health indicators are core elements of data analysis and the standard-setting instrument used to measure the performance of healthcare services. Standards are agreed-on health information procedures (i.e., the way data are collected). They also refer to the content of HIS (i.e., the metadata and indicators) (Jacucci et al., 2006). In this study, we refer to these tools as standard information systems (SIS). An important outcome of implementing SIS should build infrastructural support and resources (i.e., human capacity and competencies) at the peripheral level (Jacucci et al., 2006). The findings of a study conducted in Cameroon show that following the implementation of SIS, staff at the peripheral level encountered multiple challenges, including a lack of skills to analyze data and non-involvement, rendering them incapable of using the system (Asah et al., 2021). Non-involvement during participation and a lack of adequate skills to use SIS could lead to resistance and non-compliance among IS users (Dwivedi et al., 2015). In IS literature, researchers and practitioners have identified these factors as major problems shaping IS use (Braa et al., 2002).

The implementation of IS requires the active involvement and participation of all stakeholders, particularly end-users whose involvement and participation are critical to successful implementation (Grudin, 1991; Berg et al., 2003). However, the involvement of end-users in the IS implementation projects appears to have been less than successful (Beirne and Ramsey, 1988). Due to conflicting interests, tensions, the distribution of authority (Newman and Robey, 1992), and power play (Markus, 1983; Dwivedi et al., 2015), among IS staff, particularly those in centralized organizational structures (Markus, 1983). Studies show that the relationship among staff during IS implementation leaves much to be desired (Beath, 1991). Discussions within the organization on the distribution of authority mainly center on centralization and decentralization of resources as IS practitioners tend to assume that, as technical experts, they have more power to control IS resources (Beath, 1991). While there is a large body of literature on conflicts during IS implementation of IS, little of it has addressed them from the end-users' perspective (Lin et al., 2018; Warne, 1998). In this article, we examined the relationship among IS staff during the implementation of standard indicators. While targeting the end-users, we seek to explore the relationship between IT professionals and end-users and bring to the fore the meaning of their experiences. IS are socio-technical artifacts designed for local adaptation; therefore, understanding

[1] The DHIS2 is an electronic platform that facilitates data analysis and comparison. It is a web-based system that users at all levels can access, provided they have Internet access and access to the platform.

the root causes of the tension is beneficial as this could enable these issues to be addressed (Fiorelli et al., 1993), hence improving implementation and therefore, the use of IS, which is one of the goals of ICD4.

The empirical setting for the study is the implementation of standard health indicators in Cameroon's health sector. The IS implementation process is one of the times that both IS groups come together and is thus an appropriate time to examine their relationship. We draw on the concepts of supplément and différance to under the relation.

2. DEFINITION OF CONCEPTS AND CONCEPTUAL BACKGROUND

2.1. The term end-user has been used differently, but in this case, it refers to potential users or anyone in the organization who will directly or indirectly utilize the system. This is based on the notion that the end goal of developing a system is that it will be useful to the consumers. An example, in this case, is the HIS, and the end-users are staff at the peripheral level who generate, collate, analyze, and capture routine data on the IS. **IT professionals** are the designers, developers, and implementers who design the IS. In this case, they are staff of the CIS[2] who also have the decision-making powers.

2.2. Implementation of IS has been a topic of discussion amongst researchers in the fields of IS. Two schools of thought exist. The first views IS implementation from a pure technological stance. The main concern of this school of thought is how to offer technical solutions to integrate the systems of different backgrounds to cater to technological needs (Bostrom and Heinen, 1977). However, this conception is criticized by the other school of thought that social and organizational aspects play an equally important role in IS development. This group conceptualizes IS implementation as a socio-technical process, highlighting the need to address organizational and social issues during the development and post-development of IS (Bostrom and Heinen, 1977). The socio-technical approach offers a broader understanding of IS implementation, meaning that implementing IS involves incorporating the technical tools and associated procedures into existing organizational routines.

2.3. Concepts différance and supplément. When computers were first introduced for everyday use within the organization, there was an expectation shared among many observers that they would centralize organizational power (Pichault, 1995). Thus, information was equated to

2 Know by the French acronym, Cellule d'Information Sanitaire

power, and the information processing capacity of computers was seen as an extension of managerial control. The dissemination of computers in the organization was accompanied by ideas that engendered a reconceptualization of managerial and organizational processes, explicitly emphasizing the importance of control over IS (Bloomfield et al., 1992). This thinking has often been associated with technocrats and further strengthened the feeling that computers and IS would pave the way for enhanced centralization of organizational activities (Bloomfield et al., 1992). This power relation is a post-structural approach (Chiasson et al., 2012), and we use the concepts of d*ifférance* and s*upplément to* explain this in our context.

D*ifférance* is a term coined by Derrida to unveil the fundamental conceptual oppositions inherent in Western philosophy (Chiasson et al., 2012). D*ifférance* means both difference and an act of deferring. It is used to characterize how linguistic meanings are created rather than given (Norris, 1991). According to Derrida, concepts are understood by comparing them to similar concepts that one is familiar with. For example, one can distinguish colors such as blue and red because of how different each relates to the other (Chiasson et al., 2012).

