SUSTAINABILITY ASSESSMENT OF ELECTRONIC BASED HEALTH INFORMATION SYSTEMS IN TANZANIA: A CASE STUDY OF TB AND LEPROSYDHIS2 SYSTEM IN DAR ES SALAAM AND DODOMA, TANZANIA

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CERTIFICATION

The undersigned certifies that he has read and hereby recommends for acceptance by the Open University of Tanzania, a research report titled***; "Sustainability Assessment of electronic based health information systems in Tanzania: A case study of TB and Leprosy DHIS2 system in Dar Es salaam and Dodoma July 2019"*** in partial fulfillment of the requirements for the degree of master of arts in monitoring and evaluation (MAM& E) of the Open University of Tanzania.

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Dr. Christopher Awinia

(Supervisor)

…….……

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DECLARATION

I**, Zuweina Kondo**, do hereby declare that this dissertation is my own original work that it has not been presented and will not be presented to any other University for a similar or any other degree award.

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Date

DEDICATION

This work is dedicated to our Librarian; Aunt Khadija Ally Kigingi for her exemplary support in assuring learnt generations exist in our extended family.

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ABSTRACT

A case study on the TB and Leprosy DHIS2 system was conducted by a cross sectional descriptive research design, to assess the sustainability factors of the TB and Leprosy DHIS2 system in Dar es Salaam and Dodoma regions. The main objectives were to identify the availability of resources for the TB and Leprosy DHIS2 system, to identify the benefits of the system and to find out availability of formal guidance in the implementation of the TB and Leprosy DHIS2 system measures. A sample size of 68 health care workers and 05 Ministry of Health officials were selected purposively.

The study revealed that health care workers participants agree that the system is useful to them, extraction of reports being the major reason for that. 54% were the permanent government staff with 40 of them (59%) having basic computer knowledge before and 54% have available ICT assistance at their facilities. The study established a use of a local developer, availability of guidelines and coordinative platform for digitization in the Country. 63% of the hardware we repurchased by the Ministry while 53% of them use their own means to cover for internet cost.

It is recommended that the government should ensure the existing efforts are synchronized with factors which can endanger the sustainability. Measures like expanding and improving the fiber optic networking and budgeting for the system support at lower levels should be given priority. Similar studies in the context of the PO RALG ministry and the benefits of the electronic based Health Information Systems in terms of quality of data have been recommended.

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LIST OF ABBREVIATIONS

CCHP	Comprehensive Council Plan
DHIS2	District Health Information System 2
DSM	Dar Es Salaam
EPI	Ministry of Health Community Development Gender Elderly Children
EHIS	Electronic Health Information System
HCWs	Health Care Workers
HIS	Health Information System
HISP	Health Information System Program
MOHCDGEC	Ministry of Health Community Development Gender, Elderly and Children
MHN	Metrics Health Network
MTUHA	Mfumo wa Taarifa, wa Utoaji, Huduma za Afya
NTLP	National Tuberculosis and Leprosy Program
PO RALG	President Office Region Administration and Local Goverment
TB	Tuberculosis
WHO	World Health Organisation
UDSM	University of Dar Es Salaam

CHAPTER ONE

INTRODUCTION

1.1 Background

Health information system (HIS) is an organized combination of people, technology and dissemination of information in the health care organization. It has four key functions: data generation, compilation, analysis and synthesis, and communication and use. The health information system collects data from the health sector and other relevant sectors, analyses the data and ensures their overall quality, relevance and timeliness, and converts data into information for health-related decision-making(WHO, 2008).It is one of the six core components of health system and thus essential in attaining the health goals, (WHO, 2008).As such countries around the world, developing world included have been putting deliberately efforts in order to have functional and effective HIS.

Tanzania HIS history goes as back as from 1960s with only a system to collect the mortality and morbidity to early1990s when a more comprehensive system was implemented known as MTUHA (Mahundi M.H., 2010)Apart from MTUHA, the other major source of health information in the country is from the Vertical Programs which have additional different tools for recording and reporting of their information (Mwangu, 2003).The Vertical programs started to be in the picture since the 1980s (Mungwabi, 2006) and therefore new data needs were introduced in the Ministry.

The Paper based system proved to be not useful as the evidence shows that data produced were not used for planning and decision making as they were untimely

reported, incomplete and of poor quality (Makombe, et al., 2008).Thus it has been established that to make HIS more efficient computerization or digitalization is essential. The potential of computerization in transforming health care delivery has been long been identified in the developing countries including Tanzania (MOHCDGEC, 2013) and in other African countries (Wilson, 2000).Thus many African countries had started to embrace the process by utilizing information technology to strengthen its health information systems.

Tanzania is one of the countries which embraced the process of utilizing electronic systems through information communication and technology (ICT) in the management of health. There are couples of systems which have been introduced, from the simple hospital management applications to complex surveillance systems for monitoring care and health interventions. These technologies have been implemented either by the government, private sector or with other stakeholders (GoT, Systems Inventory from multiple sources, 2016). The electronic systems have been implemented with a rationale that they will improve healthcare delivery by enabling information access and supporting healthcare operations, management, and decision making(MOHCDGEC, 2013).

The process of introducing the computerized systems in HIS is not simpler and thus its success mostly relies on the foundation available which will guide, support and advocate its existence and hence sustenance. Lack of formalized policy guidelines was attributed to the failure of the initial implementation of DHIS2 in Tanzania(Lungo J. , 2008). Health Information system comprises of many stakeholders and actors whose interests can be competing and challenging. Clear guidelines are essential to guide the

implementers and to safeguard the Government's interest and focus. The absence of guidelines resulted in weak coordination and challenged decision making such that integration and standardization in the DHIS2 was not achieved (Mahundi M. H., 2010). The integration process has been a main struggle in the implementation of computerized HIS in Tanzania bringing fragmentations of information (Mahundi M. H., 2010).

The fragmentation is brought by the parallel systems of the vertical programs, implementing partners and private sectors. This has resulted inconsistency, and inefficiency of the system and the data reported as well as challenged standardization process (Mahundi, Chaula, & Igira, 2018).The influx of parallel systems introduced by different stakeholders and different units within the ministry has been cited to be due to the inability of the main HIMS system (DHIS) to carter for the need of all. In this chaotic situation which seems unavoidable, then integration, linkage and interoperable systems has been since been advocated (MOHCDGEC, 2017). The systems are urged to be implemented only if there is really a need and that they should be able to function with other existing and recurring system.

The implementation of electronic based HIS in Tanzania, just like in other developing countries is characterized by poor support and hence low investment. Fund support for the implementing of these systems is mostly from the developing partners, making a financial sustainability a challenge (Nyella & Kimaro, 2015). This is made worse by the existence of the systems implemented by the vertical programs which although are coordinated by the Ministry but they are mostly financed by developing partners, raising serious questions about their sustainability (Kiwara, 1994).

Availability of human resource who are capable of using and maintaining of the system is a key ingredient. Human resource capacity to sustain these systems goes beyond the development of basic skills. It extends to technical skills, planning, policy analysis, formulation and management (Kimaro H. , 2006).In 1997, Tanzania had to opt to purchase a new software simply because the existing Dbase could not be upgraded to align with the newly revised paper HMIS, even though the Ministry of health had a source code (Kimaro H. , 2006).

The implementation of technology on one hand and the information system on the other has made the electronic based HIS implementation a complex process. Thus, Organizational context plays a role in determining how these complexities will be accepted and use. The context dictates how ready the people are and what is their culture in regard to computer and data use. Thus, the social technical factors play a major role in shaping the complexity nature of these systems and hence affect the sustainability.

The computerization process comes with an introduction of "new" technology of which for the developing countries is a forced global opportunity which they have no choice rather to face the challenges which comes with it. The technologies adopted pose challenges arising from the designs, which most of the time have external origins, which poses threats to the success of the implementation in another context. The technological adaptations challenges are exacerbated by the preexisting health systems gaps such as the shortage of the human resources and their capacity to use the Computerized systems (Kimaro H. , 2006). Technically the kind of technology to be adopted is important to determine the customizability, flexibility and hence sustainability of the technology. Source codes which are owned by private vendors have proved to be a failure to the

developing countries Tanzania included (Kimaro H. , 2006).The experience is that the private vendors usually retain the code and keep charging the government for the services such as clearing the bugs and developing new formulas for new indicators (Kimaro H. , 2006).

Other contextual factors which affect the implementation of the ICT based HIS and pose a threat to sustenance are the poor culture of the use of the collected information and also the challenged administrative structures which determines the decision-making process. Tanzania is among the countries which are implementing the D by D policy where by planning has been decentralized to the local government authorities. However, the Ministry responsible for health remains to be the responsible one to develop guidelines and policies and also responsible for resource mobilization. It is a practice that the innovations in HIS, computerization included, are mostly introduced by the higher ministries and dropped down to the local government for the implementation and sustainment.

Tanzania has come a substantial way in the implementations of these systems. Lessons have been learned and evidence gathered. Even though the ICT based HIS implementation has been faced with the challenges, benefits have been registered and that is why the government is continuing supporting the implementation and strengthening of the systems.

During this past two decades, it has been established that the electronic based HIS systems consumes high investments, i.e. time as well as a substantial amount of funds. Making sure that these systems deliver what they were aimed for is mandatory. Hence

assessment of sustainability of the systems is important to inform the government and the partners on what works and what do not.

1.2 Statement of the Problem

Robust information system is needed not only to monitor progress towards the SDGs but also to improve care at the local patient level(WHO,2008).Digitization through ICT in the HIS is believed to be a better way to strengthen the systems in order to improve efficiency and effectiveness.

Tanzania has embraced and adopted the use of electronic systems in health care as witnessed by mushrooms of multiple ehealth systems for the past two decades. The systems implementation provide a unique opportunity for a pool of lessons learned and best practices to further informing the current national wide efforts in maintaining the electronic based HIS.

Therefore, due to the fact that electronic based HIS has promised to bring fruitful results apart from exiting implementation challenges, taping the learned lessons is very crucial as a means to drive the country towards sustenance of the systems. As the investment to these systems is very high, this also calls for the need of sustainability assessment of the systems.

The study is a formative evaluation of the DHIS2 system for Tuberculosis and Leprosy control to assess how the challenges of digitization of his implementation have been considered. The study aimed at finding out if the desired outcome has been attained and if the system will likely be sustained or not. The assessment focused at what is working, and why or what is not in the context of Tanzania. In line with this, lesson learned have

been documented for Program progress improvement. This will also provide a lesson learned to inform the government in line with the current national efforts. In addition, as the Policy makers and donors are also increasing concerned with the impact of the invested interventions (Stirman, et al., 2012) thus the study will provide a valuable information to this community for their further decision making, planning and resource allocation.

1.3 Objectives of the Study

1.3.1 General Objective of the Study

1.3.2 To Assess the Sustainability Factors of the TB and Leprosy DHIS2 System in Dar es Salaam and Dodoma Regions July 2019 Specific Objectives

(i) To identify the availability of resources for the TB and Leprosy DHIS2 system

(ii) To identify the benefits of the use of TB and Leprosy DHIS2 system

(iii) To find out availability of formal guidance in the implementation of the TB and Leprosy DHIS2 system measures.

1.4 Research Questions

1.4.1 General Research Question

What factors will make the TB and Leprosy DHSI2 system sustainable.

