FACTORS INFLUENCING IMPLEMENTATION OF VACCINE INFORMATION MANAGEMENT SYSTEM IN DAR ES SALAAM REGION, TANZANIA

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FACTORS INFLUENCING IMPLEMENTATION OF VACCINE INFORMATION MANAGEMENT SYSTEM IN DAR-ES-SALAAM REGION, TANZANIA

By

Bahati Isingo

A Dissertation Submitted in (partial) Fulfilment of the Requirements for the Degree of Master of Science in Project Management Monitoring and Evaluation in Health of Muhimbili University of Health and Allied Sciences

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CERTIFICATION

The undersigned certify that he has read and hereby recommend for acceptance by the Muhimbili University of Health and Allied Sciences (MUHAS), a dissertation entitled **"Factors influencing implementation of vaccine information management system in Dar-es-Salaam region, TANZANIA"** in (partial) fulfillment of the requirements for award of the degree of Master of Science Project Management, Monitoring and Evaluation in Health (PMMEH) of Muhimbili University of Health and Allied Sciences (MUHAS).

_____

Prof. Daudi Simba.

(Supervisor)

_____

Date

DECLARATION AND COPYRIGHT

I, Bahati Isingo declare that this dissertation is my original work and it has never been presented and will not be presented to any other University for a similar or any other degree award.

Signature……..…….. Date…….

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DEDICATION

This dissertation is dedicated to my beloved daughter Tiffany Dennis.

ABSTRACT

Background: High-quality vaccination data is needed for decision making and planning at all levels within the health system. But unfortunately, vaccination data from developing countries are often considered to be of low quality. Poor quality data, planning, and decision making is difficult in the healthcare institutions and government regardless of how data is recorded and processed. Therefore, Better Immunization Data (BID) initiative was developed and implemented vaccine information management system (VIMS) as an intervention to improve immunization data quality and use.

Objective: The objective of this study was to explore factors affecting the implementation of Vaccine Information Management System (VIMS) in Dar es Salaam region.

Methodology: This study employed a cross-sectional exploratory design which used a qualitative approach in exploring the factors affecting implementation of VIMS. The study was conducted in Dar es Salaam at JSI headquarters, Kinondoni, Ubungo, Ilala district medical office and IVD headquarters involving the IVD program officers, JSI program developer and DIVOs from the selected districts. The study employed a purposive sampling technique to recruit participants. Data was collected using key informant interviews and observations therefore this study used primary data. Qualitative data were analyzed using thematic analysis.

Results: A total of nine (9) participants were interviewed using key informant interviews. The study showed that VIMS information sharing, introduction, adoption, and governance were affected by several factors which either facilitated or hindered VIMS implementation. The factors that hindered VIMS implementation were poor internet and network connectivity, deficiency in ICT infrastructure, workload at the district level, shortage of staff, inadequate capacity building, inadequate skills, lack of staff motivation

and individual perceptions. Complexity of the system and VIMS integration with other systems facilitated implementation of VIMS.

Conclusion and recommendation: The implementation of VIMS in Dar es Salaam was affected by several factors that not only facilitated VIMS program implementation but also hindered the program as explored in this study. Factors that facilitated the implementation of VIMS were such as VIMS integration with other systems and user-friendliness of the system. VIMS implementation was hindered by the deficiency of ICT infrastructures, poor internet and network connectivity, shortage of staff, inadequate training and skills as well as lack of motivation. This study recommended constant maintenance of ICT infrastructure, an increase in the number of staff, a need for training of new recruits and conducting more refresher training to in-service workers.

TABLE OF CONTENTS

CERTIFICATION i
DECLARATION AND COPYRIGHT ii
ACKNOWLEDGEMENT iii
DEDICATION iv
ABSTRACT v
ABBREVIATIONS xi
DEFINITIONS xii
CHAPTER ONE 1
1.0 INTRODUCTION 1
1.1 Background of the study 1
1.2 Problem statement 5
1.3 Rationale 6
1.4 The conceptual framework of the study 6
1.5 Broad Research Question 8
1.5.1 Specific Research Questions 8
1.6 Broad objective of the study 8
1.7 Specific objectives 8
CHAPTER TWO 9
2.0 LITERATURE REVIEW 9
2.1 Implementation of VIMS as e-Health solution 9
2.2 Technical factors affecting vaccine information sharing 10
2.3 Human factors 12
2.4 Organizational factors 13
CHAPTER THREE 14
3.0 RESEARCH METHODOLOGY 14
3.1 Study design 14
3.2 Study area 14
3.3 Study population 15
3.4 Sampling and Sample size 15
3.5 Data collection methods 15
3.5.1 Key informant interview 16

3.5.2 Observation 16
3.6 Type of data 17
3.7 Data collection process 17
3.8 Data management and analysis 18
3.9 Trustworthiness 19
3.10 Ethical consideration 20
CHAPTER FOUR 21
4.0 RESULTS 21
4.1 Social-demographic characteristics of study participants 21
4.2 Thematic framework 21
4.3 Technical factors that affect the implementation of VIMS vaccine information sharing across Dar es Salaam 23
4.3.1 Deficiency and quality of ICT infrastructures. 23
4.3.2. Poor network and internet connectivity. 24
4.3.3. Complexity of the system 24
4.3.4 Failure of the system 25
4.4. Organizational features that affect the implementation of VIMS in Dar es Salaam 25
4.4.1. Successful integration of VIMS with SMT, DVDMT, and CCIT 25
4.4.2. Workload at the district level 26
4.4.3. Inadequate capacity building 26
4.4.4 Shortage of staff 26
4.5. Human factors affecting the implementation of VIMS 27
4.5.1 Inadequate skills 27
4.5.2. Lack of motivation 27
4.5.3. Individual perceptions 28
4.6 Summary of the findings 28
CHAPTER FIVE 29
5.0 DISCUSSION 29
5.1. VIMS technical factors that affect vaccine information sharing 29

5.2. Organizational features that affect appropriate governance of VIMS implementation 30
5.3. Human factors that affect the introduction and adaptation of VIMS 32
5.4 Limitations of the study 33
CHAPTER SIX 34
6.0 CONCLUSION AND RECOMMENDATIONS 34
6.1 Conclusions 34
6.2 Recommendations 35
REFERENCES 36
APPENDICES 41
Appendix A: Informed Consent 41
Appendix B: Fomuyaridhaa 43
Appendix C: key informant interview guide 45
Appendix D: Key informant interview guide 47
Appendix E: Key informant interview Guide 49
Appendix F: Observation checklist 51
Appendix G: Observation checklist findings 52
Appendix H: Consolidated criteria for reporting qualitative studies (COREQ) 53
Appendix I: Ethical clearance letter MUHAS 55
Appendix J: Research permit Kinondoni District 56
Appendix K: Research permit Kinondoni Municipal 57
Appendix L: Research permit Ilala Municipal 58

LIST OF TABLES

Table 1: Thematic framework.....22
Table 2: Observation checklist.....51
Table 3: Observation checklist findings 52
Table 4: Consolidated criteria for reporting qualitative studies (COREQ): item checklist.....53

ABBREVIATIONS

BID	Better immunization data
CCEIT	Cold Chain Equipment Inventory Tool
CHMT	Council Health Management Team
COREQ	Consolidated Criteria for Reporting Qualitative Studies
DHIS2	District Health Information Software Version 2
DIVO	District and Immunization Officer
DMO	District Medical Officer
DVDMT	District Vaccines Data Management Tool
EHealth	Electronic Health
EIR	Electronic Immunization Registry
EIS	Electronic Immunization System
ELMIS	Electronic Logistics Management Information System
GAVI	Global Alliance for Vaccines And Immunization
ICT	Information, Communication and Technology
IIS	Immunization Information System
IVD	Immunization and Vaccine Development
JSI	John Snow Incorporate
LAN	Local Area Network
MOHCDGEC	Ministry of Health, Community Development, Gender, Elderly and Children
MUHAS	Muhimbili University of Health and Allied Science**s**
SMT	Stock Management Tool
TIMR	Tanzania Immunization Registry
VIMS	Vaccine Information Management System
WEBIZ	Immunization Information System
WHO	World Health Organization.

DEFINITIONS

Electronic health system (e-Health): Has been defined as a computerized medical record used to capture, collect and share information among healthcare providers in an organization so as to support the delivery of healthcare services and decision making related to immunization programs. e-Health also includes the use of modern information and communication technologies to meet the needs of health care population including policymakers(1).

Implementation: Refers to the process of putting a decision or plan into effect. These are activities undertaken to ensure the adoption of vaccine information management system (VIMS) transforms vaccine recording processes in the facility and the expectations of the system are achieved. The implementation of VIMS focuses on four phases such as information sharing, developing and introducing computing tools, adopting the tool, and creating appropriate governance as per E-health strategies (2) introducing and adopting the tools

Immunization information systems (IIS): Are computerized data bases that records all immunization doses administered by health providers to persons residing within a given geographical location. IIS is characterized as confidential and population-based (3)

Accessibility: The capability of reaching and using people (4). Accessibility of VIMS is defined as the practice of making the tool usable by many healthcare workers as possible

Competence: Having the capacity to function or develop in a particular way this includes the knowledge, skills, values, and attitudes needed to carry out properly an activity with regards to VIMS (4).

Governance; Refers to the body at the national or regional level in charge of the management of VIMS and data contained in the system(5). A framework for managers to improve how decisions are made and carried out and contribute to better outcomes.

Reliability: Refers to the extent to which an experiment, test, or measuring procedure yields the same results on repeated trials(4). This includes the availability, testability, maintainability, and maintenance of VIMS

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background of the study

High-quality vaccination data is needed for decision making and planning at all levels of the health system, monitoring the performance of various programs, and justifying financial support within the health sectors. But unfortunately, vaccination data from developing countries are often considered to be of low quality (6).With poor quality data, planning, and decision making becomes difficult in the healthcare institutions and government regardless of how data is recorded and processed (7).

Several studies conducted in developing countries have reported inconsistencies in data reporting and poor monitoring mechanisms to ensure data quality at the district level. For example, a study conducted in Nepal found out that data obtained from the facility registers were lower than the data reported at the district level which showed a tendency of over-reporting. Therefore, to battle such a challenge, donor-supported initiatives like Global Alliance for Vaccine and Immunizations (GAVI) has been putting a lot of effort into assessing the quality of data used since accurate immunization information is essential for the health sector managers to track and improve program performance throughout the world(8).