In most cases, one focuses on conceptual distinction by contrasting a concept with the one that appears to be orthogonal to it. Examples are good/evil, masculine/feminine, and speech/writing (Cooper, 1989). Derrida argues that while the two elements are placed in such a dichotomous relationship that they may seem to be in simple opposition, d*ifférance* suggests that, in practice, one element of the dichotomy is often privileged over the other (Chiasson et al., 2012). The element appearing first often masks a relationship of superiority over the other. The first element is considered a primary member of the pair, while the other is regarded as secondary and often undervalued (Derrida, 1985). An example, in this case, is IT professionals/end-users. The IT professionals are considered superior, while end-users are considered secondary. To "deconstruct" the opposition is to explore the tensions and contradictions between the hierarchical ordering assumed in the concept and other aspects of the concept's meaning, especially those that are indirect or implicit (Chiasson et al., 2012).

Supplément is defined as "an inessential extra added to something to complete itself" (Cooper, 1989). Going back to the explanation of d*ifférance* and how we attach more importance to words that appear first, exaggerating the differences between two words leads us to ignore their common roots and undermine what may be inherently inseparable (Cooper, 1989). In such a case, the privileging of one side conceals the other's often critically important compensating role. From our example of IT professionals/end-users, the end-users are *supplément* of IT professionals using this concept. The interdependency of two opposing elements in a dichotomy can often be seen as the privileged element's reliance on the supplemental one for its meaning. To deconstruct, Derrida

argues that if something is complete, there is no need to add any s*upplément*. *Supplément* is used to compensate for the inherent inadequacy or incompleteness of the privileged element (Beath et al., 1994; Chissson et al., 2012). Going back to our example, one would say that if IT professionals are complete, there is no need to have end-users as s*upplément*.

Deconstruction is an interpretive approach used to study language (Jones, 2003) and is considered a post-structural (Agger, 1991) approach. As an analytical strategy, it is a tool for "de-constructing" or taking things apart, including philosophical arguments, literary text, or understandings of lived experiences (Miller, 1976). It is used to examine cultural artifacts with "an eye sharply trained to look for contradictions" (Norris, 1991, p. 137) and contradictory ideas about something or someone. Contemporary social scientists who work to deconstruct text draw on the work of Derrida[3] (Agger, 1991). Derrida sought to establish a set of rules that could be applied in reading, writing, and interpretations of text to unearth their historical, cultural, and social construction (Agger, 1991). Deconstruction's strengths lie in revealing implicit meaning and unacknowledged biases in groups of individuals such as cultural, class, or gender differences. We shall use these concepts to explore the relation between IT staff and end-users in Cameroon's IT domain. Using these concepts highlights the social divide that is prevalent but not discussed in the IS domain.

3. RESEARCH SETTING AND METHODS

3.1 Research Setting

The empirical setting for this research is Cameroon, a low-income country located in Central Africa with about 24 million in 2018. The country has a hierarchical organizational structure characterized by centralized decision-making, bureaucracy, and poor communication channels (WFP, 2018).

3.1.1 Cameroon's Health Information Systems

Routine data management in Cameroon has a long history, but the country started developing its national HIS around 2013. Prior to 1995, routine data was collected and managed haphazardly. That is, each parallel health program had its IS (ADF, 2000). For example, the North-West and the South-West regions had two projects, SESA[4] and OCEAC[5]. Each had its HIS, list of indicators, data collection forms, and computer (ADF, 2000). In 2013, the Ministry of Public Health (MoPH)

3 The most celebrated and principal exponent of deconstruction

4 Child Health in the South and Adamaoua

5 Organization of Coordination for the Control of Endemic Diseases in Central Africa

first attempted to develop a national HIS. A presidential decree was signed that created a national department of IS, named the CIS. The CIS is charged with designing, implementing, and disseminating health information throughout the country. As noted previously, Cameroon has a hierarchical organizational structure that is characterized by centralized decision-making, bureaucracy, and poor communication channels (WFP 2018). In 2017, the country adopted the DHIS2. Routine data is compiled weekly, monthly, or quarterly depending on the program, aggregated, and recorded in the MRA booklet. The booklets are sent to the district office for validation by the information team, and it is then captured on DHIS2 platform. After that, those with access to DHIS2 can access the data. At the health centers, end-users have poor access to information because the books are out of date, there is no access to journals and the Internet, and the information available is not appropriate for the local situation. Many studies describe the IS as dysfunctional (Nkoa et al., 2009; Ngwakongnwi et al., 2014; Asah et al., 2017).