1.4.2 Specific Research Questions

(i) What resources are available for the use of the TB and Leprosy DHIS2 system?

(ii) What are the benefits of using TB and Leprosy DIHS2 system

(iii) What are the key policy guidelines, which guided the development of the TB and Leprosy DHSI2 system?

1.5 Relevance of the Study

The Study will provide information of how the government of Tanzania has so far gone to ensure the highly invested useful eHealth systems are sustained. It will contribute to the pool of knowledge of the factors which are affecting sustainability of the ICT based HIS focusing on what works and what does not. Specifically, it will provide information of how the DHIS2, a system which has gained popularity in developing countries, has evolved and possibly sustained.

Thus the evidence based generated by this research will provide the policy makers, donors and planners with information to use in decision making, planning and resource mobilization with regarding the implementation of the electronic systems in health.

1.6 Organization of the Study

This research study involves five chapters, whereby chapter one includes the background of research problem of sustainability of electronic health information systems, state the statement of research problem and describing the objectives. The Chapter also has the stated the research questions and justification of the research.

Chapter two comprises of conceptual definitions, theoretical literature review and empirical literature review from the World, Sub-Saharan Africa and home country Tanzania. In addition policy review on the information technology, research gap and

Conceptual and Theoretical framework as a guide has also been described in this chapter.

Chapter three covers research methodology, describing the approach and design used in this study. The data collection techniques and methods of sample determination has been described. It further describe how the collected data was analysed. Chapter four comprises the Analysis and Interpretation of the findings and Chapter five summarize, concluding and providing the recommendations about the study.

CHAPTER TWO

LITERATURE REVIEW

2.1 Overview

This chapter highlights the meaning of key terms which will be used in this study and then provide insights of the available theories regarding the HIS, eHealth, (ICT) and their evaluations with a focus sustainability assessment. It will also provide of review of previous sustainability studies focusing on their recommendations towards sustainability of ICT in health. The review will explore the similar studies in Tanzania, neighboring countries, Africa at large and other developing countries.

2.1.1 Conceptual Definitions

2.1.2 Health Information System (HIS)

Health information system is defined as an organized combination of people, technology and dissemination of information in the health care organization. It collects data from the health sector and other relevant sectors, analyses the data and ensures their overall quality, relevance and timeliness, and converts data into information for health-related decision-making (WHO, 2008).A national HIS is composed of data from the routine data collection systems, as well as information from other sources such as community surveys, census. It is recognized as one of the six building block of Health System Strengthening (HMN, 2008).

2.1.3 eHealth

The term eHealth -electronic Health, means the use of information and communication technologies (ICT) for health. It is defined by WHO as: “the transfer of health resources

and health care by electronic means". Examples of eHealth solutions are disease surveillance, primary data acquisition and analysis, support of community health care workers, teleconsultations, teleeducation, research and patient management (Kiberu, Mars, & Scott, 2017).The solutions use variety of technological solutions including online medicines, radio, fixed phones, television, devices for text messaging, teleconference, and video conferencing and sharing through email (GoT, 2013).

2.1.4 mHealth

mHealth is a sub component of eHealth. It refers to medical and public health practices supported by mobile devices personal digital assistants (PDA) and other wireless devices. Rapidly internet and mobile cellular use has provided opportunities for innovation and cost effective health services through use of ICT. They bring services closer to hard to reach populations who have restricted access to health care facilities.

2.1.5 DHIS2

DHIS2 is a short form for District Health Information System. It is an open source code web-based system which was originated in South Africa in 1998 and then later its use has been spread to other African countries(Karuri, Waiganjo, Daniel, & Manya, 2014).It is a computerized tool for collecting compilation and dissemination and use of HIS data.

The source code is free and thus health care workers are able to use their data, analyses, predict needs and assess performance in achieving the set targets. The system can easily be adopted to fit the country context.(Braa, Monteiro, & Sahay, 2004).It has been playing and enabling tool role for acquisition, dissemination and use of HIS data.

The system has been scaled up in other developing countries such as Mozambique, Tanzania, Srilanka, Malawi, Mongolia, Cuba, Ethiopia, Kenya and Uganda. As it based on a free and open source software (FOSS), it gives the countries an opportunity to get the software free of charge and make use of local expertise to customize it according to the specific needs (Karuri, Waiganjo, Daniel, & Manya, 2014).

DHIS was initiated by HISP network which focuses on action research and user participation to customize the health information software with the aim of developing local knowledge and skills in computer, design, data handling and use.

DHIS2 supports data collection and analysis of routine health services as well as non-routine data such as population estimates, facility workload and survey data. In most countries the data is first collected in paper-based system of registers, tally sheets and monthly data collation. The collated monthly data is either entered directly into the web based DHIS2 or sent to the district level where is entered onto the DHIS2 then analyzed in the system. It captures health service delivery data and able tp do analysis at that level which promote data use.

2.1.6 Sustainability Analysis of Electronic Based HIS

In an oxford dictionary, sustainability comes from an adjective word, sustainable which means able to continue over a period of time. It means to maintain something that already exists overtime and is equated with being “self-sustained” implying no outside support is needed to continue its existence (Reynolds & Stinson, 1993).The early emphasis on sustainability was placed as an agenda within the environmental field in the Rio conference in 1997.

Young and Hampshire 2000 define sustainability strategy as specific approaches to ensure that the benefits are sustained and specify how key constraints to sustainability are addressed. Analysis of sustainability involves identifying the key factors which are likely to affect, whether negatively or positively the like hood of achieving sustainable benefits, (Kimaro & Nhampossa, 2004).

Sustainability of ICT is the ability to identify impacts and manage risks threatening the long term viability of ICT (Reynolds and Stinson 1993; Korperla et al 1998).On the other hand HIS sustainability refers to a system which is reliably meets information need of the health care sector. Thus the sustainability of ICT based HIS is a complex process as it involves the skills and knowledge of humans to collects analyses use and disseminate information as well as to deal with risks threatening ICTs (Kimaro H. , 2006).

2.1.7 Reviews of Theoretical Literature

Since the eHealth has gained popularity in the developing countries an interest to find out on their success and hence sustainability has also been growing. Thus a number of studies have tried to identify the factors associated with effective implementations of the ICT based health systems although most are focusing on only on the initial period which is still characterized by significant support from the donors.

Specifically, in Tanzania sustainability of HIS was assessed in an action research design study which the focus was on how the network of the involves partners could affect the attainment of sustainability of the DHIS2 system. The study which was conducted a decade ago suggested 3 networks: Ministry of health and the software vendors, Ministry

of health and the donors and donors and the software vendors which are crucial in shaping the sustainability of ICT in health (Kimaro & Nhampossa, 2004).Another study looked at how the human resources capacity had a an effect on implementation of DHIS2 in Tanzania and thus affect is success which was related that it would affect its sustainability.

Other studies have looked in challenges relating to the implementations of the HIS in Tanzania and other developing countries (Karuri, Waiganjo, Daniel, & Manya, 2014).Even though sustainability has been part of these studies but it was not a key focus. Sustainability study is a difficult endeavor the main challenge being the tension that exists between continuation of intervention as originally designed and the need to adapt them for use in different context from where they were developed and tested (Scheirer & Dearing, 2011).The assessment of Sustainability of interventions has been suggested to be done separately (Shediac-Rizkallah & Bone, 1998,).The successfulness of initial implementation of intervention/programs do not imply that the end results will also be successful. (Rogers, 2003).

The concepts for the assessment of ICT based HIS needs to originate from both sustainability of HIS and sustainability of ICT in order to understand the complex nature of sustainability of the ICT based HIS.

This study adopted a definition of sustainability as per Sterman et al 2012 as the continuation of the Programme or an intervention after initial implementation efforts of funding have ended and if: (i) core elements are recognizable and (ii) there are adequate capacity for making sure that continuation of the core elements is maintained. Further

pointed are the sustainability outcomes') continued reliability to core elements(ii)program activities and sustained (iii) desired benefits are maintained and (iv) maintenance of capacity to maintain the intended health benefits (Stirman, et al., 2012).

Thus for the TB and Leprosy DHIS2 system to be sustained the core elements are to be recognized such as the design and maintenance of the system, the HR capacity and outcomes of the system are realized. As available sustainability studies of ICT in health studies are as old as a decade ago, and mostly without a specific focus on sustainability per se, especially on the factors beyond the initial deployment of the software, this study will utilize the Sterman et al definition to assess the sustainability of TB and Leprosy DHIS2 exploring if the past lesson learned has informed its implementation to foster sustainability.

2.1.8 Empirical Analysis of Relevant Studies

2.1.9 Electronic based HIS (eHealth) in Tanzania

The Tanzania Government has been supporting the electronic of systems through ICT innovations as reflected by its introduction of the ICT policy in 2003, which outlines various issues including the need for continued effort for development of ICT infrastructure and appropriate human resources in the country as well as enabling environment for the adoption and use of ICT in all sectors.

Several ICT based health systems have been introduced in Tanzania even though few benefits has been documented as achievement (Lungo J. , 2008).Examples of these systems ranges from simple patient electronic medical records, supply chain management to complex data bases for data management such as the DHIS2.The 2016

Ministry of health inventory of the ICT based systems identified more than 100 eHealth systems in Tanzania.

The failure was characterized not only by the inability of the technology chosen but also inability to meet the desired objectives such as integration for case of initial DHIS2 implementation in Tanzania (Lungo J. , 2008).A literature review of e health implementations in Uganda by Kiberu VM, mars M and Scott in 2017 concluded that most of the implemented eHealth interventions in the developing world, were donor funded, operated in silos and thus lacked sustainability.

Table 2.1: eHealth Inventory, 2016

eHealth System type	**Total number**
Aggregate data	9
Facility data	3
Patient/client health data	28
Transport coordination	3
Human Resources	11
Supply chain	13
Finance	5
Insurance / payments	5
Hospital administration	14
Laboratory	4
Individual identification	6
Birth registration	5
Total	106

Source: MOHCDGEC -ICT unit database- 2016

DHIS2 system in Tanzania was first introduced in 2002 under an action research project between the University of Dar Es Salaam and University of Oslo. DHIS2 implementation has also been seen in other African countries such as Kenya, Uganda, Malawi and also in Zanzibar (Karuri, Waiganjo, Daniel, & Manya, 2014).The major

gap with the DHIS2 has been to integrate all the data requirement including the data from the vertical programs. Thus in 2013 the Ministry decide to accommodate the extra requirement for the TB and Leprosy Program using the same technology of the DHIS2 built on top of the main Ministry of health HMIS-DHIS2 and its data sync to the main ministry data warehouse. (GoT, 2017).

2.1.10 ICT Based HIS Sustainability Factors

Several factors have been implicated to be the cause of failure and thus un sustainability of the electronic HIS in the developing countries. The factors range from those relating to the nature and context of the organizations to the relationship between the actors.

2.1.10.1 Guidelines and policies

A strong foundation to implement successful eHealth systems is the presence of supportive and comprehensive health policy frameworks (Shuvo, et al., 2015). Lack of these guidelines has been reported as major barrier for eHealth innovations (Ahmed, et al., 2014).This result into un coordinated projects, which cause fragmentations, duplication of efforts and thus wastage of the investments.

