IMPACT OF HEALTH INFORMATION SYSTEMS ON COVID-19 VACCINATION COVERAGE IN MWANANYAMALA MUNICIPALITY, TANZANIA

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A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF ARTS IN MONITORING AND EVALUATION (MAME)

DEPARTMENT OF ECONOMICS AND COMMUNITY ECONOMIC DEVELOPMENT

OF THE OPEN UNIVERSITY OF TANZANIA

2023

CERTIFICATION

The undersigned certifies that he has read and hereby recommends for acceptance by Open University of Tanzania a dissertation entitled; **"Impact of health information systems on COVID-19 vaccination coverage in Mwananyamala municipality, Tanzania"** in partial fulfilment of the requirements for the award of Degree of Masters of Arts in Monitoring and Evaluation (MAM&E).

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Dr. Emmanuel Nyankweli

(Supervisor)

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Date

DECLARATION

I, **Joseph Gaspar Hakili,** declare that, the work presented in this dissertation is my own, that it has never been presented for assessment to any other University or Institution. All direct or indirect sources used are acknowledged as references. The dissertation is hereby presented in partial fulfilment of the requirement for the Degree of Masters of Arts in Monitoring and Evaluation (MAM&E).

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Signature

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Date

DEDICATION

To my beloved Daughters and Sons, Mother and Father, Sister and Brother and lastly my Wife. You are forever cherished.

ACKNOWLEDGEMENT

I would like to acknowledge and give my dearest thanks to my supervisor Dr. Emmanuel Nyankweli for his guidance and advice throughout the writing of my dissertation. I would also like to thank the Department of Economics & Community Economic Development (ECED) coordinators; Henry Tumaini, Janet Gwimile and Abdul Kilima for their continued assistance during my study.

I extend my gratitude to the Medical Officer In-charge and staff at the Mwananyamala Regional Referral Hospital for their cooperation and contribution towards completion of my research. Finally, I thank my family for their unending support, and the Almighty for blessing me with strength and perseverance.

ABSTRACT

The study assessed the impact of health information systems on COVID-19 vaccination coverage in Mwananyamala Municipality. Specifically focusing on; assessing the contribution of DHIS2 on improving COVID-19 vaccination data quality, evaluating the impact of DHIS2 on improving COVID-19 vaccination data utilization, examining the role of DHIS2 in supporting resource commitments towards COVID-19 and identifying specific challenges encountered in the implementation of DHIS2 for COVID-19 vaccination distribution and coverage. The study was theoretically guided by the Normalization Process. A sample size of 65 respondents was selected using systematic random sampling and purposive sampling techniques. Data was collected using interviews. Quantitative data analysis techniques were aided by SPSS version 27; where both descriptive and Multiple Linear Regression (MLR) analysis was done. The study found that DHIS2 significantly contributes to enhancing the quality of COVID-19 vaccination data, including attributes such as data availability, user-friendliness, accessibility, and visibility. DHIS2 has a positive influence on the utilization and implementation of COVID-19 vaccination data in program planning, decision making, clinical management, and cost control. Furthermore, the study revealed that DHIS2 facilitates increased commitment of resources to COVID-19 vaccination efforts. The study also revealed several constraints that hinder the full realization of DHIS2's potential, including resource limitations, data set incompleteness, healthcare system weaknesses, lack of COVID-19 funding, healthcare accessibility barriers and vaccine hesitancy. The study concluded by recommending that health authorities and governments prioritise DHIS2 integration, policymakers develop supportive policies and stakeholders actively engage in DHIS2 implementations.

Keywords: *Vaccination, Vaccination Coverage, Health Information Systems, Overview of DHIS2*

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LIST OF ABBREVIATIONS

ANOVA	Analysis of Variance
CDC	Centres for Disease Control
COVID-19	Coronavirus Disease 2019
CVC	COVID-19 Vaccination Coverage
DHIS2	District Health Information Software 2
DQ	Data Quality
DUI	Data Utilization and Implementation
EIR	Electronic Immunisation Registry
HIS	Health Information System
HISP	Health Information System Program
HMIS	Health Management Information System
KMO	Keiser-Meyer-Olkin
LMIC	Low to Middle Income Country
eLMIS	Electronic Logistic Management and Information System
MLR	Multiple Linear Regression
MoHCDGEC	Ministry of Health, Community Development, Gender, Elderly and Children
MRRH	Mwananyamala Regional Referral Hospital
NPT	Normalization Process Theory
RC	Resource Commitment
SARS	Severe Acute Respiratory Syndrome
SPSS	Statistical Package for the Social Sciences
TVET	Technical and Vocational Education and Training

UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
VPD	Vaccine Preventable Disease
WHO	World Health Organisation

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

The COVID-19 pandemic has greatly affected Africa and other parts of the world. It has had a big impact on the economy, healthcare, and people's lives in African countries. The risk of COVID-19 recurrence is high in some African countries because people are not following health guidelines, there are large gatherings, and there is not enough testing and vaccination (Cholongola, Rwegoshola, Balingumu, Semvua & Kwigizile, 2022). Vaccination is extremely important in fighting COVID-19 and achieving herd immunity. However, only 11% of adults in Africa have received their full COVID-19 vaccine doses (Osuagwu, et al., 2023).

Vaccinations have successfully reduced the burden of various diseases. For example, polio is close to being completely eradicated, with no new cases in India and Nigeria's last case reported in 2016 (Kolff, Scott, & Stockwell, 2018). On 30 January 2020, the WHO Director-General declared the outbreak of novel coronavirus 2019 (SARS-CoV-2) to be a Public Health Emergency of International Concern. On 11 March, WHO confirmed COVID-19 as a pandemic. In December 2020, the first COVID-19 vaccine doses were administered. COVID-19 vaccine roll-out continues, with doses delivered and administered across continents. But efforts to curb the pandemic are threatened by inequities in vaccination coverage (WHO, 2023).

In 2020/2021, the global population has experienced disproportionate impacts due to COVID-19. Notably, the majority of populations in developing countries have been reported as the least likely to receive vaccination (Msuya, et al., 2023). Obstacles to

vaccination among low-income countries' populations have been extensively documented, encompassing factors such as low confidence in the vaccines, limited access, and distrust of the healthcare system (Osuagwu, et al., 2023).

To address these challenges, the World Health Organization (WHO) and other health organizations have introduced several digital health initiatives. These initiatives emphasize that digital technology can play a pivotal role during the COVID-19 pandemic by enhancing communication between people and healthcare services, empowering individuals and patients, and reinforcing crucial public health functions, including disease surveillance (The Lancet Digital Health, 2021). Furthermore, these digital health initiatives aim to foster trust and encourage vaccination within the affected communities.

Tanzania recorded its first COVID-19 case in March 2020. The virus was first recorded in Arusha before spreading to other locations. As of March 2023, the country has recorded 42 823 cases and 846 deaths. In the two years, public health measures, including improved surveillance and contract tracing, and testing public awareness about preventive measures have been crucial in curbing the spread of the virus. Vaccination is also being stepped up to help control the pandemic, to vaccinate 60 per cent of the population (WHO, 2023).

Tanzania’s Ministry of Health, Community Development, Gender, Elderly and Children (MoHCDGEC)’s National Digital Health Strategy 2019-2024 mission is “to accelerate the transformation of the Tanzanian health care systems through innovative, data-driven, client-centric, efficient, effective, and integrated digital

health solutions."