3.2 Methods

This paper is based on an interpretive phenomenological (IP) approach (Heidegger 2010). An IP approach was used as the objective of the phenomenological method to describe the experiences rather than to test hypotheses (Larkin et al., 2006). Phenomenological studies are conducted when a researcher wishes to explore the perceptions and experiences of the participants from their point of view. This approach seeks to understand the meaning that individuals ascribe to their lived experiences, and the researcher aims to interpret this meaning in the context of the research (Smith, 1996). Phenomenologists are concerned with understanding a phenomenon from the participants' perspective (Larkin et al., 2006; Van Manen, 2016). The phenomenon studied is the relation between IT professionals and end-users. Pichault (1995) explains that those actions or behaviors that lead to conflicts often occur when IT professionals are not aware. Thus, they go unresolved or undiscussed. Heidegger (2010) argues that phenomenology does not have as it objects that which is visible and clearly defined. Instead, it is that phenomenon that remains hidden or somehow disguised which are of interest. Using the IP approach enables us to interpret the meaning of the relationship between both parties. Such an approach allows researchers to put themselves in the end-users' shoes to understand their subjective experiences (Creswell, 2007) while describing the experiences as accurately as possible and refraining from subscribing to any pre-given facts but remaining true to the facts. Since a basic phenomenological assumption is that all human experience is structured and has meaning, the need to force a priori structured is eliminated (Larkin et al., 2006). As described by Colaizzi (1978), a semi-unstructured interview was selected as the most appropriate and powerful tool for obtaining current and retrospective data

from participants. Twenty-five interviews were conducted with staff in their chosen locations. Using interviews allows participants to narrate their accounts as they lived them while not limiting the researcher to the rigid format of structured interviews.

Staff interviewed	**Code**	**No.**	**Brief description of Tasks**
District information officer	DIO	3	DIO manages information at the district level
Facility information officer	FIO	6	FIO manages information either at a General/regional hospital
Manager of IHC	M-IHC	7	M-IHC & MDH manage data at a health facility
Manager of District Hospital	M-DH	2	
Monitoring and evaluation officer	M&E O	4	Information manager from parallel programs
Program Manager	PM	3	

Table 1: List of staff interviewed

We used interview schedules with broad questions to collect data from April to September 2017. The participants were selected because they attended the implementation workshop and are directly involved in the management of information at their respective health facilities. The questions focused on exploring the nature of their role and experiences during the implementation of SIS. This includes support they receive from the CIS staff and their involvement in the implementation process. This enabled them to describe their personal and subjective experiences as freely as possible in their own words. Where necessary, the interviewer asked additional questions for clarification and elaboration.

Before starting each interview, time was dedicated to building trust and rapport that helped set the tone for the rest of the discussion. The aim of the study and the interviewee's rights were clarified, and written informed consent was obtained. The interviews were held at the participant's office. Each interview lasted for about 50 minutes and was audiotaped and transcribed verbatim. The researcher kept a diary to record comments and describe the context and behavior that could not be captured through audio recording.

Data analysis began during data collection. At the end of each day, the researcher organized the data collected and developed impressions and issues. The researcher relied on Braun and Clarke's (2006) thematic analysis to aid analysis. Data analysis was cyclical, with the researchers went back and forth, i.e., from the data to the analysis and from the analysis back to the data to refine the interpretations and gain an in-depth understanding of what the participants were saying to understand the world from the interviewees perspective. The researcher read each

interview transcript separately to get an overall sense of the participants' lived experiences and to obtain a sense of immersion in the data.

This paper is based on a large Ph.D. research project that focuses on the challenges that staff experience following the implementation of SIS. However, this paper reports on the relationship among staff, which is part of the overall research project. For this paper, which scrutinizes the relationship between IS professionals and end-users, the researcher identified statements within the data that seemed most likely to achieve this objective. We identified decision-making around HIS and the organization of IS implementation and development of training content and training. The next step was to analyze the text by identifying sections that might reflect différance or supplément.

4. FINDINGS AND ANALYSIS

This section presents the findings supported by verbatim quotations as well as our interpretation. Reading the transcripts, we identified two factors that characterize the relationship between IT professionals and end-users.

4.1 Organization of SIS implementation workshop

The CIS unit makes all decisions concerning the design and implementation of IS nationwide. In this era where information is a powerful resource and CIS, being the custodian of information-related activities, making it strategic and powerful. In terms of organization hierarchy, CIS is at the top of the organization structure; they have the power of command. Therefore, the hierarchical position and organization context bestowed on CIS staff make them more powerful. Consequently, they do not want to engage in mutual negotiations (Pichault, 1995) with the end-users. This is technocratic reasoning as technocrats believe that information is a powerful resource that many people value in any organization (Pichault, 1995). Therefore, implementing IS could create a conundrum regarding power and control (Warne, 1998).

The implementation of SIS took the form of training workshops with staff at the peripheral level. The workshops were held in the regional health delegations but were organized, supervised, and facilitated by CIS staff. For example, a series of workshops organized at the Littoral Delegation of Health were attended by end-users (district offices and program managers) from the Littoral, Northwest, and Southwest regions.

We take as a general conviction the importance of involving staff at the peripheral level throughout the design and implementation of IS. The World Health Organization (WHO)

emphasizes that the process of implementing IS should be highly participative so that there should be consensus (WHO, 1995). However, in practice, the CIS makes all decisions. As shown, this has created a paradox that has left the end-users in an indefensible position with no opportunity to participate in mutual negotiations.

4.2 The distinction between IT professionals and end-users - différance

Decision-making - Despite preaching commitment to and recommendations on the value and participation of end-users, a close examination of the dynamics during implementation suggests a contrary interpretation. We found that, rather than creating an atmosphere to foster joint participation, the CIS' decisions limited end-users' involvement during implementation.