Guidelines and strategies are important making sure that there is standard way of collecting information across the country. Lack of formal guidance resulted in freedom of health care workers to decide what data to collect which results into disparities. In Tanzania for example in a HISP project implementing DHIS2 found that one district was collecting antenatal visits before and after 16 weeks while the other district was collecting before and after 20 weeks (Mahundi M. H., 2010). In Uganda it was found out that the eHealth interventions lack prior planning stages such as strategy and need

readiness assessment which affects scale up and sustainability an of the interventions (Kiberu, Mars, & Scott, 2017).

The absence of regulatory systems for private sectors has also been condemned to be the cause of donors to yield unpleasant results (Rubona, 2001).An example is HIS for the HIV services in Tanzania where by the partner Medical Del Mundo operated for some time and then the duties were taken over by other partner called EGPAF (Mahundi M. H., 2010). Changing partner's results in dormancy of data introduced by the previous partner as the current one introduces additional variables as per their interests (Mahundi M. H., 2010).As a results HIS in developing countries are characterized by high volume of data but rarely used (Lungo J. , 2003).Thus coordination of donors and partners should be a priority in order to address sustainability.

2.1.10.2 Resource Availability

Resources which are required for the introduction and maintenance of the ICT based HIS ranges from the capital investments on the development of the software to the management of the human resources and equipment and infrastructure needed for the execution of the systems.

ICT in HIS in developing countries are characterized by scarcity of resources. Government investments in HIS is very low as WHO has stipulated that "It is often in countries which the greatest need that reliable and timely information is not available, owing to chronic under investment in systems for data collection, analysis dissemination and use (HMN, 2008).

Lack of funding in developing countries is one of the critical challenges. The general trend in these countries is for HIS projects to be funded through various sources from international donors to local-non-governmental organizations (Karuri, Waiganjo, Daniel, & Manya, 2014). In this way they frequently find themselves in a lock in situations. For example, the computerization of the MTUHA in Tanzania finds the Ministry of Health in a situation where by extra funds from donors was frequently sought to improve the system further and this drove the system to death (Kimaro, 2006).The trend of funding is still persisting as shown by (Karuri, Waiganjo, Daniel, & Manya, 2014) that implementation of the DHIS2 system in Kenya, Uganda, Mozambique, Zanzibar and Ethiopia was all funded by the donors.

Botswana experience of long term government support and funding in a telemedicine intervention show case how sustainability depends on government ownership (Littman-Quinn, Mibenge, Antwi, Chandra, & Kovarik, 2013).Thus the source of fund has been mentioned as a key to sustainability.47% of eHealth interventions in Low and Middle income Countries (LMCs) are donor dependent (Lewis, Synowiec, LagomarsinoI, & Schweitzer, 2012).

The fund support received by these countries extends to the purchase of the hardware so that the system can work as the availability of these equipment is not a common finding in the health care delivery settings. In a study by Muzaffar M and Haroon K in Peru. They found complete lack of IT hardware in the hospital, even when they decided to purchase some, none was available in the local market. In Tanzania Kimaro (2006) found out that the regional level health team had only five computers two of which were not working including the one used for HMIS.

Even though most of ICT in HIS projects do not necessarily lack equipment such as hardware, the experience is that once computers and software are installed, they require regular support, maintenance and upgrading of which government institutions fails to afford (Kimaro H. , 2006).

Adequate resources are a pre requisite for the sustainability of HIS, as it will decrease the dependence on donors. The required donor support might be important initially however it also paradoxically creates a situation of unsustainability. Donor supported IS projects have high risk of failure making sustainability a challenge (Muru et al 200).

2.1.10.3 Human Resource Availability and Capacity

ICT in health promise to increase efficiency and increase productivity and reduce workload, but in the environment where the healthcare workers do not have capacity to use the systems the reverse is true. Appropriate human resource is an important factor in the introduction of ICT in health.

It has been argued that for the success of ICT in HIS human resources with mix skills to understand meaning of data and use of computer is needed. ICT literacy contributes much to the success of the system (HRDR,2003: UNDP,1999).A study conducted in Tanzania establishes that formal training in ICT among health care workers is limited and thus usage of ICT was low (Ndumbaro, 2003).

It is has been shown that ICT projects in developing countries fails at higher rate than in developing world simply because of lack of appropriate skills and knowledge to identify and deal with risks associated with ICT on long term basis (Heeks, 2002).It is critical to have appropriate ICT learning and training measures for sustainability of ICT

(World Bank, 1997).In Tanzania regional health team levels were characterized by inability to fix bugs such that a private company provider was hired and computers were left without being used just because of a hard disk problem and data were lost due to viruses in computers without anti viruses (Kimaro H. , 2006).

Two key challenges have been recommended to be addressed by the developing countries in order to benefit from IT investments. The challenges are: to address the lack of knowledge of best practices in IT usage and to address IT related skill deficiencies in the workforce through learning and training (Indjikian and Siegel 2005, p.1). Apart from the ability to use the system, the capacity to manage an troubleshoot is also essential. Here there is importance of building in country capacity around ICT development and support for long-term sustainability. (Ahmed, et al., 2014).

2.1.10.4 Technology Based Factors

On a technical side we see that the designs of the eHealth solutions have been reported to be an important ingredient if health innovations are to be scaled up and sustained(Ahmed, et al., 2014).Thus the nature of the Software itself plays an important role in assuring sustainability. Appropriately complexity of the projects, scope creep, poor user- interface design, lack of clarity on the functionality required and lack of sensitivity to the local systems have been identified as important failure factors (Cassels, 1995). Flexibility and scability are important technical factors for successfully implementation of ICT in HIS. It is important to design the system in such a way that they can be constantly aligned with changing conditions. The system must allow continual changes in form of design and deployment and adding needed information to the system must not be delayed. Also, as the clinical care evolves there is a need of an

easy modifying content and format of the new information to accommodate change (Mamlin, et al., 2006).

Access to technology and technological infrastructure forms a pre requisite for eHealth. Even though there has been a revolutionary use of telecommunication and penetration of internet in the developing countries, still the connectivity is unreliable to most of the places. In Zambia a virtual project had to use a satellite technology due to poor and unreliable network coverage (Mupela, Mustarde, & Jones, 2011). Road and transportation network and electricity are also key when describing the ICT infrastructure needed to sustain eHealth, (Mohammed-Rajput, et al., 2011).

2.1.10.5 Other Contextual Factors to Sustainability of ICT Based HIS

HIS does not stand alone rather as a part of a wider environment. It is thus linked to other surrounding environmental factors such as political, culture and administrative that influence performance (Kimaro & Nhampossa, 2004).

2.1.10.6 Outcomes of ICT Based HIS

ICT in health promise to increase efficiency increase productivity and reduce workload. Workload specifically has been a cry for the health workers who in addition to providing clinical care to their clients are responsible for filling up the registers and forms for reporting. This workload contributes to the poor-qualitydata. As Tanzania is constrained with availability of human resource for health with a shortage at 56.38% (MOHCDGE, 2014), For example there are facilities which have only one nurse per shift who is responsible for providing antenatal care, postnatal care and child health

services (Mahundi, Chaula, & Igira, 2018).Introducing the electronic system is believed to improve this as the paper workload will be reduced.

The utilization of the data is another area which is hoped that the ICT will improve. It has been established that there are large amounts of information which is being collected but not fully utilized reviews (Mwangu, 2003).There is lack of data ownership and information culture feedback.

2.1.10.7 User's Expectations

The end users' expectations also play an important part in the success and sustainability of the Introductions of IT in health care settings. Due to expectation problems and fear of failure the users tend to resist the systems implementation. Some scholar attributes the problems of resistance to structural variables such as value conflicts, power conflicts, and ones that involve the man-machine interface (Mendell S F, 1987). Other view the resistance as a process oriented, citing such key factors as inadequate training, lack of user involvement, and discomfort due to organizational change.

For example, Nurses in Kuwait have been found to resist computerization, seeing computerized health information systems as dehumanizing, confusing and uncaring. Nurses with more computer experience tend to have more positive views; education and training positively influence attitudes; and younger and less experienced nurses may have more positive attitudes (Habib A. et al, 2007).

In the study by (Mendel S F, 1987) respondents generally had positive attitudes toward computerized health information systems. There were statistically significant

differences in attitudes in relation to nationality, level of education, previous experience in computer use and computer skills. Analysis showed that gender, nationality education levels and duration of computer use were statistically significant predictors of attitudes towards computerized health information systems. Resistant can be very severe to the extent of sabotaging the progress of the system (Muzafffar and Haroon, 2009) Multiplicity of Stakeholders and their Allocation.

2.1.10.8 Political Support

Political support plays a major role in the system introductions and their sustenance in the developing world. It has been cited that apart from the health management and health services delivery system, political administrative is also a key set of institutional influences on the HIS (Kimaro H and Sundeep, 2007). In a Hospital HIMS implementation in Peru they faced problem in expanding the system due to lack of political support at the senior management level (Muzaffar A and Haroon R, 2009).The lack of support affects the decision and prioritization of the EHIS hence low investment.

2.1.10.9 Administrative

Tanzania is among the developing country which has adopted the decentralization by Devolution which means the transfer of decision-making, planning (political), budgeting (financial), management, and resource allocation (administrative) of health care from the national to the district and sub-district levels (Litvack, Ahmed, & Bird, 1998). As part of this reforms, HIS is included which will imply creating local ownership, budget and resources to support the HIS.A more sustainable health systems

is urged to be realized if the local communities are being involved in planning and have authority of their resources thus local ownership is realized(World Bank, 1993).

Kimaro and Namphosa, 2006 identified three key set of institutional influences in regard to decentralization: Political administration, health management and service delivery systems. Through this informal constrains were identified which drive the process of decentralizing HIS confirming that health care decentralized process is mostly only in theory. They found out that a top down approach, which is favored by donors, is deeply entrenched and invites unsustainability of the interventions. They witnessed lower level staff that do not have authority on the formalized national tools, tends to creating their own local forms to cater for their need. This practice creates fragmentation and hence affects sustainability.

2.1.10.10 Ownership, Partnership and Networks Relationship

The ownership of the project has been described as a factor influencing outcome and success of eHealth innovations hence their sustainability. (Ahmed, et al., 2014).The greater the extent of government and local ownership or involvement, the more likely it appears that innovation will achieve scale and sustainability. This is the case of success of DHIS2 in South Africa (Ahmed, et al., 2014).

Kimaro and Namphosa, 2004, had identified three set of relationship which are crucial in shaping the sustainability of HIS. The relationship between the Ministry of Health and the software development agent, between the Ministry of health and the donors and between the donors and the software agency. They argued that these networks if created effectively they can assist assuring long term sustainability of the eHealth systems.

Making sure that every partner is reporting the required data is another challenge which is facing the health information system in Tanzania set up. The health service is being offered by the public and private facilities. Even though the Ministry responsible for Health is the sole owner of the health data in the country, this is not the reality on the ground. Facility ownership have been known to have a significant effect of the data monitored. A study conducted by Mahundi et al found the shortcomings of reported data on family planning indicators from 2 major cities which have a big proportion of private hospitals as compared to the city which have few private facilities. (Mahundi, Chaula, & Igira, 2018).In another instance it was reported that getting the information about the human resources for health from the private facilities it was difficult (MOHCDGE, 2014) . Implemented systems need to assure that all facilities are able to report through the system to enable the ministry to have this information.