Digital Square's landscape analysis, through US Agency for International Development (USAID)-funded Map and Match found that "Tanzania's health system uses 91 digital health tools with at least 42 already deployed for COVID-19 response." Digital solutions that have been deployed for Tanzania's COVID-19 response include the District Health Information System (DHIS). Tanzania's Health Management Information System (HMIS) is built on the District Health Information System (DHIS). DHIS2 strengthens contact tracing by enabling the identification and follow-up of contacts of a suspected or confirmed COVID-19 case. COVID-19 case-based surveillance enrols and tracks suspected cases; captures symptoms, demographics, risk factors, and exposures; creates lab requests and captures laboratory data about the case; links confirmed cases with contacts; and monitors patient outcomes. Of the DHS2 12 pandemic use cases, 5 have been utilized while 7 adaptation opportunities have been identified (Kinkade, et al., 2022).

1.2 Problem Statement

The COVID-19 pandemic has profoundly affected Africa and other regions worldwide, including Tanzania. The pandemic has had a significant impact on the economy, healthcare systems, and people's lives in African countries. However, addressing the pandemic's challenges, especially low COVID-19 vaccination coverage, remains a crucial task.

Tanzania, like many low- to middle-income countries (LMICs), has faced numerous

obstacles in effectively responding to the COVID-19 pandemic. The introduction of COVID-19 vaccination has been hindered by political barriers, leading to vaccine hesitancy and limited uptake. To achieve a significant impact and stop the outbreak, it is essential to vaccinate at least 70% of the population to create immunity and reduce disease severity and mortality (WHO, 2022; Msuya et al., 2023). However, as of November 2022, COVID-19 vaccination coverage in Africa remains the lowest globally, with only 24% of the population fully vaccinated (CDC, 2022). Tanzania's vaccination efforts were initially delayed due to political factors, leading to hesitancy and limited vaccine uptake (Mohammed, et al., 2022).

In response to these challenges, the Tanzanian government has implemented various measures, including expanding vaccine access to remote areas and leveraging the Health Management Information System (HMIS) through the adoption of the District Health Information System 2 (DHIS2). DHIS2 aims to facilitate data access and usage, which could potentially strengthen the performance of HMIS and support surveillance of vaccine-preventable diseases (VPDs) (Mboera, et al., 2021).

However, despite the effort of the government and international organization to control and manage the spread of COVID-19 in Tanzania, the country has among the lowest COVID-19 vaccination rates globally, with only 5.1% of the population fully vaccinated. Despite two years of changing policies concerning the disease, the country faces challenges in initiating an effective vaccination campaign. Approximately 2 million COVID-19 vaccine doses remain unused and have not been administered in Tanzania (Espen, Dewachter, & Holvoetb, 2023).

While studies have evaluated the effectiveness of DHIS2 in tracking vaccine stockouts and monitoring vaccination coverage during the COVID-19 pandemic (Abdullah et al., 2021), there is limited empirical evidence specifically regarding its impact on COVID-19 vaccination coverage in Tanzania. Therefore, the current study seeks to address this research gap by assessing the contribution of DHIS2 to the COVID-19 response and its role in improving vaccine delivery, treatment, clinical management, cost reduction, disease control, and ultimately increasing COVID-19 vaccination coverage.

1.3 Objective of the Study

1.3.1 Main Objective

To assess the impact of health information systems on COVID-19 vaccination coverage in Mwananyamala Municipality.

1.3.2 Specific Objectives

1) To assess the contribution of DHIS2 on improving COVID-19 vaccination data quality in Mwananyamala Municipality.
2) To evaluate the impact of DHIS2 on improving COVID-19 vaccination data utilization in Mwananyamala Municipality.
3) To examine the role of DHIS2 in supporting resource commitments towards COVID-19 in Mwananyamala Municipality.
4) To identify specific challenges encountered in the implementation of DHIS2 for COVID-19 vaccination distribution and coverage in Mwananyamala Municipality.

1.4 Research Questions

1) How does DHIS2 contribute in improving COVID-19 vaccination data quality in Mwananyamala Municipality?
2) What is the impact of DHIS2 on improving COVID-19 vaccination data utilization in Mwananyamala Municipality?
3) How has the use of DHIS2 supported resource commitments towards COVID-19 in Mwananyamala Municipality?
4) What are the challenges encountered in the implementation of DHIS2 for COVID19 vaccination distribution and coverage in Mwananyamala Municipality?

1.5 Significance of the Study

This study is essential because it aligns directly with Tanzanian policies and strategies related to COVID-19 vaccination. The Tanzanian government is working hard to control the spread of the virus, and vaccination is a crucial part of their plan. The study focuses on evaluating how a specific health information system, namely DHIS2, has contributed to COVID-19 vaccination efforts in Tanzania. Understanding the impact of DHIS2 on vaccination coverage is vital for decision-makers, healthcare professionals and policymakers. The study provided valuable insights into whether DHIS2 has been effective in supporting vaccine delivery, treatment, and management of COVID-19 cases. By identifying challenges and opportunities in using DHIS2, the study helped to improve its implementation and effectiveness in Tanzania.

The findings of this study will directly inform Tanzanian healthcare policies and strategies, enabling better decision-making and resource allocation to improve vaccination coverage rates. Ultimately, this research aims to support Tanzania's efforts in controlling the spread of COVID-19 and protect the health of its population.

1.6 Scope of the Study

This study is limited to Mwananyamala Regional Referral Hospital. The key determinant for this study is data quality, data utilization and implementation from facility to national level, resource commitments and perceived constraints.

CHAPTER TWO

LITERATURE REVIEW

2.1 Overview

This chapter contains three main sections namely theoretical literature review, empirical literature review and conceptual framework. The theoretical literature review comprises theories that guide the study, followed by the empirical review which outlines the review of earlier studies including discussions of the research gap and the final part- the conceptual framework, outlines the relationship between the variables used to answer the research questions.

2.1 Introduction of Key Concepts

2.1.1 Vaccination

Vaccination refers to the administration of vaccines to individuals to protect them from infectious diseases, such as COVID-19 (Espen, Dewachter, & Holvoetb, 2023). Vaccines contain weakened or inactive parts of the disease-causing microorganisms or their toxins, which trigger the body's immune response. This immune response creates immunity to the disease, preventing severe infections and reducing the risk of transmission to others (World Health Organization (WHO), UNICEF, 2018). In this study vaccination refers to the process of administering COVID-19 vaccines to individuals in Tanzania to protect them from the SARS-CoV-2 virus, it includes the delivery of vaccine doses and the subsequent development of immunity against COVID-19 in vaccinated individuals.

2.1.2 Vaccination Coverage

Vaccination coverage measures the proportion of the target population that has

received the recommended vaccines (Msuya, et al., 2023). In the context of the study, COVID-19 vaccination coverage specifically refers to the percentage of the Tanzanian population that has been vaccinated against COVID-19. It is a crucial indicator of the effectiveness of vaccination campaigns and the extent to which the population is protected against the virus (WHO Africa, 2022). Vaccination coverage in this study refers to the percentage of the Tanzanian population that has received one or more doses of the COVID-19 vaccine. It is calculated based on the number of vaccinated individuals relative to the total eligible population, providing insights into the extent of COVID-19 vaccination among Tanzanians.

2.1.3 Health Information Systems

Health Information Systems (HIS) are digital platforms and tools used to collect, manage, and analyze health-related data (Abdullah, Nathan, Mwakambaya, Mandike, & Ubuguyu, 2021). These systems play a critical role in capturing and processing information on various health aspects, such as disease surveillance, vaccine delivery, treatment outcomes, and patient demographics.

In the study, the focus is on the specific HIS known as District Health Information System 2 (DHIS2), which aims to support data-driven decision making and strengthen healthcare services, including COVID-19 vaccination efforts in Tanzania (Endriyas, et al., 2019). In the context of this study, Health Information Systems (HIS) refers to the digital infrastructure, particularly the District Health Information System 2 (DHIS2), used in Tanzanian healthcare facilities to collect, store, and analyse data related to COVID-19 vaccination.