Better Immunization Data (BID) initiative developed and implemented a vaccine information management system (VIMS) as an intervention to improve immunization data quality and use (9). In sub- Saharan African countries, BID Initiative started collaborating and planning country-driven health system solutions to meet critical immunization service delivery problems and related data challenges. This was done by working with technology developers to design and encourage adoption of the digital solutions and increase the use of the data captured in making decisions. Collaborating

with Tanzania and Zambia, BID led the implementation of VIMS to share information(10).

VIMS is a web-based system developed by John Snow Incorporate (JSI) in 2015 under the immunization and vaccine development program (IVD). It was first developed and piloted across seven Tanzania mainland regions (Arusha, Dar es Salaam, Lindi, Mtwara, Mwanza, Njombe, and Tabora). VIMS was then studied in selected facilities and regions before further rolling out (9,10). VIMS was developed on the existing open logistics management information system platform to manage immunization data quality, challenges associated with the use of district vaccines data management tool (DVDMT), stock management tools (SMT), and cold chain equipment inventory management tool (CCEIT). VIMS was also aimed to join the tools to form a single logistics data and immunization programs (2).VIMS implementation in the health sector was meant to improve immunization decisions at all levels within the health facilities to produce better health outcomes by ensuring that every child in Tanzania has been vaccinated and to provide accurate and reliable vaccine data. It can be concluded that decisions made on immunization data management at the district levels reflect the quality of data collected by VIMS (12).

The implementation of VIMS is based on supporting the common workflow in the system by managing the vaccine stock, cold chain equipment and routine immunization by the IVD managers and officers. The management of vaccine stock deals with forecasting demand, ordering, issuing, receiving, conducting physical counting of stock, adjusting the stock, transferring stock in the store or out of vaccine store, visualizing stock in the stores of health facilities and tracking performance by the use of dashboard and system reports. Apart from that, the users of VIMS are provided with immunization data which assists in the tasks of completing and submitting summary forms, following up on the submitted and uncommitted summary forms, approving monthly summary forms, tracking performance using system reports and dashboards and settings demographic data. In the process of managing the cold chain equipment, the users

manage and track cold chain equipment data as well as changing the functional status of equipment(13).

The National e-Health strategy is a document that provides direction for the long term vision of e-Health. The document also describes the leadership and governance structure that will help ensure the timely implementation of e-Health initiatives (2).The national e-Health strategies, guides information and communication technology (ICT) in the health sector to transform from paper-based to electronic based (2). VIMS was designed as an e-Health solution under the national e-Health strategy (14). Therefore, it employs Tanzania's e-Health strategy in the process of tracking vaccines, related commodities, cold chain assets, and routine immunization data from the health facility level through the districts, zonal and national levels (11).

Under the governance of the Tanzania Ministry of Health, Community Development, Gender, Elderly, and Children (MOHCDGEC), fund supporting VIMS is provided by the Immunization and Vaccine Development program (IVD), the US Agency for International Development, the Bill & Melinda Gates Foundation, and GAVI with the Clinton Health Access Initiative. Not only that but also the JSI supports the program through the Supply and the Maternal and Child Survival Program, PATH and Village Reach provide technical assistance on VIMS (15). Data on vaccination has been collected using Excel based district vaccines data management tool (DVDMT), stock management tools (SMT) and cold chain equipment inventory management tool (CCEIT) developed by WHO (9). But due to the need for quality improvement of these tools, VIMS was designed to combine all the tools (16).

Tanzania introduced VIMS a district-level digital tool across 26 districts and 924 facilities and serves a population of 6.2 million people. VIMS is an automated data exchange system in which the users can easily access the same information like the supply chain information on the district-level so long as there is network connectivity,

district-level staff can access stock information on demand more quickly rather than waiting for monthly reports (17).

The Tanzania immunization data is generally characterized by complex data compilation from multiple systems, poor forecast of vaccine, and immunization supplies. The national, regional, and district-level lack the capacity of obtaining reports through a common window and also inability to visualize the reporting process in one system including cold chain maintenance reports (16). This study explored the factors behind the implementation of VIMS in Dar es Salaam.

1.2 Problem statement

The quality of immunization data in Tanzania has been characterized by unreliable and inaccurate data that often does not reflect the actual or real challenges on the ground for immunization decision making (12). The accessibility, visibility, timeliness, and transparency of data in health facilities has been reported and scored to be62% in health facilities, 77% in district vaccine stores, and 63% in regional vaccine stores and so immunization data quality is considered poor or moderate (16).

VIMS was established and implemented to address these challenges. But studies conducted in Tanzania on the effectiveness of the VIMS have shown that there was no difference in the quality of data between VIMS and non-VIMS users in the country. The study suggested that VIMS as an intervention is supposed to yield better immunization data quality compared to non-VIMS users (2).

Studies conducted in Iran on accuracy and quality of immunization data showed that information related to the accuracy of data from the national immunization registration system was adequate however; there were some weaknesses in timelines of reporting and quality of data. Therefore, the study suggested the use of appropriate software to record vaccination data, supervision on the vaccinators' performance, staff training as a way forward to improve monitoring practices, and management of immunization (18).

Various studies have been conducted on the factors that influence the implementation of immunization systems throughout the world but very little is known on the factors that influence the implementation of VIMS. Therefore, this study aimed to explore the factors that affect the implementation of VIMS as an immunization and vaccine computing system in Dar es Salaam region.

1.3 Rationale

Findings from this study are aimed to generate further understanding on factors affecting the implementation of the VIMS program. It was worth carrying out this study as it examined and made recommendations on what should be done to improve the implementation of VIMS in health facilities for better immunization services. Also, information obtained from this study will provide baseline data for other researchers and academicians who would like to conduct studies related to VIMS implementation in Tanzania.

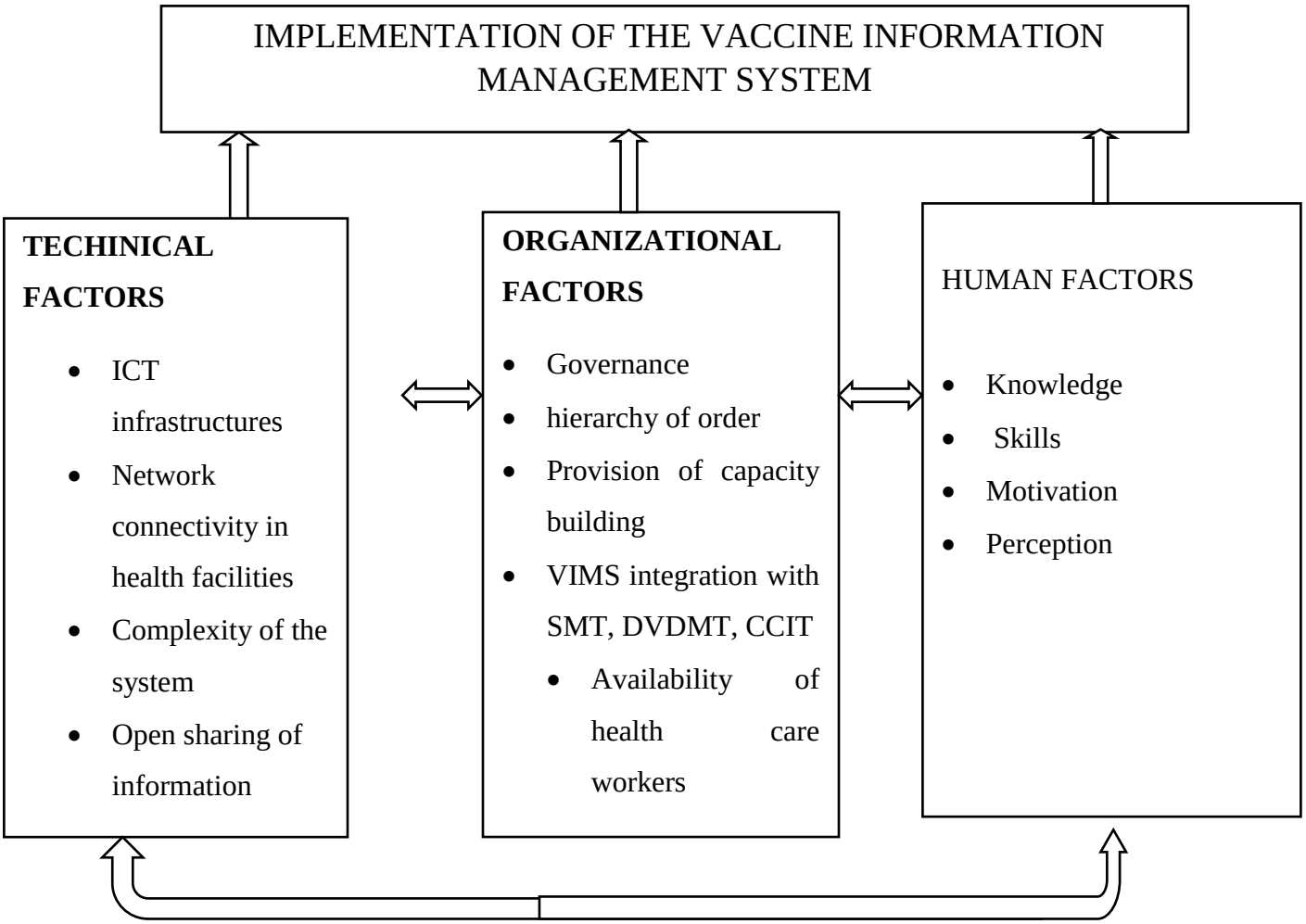
1.4 The conceptual framework of the study

The conceptual framework explores the factors affecting the implementation of VIMS. It is essential to have strategies that when adhered to will result in a program with ensured quality, equitability, and sustainable health system ICT programs for better health services (2). According to the e-Health strategies, technical factors are the requirements and infrastructures needed to improve information sharing across a country. Infrastructures including all the software and hardware requirements to process digital details which can improve information and communication sharing such as computers, internet cables, and network connectivity (19). Not only that but also the periodic maintenance of hardware, network systems, and connectivity are a requirement as well. Although Tanzania has improved in providing the power supply, the presence of reliable connectivity of an offline system design is also important in ensuring information flow and sharing for any system to work as expected (20).