2.2 Research Gap

Strengthening of HIS has been higher in the development partner's agenda as a means of showing accountability of their investments but also advocating of the use of information in line with result-based management. Many studies have been conducted to establish the challenges of the implementations and thus recommended the better way to make sure that the systems becomes successfully and sustainable. This has been happening for more than past two decades in developing countries, Tanzania included. (Karuri, Waiganjo, Daniel, & Manya, 2014). There are few studies or evaluations, which have shown how the lesson learned so far has been cultivated and integrated in the ongoing implementations of these systems.

As computerization in HIS is believed to improve the HIS through cost reduction, improve quality and make data timely available and visible at all levels, (Wilson, 2000) and the fact that these expected results has started being realized in different developing countries (Karuri, Waiganjo, Daniel, & Manya, 2014), then it is inevitable that their implementation will prevail. And so, the means to sustain the systems based on the context is crucial. Therefore, this study have established how far have this been achieved and found out how the lesson learned have been accommodated as a way to ensure attainment of sustainability.

Specifically, the study will research on the how the factors which affects sustainability of the DHIS2 system have been addressed in the implementation of the TB and Leprosy DHIS2 in Tanzania.

2.3 Conceptual Framework

There are different conceptualizations of sustainability process which have been proposed and they reflect different priorities. (Stirman, et al., 2012).It is recommended that a definition and a conceptual framework be carefully chosen to guide sustainable studies.

This study has adopted a definition proposed by (Stirman, et al., 2012) where by sustainability is defined as the continuation of the Programme or an intervention after initial implementation efforts of funding have ended and if: (i)core elements are recognizable and (ii) The are adequate capacity for making sure that continuation of the core elements is maintained and there is sustainability of outcomes: (i) continued reliability to core elements (ii)program activities are sustained (iii) desired health

benefits are maintained and (iv) maintenance of capacity to maintain the intended health benefits (Stirman, et al., 2012).To assess the mentioned core components, a Health Metric Network assessment tool/framework has been adopted. The tool assess the strength or effectiveness of a health system by addressing the core compone nts of HIS which are resources available (inputs), its methods of work and products (processes and outputs) a results in terms of data availability quality and use (outcome) (HMN, 2008).

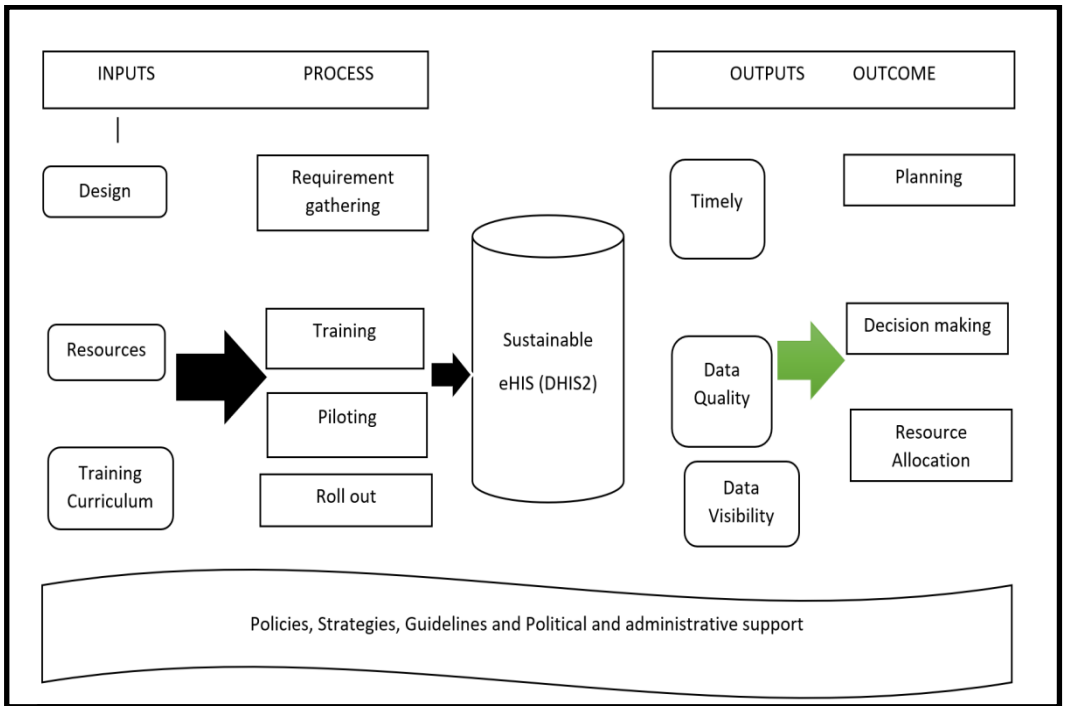

Figure 2.1: Conceptual Framework: Assessment of Sustainability of Tanzania TB and Leprosy DHIS2 System

This definition is being used and thus conceptual framework will show how the DHIS2 system of the TB and Leprosy Program variables relates during implementation and outcome to fosters desired outcomes and hence sustenance.

2.4 Theoretical Framework

This framework has been selected as unlike traditional assessment methods which focused on only the technical aspects of health systems i.e. indicators, data collection tools and the technology in use, it recognizes the importance of core elements of a program under assessment. Dependent variable / factor: Sustainability of eHIS, for this case a TB and Leprosy DHIS2, It is dependent on various factors as conceptually shown above in Figure 2.1: such as the policies and guidelines, availability of funds and human resources capacity.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Overview

This chapter details how the study was conducted in order to answer the posed questions on the assessment of sustainability of the TB and Leprosy DHIS2 system. It will describe the study population and the methods used to collect and analyses the data.

3.2 Research Design

Research design is defined as the arrangement for collection and analysis of data in a manner that aims to combine relevance to the research purpose (Kothari C, 2004).In the fields of health informatics, social, environmental, political, managerial and organizational issues are crucial when impacting information technology on an organization and people. HIS are socially constructed and complex in nature. Hence the study used both methods of quantitative and qualitative to facilitate the description of the factors and understanding of how are the factors associated with sustainability has been addressed in the implementation of the DHIS2 system.

In this descriptive designed research, a case study method was used to assess the sustainability of the TB and Leprosy DHIS2. It assessed how are the core elements of eHIS have being delivered for the sustenance in Tanzanian organizational arrangements. A cross sectional descriptive research approach was employed in this study. The objective of descriptive research is to portray an accurate profile of an event or situations (Robson, 2002) that is why this design was selected to study a case of TB and Leprosy Program's DHIS2 system on sustainability factors. The design was also suitable because it allows for the qualitative triangulation of the information gathered quantitatively.

3.3 Social Demographic Characteristics of Study Area

The study was conducted in two regions of Dodoma and Dar es Salaam. The researcher has chosen these two regions because first they represent an urban and a semi urban perspective. Secondly because the two regions provided conveniences of easy meeting with national level officers. Third reason was the convenient of the researcher as she was relocating to Dodoma from Dar es Salaam as requirement of the government to institutionalize the capital city.

3.3.1 Dar es Salaam

Dar es Salaam is the Tanzanian major business and economic center city of which for the past 57 years of independence it held all of capital city operations. It is 1,590 km2 big but with a population of 4 million people according to the 2012 census (GOT, 2019).Dar Es Salaam has five administrative districts of Kinondoni, Temeke, Ilala, Ubungo and Kigamboni. The City harbors most of the country's technical expertise in public as well as in private sector such as major hospitals, universities and other companies.

The TB and Leprosy service in the region is organized within the government service delivery structure. There are total of 650 health facilities of which 176 provides TB and Leprosy services i.e. DOT centers(MOHCDGEC, 2018). The programmatic services for TB and Leprosy have divided DSM region in 4 "TB and Leprosy regions" i.e,Temeke, Kinondoni, Ubungo, Ilala1, Ilala2. These regions have a total 29 districts which oversees maximum of three facilities each.

3.3.2 Dodoma

Dodoma is the capital city of the Tanzania, which started to gain its capital status operational wise beginning of 2016.By 2017 all the ministries were officially shifted to the city. It covers an area of 2,669 square kilometers (1,031 sq mi) of which 625 square kilometers (241 sq mi) is urbanized (GoT, Dodoma Region, 2019)

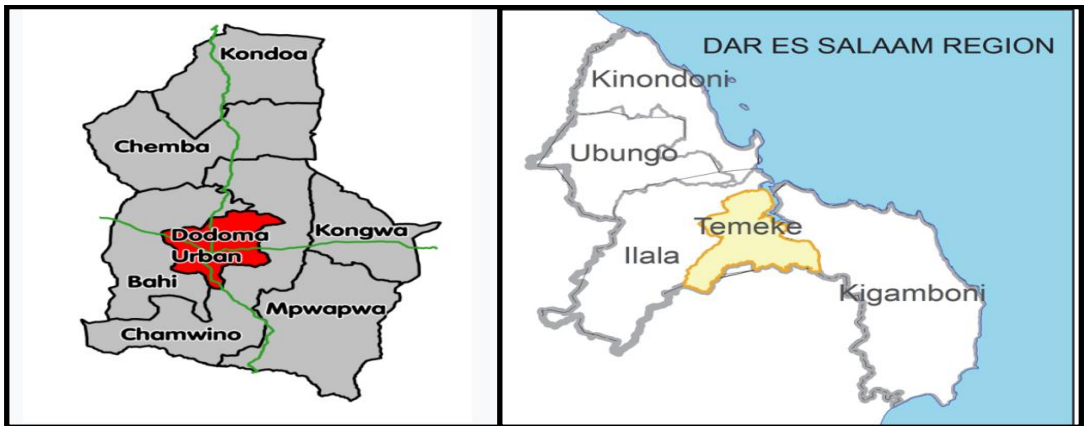

Figure 3.1: Dodoma and Dar es Salaam Regions Maps

Source:http://www.dodoma.go.tz/**Source:** Hindawi Journal of Chemistry https://doi.org/10.1155/2018/1402674

The TB and Leprosy services in the region are organized within the government service delivery structure. There are 415 health facilities in Dodoma of which 165 provided TB and Leprosy services known as DOT Centres. There is a regional TB and Leprosy coordinators overseeing the whole region, the District TB and Leprosy coordinators overseeing the whole council and at the facility level there are DOT nurses of which there are a minimum of are two nurses per DOT centre (MOHCDGEC, 2018).