2.1.4 Overview of DHIS2

DHIS2 is software developed by the health information system program (HISP) in 2005 in partnership with the University of Oslo. DHIS2 is a health information system that incorporated modules for data collection and validation, provision of aggregated statistical health data, data analysis to data visualization and presentation (Manoj, Wijekoon, & Wiesooriya, 2013). Since its release, DHIS2 has been deployed in 54 countries including Tanzania (Reynolds, et al., 2022).

2.1.5 DHIS2 in COVID-19 Pandemic and Vaccination Coverage

Since WHO declared the outbreak of COVID-19, the DHIS2 has been used in COVID-19 surveillance and vaccine delivery, incorporating customizable functions for detecting and tracking COVID-19 cases, management of vaccine delivery and monitoring of COVID19 vaccine supply (Frost & Kwame, 2021).

2.2 Theoretical Review

One purpose of the theoretical review is to widen the understanding of the studied phenomenon under the guidance of assumptions and explain the relationships of the variables within the study. This study used Normalization Process Theory (NPT) to establish the relationship between health information systems and vaccination coverage.

2.2.1 Normalization Process Theory

The NPT is a social theory that deals with creating an environment allowing the adaptation of technological innovation for improving the delivery of healthcare services, it establishes how the healthcare system can organize treatment, improve

clinical function, deliver cost-effective services, and control the impact of illness (May, et al., 2018).

NPT focuses on indicating the interaction between healthcare services and a dynamic environment with the information system that deals with explaining the implementation, integration, and promotion of various healthcare technologies, techniques, methods, and other health intervention strategies to improve public health (Tumbo, 2020). To understand the impact and flow of function for every new practice adopted in the health system, the theory introduced four components as indicated in Figure 1.

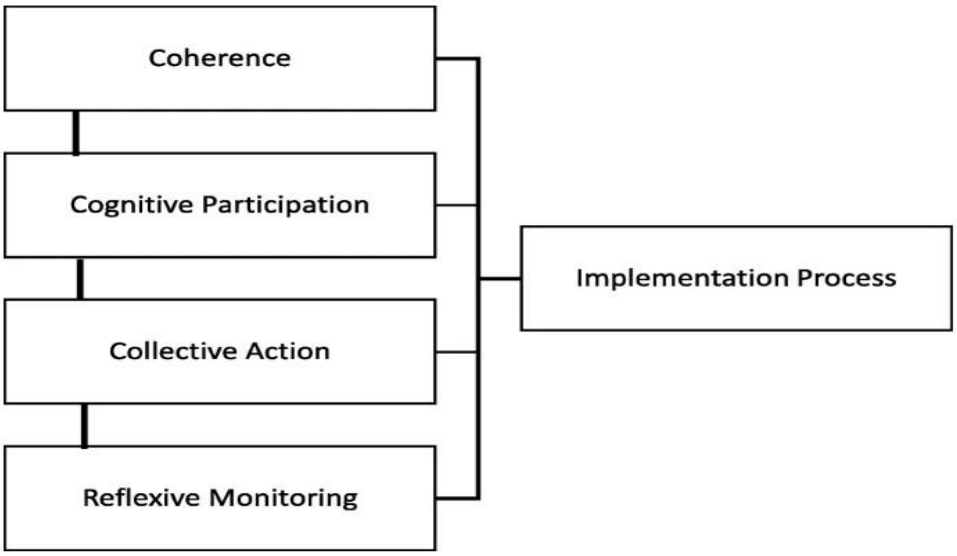

Figure 1.1: Normalization Process Theory

Sources: (May, et al., 2018).

The four components are: coherence that explains the consistency and logical decision-making on new health practices; reflexive monitoring on the utilization and monitoring progress of new practices adopted; collective action deals with how healthcare facilities committed resource to the practices; and cognitive participation

which explains health stakeholders' usage of the system (Mishuris, et al., 2019). Various studies have shown the implication of NPT on health services delivery (May, et al., 2018; Mishuris, et al., 2019; Tumbo, 2020). Therefore, this study adopted NPT generated from those studies concerning electronic health information systems to assess the impact of health information systems on COVID-19 vaccination coverage in Dar es Salaam.

2.3 Empirical Review

2.3.1 Contribution of DHIS2 on Improving COVID19 Vaccination Data Quality

From the study of Wu et al (2020) who discussed the application of big data technology to prevent, control, and contain COVID-19 pandemic diseases in China by using data and technology to monitor the spread of COVID-19 and prevention of the disease the society. The study used qualitative approaches to analyse data on China before and after the outbreak of COVID-19, using qualitative data that was collected through secondary sources from health facilities based on COVID-19 information. Also, the study collected data on technology usage, data application level and logic level. The study analysed data using content analysis. The results indicated that big data technology has a significant contribution to preventing and controlling the spread of COVID-19. The quality of data generated has an important role in early surveillance and disease warning, tracking and allocation of resources.

Zhao, et al (2021) prepared the study on the roles of Technology in management and control of COVID-19 pandemic impact, the study descriptive research design that enable usage of mathematical data visualization model (MDVM) that describe

overall population infected with COVID-19 and its growth rate after adaptation of management strategies include vaccination. The outcome show that advent of technology has significant inapt on the presentation of data and exchange of information, as well as management of medical resources like distribution of Covid-19 Vaccination.

2.3.2 Influence of DHIS2 on Improvement of COVID-19 Vaccination Data Utilization

Talukdar, et al (2021), conducted the study on the roles played by the ICT in drive the Covid-19's Vaccination and essential roles in awareness creation on the COVID-19 pandemic vaccines and health benefits to the society. The study conducted survey foe more than 60 countries using qualitative descriptive design that allow describing phenomena based on the experience of the individual, study used sample of 437,240 respondents. The study used the pre-randomized experimental by demonstrate the usage of ICT in mobilizing individual based on the diversity in the communities and evaluate their behaviors, beliefs, and social norms. The outcome indicted that acceptance of COVID-19 Vaccine are varying based on the behaviors, beliefs, and social norms of the respondents, also it was found that ICT has influenced 65.06% of respondents to willingly accepting vaccination. It was concluded that Health information technology has important roles to control and prevent spread of COVID-19, also increase development of efforts on the vaccination.

Prescott and Prescott Jr, (2022) prepared the study on the impact of health information technology utilization on COVID-19 Vaccination in global context. The study conducted three surveys on the vaccination against the pandemic using

scientific monitoring of the utilization of COVID-19 vaccination after integration of health technology system in distribution of vaccine. Results show that technology enhanced the vaccination of the Covid-19 through increase identification of patients at risk, increase engagement of the society in relations to COVID-19, and facilitate tracking of the patients enrolled in the vaccination program. Thus, it was recommended to combine health strategies adopted to combat the COVID-19 pandemic with the technology and increase efficiency and results on the control and manage the spread of the pandemic.

2.3.3 Perceived Constraints Hindering full realization of DHIS2

Zgovu (2021), conducted the study to examine the roles played by technology and challenges in addressing the COVID-19 pandemic in East Africa, the address the objective of the study qualitative and descriptive quantitative analysis was applied. Secondary data was collected for the study from East Africa, WHO, UNCTAD, and other reliable sources articles related to Covid-19 in East African Countries. The main finding of the study shows that despite of the influence of the Technology in addressing COVID-19 pandemic in East Africa through enable healthcare facilities to have reliable information sharing system that facilitate data intensity on pandemic and data surveillance, however, there various challenges that hindrance the effective utilization of technology in health system such as low income and high maintenance cost of the health system, low digital literacy among healthcare workforces, limited telecom infrastructure that results to poor network services. Therefore, it was recommended improvement of telecommunication infrastructure which automatically would enhance adoption of digitizing of health system.