E-Health strategies highlight the need for improving and adopting e-Health related programs. The integration of health information systems to support efficient access to needed data and information for the development and delivery of health care services is inevitable as multiple data recording tools have been used in the health sector. This often focuses on ensuring that individuals, health-care providers, and managers have access to the services and applications that allow them to access, view, use and share health

information and so actions are needed to encourage health care workers to adopt and utilize VIMS (2). Proper relevant training with training material such as computers and skilled instructors to increase the skills and competencies of health workers in ICT as well as plans made by the administration or management to ensure that change is managed for better implementation of the program (16)(21).

Figure 1: The conceptual framework of the study
The conceptual framework on VIMS implementation in Dar es Salaam



SOURCE: Adopted and modified from Muhammad Masum and Abdul Kadar. 2016

1.5 Broad Research Question

What are the factors affecting the implementation of VIMS in Dar es Salaam?

1.5.1 Specific Research Questions

1. What are the technical factors that affect the implementation of VIMS in vaccine information sharing across Dar es Salaam region?
2. How do organizational features affect appropriate governance of VIMS implementation in Dar es Salaam region?
3. What are the human factors that affect the introduction and adoption of VIMS in Dar es Salaam region?

1.6 Broad objective of the study

To explore the factors affecting the implementation of VIMS in Dar es salaam region.

1.7 Specific objectives

1. To explore the technical factors that affect the implementation of VIMS in vaccine information sharing across Dar es Salaam region
2. To explore organizational factors that affect appropriate governance of VIMS implementation in Dar es Salaam region
3. To explore the human factors that affect the introduction and adoption of VIMS in Dar es Salaam region

CHAPTER TWO

2.0 LITERATURE REVIEW

This chapter consists of various research studies and literature on the implementation of immunization information systems that includes VIMS. The organization of the chapter is guided by the specific objectives of the study that focuses on the organizational, technical and human factors affecting VIMS implementation.

2.1 Implementation of VIMS as e-Health solution

Health information in the health systems shared through electronic means by health institutions in developing countries like Tanzania aims at increasing the efficiency and effectiveness of health service delivery (22). Among the general goals of establishing the e-Health strategies in Tanzania was to overcome fragmentation and duplication of health services within the health sector by forming single data management tools like VIMS to replace paper-intensive processes through ICT programs. Targeting to improve information sharing and communication among healthcare workers, enable electronic access to appropriate healthcare services and support decisions through quality reporting of health information (2).

The implementation of VIMS intervention aims at improving immunization data quality and availability throughout the supply chain. Specifically to improve supply chain and distribution system, prediction of vaccine requirements accurately, to manage and improve performance through data influenced decision making by integrating tools and increasing data use and decision skills at all levels of the health system (15,16). Not only that but also, integrating tools and triangulating data captured by different tools such as SMT, DVDMT, and CCEIT. With the VIMS vaccine supply and distribution system is expected to be accurately forecasted as well as vaccine requirements, and prevention of equipment breakdowns monitored without affecting the immunization performance.

Before the development of VIMS, at the national level, there was a burden of reporting, at each level, the chances of errors to occur were high and delayed reports at the national level. All these were challenges in routine immunization by DVDMT at the national level that prompt the development of VIMS (15). VIMS is expected to address the IVD concerns on the challenge of inadequate quality data linkages associated with managing vaccine supplies, it is also responsible for supporting better management of immunization commodities, and vaccine delivery on a timely and accurate basis (16).

Through VIMS implementation, the intervention aims to increase vaccine data quality and availability The current situation with VIMS is associated with the accuracy of data in district hospital on the targeted population for vaccination within the health facilities is questionable with the denominators for calculating vaccination rate (11). The estimates tend to be high or low compare to the demand for vaccines and hence vaccine stock imbalances and decision making remains to be a problem in health facilities (23).

2.2 Technical factors affecting vaccine information sharing

Globally, there have been several studies pointing out some of the technical factors that affect vaccine information sharing within the health systems. A studies conducted in India indicated that the implementation of the Immunization information system is driven by technical capacity. The technical capabilities include infrastructures, design, and reliability of the system; that is, whether the system is complex or simple to use as well as compatible infrastructures in form of hardware, software, and internet connectivity (24).It is also reported that the role of poor data quality arising from various issues such as ambiguity in data definitions, lack of a data dictionary, poor human resource capacity, etc., adversely impacts the functioning of programs such as the Extended Program on Immunization (EPI) (25).

The study done in Albania reported that one of the barriers affecting the Immunization information system is the lack of “last-mile” Internet connectivity, which is not

commonly available in many developing countries. However, mobile technologies may have the ability to bring information systems to even the most peripheral locations. In Albania, nurses in remote locations without good Internet access and stable electricity will shortly be able to access the system through a software application ("app") on Android phones (26).

In Africa, a study conducted in Zambia reported that a hindrance in the implementation of e-Health programs was that technology use is challenged with complex technology design and system's inability to function. The same study reported that due to the complexity of the technology and system makes it difficult for users' especially health care providers on reporting and record keeping (11).
Another study conducted in South Africa by Ruxwana et al. reported that some of the hospital and healthcare centers have insufficient ICT resources including power, phones, system, and computers particularly in rural healthcare centers; all the advanced technologies only remain in the cities (27).

Studies in countries within the northern African countries; Tunisia as an example, has reported that lack of Internet connection and inconsistent access to electricity are other potential barriers to system implementation. Sometimes this can be mitigated by selecting the right system model for the context in which it will be implemented. For example, slow connection speed hampered the use of w-VSSM (28).

A multicenter study conducted in Kenya, Malawi, Uganda, Rwanda reported that the immunization information system in developing countries is being affected by inadequate computer technology, slow internet connections, intermittent power supplies, inadequate databases, and even limitations in the software. Lack of reliable electricity impacts computer use, lights, and internet capabilities (29).

Ineffective Health information system in Mozambique has been attributed to lack of standards, poor human resources capacity, lack of knowledge of immunization related

concepts (such as coverage), heavy workload of field workers, and poor infrastructure – both informational and of the cold chain, adversely affect the functioning of the Extended Program on Immunization (EPI)(30).

2.3 Human factors

In developed countries like the USA, a study conducted in Nevada identified time to create new records as the most commonly reported barrier to implementing such preventive care guidelines and physician education strategies alone often fails to prompt practice change. The study reveals time is one of the factors which affect a web-based immunization information system (WEBIZ) among health care providers (31).

In African countries, a study conducted in South Africa reported that inadequate ICT-related knowledge and skills to most health professionals are inherent problems in the implementation of the immunization information system which in turn result in poor use of ICT solutions. The same study reported that such a result affects the performance, record keeping, and increase the level of resistance in adoption and use of e-Health system (27). Another human factor is low training among users on the use of e-Health programs. In Zambia, this has hindered the implementation of e-Health programs such as Immunization information system in health facilities, because most of the users such as health care providers lacked knowledge and skills on the use of information technology (11).

Another study done in Kenya and Ghana by Scott et al. reported that staff members at most health facilities reported that they required more training in vaccine data record keeping, reporting, analysis, and decision making in Kenya. Most of them were not having adequate training on the immunization information system on data recording and keeping as well as reporting and analysis. The same study revealed that incompleteness of the facility reports, target population data was found to be inaccurate, and the challenge in infrequent analysis and use of data (32).

2.4 Organizational factors

In developed countries, a systematic Cochrane review done among European countries reported that among the challenges during the implementation of the immunization information system in 2016 was a lack of human resources. The inadequate number of staff to be able to successfully integrate health programs within the workplace environment was a challenge (33).

Another study conducted in Geneva reported that the absence of clear governance structure is a critical challenge. Among the components of an organization is governance and leadership. This factor is essential in guiding, directing, monitoring and planning for activities within the organization. Weak governance system will lead to a weak organization (34).

A multicenter study conducted in Africa reported that the use of electronic immunization registries in Africa is challenged by lack of or unreliable electricity especially in rural areas, lack of time, and shortage of staff (35).

In another study done in Kenya and Ghana by Scott et al. indicated that data quality is a challenge in Kenya because it is affected by low confidence in facility level and poor data concordance between child registers and facility tally sheets. The same study revealed that systemic challenges including limited supportive supervision and lack of resources to access electronic reporting systems. The same study done indicated that the data quality of the immunization information system in Ghana is being affected by poorly defined sub-district administrative levels (32).

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 Study design

The study conducted was a cross-sectional exploratory design that employed a qualitative approach in exploring the factors influencing the implementation of VIMS. A case study qualitative approach is used to explore a situation in which the intervention being studied has no clear, single set of outcomes. This approach explores phenomenon's within its context using a variety of data sources to ensure that the issue is not explored through one lens to allow for multiple facets of the phenomenon to be revealed and understood(36). Therefore, a qualitative cases study approach applying observation and key informant interview was suitable as it enabled the researcher to generate an in-depth understanding of issues in a real-life context.

3.2 Study area

The study was conducted in Dar es Salaam. Dar es Salaam is located in Tanzania it consists of 5 districts with a total of 107 health facilities including 16 hospitals according to the Tanzanian government basic statistics portal database of 2014. Dar es Salaam is the headquarters for immunization and vaccine development as well as John snow Inc. (JSI) therefore Dar es Salaam was the perfect region to conduct the study as the coordinators of the VIMS program who were included in the study are located in Dar es, Salaam as well. The current population of Dar es Salaam is 6,701,650 making it the most populated region in Tanzania and therefore hospitals in Dar es Salaam have the most data on IVD as well as utilization of VIMS compared to other regions. Apart from the program developers, the study was also conducted among the VIMS prime users in district medical offices from Kinondoni district, Ubungo district, and Ilala district.

3.3 Study population

The population of this study included the IVD program officers, the district immunization, and vaccine officers (DIVO), and JSI personnel. The IVD program officers, provided information on the technical and organizational aspect of VIMS, the DIVO as well as the CHMT members are the main users of VIMS. They provided more information on organizational factors, technical and human factors. Besides, JSI personal were included in the study as they were the developers of the VIMS program and so information on technical and organization factors were obtained from them.