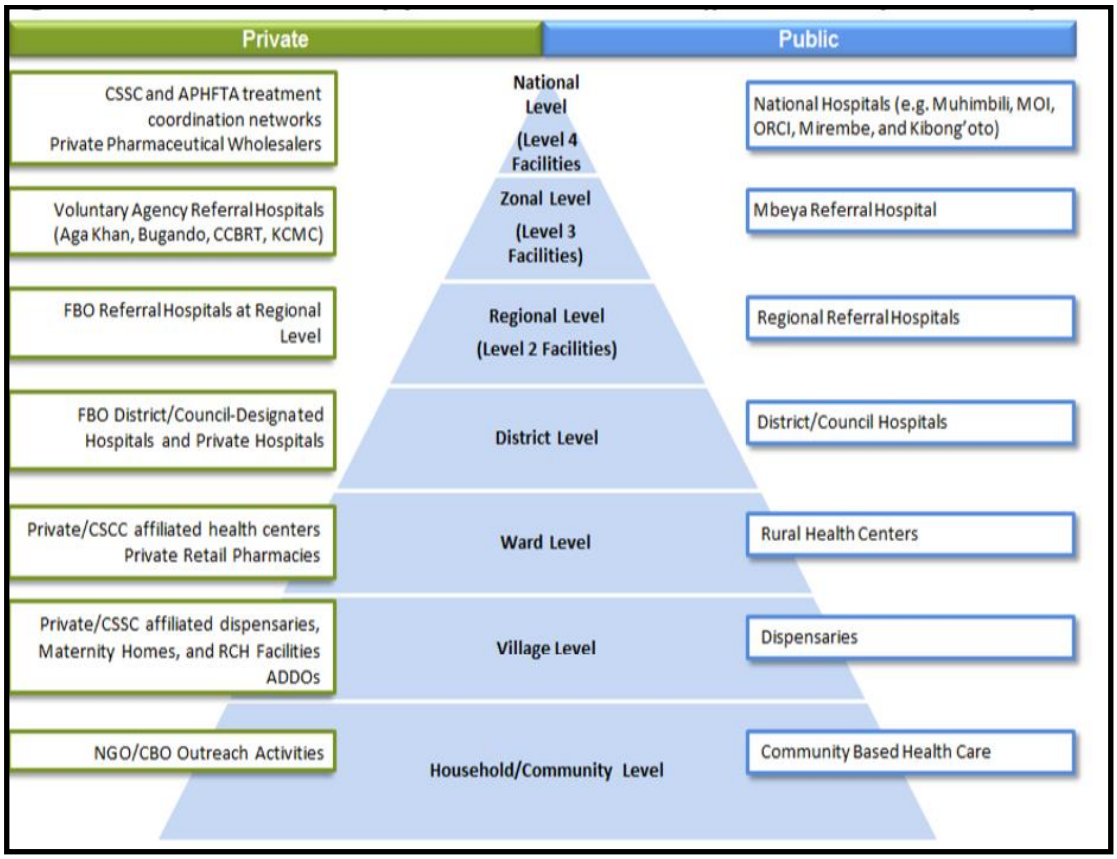

Figure 3.2: Tanzania Health Care Delivery Organisation Structure

Source: Tanzania Health sector Strategic Plan IV 2015-2020

3.4 Information Sources

Given the nature of this research design, data collection methods and analysis followed the quantitative and qualitative techniques.

3.4.1 Primary Data Sources

The primary data are the data and information which are collected by the researcher herself i.e. first hand. The researcher in this study collected the primary data in two main ways. The first type of primary data was collected from the health care workers who are the users in terms of data entry and information use of the TB and Leprosy DHIS2 system by using semi structured questionnaires. The second source of primary

data in this study was collected through key informant interview with the ministry's officials.

3.4.2 Secondary Data Sources

Saunders (2003) defined secondary data as the data that is already available in public domain and includes both raw data and published summary. It is categorized into subgroups, such as documentary data, survey-based data, and complied from multiple sources. Data can be obtained through reading books, magazine, journals, televisions, from management reports and internal reports (Saunders, 2003).In this study; the researcher used the secondary data to establish the study area and population and also reviewed the documents cited by the key informant for further confirmation.

3.5 Study Population

The study population for this study was made up of health care workers at the districts and health facility levels in Dare es Salaam and Dodoma regions who are using the TB and Leprosy DHIS2 system and the Health management Information officers at the ministry level in the directorate of policy and planning and National TB and Leprosy Program.

Tanzania health service delivery organization structure is divided into six levels from the community, dispensary, and district, regional and national level. The national levels comprise of specialized hospitals and the ministry's officials. The organization of TB and Leprosy services follows this structure such that there is a designated focal person for the programmatic interventions at each level. These are DOT clinical officers and nurses at the facilities.

The use of the system in this study is defined as data entry and use of the information within the system. Based on the Tanzania health service delivery organization and the TB and Leprosy Program, the health care workers study population comprised of: DoT Nurses, TB clinical personnel (doctor and medical assistant) and data clerks at district and lower levels health facilities.

The sample size was determined based on accepted range for the sample size in social science researches. Small sample sizes are acceptable when there is a large effect being observed (Creswell, 1994).Thus, the sample size for this study included a total of 68 health care workers who use the TB and Leprosy DHIS2 system and 05 ministry officials. The health care workers were selected by purposively sample selection where by voluntereed health workers who are using the system was visited at the DOT clinics and given a questionares to fill. The ministry officials were selected through purposive judgemental sampling.This method was selected to get the participants who have enough information about the TB and Leprosy DHIS2 system.

3.6 Data Collection Techniques

The following quantitative and qualitative data collection methods were used in this study.

3.6.1 Semi Structures Questioners

This technique is a mix of unstructured and structures questionnaires which mean it is a question guide to direct the interview and that the questions are precisely determined and some are not. This technique allowed the identification of insights into factors affecting sustainability of the TB and Leprosy DHIS2 from the perspective of the health

care workers who are the main users. Health Care workers were visited at the DOT clinics and explained about the study and its importance. Once the consent was given, the questionnaire was given for them to fill the answers and it was allowed to ask the researcher whenever they needed further understanding of the questions.

3.6.2 Key Informant Interview

This is a qualitative technique which involve in depth interview with people. The researcher uses this technique to do the in-depth interview with the ministry's officials who are expected to know about the TB and Leprosy HIS. These officers have firsthand knowledge about the system in the study based on the ministry's main role. This technique was used to not only to get information of implementation of the TB and Leprosy DHIS2 system in relation to interests on its sustenance but also to understand the motivation, beliefs and opinions of these key officials on sustenance of the system. In addition, the technique provided a researcher with an opportunity to further probing on the experience regarding the system. The researcher used two ways to conduct these interviews: face to face and through telephone.

3.7 Data Analysis

The collected data was organized by numbers and the questions were coded based on the SPSS codding (code book). The open-ended questions were studied by randomly sampling ten questionnaires and answers were organized into the common themes. The identified themes were then coded into only 4 options. The information was then entered in the SPSS version 20. The data was then assessed for any missing information and corrected by tracing the questionnaire by their identification numbers.

Descriptive analysis was done to study demographic profile and the variables of interests. The variable of interests were demographic variables such as sex, cadre and type of facility, and variables to answer the research questions which were: type of employment, status of formal training on the system, duration of using the system, Computer knowledge before using the system, availability of assistance for ICT issues, availability of assistance of the system issues, types of hardware used, hardware purchaser source, Source of internet cost, acceptance of the system, system use and the challenges on the use of the system. The analysis generated and summarized frequencies of the responses with regard to the posed research questions.

3.8 Data Reliability and Validity

Data reliability and validity helps to ensure the credibility of the research findings by reducing the possibility of getting answers wrong. This is very crucial. This is what is referred to as “how do I know? Test subjected to the study findings (Raimond, 1993). Reliability is the extent to which data collection techniques or analysis procedures will yield consistent findings, (Raimond, 1993). In this study the threats of reliability were reduced by choosing the best timing to visit the participants. The researcher made the visit on Tuesdays through Thursdays, from 14 to 15.30 hrs. These timings ensured that the HCWs have already attended to their meetings or to the clients. This measure was put to reduce participant error.

The questionnaires did not ask for the respondents’ names. In addition, the importance of the study was explained as how it will benefit the HCWs such that to minimize bias (participant bias) of answering, considering the researcher is working at the ministry in the same program. Validity refers to whether the findings are really about what they

appear to be about. Validity is the extent to which the scores actually represent the variable they are intended to. It is important for a researcher to control all possible factors which threaten the validity. This applies to both design and the methods of research.

3.8.1 Triangulation

Triangulation refers to the use of different data collection techniques within one study in order to ensure that the data are telling you what you think they are telling you (Raimond, 1993).The researcher in this study uses qualitative data collection techniques by key informant interview of the ministry of health officials to triangulate the quantitative data collected on the HCWs.

3.8.2 Ethical Issues

Ethics refer to the standards of behavior which guide the conduct in relation to the rights of those who are subject of the study or the one who are affected by this. (Raimond, 1993).Adherence to ethics applies from the design to research reporting stage. The researcher ensured conformity to the Tanzania National Medical research institute and Tanzania Commission for Science and Technology principles which relates to this study.

The clearance to carry out the research was approved by Open University of Tanzania and the same University facilitated the permission to carry the research in the ministry and in the regions and local government levels in Dar es Salaam and Dodoma. The researcher made sure that the research problem i.e. sustainability of the electronic HIS will benefit the participants as they are the main users of such systems. This is achieved

as the study fits as an outcome assessment of the implementation of the DHIS2 for the Program. Hence the results will add to the pool of the Program's operational research to improve programming. This purpose of the study was disclosed to the participants and consent was sought before engaging them. They were asked what will be the right time for the interview to make sure their routine duties were not disrupted as little as possible.

Information obtained from the field was treated as confidential information and for academic purpose only. Also the researcher informed the respondents about the importance of the study, and how are they going to benefit from the study. They were not asked to disclose their names, so as to give them confidence and make them free to give out their experience on the use of the system. During data analysis and interpretation, the researcher made sure that she presented both positive and negatives findings based on the posed research questions. This study on the sustainability assessment of electronic health information system a case study of TB and Leprosy DHIS2 did not include any children.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND DISCUSSION OF THE FINDINGS

4.1 Overview

This chapter details the major results from the analysis of the data collected regarding the assessment of the sustainability factors of TB and Leprosy DHIS2 system. The chapter has been organized in three sections whereby the first one describe the demographic characteristics of the health care workers and managers who were the participants of the study and the other sections focus on the results based on the study objectives and the related research questions as follows: the second section is about the availability of human and other resources for the use and maintenance of the DHIS2 system, the third focuses on the usefulness of the system in terms of benefits it provides to the HCWs and the third section highlights the results from the key informant interview on the measures which the ministry is undertaking to ensure the sustainability of the system.

4.2 Sample Description

4.2.1 Sample Description by Gender

The study sample comprises of two main groups. The first groups were the Health care workers at districts and health facility levels who are using the TB and Leprosy DHIS2 system in their daily duties of management of TB and Leprosy patients. The second group is made up of ministry level officials who are responsible for the health management system of the country. A total of 68 Health Care Workers (HCWs) participated from Dar es Salaam and Dodoma regions with almost equal representation of each gender. 52% of them were female as shown in Table 4.1.

Table 4.1: Distribution of Health Care Workers (HCWs) by Sex

Gender	Number of respondents (HCWs)	%
Female	35	52
Male	33	48
Total	**68**	**100**

The second group for the key informant interview had a total of five ministry officials of which only one of them was a female. This is shown in Table 4.2.

Table 4.2: Distribution of Ministry's Officials by Sex

Gender	Number of respondents - Ministry officials
Female	01
Male	04
Total	**05**

4.2.2 Sample Distribution by Position and Professional

Among the 68 HCWs, majority i.e. 54% were clinicians i.e. medical assistant followed by nurses who were 17 out of all participants. There was one health secretary who participated in the study. This implies that the clinicians and the nurses are the main users of the TB and Leprosy DHIS2 system. The distribution of the participants' cadre is shown in Table 4.3 and Figure 4.1.