Bundara (2020), carried the study to address factors that influence adaptation of health information technology in healthcare facilities in Tanzania by focus on limitation, the study adopted cross-section research approach with guidance of three theories which are Technological Acceptance Model, unified theory of acceptance of technology model, and Innovation Diffusion Theory. The study used sample size of 120 respondents that used for data collected using questionnaires and interviews as tools for data collection. The results revealed that adaptation of health information technology in healthcare facilities are constrained by various challenges such as information technology illiteracy among healthcare workers, limited technologies resources in health sector, lack of relevant financial supports from government. It was recommended that, government and other stakeholders in health sector should develop unique strategies that facilitate adaptation of appropriate e-Health system in Tanzania.

2.4 Research Gap

Several studies have been carried out locally and internationally reviewing health information system; most of these have been done on HIS or advancement in technology with respect to COVID 19 were done in abroad. For instance; Wu, et al (2020) conducted the study to discuss the application of big data technology to prevent, control, and contain COVID-19 pandemic diseases in China; Zhao, et al (2021) prepared the study on the roles of Technology in management and control of COVID-19 pandemic impact; Talukdar, et al (2021), conducted the study on the roles played by the ICT in drive the Covid-19's Vaccination and essential roles in awareness creation and. Much remain unknown about the DHIS2 systems on

COVID19 vaccination coverage, specifically none done at Mwananyamala Regional Referral Hospital on the context of previous 10 years.

2.4 Conceptual Framework

The dependent variable for the study is COVID19 Vaccination Coverage (CVC), determined by vaccine stockout, vaccination coverage rate and vaccination dropout rate, which are influenced by independent variables which are functions of HIS including Data Quality (DQ), Data Utilization and Implementation (DUI), and Resource Commitment (RC). However, the relationship between independent variables and dependent variable is affected by the intervening variables which are perceived constraints.

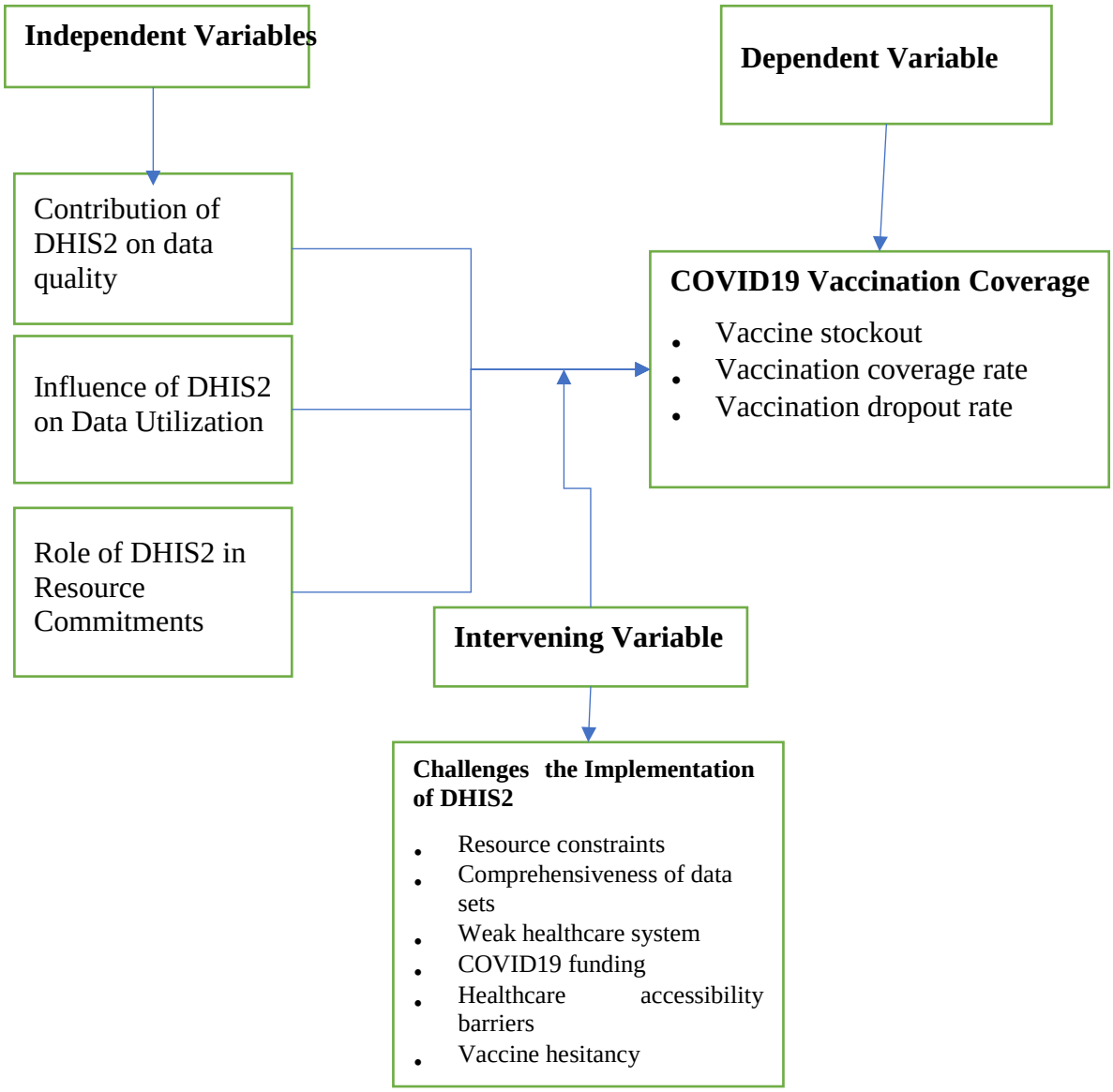

Figure 2: Conceptual Framework

Source: Conceptualized from literature review (2023)

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This section of the study covered the research philosophy adopted by the study, research design, area concerning the study, methods and different techniques used in data collection and sampling techniques.

3.2 Research philosophy

Positivism is based on scientific observation of the phenomenon through scientific verification which is tested on the hypothesis (Patton, 2002). This research follows the positivism research philosophy to measure the impact of health information systems on COVID-19 vaccination coverage. For effective results, quantitative research methodology was used in the study where each variable was measured to determine its effects on the objective of the study. The positivist paradigm is chosen for this study as it allows for objective measurement of the impact of health information systems on COVID-19 vaccination coverage. The use of quantitative research methods enables the collection and analysis of measurable data, providing evidence-based conclusions that can contribute to the understanding of vaccination coverage in the context of the COVID-19 pandemic.

3.3 Research Approach

The research approach refers to the structured framework directing research on the achievement of established research objectives and providing answers to the research questions (Saunders, 2015). This study employed the quantitative research approach, which involves the systematic collection and analysis of numerical data to answer

research questions. However due to the nature of health facility work, data was collected using interview guide and then quantified to numeric data. It focuses on measuring and quantifying variables to understand the relationships between them and draw objective conclusions. The quantitative research approach is chosen for this study to systematically measure and quantify the impact of health information systems, particularly DHIS2, on COVID-19 vaccination coverage.

3.3 Research Design

This study was implemented through an explanatory research design since it explores why the problem occurred with all available information. The study used this research design since it helps in better understanding the cause-and-effect relationship between dependent and independent variables,

3.3.1 Area of the Study

This study was conducted at Mwananyamala Regional Referral Hospital, Kinondoni, Dar es Salaam, Tanzania. Dar es salaam has a population of 6,400,000 from 5 districts i.e; Kinondoni, Ilala, Ubungo, Temeke and Kigamboni. Mwananyamala Regional Referral Hospital (MRRH) offers referrals from Kinondoni, Ubungo municipalities and nearby areas. The hospital serves around 2.2 million people with s bed capacity of 254 and bed occupancy of 317. The facility attends 1500 to 1800 patients per day *(www.mwananyamalarrh.go.tz).* choosing Mwananyamala Municipality, specifically, Mwananyamala Regional Referral Hospital as the area of study for this research is justified by its significance in providing healthcare services to a large population, its role as a referral center, and the potential to gain comprehensive insights into the utilization of DHIS2 data in a major healthcare

facility in Tanzania.