The end-users reported that they were delighted that the CIS is seeking to strengthen the IS by introducing a standard list of health indicators. The participants (end-users) expressed the desire to be more involved in the process; for example, in designing tools, because many of those designing the tools are not familiar with the context and how data is collected:

> *"…the CIS people sit in Yaoundé and design tools to be used by someone working in Limbe [on the ground] for example, without them knowing how data is collected on the ground. … when it comes to information, the central level seems to impose tools"* (PM).

When CIS designed the tools without involving them in the process when they are the ones to use the tools, it highlights a distinction between both levels of staff. It illustrates a relationship of superiority (Mintzberg 1984; Chen et al., 207), that the IT professionals have control and authority, while the end-users are subordinates. The health care sector includes partners and stakeholders with different information needs. The national list of indicators should, to some extent, accommodate the needs of the other partners (Sapirie and Orzeszyna, 1995), hence the need for stakeholders to participate. When a single body makes the decisions, as in this case, the list of indicators is not representative or comprehensive. The program managers reported that the MRA is not exhaustive because the indicators represent the information needs of the managers at the central level. This exclusive decision-making by the CIS illustrates their supremacy in IS implementation.

Reinforcing the CIS' superiority over staff at the peripheral level was the title of the workshop, namely "END-USERS WORKSHOP ON DHIS2 IMPLEMENTATION". Another way of illustrating dominance was how the staff were grouped. For example, CIS staff, i.e., computer programmers and data analysts, are known as "IT professionals," and staff at the peripheral levels are grouped as "end-users." It is interesting that in the IS domain, staff are acknowledged as 'professionals' while there is no acknowledgment that many so-called end-users may also be

professionals in their respective domains. For example, the peripheral level includes professional nurses, medical doctors, monitoring and evaluation specialists, and program managers who are all professionals in their respective domains. Consistent aggregation of end-users across the disciplinary and hierarchical levels to create a homogenous end-user category facilitates stereotyping and emphasizes différance. Furthermore, the use of the term end-user depicts them as technologically naïve. It suggests that staff at the peripheral level are consumers rather than those managing and controlling the IS at the peripheral level.

Reaffirming the distinction between IT professionals and end-users is the separation of activities. The DIO reported that CIS staff facilitated all sections of the workshops while the end-users were participants who sat down to be taught how to manage the system. Other qualified and experienced staff at the peripheral level could have been involved but were not among the facilitators. This distinction validates the separation between the two groups. Similarly, it depicts end-users lacking technical knowledge and as inexperienced consumers who play a passive role while the IT professionals are technocrats with technical expertise to build IS.

Training content – The end-users reported that the training primarily focused on operational aspects of using the DHIS2 platform and did not cover areas that were relevant to most staff. FIO explained:

> *"The training focused mainly on operational aspects of the new data collection tools; and how to capture data, report generation on the DHIS2 platform. They did not teach areas that were relevant to program managers such as data analysis"* (FIO).

It is evident that the training end-users received was not what they needed. Had they participated in the planning process, they would have had an opportunity to explain their training needs. Instead, the IT professionals imposed what they considered appropriate for end-users, giving them no room to negotiate. Such practices illustrate the superiority tendencies of CIS staff over end-users and reiterate différance - a difference between IT professionals and end-users.

4.3 End-users are a supplement to IT professionals - supplément

The data presented above shows that the CIS staff and end-users are different. The CIS staff teach and guide the end-users on managing health indicators at the peripheral level, portraying the end-users as lacking knowledge. Focusing on these differences sets the rationale for why CIS staff make all decisions on the implementation of SIS. The end-users' dependence reaffirms the power of the CIS and legitimates the condescending attitude towards end-users but creates a contradiction when it comes to those responsible for managing the IS at the peripheral level. At the peripheral

level, end-users such as facility information managers must ensure that data is adequately and accurately collected and submitted on time. A manager explained:

> *"…it is the responsibility of facility managers to train on health indicators, data quality assessment, data use to all staff responsible for data management activities at the health facilities, and on HIS"* (FM).

Another manager added:

> *"At the facility, we [managers] are responsible for ensuring adequate data quality. We have to review data, validate, and sign off on it...."* (MHIC).

If end-users are portrayed as *supplément* to IT professionals, the tasks end-users perform are not supplemental. End-users play a very significant role that is almost equivalent to that of IT professionals. If data is not correctly managed at the peripheral level, managers and decision-makers within the healthcare system will not have accurate data. Considering end-users as *supplément* to IT professionals while, at the same time, expecting them to manage the IS, is contradictory. This is because, on the one hand, they are considered passive and technologically naïve. At the same time, on the other, they are recognized as managers who are supposed to train staff on data management-related activities and manage the IS at the peripheral level.