Table 4.3: Distribution of Health Care Works by Cadre

Type of cadre	Number of Respondents - HCWs
Data clerk	4
Doctor	7
Health Secretary	1
Laboratory staff	2
Medical assistant	37
Nurse	17
Grand Total	**68**

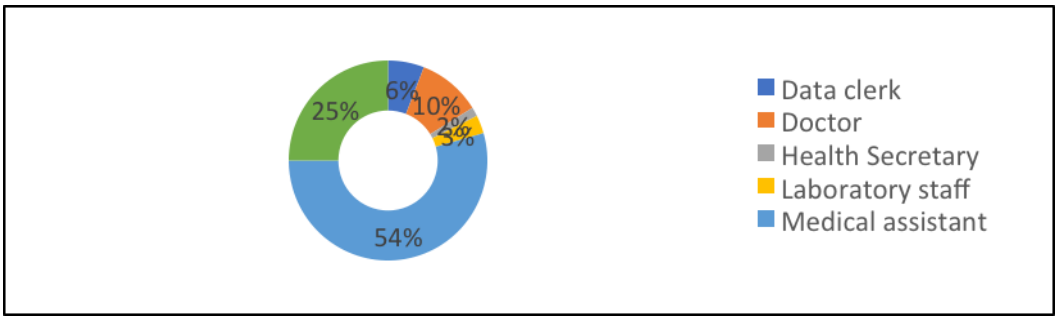

Figure 4.1: Distribution of Health Care Workers by Cadre

The findings above implies that TB and Leprosy DHIS2 system depend more on the health care workers as the data clerks who participated in this study were only 10% of the study participants. The key informant group was made up of 4 statisticians and one ICT by professional.

Table 4.4: Distribution of Ministry's Official's Cadre

Type of cadre	Number of respondents - ministry officials
Statisticians	04
ICT	01
Total	05

4.2.3 Sample Distribution by Place of Work

Health care workers respondents were from Dar Es Salaam and Dodoma region. Dar Es Salaam had more participants (69%) while Dodoma have more district councils (8).Majority of the participants were from Ilala D.C whereby there were 25% of all respondents. The lowest was from Kondoa Dc and MC which had only one participant from each. This may imply that the users of the systems are more from the urban areas which could be explained by favorable ICT environment. Table 4.5 below shows the distribution of health care workers by political administration i.e regions and district councils.

Table 4.5: Distribution of Health Care Workers by Political Administration

Dodoma		**Dar Es Salaam**	
District Council	**Number of HCWs**	**District Council**	**Number of HCWs**
Bahi	2	IIala	17
Chamwino	3	Kigamboni	3
Chemba	1	Kinondoni	11
Dodoma Mc	8	Temeke	10
Kondoa Dc	1	Ubungo	6
Kondoa Tc	1		
Kongwa	3		
Mpwapwa	2		
Total	**21**		**47**

Most, 49% of the HCWs respondents were working at hospital levels followed by those at health center levels. The results reflect the percentage of the responded by cadre whom majority were the clinicians. These are expected to be more allocated at the hospital level. In addition, it is in line with the TB and Leprosy program structure of which the clinicians are positions at the district hospitals and thus oversee all other health facilities at the lower levels. The results are shown in Table 4.6.

Table 4.6: Distribution of the Health Care Workers by Health Facility Type

Facility type	**Number of HCWs participants**	**%**
Dispensary	7	10
Health centre	28	41
Hospital	33	49
Total	68	100

The above results also imply that the hospitals provided good ICT infrastructure environment for the system use that's why majority of the users were found at that level.

Further the researcher had an interest to find out if private facilities are also involved in the government systems. Among the facilities, which the respondents came from, 7% (5) were from private for-profit facilities. This is shown by Table 4.7.

The public facilities included the government facilities and the faith based one which are designated facilities to assist the government. The involvement of the private facilities in the use of this system implies a good measure put by the government to make sure all country data are captured.

Table 4.7: Distribution of Health Facilities by Type

Type of facility	**Number of facilities**	**%**
Private	5	7
Public	63	93
Total	68	100

4.2.4 Employment Status of Human Resources who use the System

This study intended to find out sources and availability of the human resources who use the system in the context of the employment type. The use of the system is defined as: data entry and use of the information.

The results show majority of the participants were the permanent employees of the government, i.e. 57 of them (84%) while 12% of them i.e. 8 were the private hired. This implies the possibility of continuity of the skills and usage of the system in the councils. The Figure 4.2 shows the respondents type of employment.

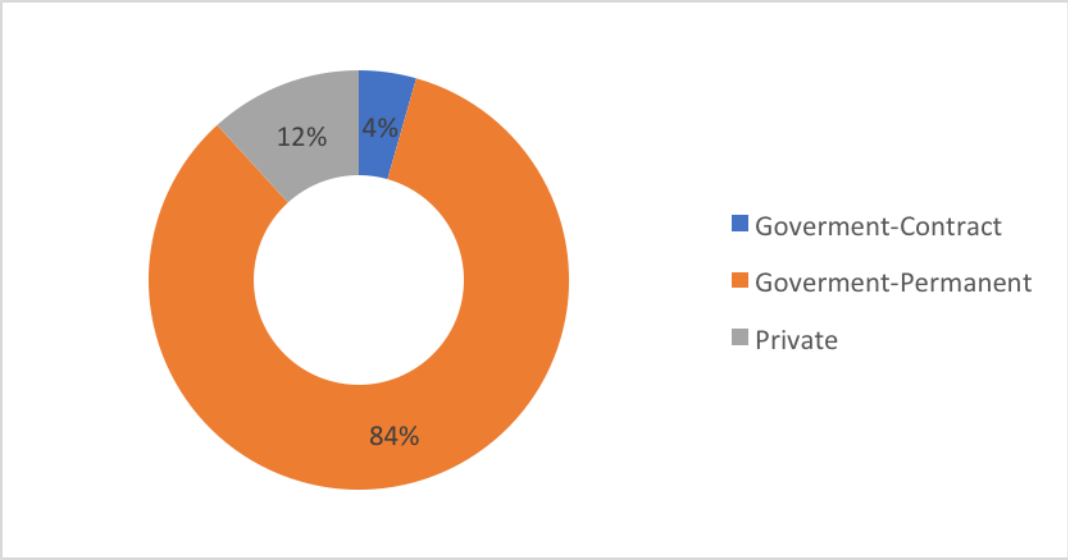

Figure 4.2: Type of Employment of Health Care Workers

4.2.5 Formal Training on the use of the TB and Leprosy DHIS2 System

The researcher also wanted to find out if the users of the TB and Leprosy DHIS2 system had received formal training on how to use the system. This is a pre requisite for the success of the system. The finding showed that 85% of the respondents received the formal training of how to use the system.

Table 4.8: TB and Leprosy DHIS2 System Formal Training Status

Status of training receipt	Number of respondents	%
No	10	15
Yes	58	85
Total	**68**	**100**

The above findings imply that the users are equipped with knowledge of how to use the system. This finding was triangulated with the question of how long they have been

using the system to see if the system is being used by the trained health care workers. The figure 4.3 below shows the duration of the use of the system by the respondents.

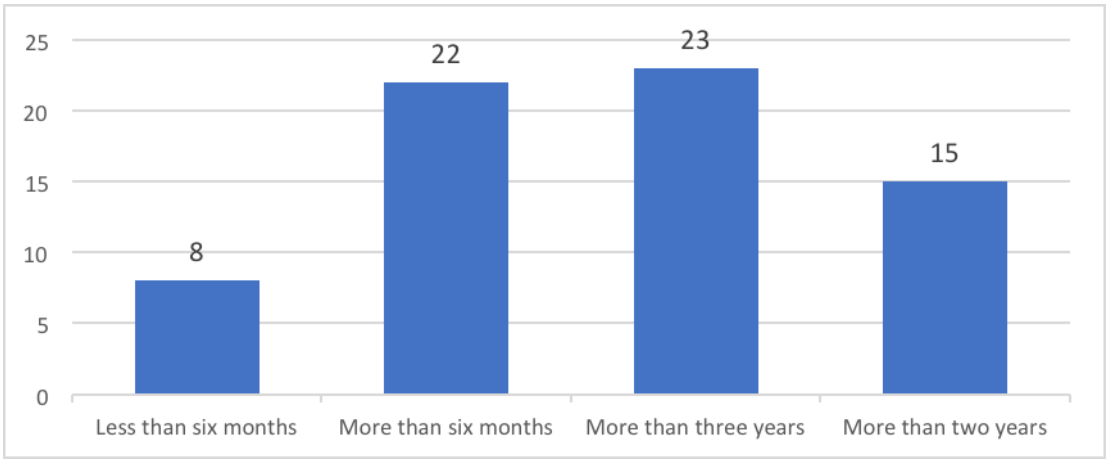

Figure 4.3: Health Care Workers' Duration of use of the TB and Leprosy DHIS2 System

The above finding shows that majority,23 of them(39%) have been using the system for longer duration of more than three years, 32% (22) of them for more than six months and 22% (15) for more than two years. This implies a total of 60 respondents which is 80% of all have been using the system for more than six months. This is a significant duration of time to experience a system. In addition, as 85% of them received the formal training (table 4.8 above) then it implies majority of users have significant knowledge of using the system.

4.2.6 Basic Computer Knowledge and Skills before the use of the TB and Leprosy DHIS2 System

Further the participants were also required to provide information on their ability to use computer on basic functions before they started to use the TB and Leprosy DHIS2 system. The researcher was interested with this variable as this technology is considered fairly new in health care workers in the developing countries while the success of the

ICT based system relies on computer literacy and technical skills. The table 4.9 below shows the responses of the participants HCWs on their computer knowledge and skills.

Table 4.9: Health Care Workers Basic Computer Knowledge before the use of TB and Leprosy

Basic Computer knowledge before	Number of respondents -HCWs	%
No	28	41
Yes	40	59
Total	**68**	**100**

The results found out that majority had the basic skills before and only 28 of them did not have any prior knowledge of basic computer. This imply that the computer technology has gained popularity in the health care field. Further the respondents were asked to mention as to where did they get that computer literacy of which the it was established that among those who had computer knowledge before, majority 35% (14/40) gained the expertise by self-initiative while 30% of them received the knowledge while being trained to use other health systems at work such as CTC, DHIS2-MTUHA.Table 4.10 below shows these findings.

Table 4.10: Place of Basic Computer Knowledge and Skills before use of TB and Leprosy DHIS2 System

Place of Basic Computer knowledge	Number of respondents - HCWs	%
At work during training of other systems	12	30
During college	7	18
Computer short course	7	50
Private initiative	14	35
Total	**40**	**100**

4.2.7 Availability of ICT Assistance

The researcher wanted to find out who assists the user of the TB and Leprosy DHIS2 system when they have ICT related issues relating to the system such as malfunction of the computers. This is very crucial as their ability to deal with day-to-day technical issues is a pre requisite of the system to function and brings timely results. The ICT personnel at facility was responded by majority of the respondents with a total of 37 i.e. 54% of all. Table4.11 shows the responses on this variable.

Table 4.11: ICT Assistance while using the TB and Leprosy DHIS2 System

Type of assistance for ICT	Number of Respondents - HCWs	%
ICT at facility and D Council	5	7
ICT P at D. Council and Region	1	2
ICT P at ministry and at D Council	1	2
ICT P at ministry and at facility	3	4
ICT personnel at the D Council	12	18
ICT personnel at the ministry	5	7
ICT personnel at the facility	37	54
ICT personnel who developed the system	1	2
Other	3	4
Total	**68**	**100**

The results above implies that there are actually some measures put on the ground to ensure smooth running of the electronic systems such as availability of the ICT personnel at lower levels. However, when asked on the assistance for the system itself, a significant number of responses were depending on the national level; 47 out of 68 participants (69%). These findings are presented in Table 4.12.