3.4 Population Used in the Research

The study targeted Mwananyamala Regional Referral Hospital staff that have access to the DHIS2 system and staff of the vaccine delivery department.

3.5 The study sampling techniques used and the sample size of the study

3.5.1 Research Sampling Techniques Adopted

From the population of the study, the research needed representatives of the entire population that was to be studied. The sampling meant the selection of individuals with the same characteristics that were present in the population (Hanif, Shahbaz, & Ahmed, 2018).

The study adopted a combination of systematic random sampling techniques and purposive sampling techniques as they gave the researcher an overview of the sample population that would provide the best results as intended by the study.

Systematic Random Sampling: Systematic random sampling involves selecting every nth individual from a list of the target population. In this study, the researcher used systematic random sampling to select participants from the staff who have access to the DHIS2 system at Mwananyamala Regional Referral Hospital. This method ensures that each eligible staff member has an equal chance of being included in the study, enhancing the sample's representativeness.

Purposive Sampling: Purposive sampling involves the intentional selection of participants based on specific criteria or characteristics relevant to the research objectives. In this study, the researcher used purposive sampling to select staff

members from the vaccine delivery department. These participants are specifically targeted because of their direct involvement and expertise in COVID-19 a vaccination effort, which aligns with the study's focus.

3.5.2 Sample Size of the Study

The sample size is the number of individuals that were used by the study from the target population, the sample possesses similar characteristics as the population under the study. The population of the study, MRRH, comprises more than 200 employees. The study needs to extract a sample to represent the target thus remaining relevant to the study. The study used a systematic sampling technique that advocated the selection of samples at regular intervals within the probability sampling methods in the known population, specifically within a particular interval.

The simple formula that was adopted from study conducted by (Ntundi, 2015) who used the following formula in calculation of sample size;

$$n = \frac{N\sigma}{\sigma + (N-1)}$$

$n = \frac{200*96.4}{96.4+(200-1)}$ = 65.2 employees

Therefore, the procedure above derived 65 MRRH staff as the sample from the population. However, out of these, 10%, amounting to 6 respondents, were purposefully interviewed.

The study targeted sampling 65 respondents from a population of 200 employees. Therefore, the targeted sample was indicated by "n," and the study population was

indicated by "N." The sample was selected from the interval "k" within N/n. N/n was calculated as 200/65, resulting in a value of 3 for the interval "k." The first element was randomly selected from within the sample interval. The sample size was chosen from the list of 200 employees at Mwananyamala Regional Referral Hospital, with every 3rd employee from the list being selected.

3.6 Data Collection Method

There are two types of data used by researchers in most studies, i.e. primary or raw data collected for the first time from the source of the studied population and secondary data already existing and research only needs to retrieve necessary information relevant to the study (Smith, 2009). All data that are collected should aim to provide answers to the research questions established. Below are types of data collection methods to be implemented to collect information that aligns with the research objective and answer the research questions.

3.6.1 Interview Data Collection Method

Interviews as data collection tools, allow respondents to share their knowledge and understanding of the topic presented to them, the interview should create a positive relationship between the researcher and respondents. This study needs employees with a deep understanding of DHIS2 and those with immunization and vaccine delivery knowledge and experience for the interview. The interview provided qualitative data.

The unit of Analysis: The unit of analysis in this study is the individual staff members at Mwananyamala Regional Referral Hospital who have access to the

DHIS2 system and the staff working in the vaccine delivery department. Each staff member was treated as a separate unit of analysis, and their responses and data were collected and analysed individually to understand the impact of health information systems on COVID-19 vaccination coverage.

3.7 Data Processing and Analysis

Data analysis involves the interpretation of data collected to describe facts and develop explanations and test hypotheses (Anagnostou, et al., 2015). This study employed quantitative data analysis to answer research objectives.

3.7.1 Qualitative Data

Data that did not present numerical values by themselves were considered qualitative, collected from interviews. This kind of data needed to be assigned numerical values to be analysed and measured concerning the objective of the study. The qualitative data collected from interviews were organized and quantified to have scientific values measured numerically.

3.7.2 Quantitative Data

Quantitative data analysis techniques were employed with the aid of SPSS version 27, where both descriptive and Multiple Linear Regression (MLR) analyses were conducted. All variable indicators were ordinal with 5-point Likert scale measurements, excluding demographic characteristics of the respondents such as age, gender, education level, working experience, and working departments. All MLR analysis assumptions, such as linearity, normality, hetero/homoskedasticity, and multicollinearity, were observed. Each specific objective was analysed using a

combination of descriptive statistics, thematic analysis of qualitative data, and MLR analysis where applicable. The aim was to provide comprehensive insights into the impact and challenges of DHIS2 in COVID-19 vaccination coverage at Mwananyamala Municipality.

3.7.3 Regression Equation Analysis

Regression analysis shows the relationship created between independent variables to the objective of the study that presents the dependent variables, the regression analysis analyses the effect of one factor on others either positively related or negatively. The regression analysis is presented as follows,

$COVID19\ Vacination\ Coverage\ (CVC) = f(HIS)$----------Eq.1

$$CVC = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \dots \dots \dots \dots . \varepsilon$$

Whereby;

β_0=Constant term

$\{\beta\ i = 1,2,3\}$=The coefficients representing the various independent variables

X_1= Data Utilization and implementation

X_2= Resource Commitment

X_3= Data Quality

ε =Error terms

3.7.4 Correlation Equation Analysis

This research method determines the strength of the bond between variables of the study in a linear relationship and how that bond can be affected by each variable

within the relation. The correlation can either be positive or negative (Saunders, Lewis, & Thornhill, 2009). There are many formulas for measuring correlation. This study implemented Spearman's linear correlation equation denoted by the formula below;

$$Rs = 1 - \frac{6\sum d^2}{N(N2-1)}$$

Whereby Rs means Spearman's rank correlation coefficient, (d) differences existing in ranking, and (N) the total number of variables measured in the study.

Table 3.1: Data Analysis Summary

Objective	Variable	Type of variable	Proxy Measures	Data collection Technique	Data analysis methods
To assess impact of health information systems COVID-19 vaccination coverage of	COVID19 vaccination coverage	Dependent Variable	Vaccine stockout Vaccination coverage rate Vaccination dropout rate	Questionnaire Interview	Descriptive statistics Regression analysis Content analysis
To assess contribution DHIS2 improving COV 19 vaccination data quality in Tanzania. the of on ID-	Data Quality	Independent Variable	Data availability User friendly Data accessibility Data visibility	Questionnaire Interview	Descriptive statistics Regression analysis Content analysis
To evaluate the impact of DHIS2 on interventions to improve COVID-19 vaccination data utilization at scale and national level	Data Utilization and implementation	Independent Variable	Program planning Decision making Organization and clinical management Cost control and financial optimization	Questionnaire Interview	Descriptive statistics Regression analysis Content analysis
To examine the role of DHIS2 on resource commitments towards COVID-19 vaccination uptake in Tanzania.	Resource Commitment	Independent Variable	Technical capacity Human resource capacity Training and tool replacement Vaccine administering programs	Questionnaire Interview	Descriptive statistics Regression analysis Content analysis

To identify specific challenges encountered in the implementation of DHIS2 for COVID19 vaccination	Perceived Challenges	Intervening Variable	Resource constraints Comprehensiveness of data sets Weak healthcare system COVID19 funding	Questionnaire Interview	Descriptive statistics Regression analysis Content analysis
distribution coverage. and			Healthcare accessibility barriers Vaccine hesitancy		

3.8 Ethical Issues Consideration of the Study

Ethical issues in research are a set of principles that guide research designs and practices to be observed by researchers and scholars such as when dealing with human subjects. This study considered all ethical issues from the start of the research.