5. DISCUSSION

This study aimed to explore the relationship between IT professionals and end-users. Focusing on implementing SIS within a centralized, hierarchical structure, we found evidence of contradictions and logical inconsistency in their relation. Despite emphasizing the importance of end-users' involvement and joint participation, in terms of decision-making, distribution of tasks, and responsibilities during implementation, we identified ambivalence regarding the degree to which end-users can be expected to be true co-agents with IT professionals. The heavy emphasis on joint participation during the implementation of IS, is contradicted by the actual procedures recommended to engage end-users. Pichault (1995) explain that from the IT professional perspective, IS implementation creates a conundrum in respect of power and control in the organization because the political structure of the organization is affected (Warne, 1998). While from the end-users' perspective, the actions and behavior of the IT professionals are equivocal in their commitment to participate and ambivalent, reinforced by the dichotomy set up between the groups. These behaviors by staff at the central level have elements similar to différance and supplément. In terms of différance, end-users are portrayed as naïve and passive, and IT

professionals are more knowledgeable and professional. The IT professionals are in charge, and end-users are supplementary staff.

Using the concept of supplément, we showed that this privileged dichotomy is not sustainable in that the end-users are expected to be responsible for the IS outcomes as they manage the system at the peripheral level. This contradiction illustrates the confusion surrounding the relationship between IT professionals and end-users. It leaves both end-users and IT professionals in an untenable position, with end-users submissive while IT professionals are in charge of the implementation of SIS. We argue that these characterizations are likely to undermine mutual interactions between IT professionals and end-users and, in an exciting twist, disable end-users, leaving them ill-equipped, less confident in using health indicators and negotiating with IT professionals. As a result, end-users do not have the necessary skills and resources required to manage the IS. These findings may shed light on end users' recurrent lack of skills and resources to use IS at the peripheral level, which has been well-documented in the literature (See: Asah et al., 2021; Njuguna et al., 2019; Lippeveld, 2017; Nicol et al., 2017; Nutley et al., 2013).

Using deconstruction is valuable in exposing inconsistency and the contradictory actions and behaviors embedded in the organization where the two groups (IT professionals and end-users) interact daily. Such behaviors or actions are often not detected and tend to remain undiscussed or unexamined (Beath et al., 1994). In this case, deconstruction helped bring to light the dominance and contradictory relations in the management of HIS. These actions or behaviors do not exist in a vacuum; they are derivative of the institutional context, which includes industry-wide structures of historical patterns of resource allocation and the norms on how and where institutions operate.

In every organization, there is a relationship of interdependence between different professional groups. These relationships are often complex and tend to be managed by dominance and are sustained by the particular structures of power and norms that constitute the organizational structure (Giddens, 1984). This could lead to one interest group having more privilege and authority over another by being assigned greater legitimacy and resources, which are the same means through which dominance is perpetuated. Similarly, in HIS management, the interdependence between IT professionals and end-users depicts a relationship of domination. The very notion of end-user portrays CIS staff as naturally in charge and having the authority to decree the participation of end-users. Therefore, the process of implementing SIS in Cameroon is one in which some staff is designated as IT professionals and others as end-users, with the IT professional having more power and control over the end-users.

6. CONCLUSIONS

This study examined the relations between IT professionals and end-users. In theorizing these relations, we found that IT professionals and end-users are embedded in a relationship of dominance exercised through actions and behaviors similar to that of différance and supplément. These actions are derivative of the technocratic ideas of HIS and the hierarchical organizational structure of HIS in Cameroon, which tends to privilege one group, IT professionals, over end-users.

From a theoretical perspective, the study feeds into the discourse around IS implementation and ICT4D by illustrating a novel way of examining relations within IS management and bringing to light a new factor that could explain the non-use of IS at the peripheral level. In addition, using the hermeneutic phenomenological focus and linking to différance and supplément to scrutinize the relations between IT professionals and end-users is novel. These concepts are generally utilized to deconstruct the published text. Using them to deconstruct unpublished text makes the analysis unique and innovative. The paper concludes that the technocratic thinking and centralized decision-making in HIS are roadblocks to the successful implementation and use of IS. Such as in building local capacity and provide infrastructural support at the peripheral level in centralized organizational settings.

This study has several limitations. First, deconstruction has often been used to analyze printed and published text. Second, we only interviewed end-users, and the study focused on the two English-speaking regions (formerly known as Southern Cameroons). These regions have lower levels of socio-economic development than other regions in the country. Third, the fieldwork was conducted amidst political unrest in the English-speaking regions of the country. The findings presented are the participants' interpretations and the researcher's interpretation of social reality. Another researcher could have a different interpretation. While this is one possible approach to theorize a case in point, further research is required on alternative paths.

AUTHOR'S CONTRIBUTIONS

FN led the interviews, transcribed and analyzed the data, and kept a reflective diary throughout the process. FN is a Cameroon and a knowledge broker who has worked with healthcare providers at the peripheral level. The impact of an existing professional relationship between the interviewer and interviewees was taken into account during data analysis through the researcher's reflexive diary entries. Throughout the study, the themes identified were discussed with JK, and he gave critical input to the manuscript.

ACKNOWLEDGMENTS
We would like to thank the DIOs, FIOs, Program managers, Data managers, and health facilities managers from the North and South West and the Littoral regions who were interviewed, especially Mss. Bridget Kah, Munge Hellen, and Mr. Lukong of Limbe Regional Hospital.