3.4 Sampling and Sample size

The study employed a purposive sampling technique to recruit participants. Purposive sampling technique is considered desirable to use when the sample is small and with known characteristic(37).The nature of the research objectives required a specific population from the study areas of those who have access to VIMS. In-depth interviews were conducted with nine (9) participants which included, three (3) district immunization vaccine officers (DIVO), two (2) assistant DIVOs, one (1) storekeeper (procurement officer) at the DIVOS office, two (2) program officers from immunization and vaccine development program (IVD) and one (1) program developer from John Snow Inc. (JSI). The actual sample size was determined upon reaching the saturation point. The principle of saturation was used to control the repetition of participant's responses which would not add new information.

3.5 Data collection methods

The study employed a qualitative method of data collection. The data collection techniques used to answer the research questions were key informant interview and observation techniques. The use of key informant interview was conducted to acquire information on the factors that affect the implementation of VIMS in vaccine information sharing, organizational features that affect appropriate governance of VIMS implementation and the human factors that affect the introduction and adoption of VIMS

in Dar es Salaam. Observation techniques for data collection enabled the researcher to acquire information on the factors that affect the implementation of VIMS in vaccine information sharing. These methods were used to ensure that data was credible as well as trustworthy for the study.

3.5.1 Key informant interview.

The research used the key informant interview method in data collection to obtain firsthand information from VIMS users. The researcher first developed an interview guide for the interviewees that was used as a guide in ensuring that all the relevant information was obtained. The researcher then conducted key informant interviews in which the researcher was able to ask questions within the interview guide. This type of interview provided the informants with the freedom to express their views and opinions in their terms and hence the information obtained was more reliable well as questions that popped up for further clarity of the details during the interview were asked and answers. The interview guide was developed based on specific objectives that are on factors affecting VIMS implementation in relation to organizational, technical and the human factors. The objectives were then explored using key informant interviews.

3.5.2 Observation

Observation is a data collection technique that can yield qualitative data in the form of detailed field notes. Therefore, with observational data, the phenomena's that interviewed participants may not express or even be fully aware of can easily be obtained(38). This study employed observation where by the participation method of observation was applied. In this observation, participants were aware of the study goals and so the interaction between the observer and the participants as possible. The researcher prepared a checklist and used it as a guide during the data collection process through observing the workflow and technical factors for VIMS computing infrastructures including the ICT infrastructures, network, and internet connectivity, complexity of the system, as well as open sharing of information and information exchange on how they affect the implementation of VIMS in vaccine information sharing across Dar es Salaam (*see table*

*3).*The observation findings were then documented on the checklist for a clear understanding of VIMS implementation.

3.6 Type of data

The type of data that was collected was primary data acquired from both key informant interviews and observation. With key informant interviews the information was collected from DIVOs, program officers, and program developers. Information was collected on the factors influencing the implementation of VIMS. Observation was focused on the technical features affecting the implementation of VIMS**.**

3.7 Data collection process

Data was collected by the researcher through key informant interview and observation data collection methods. The researcher prepared an interview guide before collecting data then a consent form was signed by the Interviewees which also enlightened the purpose of the study, relevance and objectives of the study before being interviewed as a means of motivating and enhancing full cooperation from the respective candidates to acquire relevant and specify information from the interviewees.

In this study, key informant interview was the primary data collection technique. Two interview guides were developed, one for the program developers at JSI and program officers at IVD and the other interview guide for the DIVOs. The interview questions were English and Kiswahili open ended to allow the respondents to express their views freely and to avoid language barriers. The researcher conducted all the interviews while a written consent for participation and audio recording was sought prior to interviews. During interviews, the researcher was actively listening on the participant's responses in order to make logic out of what is being said. The number of interviews was determined upon reaching the saturation of information at the point where no new information was coming out of interview with added respondent. The interviews were conducted in private settings at the workplace of the participants. Each interview lasted for a maximum of 20 minutes per person. The observation data collection method was applied using a

checklist used to observe the technical factors. The researcher collected data within 20 working days before the final analysis in which an interview with each person was 20 minutes maximum.

3.8 Data management and analysis

All the information that was collected during the in-depth interview was first checked and cleared daily to ensure that information is clear, complete, relevant, and correct. The data was managed with high levels of confidentiality in which all data was recorded by using a recorder that only the researcher had access to. But also the in-depth interview was conducted in a private setting as a means of giving the respondent a comfortable and private setting for the confidentiality of the information

All the information acquired from an in-depth interview was analyzed using a thematic approach. The thematic analysis consisted of six steps beginning with data familiarity, generating initial codes, searching for themes, reveal of themes, finding themes, and lastly was writing up (39). The first step began when the researcher familiarized the data by going through the data to better understand the information and further analysis. The second step that followed in data analysis was to organize the data in a way that was more meaningful and organized to generate initial codes. Theoretical thematic analysis was conducted to code relevant and specific data only. Thirdly, the theme finding in which the researcher was able to capture interesting and unique findings from the codes was organized in a broader way than before with relation to the research questions. The fourth step was to review the themes. In this step, the themes that were identified in step three were reviewed and further modified to transform and develop initial themes. At this step, the researcher was obligated to go back and forth between themes, codes, and extracts to code all the relevant data and themes to represent data accuracy. The fifth step was identifying the essence of the theme as the researcher identified each theme and understood what it was about. Lastly, findings were summarized in a tabular form (See Appendix F). The consolidated criteria for reporting qualitative research (COREQ)

checklist was used to ensure the reporting of the study findings were consistent with the guideline (see Appendix I)presented per (COREQ) requirements (40).

3.9 Trustworthiness

To ensure the trustworthiness of the study, the researcher used the four criteria of Guba to ensure the trustworthiness of the qualitative study. The trustworthiness of the findings is the key fact delivered from the data to make the findings valuable. The purpose of trustworthiness in qualitative research is to support the argument that the inquiry findings are worth to be paid significant attention to. As Guba (41) and other researchers (42,43) suggest that in ensuring trustworthiness in qualitative studies. The four criteria are credibility, transferability, dependability, and conformability (44).

The credibility of the findings was ensured to provide data that is accurate and truthful by having complete data. To ensure more credibility, the researcher used member checking in which results or data was returned to the respondents to check for accuracy and resonance as a data validation technique. The period of data collection was planned in such a way that the researcher was able to conduct preliminary analysis in between field visits as a guide for data collection.

To ensure the applicability of the study, transferability provided evidence that the findings from the study can apply to other contexts, situations, times, and populations. Therefore the researcher used a thick description to show the applicability of the study findings. Transferability in this study was ensured by making sure that the researchers' setting of the study was clearly understood by describing where the key informant interviews took place which is in JSI and IVD headquarters as well as DIVOs offices. Not only that but also, theoretical saturation was obtained through regular meetings with key informants which included JSI VIMS operators, IVD program officers, the district immunization and vaccine officer (DIVO) so, coding and identification of variations in each of the key concepts were reported and discussed.

Addressing the dependability of the study, the researcher made sure that the study had a clear research design and data gathering methods. In data gathering methods the researcher conducted a key informant interview among the targeted population of IVD officers, JSI VIMS operators, and DIVOs in Dar es Salaam of which ensured reliability of the study in a way that the study, when conducted again among the same population and method by other researchers, will probably yield the same results. The research enabled readers to further understand the methods of the study through a clear research design that is explorative and on top of that the study described what planned to be conducted.

Confirmability in this study ensured that the finding of the study is the results of the key informant's information rather than the researchers. To establish confirmability, the researcher provided an audit trail in which every step of data analysis was highlighted to establish a rationale for the decisions to be made. But also sharing the findings with the supervisor enabled the researcher to obtain different perspectives from the information gathered.

3.10 Ethical consideration

This study sought ethical clearance from the Muhimbili University of Health and Allied Sciences (MUHAS) Ethical Review Committee before conducting the study. Before commencing with data collection the researcher sought and obtained approval to conduct research from the regional, district, and municipal administration secretaries of Dar es Salaam. I then sought and obtained approval from Kinondoni, Ubungo and Ilala district medical officers. Data collected was confidential and personal consent was soughed through a written voluntary consent form before the audio recording of data from the respondents. The researcher ensured that the workflow was observed as much as possible and not disturbed during the conduct of the study.

CHAPTER FOUR

4.0 RESULTS

The findings from this study are reported regarding the objectives of the study and underlying themes to give a clear representation of the situation. The findings from the study are a result derived from the key informants of the in-depth interview with quotations from the participants and supported by observation.

4.1 Social-demographic characteristics of study participants

The participants included three (3) District Immunization Vaccine Officers (DIVO), two (2) assistant DIVOs, one (1) storekeeper (procurement and logistics officer) at the DIVOS office, two (2) program officers from Immunization and vaccine development program (IVD) and one (1) John Snow Inc. (JSI) VIMS program developer. All nine (9) of the participants were male. The participants had different levels of education in which six (6) participants had a master's degree, two (2) had a bachelor's degree and one (1) had a diploma. Out of nine (9) participants, seven (7) participates had worked with VIMS for more than a year while two (2) had less than a year of working experience with VIMS.

4.2 Thematic framework

The table below represents the codes, subthemes, and themes. The codes from the finding developed the themes in this study.

Table 1: Thematic framework

THEMES	SUB-THEMES	CODES
Deficiency and quality in ICT infrastructures	Technical factors	Lack of quality computers, Insufficient computers.
Poor network and internet connectivity.		Poor network connection and overload, unstable network, failure of the system to load data, internet bundle.
The complexity of the system		User-friendly, reliable, easy to use, easy to navigate.
Failure of the system		Unable to auto-generate quarter reports.
The workload at the district level	Organizational factors	Delay in reports, the limited number of staff, workload burden, delay in reporting, need for more staff
Capacity building		limited capacity to conduct training, less competence, need for more on the job training, resources
Successful integration of DVDMT, SMT, and CCIT		Data visibility, reduction of paperwork, eased data collection, one platform
Shortage of staff		The need for more staff, delay in preparing and reporting, workload
Skills and knowledge	Human factors	Need for more training, lack of frequent training,
		limited capacity to train, insufficient trainers
Lack of motivation		Inadequate training, unwilling to change the mindset
		toward changes
Individual factors		Personal beliefs on the use of ICT, attitude, age, ignorance

4.3 Technical factors that affect the implementation of VIMS vaccine information sharing across Dar es Salaam

Among the objectives of the study was to explore the technical factors that affect vaccine information sharing across Dar es Salaam by using VIMS. The technical aspect of VIMS was not limited to ICT infrastructures, network connectivity, and the complexity of the system to the users; open sharing of information, and electronic health information exchange. From the study, the analysis resulted in four analytical themes which were deficiency and quality of ICT infrastructures, the complexity of the system, failure of the system, and poor network and internet connectivity.