Table 4.12: Type of Assistance for the System Use

Type of assistance on the system use	Number of Respondents -HCWs
System focal person at D. Council	6
System focal person from the Region	1
system focal person at facility	10
System focal person from ministry, Region and District	1
System focal person from ministry and District	3
System focal person from the ministry	47
Total	**68**

4.3 Source of Support for the Functioning of the TB and Leprosy DHIS2 System

For this research question the researcher wanted to find out who covers for the cost of functioning of the system in the context of hardware and internet availability. The findings are as follows:

4.3.1 Source of Fund for the Hardware

The study found out that laptop was the most mentioned type of hardware to be used by 57% (39) responses, followed by the desk top computers which was mentioned by 15 respondents. This finding is shown by the Figure 4.4.

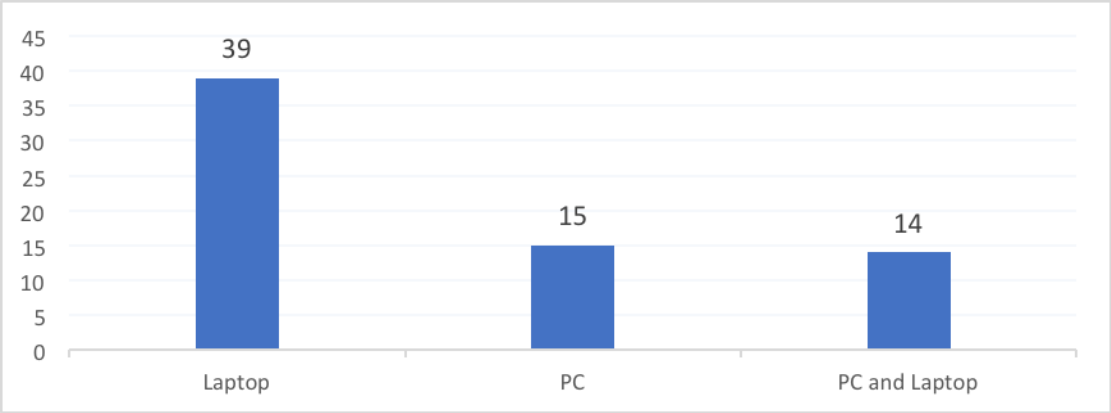

Figure 4.4: Type of Hardware used for the TB and Leprosy DHIS2 System

When the responded were asked who purchased this equipment, majority of them 63% (43) mentioned the ministry of health. This was followed by 12% which were purchased by their health facilities and 10% by the implementing partners, i.e. external fund from donors. Table 12 bellow presents these findings.

Table 4.13: Source of Hardware Purchase for the TB and Leprosy DHIS2 System

Source of hardware purchase	Number of respondents -HCWs
District Council	1
Health facility	8
Implementing/dev. partner	7
Ministry and D. Council	1
Ministry and Self	2
Ministry of health	43
Region administration	1
Region administration and self	1
Self	4
Total	**68**

Further research findings identified among those of the 8 health facilities 3 (36%) where the private health facilities.

4.3.2 Source of Fund for the Internet Costs

To answer this question, the researcher first identified the means which the HCWs gets the internet connectivity. It was found out that even though majority (17 out of 68) depend on mobile hot spot and a dongle connection (modem) for the internet connections, as shown in Table 4.14, there are also those who gets the connection directly from the facilities.

Table 4.14: Type of Internet Connection Source

Type of internet source	Number of Participants -HCWs
D.Council, dongle and mobile phone	1
Dongle and mobile phone	17
Facility, dongle and mobile phone	4
Facility and dongle	4
Facility and mobile phone	4
Facility, D council and mobile phone	1
Health facility	11
Mobile phone hot spot	15
Tele company dongle (modem)	11
Total	**68**

Table 4.15 shows the responses regarding where do health care workers gets funds for internet connection when using the other sources apart from district councils and health facilities connections. The findings show more than half (53%) of the respondents use out of pocket means i.e. buying for themselves. The table 4.15 below shows the response on the source of internet costs. The findings from the two tables imply two things, first there are no robust means to ensure availability of internet coverage for use, secondly the system seems to be of a significant help to the users such that they are ready to support themselves for internet as the findings in below question shows.

Table 4.15: Internate Costs Supporter

Internate cost supporter	Number of Respondents -HCWs
D.Council	2
D. Council, Implementing partner and self	4
H. Facility	7
Implementing partner	15
Ministry	1
Self	32
Grand Total	**61**

4.4 The Usefulness of the DHIS2 TB and Leprosy System

The researcher wanted to find out what is the outcome of using the TB and Leprosy DHIS2 system. This is a very important sustainability factor as per the used theoretical framework in this study. In this regard the researcher asked the following questions:

4.4.1 Acceptance of the System by the HCWs

The respondents were asked if the system is useful or not to their daily duties. None of the responded disagree that the system was not useful. All 68 participants responded to this particular question, however only 36 participants responded on the reason why they feel that the system is useful to them. In this regard, easiness of getting the report was the most responded reason by 56% of all respondents. Table 4.16 shows the reasons why HCWs thinks the TB and Leprosy DHIS2 system is useful to them.

Table 4.16: Reasons for the Usefulness of the TB and Leprosy

Reasons for usefulness	**Number of Participants -HCWS**	**%**
Able to work out of office	1	3
Not experienced yet	1	3
Easy to get patients information	1	3
Easy to get reports	20	56
Easy to track patient's information	5	13
Easy to use	2	5
Good storage of data	2	6
Reduce paperwork	3	8
Timely reporting	1	3
Total	**36**	**100**

Other reasons mentioned were easiness to track patient's information, 14%, and ability to reduce paper work 8%. The results imply that there is a good acceptance of the health care workers on the TB and Leprosy system. The benefits of the electronic system are very openly seen here with the responses especially if you compare with the results in table 4.15 above which shows majority of them are using their own sources to make sure they get internet access.

4.4.2 TB and Leprosy DHIS2 System Usage

This question wanted to find out how do the health care workers use the information generated by the system. Majority claim that the most features they use is extraction of reports. This imply the weak culture on data use where by the HCWs see data as for the someone else than themselves. However, there were responses which reflected the use of information at their levels such as 25% of them uses the information for extraction of reports as well as for drug ordering purposes while 18% uses information for planning. These findings are presented in the Table 4.17.

Table 4.17: Use of the TB and Leprosy DHIS2 System among the Health Care Workers

Use of system	Number of Participants-HCWs
Evaluate implementation of activities	1
Not yet experienced	1
Performance measurements	6
Planning	12
To generate reports	19
To generate reports and ordering of drugs	17
To measure burden of TB	6
Tracking patient's information	2
(blank)	4
Total	**68**

4.4.3 Challenges when using the TB and Leprosy DHIS2 system

The participants were also asked on the challenges they face in the use of this system. This helps to find out on the other side of the coin on the outcome of the system. The findings on this variable are as shown in Table 4.18.

Table 4.18: Challenges on the use of TB and Leprosy DHIS2 System

Challenge	Number of Respondent - HCWs
Double work DHIS2 & GoT-HOMIS	1
Not trained	07
unstable internet	21
unstable system during changes	19
Lack of support for internet bundle	20
Total	**68**

The findings in the Table 4.18 above shows that lack of support for the internet costs, unstable availability of internet and the instability of the system when changes are affected are the most mentioned challenges faced by the health care workers when using the TB and Leprosy DHIS2 system.21 of the respondents, which is 31% of all mentioned the internet instability as a challenge. This was followed by those who mentioned the lack of support to cover for the internet costs who were 20 of them. Instability of the system was mentioned by 19 respondents, and 7 of them mentioned lack of being trained as a challenge to them.

4.5 Availability of Formal Policies and Guidelines for the Implementation of TB and Leprosy DHIS2 System

The study wanted to find out on the presence of policies and guidelines for the implementation of the use of TB and Leprosy DHIS2 as per lesson learned in the past experiences of implementation of similar systems.

4.4.1 Guidance followed in the Development of TB and Leprosy DHIS2 System

The study found out that the following guidelines were used as a guide to implement the TB and Leprosy DHIS2 system .These are eHealth strategy 2013-2018 and the M&E Strengthening Initiative (MESI) in 2009/2010-2014

Respondent no1:

> *"…. …. any system should follow the existing government organizational structure i.e main focal people such as HMIS focal people at region and district are the main supervisors of all health information issues of the regions and the councils. Thus, the TB and Leprosy DHIS2 had to follow this structure."*

"……we had the MESI 1 and eHealth strategy when we implemented this system".

Respondent no 2:

"……. We have the ministry's guidelines such as ehealth strategy and also we involved the stakeholders during the whole process of the development"

When further asked to explain how the stakeholders were being involved the officer responded that:

"……. we did assessment of the system which was there before DHIS2 called ETR.Net. The assessment was conducted together with the implementing partner called KNCV and representative officers from the regions. After this we conducted a stakeholder workshop and invited some officers from regions, districts, other ministry sections and donors."

"……. after this meeting a roadmap was agreed and some requirement were also agreed such as system to be able to talk with other systems……..we also invited these people during the testing of the design …."

Respondent no 3

"..... we used WHO guidelines of how the electronic system should be…. and also the fact that WHO had introduced new indicators we had to improve our system.

When asked about what was that improvement this officer responded that:

"……. our system was an aggregate one but since 2017 we started to have a case base data

This implies the system implementation also is done with a pressure from outside requirements.

The eHealth strategy was also mentioned by the other 2 officials (respondent no 4 and 5).

4.5.1 Relationship of TB and Leprosy DHIS2 system with other health systems

The types of relationships described were of directly and indirectly in nature. The researcher found out that the TB and Leprosy DHIS2 system has variables of other diseases programs but also its variables can be extracted to the ministry web portal.

Respondent no1:

"……yes, it relates to the ministry web portal"

Respondent no 2

"*……relationship is there though not direct for example in the system you will find information about HIV but this do not have electronic relationship with HIV system (i.e. CTC data base)"*

Respondent no 3

"..... .... yes this system has direct relationship with others due to its nature, it is an open source and customizable"

Respondent no 4

"……that was one of a condition when we agree on the implementation of this system, that it should have relationships with other existing systems" ".... It must talk to others "

The officer further went on

"*…. we worry that many systems bring duplications and that's why the ministry has developed a mediator and thus this TB and Leprosy DHIS2 system was made to ensure it can talk to a mediator when ready"*

When asked what is a mediator the officer responded: "……some kind of central means where data from all programs are be pulled such that all important indicators can be available for national level purposes"

Further the researcher wanted to know where they are with the implementation of the mediator…

".....Health Information Mediator (HIM) is now running and about 10 systems are present such as the national DHIS2(MTUHA), eLMIS for drugs and commodities, HFR i.e, Health facility Registry, Jiva system used by Muhimbili hospital, Afya care of Mirembe, EPCOR 09,Med Pro used by MOI,……"

Respondent no 5

".....Yes, it is linked to the ministry health web portal,
It has been configured to link with other system by having the unique identifier menu but also plan is to link with the mediator"

4.5.2 TB and Leprosy DHIS2 System Developer Origin

The study established that the TB and Leprosy DHIS2 system's developer is a local one. This was a response from all 5 respondents

Respondent no1:

"…….We have a history with UDSM, we stated with them we developed the overall HMIS -MTUHA "

"……. developing the TB and Leprosy DHIS2 system came after this national DHIS2 working well and the donor became happy ……..and so they wanted for TB and HIV program as well to use the system"

Respondent no2

"*……the program had prior not so good experience with an outside developer that's is why the previous system, ETR.NET could not function anymore"*

This officer was further asked why it could not function anymore and he responded:

"……it needed further improvement such as to become a web based rather than local and also cleaning of bugs. The developer needed more funds which at that time the government could not support,

" ……. but even communicating with them was not easy as they were very far ……..just to and fro emails……"

Respondent no 3

"……. we single sourced UDSM based on the main MOU they already have with the ministry"

Respondent no 4

"*…….. we are working with our University, UDSM"*

Respondent no 5

"*……..it is UDSM under the HISP project"*

4.6 Discussions of the Findings

4.6.1 Available Resources for the TB and Leprosy DHIS2 System

Adequate resources are pre requisite for the sustainability of electronic health information system. The study found out that the TB and Leprosy DHIS2 system have established human resource to make the system functional. This has been achieved by training the health care workers who are working at TB clinics known as DOT centers. The majority, 84% of these HCWs are the permanent government employees.