Declaration of Conflicting Interests: The authors declared no potential conflicts of interest

Funding: No financial support was received for the research, authorship, and/or publication of this article.

Ethical Approval: This study was approved by the Norwegian Center for Research Data (Reference #: 45883). Ethical approval was sought from each Regional Delegation of Health.

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Ethics

REPUBLIQUE DU CAMEROUN

Paix - Travail - Patrie

MINISTERE DE LA SANTE PUBLIQUE

DELEGATION REGIONALE DU NORD OUEST

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N°297/NWR/RDPH

REPUBLIC OF CAMEROON

Peace - Work - Fatherland

MINISTRY OF PUBLIC HEALTH

REGIONAL DELEGATION FOR THE NORTH WEST

BAMENDA, the 30 SEP 2016

THE REGIONAL DELEGATE
Le Délégué Régional

To:

- Director of Regional Hospital Bamenda
- The RMCU-NMCP
- The Director of District Hospital Bafut
- The Director of District Hospital Bali
- The Focal Person, PMTCT/Reproductive Health

Subject: **Administrative Authorization to FLORA NAH ASAH to collect Research Data on "Achieving The goals of Universal Health Coverage: The Roles of Health Indicators in strengthening health management information systems in Cameroon".**

After a careful review of this study presented to us by this student, we are sure that ethical considerations will be respected in the process of data collection (which should be overseen by trained personnel), after the consent of the participant has been obtained

With the clarity of her methodology and in view of the importance of this research, we have no objection to her carrying out her research on **"Achieving the goals of Universal Health Coverage: The Roles of Health Indicators in strengthening health management information systems in Cameroon".**

I therefore call on you to give this student the necessary assistance to enable her carryout this study of scientific importance.

THE REGIONAL DELEGATE OF PUBLIC HEALTH

P.O

MINISTERE DE LA SANTE PUBLIQUE DELEGATION REGIONALE REGION DU NORD OUEST NORTH WEST REGION REGIONAL DELEGATION MINISTRY OF PUBLIC HEALTH

Dr. Che Soh Kingsley
Medical Doctor (Medecin)
M.D. (Hons). MPH (Hons)

Cc:

- Flora Nah ASAH
Department of Informatics
Faculty of Mathematics and Natural Sciences,
University of Oslo, Norway

- File

REPUBLIQUE DU CAMEROUN
PAIX-TRAVAIL-PATRIE

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N° 2493/L/MINSANTE/DRSPL/BCASS

Douala, 26 SEPT 2016

MONSIEUR LE DELEGUE
A
MESSIEURS LES CHEFS DE DISTRICT
DE SANTE DE LOGBABA ET NEW BELL

Objtet : **Autorisation de Recherche**

Messieurs,

J'ai l'honneur de vous informer que Madame **Flora NAH ASAH,** étudiante en PhD au département d'informatique de la faculté de Mathématiques et des Sciences Naturelles de l'Université d'Oslo en Norvège, est autorisée à effectuer des travaux de recherche sur le projet intitulé « **The roles of Health Management Information Systems (HMIS) for Universal Health Coverage (UHC)** » au sein des institutions hospitalières dont vous avez la charge en vue de la rédaction de son mémoire de fin de formation. Ces travaux se déroulerons sur une période de trois (03) semaines, allant du 27 septembre au 18 octobre 2016.

Veuillez agréer, Messieurs, l'expression de ma considération distinguée.

Ampliations :
- MINSANTE
- Intéressé
- Archives /Chronos

REPUBLIQUE DU CAMEROUN
Délégation Régionale de la Santé Publique du Littoral
Le Délégué
MINISTERE DE LA SANTE PUBLIQUE

Dr. YAMBA BEYAS Martin

GHANA HEALTH SERVICE ETHICS REVIEW COMMITTEE

In case of reply the number and date of this Letter should be quoted.

Research & Development Division
Ghana Health Service
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MyRef. GHS/RDD/ERC/Admin/App/921
Your Ref. No.

1st March, 2018

Flora Nah Asah
Department of Informatics
UIO

The Ghana Health Service Ethics Review Committee has reviewed and given approval for the implementation of your Study Protocol.

GHS-ERC Number	**GHS-ERC: 017/11/17**
Project Title	Operationalization of Health Indicators for the Achievement of Universal Health Coverage Goals
Approval Date	27th February, 2018
Expiry Date	26th February, 2019
GHS-ERC Decision	**Approved**

This approval requires the following from the Principal Investigator

- Submission of yearly progress report of the study to the Ethics Review Committee (ERC)
- Renewal of ethical approval if the study lasts for more than 12 months,
- Reporting of all serious adverse events related to this study to the ERC within three days verbally and seven days in writing.
- Submission of a final report **after completion** of the study
- Informing ERC if study cannot be implemented or is discontinued and reasons why
- Informing the ERC and your sponsor (where applicable) before any publication of the research findings.

Please note that any modification of the study without ERC approval of the amendment is invalid.

The ERC may observe or cause to be observed procedures and records of the study during and after implementation.