3.9 Validity and Reliability of the Research

This section measures the quality of the study and the procedure included in the study in which consistency is measured by reliability and accuracy by the validity.

3.9.1 Validity of the Research

Respondents were asked questions related to the objectives of the study. Validity was also obtained by providing respondents with data forms for review. The questionnaire was designed based on the research objectives and included relevant questions that captured the intended concepts. The questions were reviewed to ensure they accurately represented the variables being measured. The Keiser-Meyer-Olkin (KMO) test was conducted to assess the sampling adequacy of data. A KMO value close to 1 indicated that the data was suitable for analysis and supported the validity of the data collected.

The results in Table 3.2 show that the KMO value of .846 is well above the recommended threshold of 0.5, indicating that the data is suitable for factor analysis. This suggests that the sample size is adequate for the variables being analysed. moreover, Bartlett's Test of Sphericity with a significant p-value of 0.000 indicates that the correlation between variables is positive and suitable for further analysis.

Table 3.2: KMO and Bartlett's Test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.839
Bartlett's Test of Sphericity	Approx. Chi-Square	248.491
	df	6
	Sig.	.000

Source: Data analysis (2023)

On the other hands the study tested communalities of each variable/factor to test how reliable they are in the model. If communalities are high, it means that the factors under study are well reflected in collected data. According to MacCallum, et al., (MacCallum, Widaman, Zhang, & Hong, 1999), it's suggested that all communalities should be more than 0.6, or the average should be at least 0.7. the extraction communalities of variables in the study, which are COVID-19 Vaccination Coverage, data quality, data utilization and resource commitment with Extraction Communalities value of 0.912, 0.823, 0.803, and 0.894 respectively. The extraction communalities indicate that the extracted factors explain a substantial portion of the variance in study variables, which is a positive sign for the validity measurement.

Table 3.3: Extraction

	Extraction
COVID 19 Vaccination Coverage	.912
Data Quality	.823
Data Utilization	.803
Resource Commitments	.894

Source: Data analysis (2023)

3.9.2 Reliability of the Study

To test the reliability of the study, a pilot study with a sample size of 30 was conducted to pre-test the instrument's ability and accuracy to obtain the required information. Following this, any ambiguous questions on the data collection sheet were reframed. To ensure the reliability of the data collection instruments, Cronbach's Alpha was calculated to assess internal consistency.

According to the Table 3.4 Sampling adequacy of the current study is 91% based on standardized Cronbach's Alpha which is 0.910 indicating a satisfactory level of internal consistency for study's variables above the generally accepted threshold of 70% or (0.7), this indicate that the questionnaire variables are measuring the construct consistently.

Table 3.4: Reliability Statistics

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.913	.910	28

Source: Data analysis (2023)

CHAPTER FOUR

DATA ANALYSIS, INTERPRETATION AND DISCUSSION

4.1 Introduction

This chapter focused on presenting the results of analysed data from the field, covering a description of the respondents' demographics, research model diagnostic tests, the research's objective findings, and discussion.

4.2 Presentation of Demographic Data

4.2.1 Age Distribution of Respondents

The frequency distribution Table 4.1 indicates that, a majority of the respondents were aged between 36-45 which represented 38.5 percent, followed by 46-55 who were 23.1 percent similar to respondents aged above 55 years and the least, 18-35 years amounted to 15.4 percent. This indicates that, research findings were significantly extracted across all respondents' groups based on age, therefore findings were not skewed to a specific age group of the respondents.

4.1.2 Gender Distribution of Respondent

Based on gender distribution among respondent in Table 4.1, the study was largely represented by females with 53.8 percent while males were only 46.2 percent. The gender distribution in the study's sample is relatively balanced, with a slightly higher percentage of female respondents. This balance helps to ensure that the findings are not skewed by gender-related factors.

4.1.3 Distribution of Respondent's Education Level

The breakdown of education levels in Table 4.1 shows that majority of the respondents amounting to 67.7 percent holds undergraduate level of the respondents followed by postgraduate respondents who were 20 percent, and few about 12.3 percent were of secondary education or TVET education level. This indicates that, MRR has formal- educated staff and that their diversity in education influences their perceptions and responses to the COVID-19 Vaccination Coverage with respect to technology.

4.1.4 Working Experience in Healthcare

According to Table 4.1 majority of respondents (60%) had more than six years' experience of working in healthcare, followed by those working between 1 to 5 years that account 35.4% of all respondent. Whereby those in entry or junior position with less than 1 year were fewer in the study as they only represent 4.6% of respondents. This shows that majority of respondents are of senior level experience in healthcare industry, indicating that the collected information is from reliable sources.

Table 4.1: Demographic Data

Demographic data	Categories	Frequency	Valid Percent
Age	18-35	10	15.4
	36-45	25	38.5
	46-55	15	23.1
	55- and above	15	23.1
Gender	Male	30	46.2
	Female	35	53.8
Education level	Secondary/TVET education	8	12.3
	Undergraduate	44	67.7

	Postgraduate	13	20
Years of working experience in healthcare	Less than 1	3	4.6
	5-Jan	23	35.4
	10-Jun	27	41.5
	10 and above	12	18.5

Source: Data analysis (2023)

4.2 Findings and Interpretation for Research Objectives

The current study employed MLR model to express the relationship and extent of the influence between dependent (COVID-19 Vaccination Coverage) and independent variables such as data quality, data utilization and resources commitment. According to the model summary Table 4.2 indicates that the R-Square is 84% while R is 91.6% which indicates the goodness-of-fit of regression model's factors (data quality, data utilization and resources commitment) and how well it explains the variability in the dependent variables.

The result indicates that the independent variables factors (data quality, data utilization and resources commitment) as attributed by DHIS2 explain about 84% of the COVID-19 Vaccination Coverage at MRR. The R sign is positive indicating that this relationship is strong (91.6%) and direct. Therefore, data quality, data utilization and resources commitment as facilitated by DHIS2 are effectively increases COVID-19 Vaccination Coverage at MRR by 91.6%. Furthermore, the model standard error of the estimate was low value of 0.38645 indicating that, the model's predicted values are relatively close to the actual observed values.

Table 4.2: Model Summary

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson

1	.916[a]	.840	.832	.38645	2.113

a. Predictors: (Constant), Resource Commitments, Data Utilization, Data Quality
b. Dependent Variable: COVID 19 Vaccination Coverage
Source: Data analysis (2023)

Furthermore, Analysis of Variance (ANOVA) Table 4.3 gives the information about the significance of the regression model in explaining the variability in the dependent variable which is COVID 19 Vaccination Coverage. The results show that the sum of squares attributed to the model by 47.683 is significantly higher than what would be expected by chance alone, this is reflected in the F-statistic of 106.429 which is greater that the sample size of 65 and highly significant p-value (0.000) less than 0.05 significance level that implies that the overall model is statistically significant.

Table 4.3: Variance (ANOVA)

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	47.683	3	15.894	106.429	.000[b]
	Residual	9.110	61	.149		
	Total	56.793	64			
a. Dependent Variable: COVID 19 Vaccination Coverage						
b. Predictors: (Constant), Resource Commitments, Data Utilization, Data Quality						

Source: Data analysis (2023)

4.3 Multiple Linear Regression Model Results

According to coefficient Table 4.4, the collinearity statistics provided indicate the level of multicollinearity among the independent variables in a regression model. Multicollinearity occurs when two or more independent variables in a regression model are highly correlated with each other, which can lead to instability in the estimates of the regression coefficients and potentially affect the interpretability of

the results. In this study, the two key metrics that were considered are tolerance and the Variance Inflation Factor (VIF) used to test multicollinearity, the linear regression model. The result indicates that, data quality, data utilization and resources commitment had Tolerance of 0.318, 0.349 and 0.218 respectively which was relatively low and not closer to 1; while VIF were 3.14, 2.89 and 4.59 respectively which are within the accepted value of less than 5 indicative of no violation of multicollinearity assumption.