4.3.1 Deficiency and quality of ICT infrastructures.

The interview participants reported that there was an insufficient number of computers in the office compared to the number of health workers while some complained that the computers are malfunctioned that contribute to cripple the implementation on VIMS in vaccine information sharing. One of the respondents among the DIVOs had this to say:

"*In my district, we only have one laptop which so far is not working properly but my assistant has a personal laptop which he uses for conducting office work. I would prefer to be given a new laptop or desktop."* (DIVO)

With regards to the quality of the ICT infrastructures, the findings from observation showed that two of the computers that were used were of low quality as they had been used for more than seven years. From observing, one of the computers, the system operated slowly making it difficult for the user to type In addition, from an interview with a program officer, the researcher found out that, the deficiency in computers hindered timely submission of reports. One of the respondents among the program officers said that;

"The computers that are being used are not that good because some of them have already been used for a long time compared to the life span of computers. We do not have a program for providing them with new computers but the district municipal council

involved is the one supposed to buy or fix the computers once a problem occurs….. Once a malfunction occurs we can do nothing about it." (Program officer**)**

4.3.2. Poor network and internet connectivity.

VIMS is an online web-based system that functions with the use of stable internet. The respondents reported that the network and internet connectivity was a challenge for them in the sharing of vaccine information as well as a setback in the completion of tasks. One among the DIVOs responded that;

"*Internet connectivity is a problem…sometimes, the network can be down. VIMS is a new system so sometimes when you upload information then later you come to check on the information you might find that information is missing. Or after you have uploaded the information you might receive a call from the program officers at the higher levels that you have not uploaded the needed information."*(Respondent 5)

It was also elaborated by three of the respondents who use the system that at times VIMS fails to open or to upload information when the need arises. In such a situation technical assistance is needed to enable the user to complete the task. The following account was reported by one of the interviewees;

"It happens that the system fails to load data so instead of using 2 minutes to upload a form it might take longer than that." (Respondent 8)

4.3.3. Complexity of the system

This study found out that the system was user friendly, reliable and so it was not a complex system as all nine of the participants from the study acknowledged that **VIMS is** easy to use once taught on how to use it. Among the respondents one of them said that;

"VIMS is a nice system in managing vaccine data because you can easily navigate along with the system and also get all the data that you need except some aspects to need more improvement'." (Respondent 9)

4.3.4 Failure of the system

The study found that VIMS was developed in a way that provided information on vaccination that is complete and accurate. However the system does not provide an option to view quarterly reports when needed. The failure of the system to auto-generate reports makes it difficult for the users to view the needed data and make decisions on time. One of the respondents said that;

"When you want to generate a quarterly report, VIMS is not developed to produce one so it would be easier if all the data could be viewed at once in an aggregated way."(Assistant DIVO)

4.4. Organizational features that affect the implementation of VIMS in Dar es Salaam

From the study, the participants were asked about the organizational features that affect the implementation of VIMS with reference to governance of the system, hierarchy of order, provision of capacity building, and VIMS integration with SMT, DVDMT, and CCIT. This study was able to come up with three themes developed from the analysis which are, inadequate capacity building, and successful integration of VIMS with SMT, DVDMT, and CCIT, workload burden at the district level

4.4.1. Successful integration of VIMS with SMT, DVDMT, and CCIT

The integration of VIMS with other tools for immunization was found to be successful as all the features from the tools, SMT, CCIT, and DVDMT, have been moved to VIMS. The respondents were confident with the way the tools were integrated because VIMS provided more visibility compared to the use of individual tools in the past one of the program developers responded by saying;

"Because of the complexity of SMT, DVDMT and CCIT immunization data could not give the needed visibility unless it was shared using Excel (software) so what was in the tools is now in the VIMS." (Respondent 4)

4.4.2. Workload at the district level

From the findings, three respondents from the DIVOs office reported experiencing an increase in workload as a result of using VIMS. Therefore, workload led to a delay in the submission of monthly reports and poor data quality. One of the respondents suggested that the system should start from the lower level, that is, the health facilities and not at the DIVOs office. This will reduce the workload at a higher level as one of the informants said;

"We wish that the system could start at the health facility level so that the data could come directly to the DIVOS office without the need to compile the report again." (Respondent 8)

4.4.3. Inadequate capacity building

The study found out that, the system had been updated from time to time with some new features and so the users wished to receive some capacity building training to be more competent with the system. Furthermore, the users have been instructing themselves on how to use the system because few of them went for hands-on training and it was their responsibility to pass down what had been taught to their colleagues. What had also been done was that the program developers had created a WhatsApp group as a platform in which they could raise their views and receive assistance. Therefore the users were not competent enough in using the system as one of the informant said;

"Yes *I was trained only once but because the system gets new features now and then more training should be provided so that I can be more competent in using the system."* (Assistant DIVO)

4.4.4 Shortage of staff

To complete tasks in time the number of people to accomplish the task need to be adequate. For example one of the DIVOs works with 68 health facilities within the

district although each DIVO has an assistant some of the districts still need more work force. One of the program officers said that;

"One person is not enough because you might find that one person is competent and another does not fancy using electronic devices such as laptops. The challenge is in the district's level because not all of them upload the data on time in the system as they also have to handle other responsibilities as well." (Respondent 3)

4.5. Human factors affecting the implementation of VIMS

Among the objectives of this study was to explore the human factors that affect the implementation of VIMS in Dar es Salaam region. From the analysis conducted, developed themes were; inadequate skills, lack of motivation, and individual perceptions.

4.5.1 Inadequate skills

Most of the respondents were unsatisfied with the frequency of training that they received, as only one hands-on training was conducted for the users on how to use the system. Although the training was conducted among the key users the number of people who received the training and the frequency of the training provided was not enough. Therefore most of the users reported to have had no skills on VIMS. One of the respondents said that;

"*Because the system gets new features now and then more training should be provided so that I can be more competent in using the system'' (Assistant DIVO)*

4.5.2. Lack of motivation.

From the findings, most of the respondents acknowledged that human behavior in terms of willingness and motivation to learn and work with VIMS affected the implementation of VIMS in Dar es Salaam region. One of the respondents said,

"We have moved from paper to electronics, changing people's mindset is a challenge as some immunization offices are old. (Respondent 4)

4.5.3. Individual perceptions

From the findings, it was seen that peoples' perceptions and attitude towards VIMS was a problem. Some of them perceived that VIMS increases the working load. This demotivated them to use the system as required. Consequently, this affects the quality of data from the data entry point to reporting. One of the informant said:

'health facilities are many but also low supervision in the health facilities can bring about a delay from the health facilities to submit the data and so from there a problem arises'. (Program officers)

4.6 Summary of the findings

The purpose of this study was to explore the factors affecting the implementation of VIM in Dar es Salaam. From the study, various themes emerged from the key informant interview which is: deficiency and quality in ICT infrastructures that affect information sharing, the complexity of the VIMS, poor internet connectivity that pose a challenge in information sharing, the workload at the district level, shortage of staff, inadequate capacity building, inadequate skills, failure of the system to auto-generate report, lack of staff motivation and individual perceptions. It was observed that ICT hardware and software items were available but not adequate to meet the needs for the implementation of VIMS at the facility. This was also reported by the respondents during the key informant interviews

CHAPTER FIVE

5.0 DISCUSSION

This chapter presents the discussion, interpretation, and implications of the study findings interpreted in relation to the research questions and findings from other related studies by other authors across the world.

5.1. VIMS technical factors that affect vaccine information sharing

This study has revealed that various factors affect vaccine information sharing such as inadequate and low quality of ICT infrastructures, poor network, and internet connectivity as well as the complexity of the system. The DIVOs office has few computers compared to the number of users and some of the officers used for more than seven years thus out dated computers which hinders their day to day activities. A similar study conducted in seven Tanzania mainland regions found out that there was outdated computer hardware at district, regional, and national levels (16). This was one of the reasons for the VIMS program not to run or display properly as expected. Another study done in Nigeria reported that healthcare workers do not enter data on the DHIS2 routine immunization data module and dashboard on time, due to lack of computers (45). In Tanzania, vaccine information is shared through a web-based system that requires functioning computers a situation that is similar to findings of the study conducted in Nigeria.

VIMS is a web-based system and therefore it functions only when there is internet connectivity. This study found out that, the management of vaccine data at the district level by using VIMS was affected by poor network and internet connectivity. This was partly attributed to poor internet connectivity and insufficient internet bundles for monthly support. Also, the lack of immediate ICT support from ICT personnel's at the district level to assist when needed affected information sharing. Studies from Tunisia found out that, in managing vaccine data, internet connectivity was a major issue. As the

healthcare worker fails to use the system when the internet connection was low, forcing them to go back to paper-based data entry (46).

This study has shown that VIMS is a user-friendly software, meaning that the system is easy to use and navigate with no complex features that the users cannot deal with. A study on Tanzania immunization registry (TImR) a digital solution similar to VIMS, conducted in Tanzania, reported that the technology used to innovate the system was not overly complex. Due to its simplicity and ease of use, TImR had enabled the improvement of the workflow in health care delivery services (47). However, this study found out that, VIMS is user friendly and hence easy to use thus facilitating its implementation.

In order, to obtain data of quality, technical features of a system need to be supportive. The implementation of VIMS from data collection, management, and reporting requires the need for quality computers which in this study was found to be a problem. The absence of stable network and internet connectivity makes it difficult for the users to upload information on time and this hindered VIMS implementation. Moreover, it is easy to navigate within the system as the system has features which are user friendly and hence facilitates VIMS implementation.