Among these study participants 40 (58%) of them had the basic computer knowledge before use of the DHIS2 system, and 85% (58) had already received the formal training on the use of the system. These findings are not similar to what was found by Ndumbaro in 2003 where by it was established that formal computer training among the health care workers was limited. The difference could be because of the time when the study was conducted, when the computer technology was very premature in Tanzania. This reason could be confirmed by this study results whereby it has shown that there are respondents who actually received computer studies while at collage, 16% of those who had this knowledge before using the system, and also14 (35%) of this group gained the skills by their own self initiatives. The results imply that as the technology become popular it became a necessity for health care worker to have the skills and thus those who did not have a chance to receive it formally, are making their own efforts in order to be in the “market”.

Apart from the human resource availability and their basic computer skills, further the technical skills to navigate through interfaces is importance in the use electronic health information Systems, however common finding is that once the hardware are distributed and installed, regular support is not available. (Kimaro H. , 2006).This finding is

different from what has been found in this study where by majority of the users of the TB and Leprosy DHIS2 system mentioned the ICT personnel at their facility levels who assist them with ICT issues. Perhaps this was not a common picture a decade ago due to advancement and uptake of technology by the government. The lesson learned has shaped the operations to respond to the needs.

4.6.2 Established Benefits of the use of the TB and Leprosy DHIS2 System

This study has identified that there is high acceptance of the TB and Leprosy DHIS2 system by the health care workers, as all participants agreed that the system is useful. A study by Habib A. et al, 2007in Kuwait had a different finding where by the nurses had resisted using the introduced electronic system. However, a study done by Mandel and Giusti, in 2005 had similar findings as this study where he found out that the respondents had positive attitudes towards computerization.

Further the study looked at the use of the information in the system whereby the findings shows that and most of the participants HCWs uses the system to extract reports. This was very significant use as it was also mentioned to be the most reason, as to why they agree that the system is useful to them. Similar picture has been seen across the developing countries where by the culture of using the data from the system for their own use is very poor. The data is seen as to be owned by some people, higher level or the donors hence a feeling of burden of preparations of the reports.

The electronic systems are seen as their “savior” to get these reports easily. Even though the TB and Leprosy DHIS2 system provided some useful outcomes as discussed above, challenges do exist which presents a risk for the sustenance.21 of them which is 31%

of the respondent health care workers mentioned poor coverage of internet as major challenge. The findings are similar to other studies in the region. In Zambia a virtual project had to use satellite technology due to poor and unreliable network coverage. (Mupela, Mustarde, & Jones, 2011).In another study internet coverage was identified as a bottleneck and the road and transportation network and electricity were found to be the key reasons for that (Mohammed-Rajput, et al., 2011).

4.6.3 Presence of Formal Policies and Guidelines for the Implementation of TB and Leprosy DHIS2 System

The study found out that there were guidelines frameworks for the implementation of the TB and Leprosy DHIS2 system. The ehealth strategy, Monitoring and Evaluation strategic initiative and also the country's ICT policy provides a good foundation for the success of implementation of the electronic systems. In contrast finding in Uganda found that eHealth interventions lack prior planning which affects scale up and sustainability.

Further it was evidenced that the TB and Leprosy DHIS2 implementation was a participatory process as stakeholders were also involved:

Perhaps this was among the factor which facilitated successful country wise scaled up including private health facilities which was not the case for Uganda. The private facility involvement was also a finding which was not similar to what was found out in other Tanzanian studies like the finding of private facilities in not reporting through the national HMIS. (Mahundi M. H., 2010).Relationship with other systems was also assessed in this study to see how the many of already existing systems relates to the TB

and Leprosy DHIS2.It was found out that the TB and Leprosy DHIS2 was guided to take consideration of other systems such that it has features which might be used to link with hospital EMR or the existing HIM-health Information Mediator.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Overview

This chapter presents the summary of the findings, discussion and recommendations in relation to the findings on the assessment of sustainability factors of the TB and Leprosy DHIS2 system which was done in Dar es Salaam and Dodoma region, July 2019.

5.2 Summary of the Major Findings

The study wanted to assess how the sustainability factors of the TB and Leprosy DHIS2 have been addressed. The TB and Leprosy DHIS2 system is currently in its five year of operation and thus as per Sterman et al, 2012 definition of sustainability was adopted. The WHO health matrix definition of the HIS core elements was used to fit the definition into HIS perspective.

The results identified a mix of findings, such that factors like presence of permanent HCWs as the main users of the system, the use of a local vendor from a reputable country's academic institute, availability of ICT assistance at the facility levels and evidence of support of operations at facility and district level, reflect the likelihood of the system being sustained. These factors coupled with existence of guidelines, strategies and coordination platforms present a situation for control of implementation of similar systems with a focus of maximizing the system's effectiveness which is among the pre requisite for the sustainability. However, the dependence on donors on

hardware availability, internet costs and unstable connectivity puts a system at risk of becoming unfunctional and hence unsustainable.

5.3Conclusion

These findings are similar to other studies on the donor dependence aspect but different in the context of available human resources, their computer literacy, and technical assistance. The difference could be due to the advancement of the using technology in the country. Tanzania has very much embraced technology and being regarded as leader in low- and middle-income countries (LMICs) globally when it comes to creating strategy and planning for an integrated digital health infrastructure. The study established not only existing guidelines but also an advantaged relationship between the ministry and the academic institution in the development and use of the electronic system. Thus, further efforts are needed to complement the already established ones to drive the systems to the sustainable stable situation.

5.4 Recommendations

The acceptance of this system was very high and efforts which are being put to make sure that the system is working have been identified. However, this is not enough as still a significant amount of source of support is being dependent on donors. Hence Government efforts of putting measures to support smooth roll out such as assigning trained permanent health care workers, coordinative frameworks, strategies and guidelines should synchronize with efforts to fund the system at large to ensure its daily running. The Government should continue to scale up the availability of fiber optic connectivity to government facilities. The Ministry of health community development

Gender Elderly and Children through the Program of TB and Leprosy should work with the developer to make the system more stable especially when introducing changes. Changes should be communicated and orientation to the users to avoid users being faced with difficulties.

The Ministry of health community development Gender Elderly and Children should guide the local government authorities to budget in their Comprehensive Council Plans, (CCHP) items which will support the running of the system such as internet airtime costs, hardware and others. The local government authority should make sure that the electronic systems are being supported from their budgets by prioritizing them as they are the pre requisite for the overall planning.

Further studies on sustainability assessment in the context of the ministry of President Office Regional administration and Local Government (PO RALG)is recommended, as this study looked from the ministry of health perspectives whose role is providing technical advice and resource mobilization at initial stages only. Other area which needs to be studied is the situation of data quality as outcome of the system.

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APPENDICES

Appendix I : Research questionnaire for sustainability of NTLP's DHIS2 system

Questionnaire Number. ……

Please circle your answer or write in words where necessary

1. Name of Health Center …… .., District …….

2. Type:

a) Hospital b) Health Center c) Clinic d) Other types: specify …… ..

3. Your cadre a) Nurse b) Assistant doctor c) Doctor d) Lab technician e) Other cites …… ..

3.1 Your gender: a) Me …… b) Female ……

4. What type of employment do you have? a) Government-permanent b) Government-contracting c) Private d) Other, Specify ……

5. How long have you been using this system a) less than 6 months b) Over 6 months c) Over 2 years d) Over 3 years

6. Have you ever received formal training on how to use this system a) Yes b) No

7. Have you had any computer skills before TB AND LEPROSY DHIS2 system training? a) Yes b) N

8. Have you had any computer training before TB AND LEPROSY DHIS2course? a) Yes b) No .If this is yes, where …… .

9. What device do you use with this system? a) Tablet computer b) Laptop computer b) Other, specify ……

10. Who bought the above equipment for use ……

11. Do you know who or what company made this system ?? a) Yes b) No

if so, mention……

12. Have you ever been involved or involved in the process of developing this system?

a) Yes b) no If yes explain …….

13. Who is assisting you if your hardware / device (such as a laptop etc.) has a problem: a)Facility ICT specialist b)District (ICT) c)Regional Computer Specialist (ICT)d) National level e) Computer Specialist who developed the system f) Other mentions ……. , …….

14. Who is helping you if the System crashes or you are stuck using it

a) System technician from the facility b) System specialist from the District Council c) System specialist from the region d) System technician from the Ministry e) Others, Specify ……

15. Where do you find an "internate" to enable the system to work a) Center Internal b) District Internate (hospital or DMO office) c) Regional office Internate (Hospital or RMO office) d) modem company e) Telephone (private or station)

16. Who bought that modem? Or cell phone a) Ministry b) Region c) District d) Center e) Member, f) Other, specify ……

17. Who pays for the air time / internate packages a) Ministry b) Region c) District d) Center e) Member, Specify …… ..f) Other mention ……

18. Is this system useful to you? a) Yes b) no. Explain ……., ……

19. How do you use the data you fill in this system?

…… ..

20. What challenge do you face from using this system?

……

Thank you for participating in this study

Appendix II: Key Informant Interview

Introduction: Greetings!

Intention: It is my pleasure to speak with you. My name is **Zuweina Kondo** from The Open University of Tanzania. I pursue my Masters of Arts in Monitoring and

Evaluation (M&E). I am here for an interview with you. This interview is the part of my research study: Sustainability determinants of the electronic Health Information System: a case of TB and Leprosy DHS2 System I would like to ask you some questions.

1. What department do you work in?.....

2. Your position is …….

3. How long have you been working with the Ministry / Program

4. What guided you to develop the TB and Leprosy DHIS2: such as guidelines, policies and others……..

5. Does the TB and Leprosy System have any direct links (indirect or indirect) with other systems? …… .. how (explain)

6. Who paid for the expert who developed this system

7. Has the expert developed the TB and Leprosy DHIS2 system available locally or outside the country?

8. What measures have been put in place to ensure this system can be used at lower levels For example: where do they get support for system technical problems e.g.

9. Electronic systems need to be monitored such as maintenance; how is the Ministry organized for this?

It was a pleasure meeting you, I appreciate your time today and I hope to be in touch in the future

Thank you very much