Table 4.4: Coefficients

Coefficients[a]								
		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
Model		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	.107	.199		.536	.594		
	Data Quality	.373	.095	.356	3.921	.000	.318	3.143
	Data Utilization	.285	.078	.318	3.658	.001	.349	2.868
	Resource Commitments	.318	.109	.320	2.911	.005	.218	4.595
a. Dependent Variable: COVID 19 Vaccination Coverage								

Source: Data analysis (2023)

The major objective of the study was to study aims to assess the impact of health information systems on vaccination coverage by determining whether the quality of data available has contribution on the utilization of available resources in reaching the unvaccinated and delivery of the COVID-19 vaccine. The study aimed to establish the relationships between independent variables which are Resource Commitments, Data Utilization, Data Quality with dependent variable COVID 19 Vaccination Coverage. The regression analysis is presented as following,

$COVID19\ Vacination\ Coverage\ (CVC) = f(HIS)$----------Eq.1

$CVC = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots\ldots\ldots\ldots\varepsilon$

Whereby;

β_0=Constant term

$\{\beta\ i = 1,2,3\}$=The coefficients representing the various independent variables

X_1= Data Utilization and implementation (DU)

X_2= Data Quality (DQ)

X_3= Resource Commitment (RC)

Therefore, based on the results on the coefficient table … the MLR model is expressed by;

$$CVC = \beta_0 + \beta_1 DU + \beta_2 DQ + \beta_3 RC + \ \ldots\ldots\ldots\ldots.\varepsilon$$

Then;

$$CVC = 0.107 + 0.373DU + 0.285DQ + 0.318RC + \ \ldots\ldots\ldots\ldots.\varepsilon$$

The results of Multiple Linear Regression (MLR) model analysis that summarized in Table 4.7 indicate that all three independent variables such as Resource Commitments, Data Utilization, Data Quality with slope coefficients (β) of 0.373, 0.285 and 0.318 with the respective P-Values (Sig) of 0.000, 0.001 and 0.005 respectively; this implies that the independent variables have statistically significant positive relationships with the dependent variable. Each slope coefficient indicates the unit change in independent variable that led to specific (coefficient value) in dependent variable, holding other factors constant. The following sections are the interpretation and discussion for independent each variable with respective objective followed by proxy measures' descriptive results.

4.3.1 Contribution of DHIS2 on Improving COVID19 Vaccination Data Quality

According to MLR model, the coefficient for Data Quality (DQ) is 0.373 with its P-Value of 0.000; which means that for a one-unit increase in DQ as attributed by DHIS2, the predicted value of CVC will increase by 0.373 unit significantly. This indicates that an increase in data quality including data availability, user friendly of the data, data accessibility and data visibility, associated with a positive increase in the COVID-19 Vaccination Coverage in MRR in terms of vaccine stocks, vaccine coverage and dropout rate.

Furthermore, the result from MLR model is triangulated by the descriptive results on Table 4.5 indicating that among all proxy measures for Data Quality such as, data availability, user friendly of the data, data accessibility and data visibility had mean of 3.4462; 3.6308; 3.6308; and 3.5231. The higher the mean the higher the influence. Data availability mean =3.4462, user friendly of the data mean = 3.6308, data accessibility with mean value of 3.6308 and data visibility with mean value of 3.5231.

This result is empirically supported by a study of Wu, et al (2020) with the findings that big data technology has significant contribution on preventing and controlling spread of COVID-19. The quality of data generated has an important role in early surveillance and diseases warning, tracking and allocation of resources.

Table 4.5: Data Quality

	Mean	Std. Deviation
Data availability	3.4462	1.34665
User friendly	3.6308	1.18016
Data accessibility	3.6308	1.13975
Data visibility	3.5231	1.07685
Valid N (listwise)		

Source: Data analysis (2023)

4.3.2 Influence of DHIS2 on Improvement of COVID-19 Vaccination data utilization

The coefficient for Vaccination data utilization and implementation (DU) is 0.285, which indicates that for a one-unit increase in DU will increase CVC by 0.285 statistically significant with P-Value of 0.001 less than 0.05. This implies that a stronger and more vaccination data used in the facility in program planning, decision making, organization and clinical management, cost control and financial optimization; is statistically and directly affects COVID-19 Vaccination Coverage at MRR in terms of vaccine stocks, vaccine coverage and dropout rate.

On the other hand, the study triangulated MLR findings with descriptive statistics among DU proxy measures such as program planning, decision making, organization and clinical management, cost control and financial optimization with mean values of 3.3538; 3.3077; 3.3538; and 3.3538. the higher the mean the higher the activeness of the source of revenue among the proxy measures. This result is empirically supported by the study of Talukdar, et al (2021), which found that, acceptance of COVID-19 vaccine is varying based on the behaviors, beliefs, and social norms of the respondents. It was also found that ICT has influenced 65.06% of respondents to

willingly accept vaccination. It was concluded that health information technology has an important role in COVID-19 response.

Table 4.6: Data Utilization

	Mean	Std. Deviation
Program planning	3.3538	1.21746
Decision making	3.3077	1.11696
Organization and clinical management	3.3538	1.21746
Cost control and financial optimization	3.3538	1.08153
Valid N (listwise)		

Source: Data analysis (2023)

4.3.3 Contribution of DHIS2 on Improving COVID19 Vaccination Resource Commitment

The coefficient for resource commitment (RC) is 0.318, which indicates that for a one-unit increase in RC will increase CVC by 0.318 statistically significant with P-Value of 0.005 less than 0.05. This implies that a stronger and more resources is committed to adaptation of DHIS2 in the facility in technical capacity, human resource capacity, training and tool replacement; is statistically and directly affects COVID-19 Vaccination Coverage at MRRH in terms of vaccine stocks, vaccine coverage and dropout rate.

On the other hand, the study triangulated MLR findings with descriptive statistics among RC proxy measures such as technical capacity, human resource capacity, training and tool replacement with mean values of 3.508, 3.5077, 3.2308 and 3.2462. The higher the mean the higher the activeness of the source of revenue among the proxy measures. This result is empirically supported by the study of Prescott and

Prescott Jr, (202) which found that technology enhanced the vaccination of the Covid-19 through increase identification of patients at risk, increase engagement of the society in relations to COVID-19, and facilitated tracking of the patients enrolled in the vaccination program. Thus, it was recommended to combine health strategies adopted to combat the COVID-19 pandemic with the technology and increase efficiency and results on the control and management of the spread of the pandemic.

Table 4.7: Resource Commitment

	Mean	Std. Deviation
Technical capacity	3.508	1.1875
Human resource capacity	3.5077	1.27626
Training and tool replacement	3.2308	1.12873
Vaccine administering programs	3.2462	1.23783
Valid N (listwise)		

Source: Data analysis (2023)

4.3.3 Perceived Constraints Hindering Full Realization of DHIS2

The last objective of the study was to assess perceived constraints hindering full realization of DHIS2; the result found that Resource constraints had mean value of 3.8000; Comprehensiveness of data sets had mean value of 3.3077; Weak healthcare system had mean value of 3.3538; COVID19 funding had mean value of 3.9077 Healthcare accessibility barriers had mean value of 3.3538; and Vaccine hesitancy had mean value of 3.3231 with the notion that the higher the mean the higher the activeness among the proxy measures.