5.2. Organizational features that affect appropriate governance of VIMS implementation

This study revealed a successful integration of VIMS with other systems (SMT, DVDMT, and CCIT) which resulted in the reduction of workload for health workers at the district level. A study conducted in Tanzania found out that, VIMS did integrate the existing multiple tools (SMT, DVDMT, and CCIT) into a harmonized data collection, analysis, and visualization platform. VIMS's successful integration with data collection tools from other systems is a result of proper planning and monitoring that helped to resolve the problem of using multiple tools in the IVD program. VIMS was well regarded

by users for easing the burden of data collection and management. With this, VIMS brought fragmented immunization data management systems into one platform.(16)
The implementation of VIMS is dependent on the number of staff available in the health sector. This study revealed that the number of staff is not sufficient compared to the activities needed to be conducted at the district level. Studies conducted in South Sudan found out that, EPI implementation faced several challenges including lack of human resources, skilled staff, and inadequate resources. Therefore, the program's success was not uniform throughout the country as a result, the system was not used in some parts of the country (48). Adequate staff availability is an important factor in facilitating day to day activities in VIMS implementation. Most of its users are overloaded with other related work activities, as a result, there is a constant demand for more workforce to fill in the gap.

This study found out that, although VIMS integration with other tools was done the workload continues to exist. This is because in addition to working on the VIMS DIVOS has other public health-related activities that require their attention. The burden of workload had contributed negatively to the timely reporting of vaccine data in VIMS. Studies were done in Tanzania and Zambia found out that, some health care workers felt that the introduction of Electronic Immunization Register (EIR) had added to their workload. The challenge was more marked in facilities with limited resources like staff and infrastructures.

As reported in this study, lack of capacity building specifically for on-job training on the use of the VIMS program was due to a lack of resources like finance and trainers to provide regular on the job training on VIMS. This undermined the confidence of VIMS users within the district level in managing vaccine data. A study conducted in Zambia found out that, among healthcare workers using the EIR, the need for more capacity building around data use was necessary as some users were considered to be slow learners as well as technophobic (49). Similarly, in Pakistan, a study on EPI found out that, in-service training for routine immunization staff was not planned nor was it

implemented in relation to the different levels of staff. This was because the government budget for training did not usually allocate funds for continuous education or in-service training (50). In Tanzania, the constraints of funds and failure of the governance structure to plan and budget for on-job training for VIMS has hindered its implementation.

Therefore, VIMS implementation as seen from the findings was hindered by the limited number of staff which resulted in workload burden at the district level, as well as lack of capacity building. Also in addition, VIMS integration of immunization data tools such as DVDMT, SMT, and CCIT has increased data visibility therefore contributing to improved decision making.

5.3. Human factors that affect the introduction and adaptation of VIMS

This study revealed that inadequate skills and lack of motivation affected the introduction and adaptation of VIMS. This study found out that there is inadequate training of VIMS users at the district level therefore this brought about inadequate skills on VIMS. The introduction and adaptation of VIMS require the users to be well trained for the successful implementation of the system. But due to limited resources such as skilled ICT personnel at the district level and funds to conduct training for all the VIMS users, this has not been successful. A study conducted on immunization data quality in Peru and Mexico suggested that sustainable health care workers training is a key determinant of EIR sustainability and a means of promoting efficient staff. the study recommended that to avoid resistance in using the digital system, the country needed to carry out progressive training and educational activities in selected units (51).

This study found out that, adoption of the VIMS is affected by a lack of motivation among users at the district level. Among the reasons for the lack of motivation was the unwillingness of the users to change from paperwork to electronic-based systems and inadequate training. This in turn hindered the implementation of the VIMS. A study conducted by Honest C. Kimaro reported that due to lack of training resources and an unconducive environment it was not uncommon to find a health care worker with limited

computer skills and a lack of motivation to learn (52). Therefore, the lack of institutional support to VIMS users and the creation of a conducive learning environment that will enable them to adopt changes demotivates them. In turn, this affects the implementation of the program.

The introduction and adoption of VIMS by the users was seen as a result of lack of motivation and limited skills and knowledge on the use of VIMS and so with limited skills and motivation the process of ensuring data quality is maintained is affected therefore the implementation of VIMS is hindered.

5.4 Limitations of the study

This study explored the factors that influenced VIMS implementation on Dar es Salaam region and had involved few participants through a qualitative approach and therefore, to generalize the study findings, the researcher used thick description by giving details and interpretation of situations explored in the analysis. Additionally, with a small population the researcher was able to examine the situation in depth so the findings can be transferred to another study with similar context.(53)

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATIONS

6.1 Conclusions

The implementation of VIMS in Dar es Salaam was affected by several factors that not only facilitated VIMS program implementation but also hindered the program's achievements. VIMS has been seen as a system that is easy to navigate and use, making it user-friendly and less complex for the users to adopt and share information on VIMS from data collection stage to reporting of information. The merits of VIMS integration of immunization data tools(SMT, DVDMT, and CCEIT) was found to be a motivator to users because it improved data visibility and in turn, facilitated immediate information sharing for decision making.

The number of healthcare workers at the district level was reported to be insufficient thus causing more workload among DIVOs. The situation was further compounded by challenges in internet connectivity and ICT infrastructures. Challenges facing VIMS implementation in sharing of information, adopting the system, and governing of the system, demotivates the users in making proper decisions that affect the management of vaccine information management at all the national levels.

While a clear reporting system and strong management for VIMS exist, the need for more training of recruits and conducting refresher training was apparent. This is likely to enable VIMS users to improve their competence and skills in the system.

6.2 Recommendations

1. The Ministry of health should support the IVD program in increasing the number of healthcare workers on VIMS to match with the activities at the district level by providing them with the necessary resource such as funds enough to manage the expected number of workers on VIMS. The IVD program should promote the use of the digital system at the health facilities level so that data collected can be entered directly into the VIMS to reduce the workload and so, task of the DIVOs should be to validate the uploaded information)
2. Training is important in building confidence in system use among users. IVD should make efforts to provide continuous refreshers training for recruits and on job training to the DIVOs as a means of motivating and increasing the skills and knowledge of the users. The aim of the training should be to impart the competence, skills, and knowledge of the VIMS program.

3. The district councils should support VIMS users with needs to run the system including internet vouchers, proper working computers, and system expert should be allocated at each district to ensure that VIMS is working daily through constant maintenance of the system. Additionally, regular technical support should be provided on system network and connectivity to ensure functioning ICT infrastructures.

4. Mixed method studies should be conducted on the implementation of VIMS so as to inform the program developers and implementers on new knowledge on VIMS as little literature is available.

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with Proteus Qualitative Research and the Generalizability Question : Standing Firm with. 2000;4(3).

APPENDICES

Appendix A: Informed Consent

Introduction

Greetings! My name is Bahati Isingo, a student of Master of Science in Project management, Monitoring, and Evaluation in Health at the Muhimbili University of Health and Allied Sciences (MUHAS). On behalf of MUHAS, I am researching to assess factors affecting the implementation of the vaccine information management system (VIMS) in Dar-es-Salaam.

Purpose of the study: The purpose of the study is to collect information on the VIMS technical factors that ensure information sharing across health workers, organizational factors that have affected the implementation of VIMS among health workers, and the human factors for VIMS implementation among health workers. You are being asked to participate in this study because we believe that you have particular experiences that may be important to the study.

Methods of the study: As part of the study, key informant interview will be done and your responses will be recorded using a tape recorder. You will be interviewed only once for approximately 30-45 minutes in a private setting.

Procedures of the study: Participation to this study is voluntary. That is, you may decide to participate or not. You may refuse not to respond to a question that you feel not to respond to, and end the interview session anytime. All responses will be kept confidential and will be used only for the purpose of this study. Only people working in this research study will have access to the information. Your name will not be written on this form, and will never be used in connection with any of the information as code number will be used to identify your responses.

Benefits: There are no direct benefits for your participation. However, the information you provide will help the health system to improve the implementation context of the system and hence improve health services delivery. No harm is expected as a result of participation in this study and you can ask the interviewer questions any time during the study.

Whom to Contact: In case of any question or query concerning this study, please contact the principal investigator, Bahati Isingo (MSc. PMMEH) from MUHAS, P. O. BOX 65001, Dar es Salaam, mobile number 0757030522, Or my supervisor Prof. Daudi Simba mobile number 0754382209. If you have any question about your rights as a participant you may contact Dr Bruno Sunguya, Chairperson of the research and Publications Committee, MUHAS. P.O. Box 65001, Dar es Salaam-Tanzania, Tel +2552150302-6).

I……have read the contents of this form and understood it, my questions have been adequately answered. I agree to participate in this study.

Signature of participant…….Date…….

Signature of researcher……..Date……..

Appendix B: Fomuyaridhaa

Utambulisho.

Habari!, naitwa Bahati Isingo, ni mwanafunzi wa shahada ya uzamili ya Sayansi ya usimamizi, ufuatiliaji na tathmini ya Miradi ya Afya katika Chuo kikuu cha Afya na Sayansi Shirikishi Muhimbili (MUHAS). Utafiti huu unaangalia utekelezaji wa VIMS kwa mkoa wa Dar es Salaam.

Madhumuni ya Utafiti: kuchunguza visababishi vinavyoadhiri utekelezaji wa mfumo wa VIMS kwa Dar es salaam. Dhumuni la mahojiano haya katika utafiti huu ni kukusanya taarifa juu ya visababishi vya kitekinikali vinavyohakikisha mawasiliano baina ya watumishi wa afya kupitia VIMS, mpangilio wa VIMS unavyoathiri utekelezaji baina ya watumishi wa afya na visababishi vya kiubinadamu vinavyoahiri utekelezaji wa VIMS baina ya watumishi wa afya. Unaombwa kushiriki katika utafiti huu kwasababu tunaamini uzoefu wako ni muhimu katika utafiti huu.

Mbinu za Utafiti: Kama sehemu ya utafiti huu, tutafanya mahojiano ya kina, mhojaji

atanakili kwa kinasa sauti majibu yako.Utahojiwa kwa takribani dakika 30 hadi 45 kwenye eneo binafsi.

Taratibu za utafiti. Ushiriki wako kwenye utafiti huu ni wa hiari. Hii inamaanisha kuwa hutakiwi kushiriki ikiwa hutokuwa tayari kufanya hivyo. Waweza kukataa kujibu swali lolote ambalo hujisikii kulijibu, na pia waweza kusitisha mahojiano wakati wowote. Taarifa utakazotoa ni siri na zitatumika tuu kwa ajili ya utafiti. Watu wanao husika na utafiti huu ndiyo wanaweza kuzipata taarifa hizi. Jina lako halitaandikwa kwenye fomu hii na halitahusishwa na taarifa, namba za siri zitatumika kutambulisha taarifa ulizotoa.