Kindly quote the protocol identification number in all future correspondence in relation to this approved protocol

SIGNED.....
DR. CYNTHIA BANNERMAN
(GHS-ERC CHAIRPERSON)

Cc: The Director, Research & Development Division, Ghana Health Service, Accra

Institutional Research Ethics Committee
Research and Postgraduate Support Directorate
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11 December 2017

Ms F N Asah
Department of Informatics
Faculty of Mathematic and Natural Sciences
University of Oslo

Dear Ms Asah

Operationalization of health indicators for the achievement of Universal Health Coverage goals

The Institutional Research Ethics Committee acknowledges receipt of your gatekeeper permission letter.

Please note that FULL APPROVAL is granted to your research proposal. You may proceed with data collection.

Any adverse events [serious or minor] which occur in connection with this study and/or which may alter its ethical consideration must be reported to the IREC according to the IREC Standard Operating Procedures (SOP's).

Please note that any deviations from the approved proposal require the approval of the IREC as outlined in the IREC SOP's.

Yours Sincerely,

Professor J K Adam
Chairperson: IREC

DUT DURBAN UNIVERSITY OF TECHNOLOGY

2017 -12- 11

INSITUTUTIONAL RESEARCH ETHICS COMMITTEE
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health
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DIRECTORATE:
Health Research & Knowledge Management

HRKM Ref: 468/17
NHRD Ref: KZ_201711_024

Date: 30 November 2017
Dear Ms F. Asah

Approval of research

1. The research proposal titled **'Operationalization of health indicators for the achievement of Universal Health Coverage goals'** was reviewed by the KwaZulu-Natal Department of Health.

   The proposal is hereby **approved** for research to be undertaken at Umzinyathi District..

2. You are requested to take note of the following:
   a. Make the necessary arrangement with the identified facility before commencing with your research project.
   b. Provide an interim progress report and final report (electronic and hard copies) when your research is complete.

3. Your final report must be posted to **HEALTH RESEARCH AND KNOWLEDGE MANAGEMENT, 10-102, PRIVATE BAG X9051, PIETERMARITZBURG, 3200** and e-mail an electronic copy to hrkm@kznhealth.gov.za

For any additional information please contact Mr X. Xaba on 033-395 2805.

Yours Sincerely

Dr E Lutge

Chairperson, Health Research Committee

Date: 26/07/18

e-Tracker Usability Survey

Information Sheet

Achieving Universal Immunization coverage is one of the Sustainable Development Goals of health system strengthening. Unfortunately, ensuring a system of getting reliable immunization data continue to elude the program in the African Region due to many challenges. Several studies have reported inconsistencies in data reporting as well as poor support mechanisms to ensure data quality. In June 2015, Ghana, introduced e-Tracker to eliminate data omissions and improve on accuracy of immunization data which you are presently using to record immunization data.

The purpose of this survey is to assess the usability of e-Tracker in meeting the above goals. This study is part of a bigger study titled "***Operationalization of health indicator for the achievement of Universal Health Coverage goals.***" Ethical Approval obtained from **GHS-ERC: 017/11/17**.

Your participation is volunteer and free and there is no remuneration for participation. Your participation is volunteer and free and there is no remuneration for participation. In the course of answering these questions, you are either free not to answer any question or withdraw without any circumstances without any prejudice. Any information provided shall be confidential and personal details shall be concealed to maintain the confidentiality and anonymity of respondents' identities.

Your responses will help us understand what aspects of e-Tracker you are particularly concerned about and the aspects that satisfy you.

In the events of any problems of queries, you can contact the following:

Supervisor	**Researcher**	**Administrator**
Petter Nielsen University of Oslo Email: pnielsen@ifi.no	Flora Asah University of Oslo Tel: +47 94720435 Email: florana@ulrik.uio.no	Ghana Health Service Ethics Review Committee Research & Development Division Tel.: +233 0507 041 223
Complaints can be reported to:		
Ghana Health Service Ethics Review Committee Research & Development Division Tel.: +233 0507 041 223		

CONSENT FORM

Statement of Agreement to Participate in the Research Study:

- I hereby confirm that I have been fully-informed about the nature, conduct, benefits and risks of this study, Research Ethics Clearance **GHS-ERC: 017/11/17**
- I have also received, read and understood the above information (Information Sheet) regarding the study.
- I am aware that the results of the study, including personal details regarding my sex, age and date of birth will be anonymously processed into a study report.
- I am aware that at any stage, without prejudice, withdraw my consent to participate in the study.
- In view of the requirements, I agree that data collected during this study can be processed in a computerised system by the researcher.
- I have had sufficient opportunity to ask questions and (of my own free will) declared myself prepared to participate in the study.
- I understand that any new findings developed during the course of this research which may relate to my participation will be made available to me (if need be).
- I hereby provide my consent to use my photographs for research purposes.

_____	_____	_____	_____
Full Name of Participant	**Date**	**Time**	**Signature**

I, _____ (name of researcher) herewith confirm that the above participant has been fully informed about the nature, conduct and risks of the above study.