Faida: Hakuna faida za moja kwa moja utakazopata kwa ushiriki wako. Hata hivyo, taarifa utakazotoa zitaisaidia katika kuimarisha utekelezaji na matumizi ya mfumo ili kuboresha huduma za chanjo. Hakuna hatari zozote zinazoweza kukupata kwa kushiriki wako kwenye utafiti huu.Waweza kumuuliza mhojaji maswali wakati wote wa utafiti.

Mawasiliano: Kama utahitaji ufafanuzi zaidi juu ya utafiti huu, usisite kuwasiliana na Mtafiti Mkuu Bahati Isingo, mwanafunzi wa shahada ya uzamili ya sayansi ya usimamizi, ufuatiliaji na tathmini ya Miradi ya Afya (MSc. PMMEH) katika chuo kikuu cha Afya na Sayansi Shirkishi, Muhimbili S. L. P 65001, Dar es Salaam au namba ya kiganjani 0757 030522. Pia, waweza kuwasiliana na msimamizi wangu katika utafiti huu, Prof. Daudi Simba simu ya kiganjani 0754382209. Kama una swali juu ya stahiki zako unaweza kuwasiliana na Dk. Bruno Sunguya, ambaye ni mwenyekiti wa kamati ya Utafiti na Machapisho, S. L. P 65001, Chuo kikuu cha Afya na Sayansi Shirkishi, Muhimbili S. L. P 65001, Dar es Salaam au namba +2552150302-6.

Mimi ……..Nimesoma/nimesikia na kuelewa madhumuni ya utafiti huu na maswali yangu yamejibiwa ipasavyo. Hivyo, nimeridhia kwa hiari yangu kushiriki.

Saini ya mshiriki…….……...…….. Tarehe……

Saini ya mtafiti ……..…Tarehe……

Appendix C: key informant interview guide

Immunization and Vaccine Development program officers and JSI VIMS operators in immunization related services and data management on VIMS

Important Participant information

(Researcher to fill this part first)

District: _____

Job title: _____

Number of years working in the post: _____

Sex: _____

Education: _____

Date of interview: _____

1. How is VIMS program governed?
   Probe for;
   i. VIMS governance structure
   ii. Chain of command
   iii. Who is responsible for supervising activities related to VIMS?
2. How do you ensure that VIMS users are competent?
   Probe for;
   i. Frequency of training on VIMS
   ii. Skills capacity building on VIMS users
3. Is the number of staff working with VIMS enough to perform immunization and vaccine activities?
   Probe for;
   i. Availability of staff working with VIMS
   ii. Completion of tasks related to VIMS by VIMS users
4. From your experience, how would you briefly describe VIMS integration?
   Probe for;
   i. How VIMS Integrates with DHIS

ii. How VIMS integrates with SMT, DVDMT and CCIET

5. How have you ensure that VIMS technical aspect is appealing for users?

   Probe for:

   i. If the system is user friendly and easy to use
   i. Availability of ICT infrastructures such as computers, cables, switch, internet connections
   ii. Reliability of the system in open sharing of information

6. How have you ensured that VIMS provides reliable electronic information sharing system among users?

   Probe for;

   i. Is vaccine data information easily accessible to all when needed
   ii. How possible has communication been made among health workers

7. What challenges does VIMS mostly face during implementation?

Finally, I have no further questions although but you are welcome for any discussion in this topic that you would like to discuss further. For the question that I can answer here, I will do so. But for question that I may not be able to answer promptly, I will find out appropriate information and send the response.

Thank you so much for your kind participation.

Appendix D: Key informant interview guide

VIMS users the DIVOs and assistant DIVOS in health care facilities on immunization related services and data management.

Important Participant information

(Researcher to fill this part first)

District: _____

Job title: _____

Number of years working in the post: _____

Sex: _____

Education: _____

Date of interview

1. How would you briefly describe VIMS program in your perspective?
2. Can you briefly define the governance structure of VIMS program?

   Probe for;

   i. Hierarchy of command/order
   ii. Supervision and reporting structure
3. Have you received any training on VIMS?

   Probe for;

   i. Provision/ methodologies for receiving training
   ii. VIMS capacity building skills acquired during training for the improvement in implementation
   iii. Training satisfaction among VIMS users
4. How has it been ensured that ICT infrastructures are satisfactory for use?

   Probe for;

   i. ICT infrastructure including soft and hard infrastructure
   ii. VIMS user friendly and easy to use
5. How would you describe the process of immunization data information sharing using VIMS?

   Probe for:

i. Accessibility of information once needed with VIMS users
ii. effectiveness of electronic sharing of information

6. How is VIMS integrated with other tools?
   Probe for;
   i. How VIMS Integrates with DHIS
   ii. How VIMS integrates with SMT, DVDMT and CCIET
7. Can you briefly explain on the challenges you mostly face while using VIMS?

Finally, I have no further questions although but you are welcome for any discussion in this topic that you would like to discuss further. For the question that I can answer here, I will do so. But for question that I may not be able to answer promptly, I will find out appropriate information and send the response. Thank you so much for your kind participation.

Appendix E: Key informant interview Guide

VIMS users the DIVOs and assistant DIVOS in health care facilities on Immunization related services and data management- **Swahili version**

Taarifa muhimu za Mshiriki

(Mtafiti ajaze taarifa hizi kwanza)

Wilaya: _____

Cheo: _____

miaka ya kuwa kwenye cheo chako:_____

Jinsi: _____

Elimu: _____

Tarehe ya mahojiano:

1. Unaweza kunielezea kiufupi kuhusu VIMS?
2. Unaweza kunielezea mfumo wa uongozi wa VIMS?
   dodosa;
   i. Mfumu wa uwajibikaji
   ii. Usimamizi na mfumo wa kurepoti
3. Umepokea mafunzo yoyote ya VIMS?
   Dodosa;
   i. Mfumo wa kupokea mafunzo
   ii. Uwezo mpya wa kutumia VIMS ulioupata kupitia mafucmlexity
   iii. nzo ili kuimarisha utendaji kazi
   iv. Uridhikaji wa mafunzo kwa watumiaji wa mfumo wa VIMS
4. Nini kimefanyika kuhakikisha kuwa miundombinu ya tehama inaridhisha kwa watumiaji?
   Dodosa;
   i. Miundombinu ya Tehama
   ii. Utumiaji wa VIMS kwa urahisi na kirafiki
5. Unaweza kuelezea utaratiba wa kupeana taarifa za chanjo kupitia VIMS?
   Dodosa:

i. Uhakika wa upatikani wa taafifa pale zipohitajikakwa watumiaji wa VIMS

ii. Ufanisi wa kupena taarifa za kielektroniki kupitia VIMS

6. VIMS inaunganika vipi na mifumo ya chanjo mingine?

   Dodosa ;

   i. jinsi gani VIMS inaunganika na DHIS2

   ii. Jinsi gani VIMS inaunganika na SMT, DVDMT na CCIET

7. Ni changamoto zipi unazopititia unapotumia mfumo wa VIMS?

Huu ndio mwisho wa mahojiano yetu, Sina maswali mengine ya ziada. Labda kama una jambo la kuuliza au unataka tujadiliane unaweza kuuliza sasa. Yale yenye majibu ya hapa hapa nitakuelezea na yale ambayo majibu yake siyo ya hapahapa nitayafuatilia na kukujulisha. Nakushukuru sana kwa ushirikiano wako

Appendix F: Observation checklist

Table 2: Observation checklist

Checklist for Computing Infrastructures			
Facility		**Date:**	
Item Description	**Available**	**REQUIRED**	**DEFICIT**
Fire detectors and extinguishers			
Desktop computers			
Laptop computers			
Software (OS, utilities)			
Table s			
Chairs			
Power distribution Units (PDUs)			
Network switches			
Data cabinets			
Cooling system			
Network and power cabling accessories			
Wi-ALN			
Printers			
Electricity/power supply			
Backup power generator			
Adapted and modified from iHFeMS standard guidelines (MoHCDGEC 2016)			

Appendix G: Observation checklist findings

Table 3**: Observation checklist findings**

Checklist for Computing Infrastructures			
Ilala district		**Date: 3rd July 2020**	
Item Description	**Available**	**REQUIRED**	**DEFICIT**
Fire detectors and extinguishers	√		
Desktop computers		√	√
Laptop computers	√	√	
Software (OS, utilities)	√		
Tables	√		
Chairs	√		
Power distribution Units (PDUs)	√		
Network switches	√	√	
Data cabinets		√	√
Cooling system	√		
Network and power cabling accessories			√
Wi-ALN	√	√	
Printers	√		
Electricity/power supply	√		
Backup power generator	√		
Source: Adapted and modified from iHFeMS standard guidelines (MoHCDGEC 2016)			

Source: Author‟s observation July 2020

Appendix H: Consolidated criteria for reporting qualitative studies (COREQ)

Table **4**: Consolidated criteria for reporting qualitative studies (COREQ): item ch**ecklist**

No. Item	Guide questions/description	Reported on
Domain 2: study design		
Theoretical framework		
9. Methodological orientation andTheory	What methodological orientation was stated to underpin the study?e.g. grounded theory,discourse analysis, ethnography, phenomenology, content analysis	Methods
Participant selection		
10. Sampling	How were participants selected?e.g. purposive, convenience, consecutive, snowball	Methods
11. Method of approach	How were participants approached? e.g. face-to-face, telephone, mail, email	Methods
12. Sample size	How many participants were in the study?	Results
13. Non-participation	How many people refused to participate or dropped out? Reasons?	Methods
Setting		
14. Setting of data collection	Where was the data collected? e.g. home, clinic, workplace	Methods
15. Presence of non-participants	Was anyone else present besides the participants and researchers?	N/A
16. Description of sample	What are the important characteristics of the sample?e.g. demographic data, date	Results
Data collection		
17. Interview guide	Were questions, prompts, guides provided by the authors? Was it pilot tested?	Methods
18. Repeat interviews	Were repeat inter views carried out? If yes, how many?	N/A
19. Audio/visual recording	Did the research use audio or visual recording to collect the data?	Methods
20. Field notes	Were field notes made during and/or after the interview	Methods
21. Duration	What was the duration of the inter views or focus group?	Methods
22. Data saturation	Was data saturation discussed?	Methods
23. Transcripts returned	Were transcripts returned to participants for comment and/or correction?	N/A
Domain 3: analysis and findings		

Data analysis		
24. Number of data coders	How many data coders coded the data?	Methods
25. Description of the coding tree	Did authors provide a description of the coding tree?	N/A
26. Derivation of themes	Were themes identified in advance or derived from the data?	Methods
27. Software	What software, if applicable, was used to manage the data?	N/A
28. Participant checking	Did participants provide feedback on the findings?	Methods
Reporting		
29. Quotations presented	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? e.g. participant number	Results
30. Data and findings consistent	Was there consistency between the data presented and the findings?	Results
31. Clarity of major themes	Were major themes clearly presented in the findings?	Results
32. Clarity of minor themes	Is there a description of diverse cases or discussion of minor themes?	Discussion

Adopted and modified from:
Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care*. 2007. Volume 19, Number 6: pp. 349 – 357

Appendix I: Ethical clearance letter MUHAS

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES
OFFICE OF THE DIRECTOR OF POSTGRADUATE STUDIES

P.O. Box 65001
DAR ES SALAAM
TANZANIA
Web: www.muhas.ac.tz

Tel G/Line: +255-22-2150302/6 Ext. 1015
Direct Line: +255-22-2151378
Telefax: +255-22-2150465
E-mail: dpgs@muhas.ac.tz

Ref. No. HD/MUH/T.679/2018/02 **10th June 2020**
IRB#: MUHAS-REC-06-2020-288

Bahati Isingo,
MSc. Project Management Monitoring Evaluation in Health,
School of Public Health and Social Sciences,
MUHAS.

RE: APPROVAL OF ETHICAL CLEARANCE FOR A STUDY TITLED "IMPLEMENTATION OF VACCINE INFORMATION MANAGEMENT SYSTEM (VIMS) IN DAR ES SALAAM."

Reference is made to the above heading.

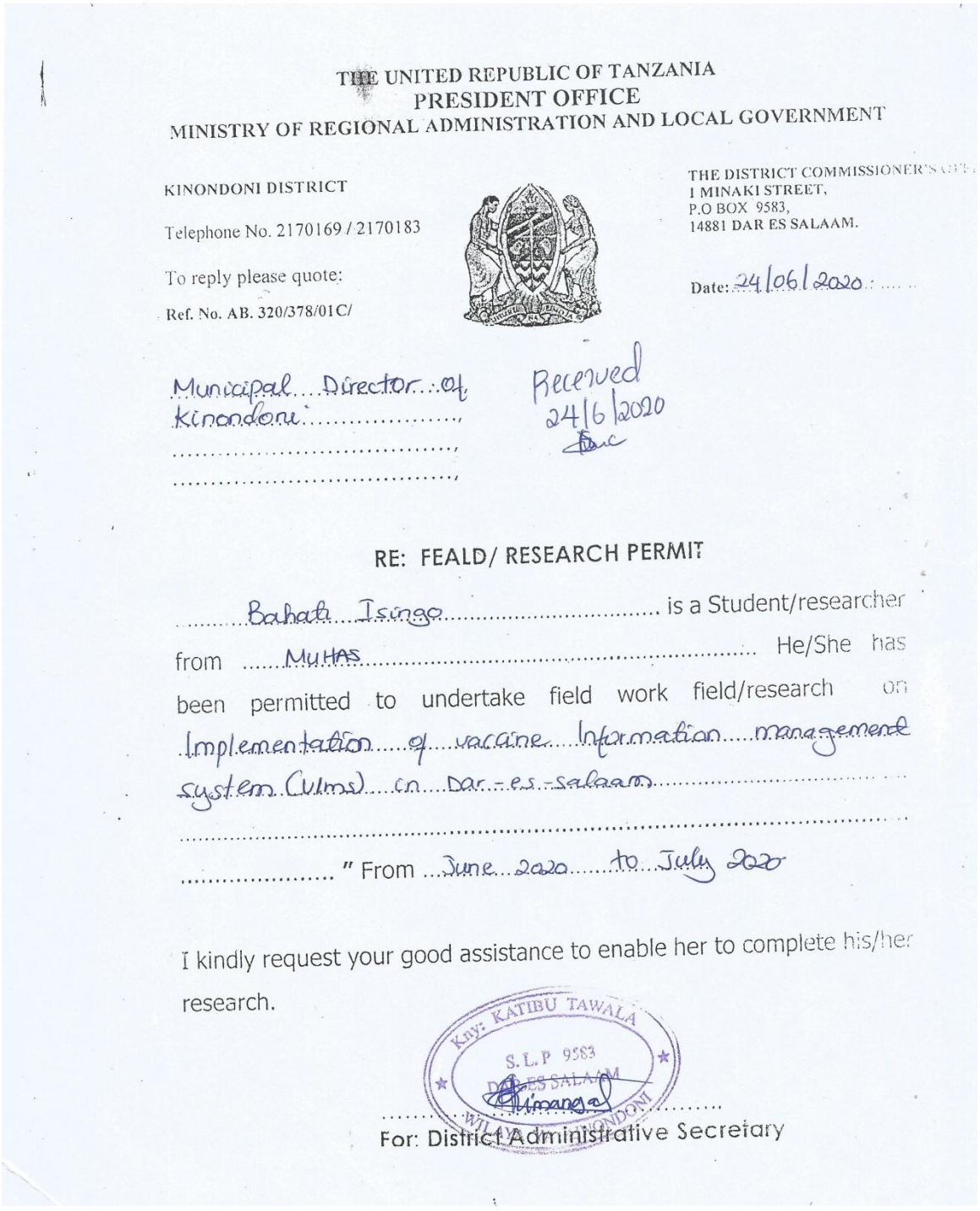
I am pleased to inform you that, the Chairman has, on behalf of the Senate, approved ethical clearance for the above-mentioned study. Hence you may proceed with the planned study.

The ethical clearance is valid for one year only, from **10th June, 2020 to 09th June, 2021.** In case you do not complete data analysis and dissertation report writing by **09th June, 2021,** you will have to apply for renewal of ethical clearance prior to the expiry date.

Dr. Emmanuel Balandya
ACTING: DIRECTOR OF POSTGRADUATE STUDIES

cc: Director of Research and Publications
cc: Dean, School of Public Health and Social Sciences, **MUHAS**

Appendix J: Research permit Kinondoni District



THE UNITED REPUBLIC OF TANZANIA
PRESIDENT OFFICE
MINISTRY OF REGIONAL ADMINISTRATION AND LOCAL GOVERNMENT

KINONDONI DISTRICT

Telephone No. 2170169 / 2170183

To reply please quote:

Ref. No. AB. 320/378/01C/

THE DISTRICT COMMISSIONER'S OFFICE
1 MINAKI STREET,
P.O BOX 9583,
14881 DAR ES SALAAM.

Date: 24/06/2020

Municipal Director of Kinondoni

Received 24/6/2020

RE: FEALD/ RESEARCH PERMIT

Babath Isingo is a Student/researcher from MUHAS He/She has been permitted to undertake field work field/research on Implementation of vaccine Information management system (Vims) on Dar-es-salaam " From June 2020 to July 2020

I kindly request your good assistance to enable her to complete his/her research.

Kny: KATIBU TAWALA
S.L.P 9583
DAR ES SALAAM
WILAYA YA KINONDONI

For: District Administrative Secretary

Appendix K: Research permit Kinondoni Municipal

KINONDONI MUNICIPAL COUNCIL

ALL CORRESPONDENCES TO BE ADDRESSED TO THE MUNICIPAL DIRECTOR

Tel: 2170173
Fax: 2172606

In reply please quote:

Ref. KMC/R.18/1



MUNICIPAL DIRECTOR
KINONDONI MUNICIPAL COUNCIL
P. O. BOX 31902
2MOROGORO ROAD
14883 DAR ES SALAAM

Date 30/05/2018

Bahati Isingo
Muhas,
P.O.BOX, 65001
DAR ES SALAAM.

RE: RESEARCH PERMIT

Refer to the above heading.

2. I am pleased to inform you that your request has been considered by the Municipal Director, and has offered you a place for research from **June to July 2020.**

3. Once you receive this letter, please report to the **Municipal Medical Office of Health** for the commencement of your research.

4. During the period of yourresearch, you are required to obey the rules and regulationas they will be defined to you.

MUNICIPAL DIRECTOR
KINONDONI MUNICIPAL COUNCIL
DAR-ES-SALAAM

Maria Masimbusi
For: **MUNICIPAL DIRECTOR**
KINONDONI

Copy : District Administrative Secretary
Muhas,
P.O.BOX, 65001,
DAR ES SALAAM

Appendix L: Research permit Ilala Municipal

ILALA MUNICIPAL COUNCIL

ALL COMMUNICATION TO BE ADDRESSED TO THE MUNICIPAL DIRECTOR

PHONE NO: 2128800
2128805
2121486

MUNICIPAL OFFICE
1 MISSION STREET
P.O.BOX 20950
11883 DAR ES SALAAM

30th June, 2020

Ref: IMC/DR.6/V/335

Facility Incharge,

Mnazi Mmoja Hosp

RE: PERMISSION TO CONDUCT A STUDY

Reference is made to the above heading

This is to introduce Mr Bahati Isingo a student from Muhimbili University of Health and Allied Sciences pursuing MSc.Project Management Monitoring and Evaluation in Health.

She requested permission to conduct a study titled **"Implimentation of Vaccines Information Management System in Dar es Salaam"**

Permission has then been granted to conduct this study in Ilala Municipal Council (**Mnazi Mmoja Hosp**) from **1st July 2020** to **30th July 2020.** Subject to the condition that she should bring a study results to the Municipal as feedback.

I kindly request your assistance and support.

Anence Kamasho

For: MMOH –ILALA MUNICIPAL COUNCIL.

For. MUNICIPAL MEDICAL OFFICER OF HEALTH
ILALA MUNICIPAL COUNCIL

Cc: Distict Immunisation and Vaccine Officer.