_____	_____	_____
Full Name of Researcher	**Date**	**Signature**

e_Tracker Usability Survey

A. Personal background (Ticket the correct answer)

1. Name: _____ Date: _____
2. Gender: Male ❑ Female ❑
3. How old are you: 15 – 20 ❑ 21 – 25 ❑ 26 – 30 ❑ 31-35 ❑ 36 – 40 ❑ 41 – 45+ ❑
4. What is your highest level of education?
   a. Primary school ❑
   b. Secondary school, ❑
   c. Higher education, ❑ Namely: _____
   d. University, ❑ Degree: _____
   e. Other: Name: _____
5. How long have you been working at this facility
   a. Less than 6 months ❑
   b. 6 months – 1 yrs ❑
   c. 2 -3 yrs ❑
   d. 4+ ❑
6. Would you please indicate your present position: _____

B. Usability Metric

Component: Efficiency, Effectiveness and Satisfaction

Instructions and Items.

This questionnaire gives you an opportunity to express your satisfaction with the usability of e-tracker.

To as great a degree as possible, think about all the tasks that you have done with the system while you answer these questions.

Please read each statement and indicate how strongly you agree or disagree with the statement by circling a number on the scale. If a statement does not apply to you, circle N/A.

Whenever it is appropriate, please write comments to explain your answers.
Thanks for your participation!

For example, 1 = Strongly Agree 5 = Strongly Disagree

		1	2	3	4	5
1	Overall, I am satisfied with how easy it is to use the e-Tracker to capture EPI data.					

Comment: Please *specify some specific features of e-Tracker that makes data capturing easy?*

_____

		1	2	3	4	5
2	I feel very confident using the e-Tracker					

Comment: ***Please could you explain***

_____

		1	2	3	4	5
3	I am able to complete my work quickly using the e-Tracker					

Comment: ***Could you give examples e.g. how much time it would take you to complete your tasks while using e-Tracker***

_____

		1	2	3	4	5
4	I can effectively complete my work using the e-Tracker?					

Comment: ***Could you explain what features in e-Tracker that have helped you to effectively complete your work?***

_____

		1	2	3	4	5
5	I am able to efficiently complete my work using the e-Tracker?					

Comment: ***What feature on e-Tracker makes you complete work efficiently?***

_____

		1	2	3	4	5
6	I feel comfortable using the e-Tracker?					

Comment: Explain why you feel comfortable using the e-Tracker

_____

		1	2	3	4	5
7	It was easy to learn to use the e-Tracker?					

Comment: ***Explain why it was easy or not easy to learn to use e-Tracker***

_____

		1	2	3	4	5
8	I believe while using e-Tracker in capture EPI data made me more productive?					

Comment: ***Explain why the e-Tracker made you more productive?***

_____

		1	2	3	4	5
9	I believe using e-Tracker to capture EPI data made me more productive?					

Comments: Provide examples of ***some of these error messages, if they are***

_____

		1	2	3	4	5
10	I think that I would like to use the e-Tracker					

Comments: Provide *example if possible*

_____

		1	2	3	4	5
11	I found the e-Tracker unnecessarily complex to use					

Comments: Provide *example if possible*

_____

		1	2	3	4	5
12	I think that I would need the support of a technician to be able to use the e-Tracker					

Comments: Provide *example if possible*

_____

		1	2	3	4	5
13	Whenever I make a mistake using the system, I recover easily and quickly					

Comments: Provide *example if possible*

_____

		1	2	3	4	5
14	The information (such as on-line help, on-screen messages and other documentation) provided with this system is clear					

Comment:

_____

		1	2	3	4	5
15	It is easy to find the information I need.					

Comment: Please provide *some examples if possible*

_____

		1	2	3	4	5
16	I found the various function in the system were well integrated					

Comment: Please provide *some examples if possible*

_____

		1	2	3	4	5
17	I thought there was too much inconsistency in the e-Tracker?					

Comment: Please provide *some examples if possible*

_____

		1	2	3	4	5
18	I found the system very cumbersome to use					

Comment: Please provide *some examples if possible*

_____

1 2 3 4 5

19	I needed to learn a lot of things before I could get going with the e-Tracker					

Comment: Please provide *some examples if possible*

_____

		1	2	3	4	5
20	The information provided with the system is easy to understand					

Comment: Please provide some *example if possible*

_____

		1	2	3	4	5
21	The information provided is effective in helping me complete my work					

Comment:

_____

		1	2	3	4	5
22	The organization of information on the system screens is clear					

Comment:

_____

Note: *The interface includes those items that you use to interact with the system. For example, some components of the interface are the keyboard, the mouse, the screens (including their use of graphics and language).*

		1	2	3	4	5
23	The interface of e-Tracker is pleasant to you					

Comment: *Please explain why it is pleasant*

_____

		1	2	3	4	5
24	I like using the interface of e-Tracker					

Comment: *Please provide specific examples*

_____

		1	2	3	4	5
25	The e-Tracker has all the functions and capabilities I expect it to have.					

Comment: Please provide *some example if possible*

_____

		1	2	3	4	5
26	Overall, I am satisfied with the e-Tracker					

Comment: Please provide *some example if possible*

_____

		1	2	3	4	5
27	I would imagine that most nurses would learn to use the e-Tracker very quickly					

Comment: Please provide *some examples if possible*

_____

Thanks for participating