Therefore, MRRH highly faces with COVID19 funding challenge, followed by Resource constraints, then Healthcare accessibility barriers, Weak healthcare system, Vaccine hesitancy and the least is Comprehensiveness of data sets. According to Zgovu (2021), despite the positive influence of the technology in addressing COVID-19 pandemic there were various challenges that hindered the effective utilization of technology in the healthcare system such as low income and high maintenance cost of the health system, low digital literacy among healthcare workers, limited telecom infrastructure that results to poor network services.

Therefore, improvement of telecommunication infrastructure was recommended which would enhance adoption of digitization of the healthcare system. Another study by Bundara (2020) revealed that adaptation of health information technology in healthcare facilities are constrained by various challenges such as information technology illiteracy among healthcare workers, limited technologies resources in health sector, lack of relevant financial support from the government. It was recommended that, government and other stakeholders in health sector should develop unique strategies that facilitate adaptation of appropriate e-Health systems in Tanzania.

Table 4.8: Challenges

	Mean	Std. Deviation
Resource constraints	3.8000	1.32524
Comprehensiveness of data sets	3.3077	1.23647
Weak healthcare system	3.3538	.79904

COVID19 funding	3.9077	1.15546
Healthcare accessibility barriers	3.3538	1.00671
Vaccine hesitancy	3.3231	1.34754
Valid N (listwise)		

CHAPTER FIVE

SUMMARY, CONCLUSION, AND RECOMMENDATION

5.1 Introduction

The chapter presents summary, conclusion, and recommendation of the study on the impact of health information systems on COVID-19 vaccination coverage in Mwananyamala Municipality. The chapter is organized in three sections; summary of the study, conclusion, and recommendation drawn from the data analysis and discussion.

5.2 Summary

The study aimed to assess the impact of health information systems on COVID-19 vaccination coverage in Mwananyamala Municipality. Specifically, the study focused on; assessing the contribution of DHIS2 on improving COVID-19 vaccination data quality, evaluating the impact of DHIS2 on improving COVID-19 vaccination data utilization, examining the role of DHIS2 in supporting resource commitments towards COVID-19, and identifying specific challenges encountered in the implementation of DHIS2 for COVID-19 vaccination distribution and coverage. The study was theoretically guided by Normalization Process Theory that links the study to existing body of knowledge.

The study employed quantitative research approach, through an explanatory research design since it explores why the problem occurred with all available information. The research was conducted at Mwananyamala Regional Referral Hospital, Kinondoni, Dar es Salaam, Tanzania, where sample size of 65 respondent that was

selected using systematic random sampling and purposive sampling technique. The study used primary data collected using interview data collection method. Quantitative data analysis techniques were employed with the aid of SPSS version 27; where both descriptive and Multiple Linear Regression (MLR) analysis was done.

The study found that DHIS2 significantly contributes to enhancing the quality of COVID-19 vaccination data, including attributes such as data availability, user-friendliness, accessibility, and visibility. Also, it was found that DHIS2 has a positive influence on the utilization and implementation of COVID-19 vaccination data in program planning, decision making, clinical management, and cost control. Furthermore, the study revealed that DHIS2 facilitates increased commitment of resources, including technical capacity, human resources, training, and tool replacement, to COVID-19 vaccination efforts. The study also revealed several constraints hindering the full realization of DHIS2's potential, including resource limitations, data set incompleteness, healthcare system weaknesses, lack of COVID-19 funding, healthcare accessibility barriers, and vaccine hesitancy.

5.3 Conclusion

The results presented in section four provide significant insight into the role of DHIS2 in the context of COVID-19 vaccination efforts. The study draws a conclusion based on the objectives of the study.

5.3.1 Contribution of DHIS2 on Improving COVID-19 Vaccination Data Quality

The study found that DHIS2 has a significant positive impact on COVID-19 vaccination data quality. Specifically, an increase in data quality metrics, such as data availability, user-friendliness, accessibility, and visibility, was associated with a corresponding increase in COVID-19 Vaccination Coverage (CVC). Therefore, it was concluded that DHIS2 plays a vital role in enhancing data quality, which is essential for informed decision-making and efficient resource allocation during a pandemic. The implication of this finding is that healthcare authorities and policymakers should prioritize the integration and continued development of DHIS2 to ensure the availability of high-quality data.

5.3.2 Influence of DHIS2 on Improvement of COVID-19 Vaccination Data Utilization and Implementation

The study revealed that DHIS2 positively influences the utilization and implementation of COVID-19 vaccination data in various aspects of healthcare, including program planning, decision making, clinical management, and cost control. A stronger utilization of vaccination data was associated with higher COVID-19 Vaccination Coverage (CVC). Hence, it was concluded that DHIS2 serves as a valuable tool for optimizing vaccination programs and pandemic responses. This underscores the importance of healthcare organizations integrating DHIS2 into their vaccination strategies to achieve better outcomes.

5.3.3 Contribution of DHIS2 on Improving COVID-19 Vaccination Resource Commitment

The research showed that DHIS2 contributes to increased commitment of resources, such as technical capacity, human resources, training, and tool replacement, to support COVID-19 vaccination efforts. A higher resource commitment correlated with improved COVID-19 Vaccination Coverage (CVC). Thus, it was concluded that DHIS2 has a direct impact on resource allocation and optimization. This highlights the need for policymakers and healthcare administrators to recognize the role of DHIS2 in ensuring efficient resource utilization for vaccination programs.

5.3.4 Perceived Constraints Hindering the Full Realization of DHIS2

The study identified various constraints hindering the full realization of DHIS2's potential, including resource limitations, incomplete data sets, healthcare system weaknesses, lack of COVID-19 funding, healthcare accessibility barriers, and vaccine hesitancy. These constraints impact the effective implementation of DHIS2. It was concluded that addressing these constraints is essential to maximize DHIS2's benefits in healthcare and pandemic response. To overcome these challenges, there is a need to invest in digital literacy among healthcare workers, increase technology resources, and secure financial support for health information technology projects.

5.3 Recommendations and Policy Implications

The study provided recommendations to various stakeholders that included Health authorities, Policymakers, and relevant Stakeholders.

Recommendations to Health Authorities and Governments: The study recommends that health authorities and governments prioritize the integration and

continuous improvement of DHIS2 within their healthcare systems. This should include investment in infrastructure and training to ensure the effective use of DHIS2 for data collection, management, and analysis.

It is recommended for health authorities to establish clear data quality standards and guidelines, emphasizing data availability, user-friendliness, accessibility, and visibility. Regular audits and assessments of data quality should be conducted to maintain high standards. Health authorities should promote collaboration between healthcare facilities, ensuring that DHIS2 is uniformly adopted and utilized across all levels of the healthcare system. This would enhance the consistency and reliability of vaccination data. Also, the study recommended to Governments to allocate sufficient funding to support the implementation and maintenance of DHIS2, recognizing its critical role in improving vaccination coverage and pandemic response.

Recommendations to Policymakers: Policymakers should consider DHIS2 as an essential tool for informed decision-making during public health emergencies. They should actively advocate for the adoption of DHIS2 and allocate resources for its integration into healthcare systems. The policy maker should develop policies that encourage data sharing and interoperability among healthcare facilities and stakeholders to enhance the effectiveness of DHIS2. Policymakers should promote data standards and open data initiatives. Policymakers should collaborate with relevant institutions and organizations to provide training and capacity-building programs for healthcare workers to ensure they can effectively utilize DHIS2 for program planning, decision-making, and clinical management.

Recommendations to Stakeholders: Healthcare organizations and providers should actively participate in DHIS2 implementations, ensuring that data quality is maintained, and data utilization is optimized. They should provide feedback to authorities for system improvements. Also, stakeholders including non-governmental organizations and international agencies, can support the adoption and expansion of DHIS2 by providing technical assistance, expertise, and financial resources. Stakeholder organizations should collaborate and share knowledge on best practices and lessons learned from DHIS2 implementations. Moreover, civil society organizations and advocacy groups can play a role in promoting transparency and accountability in DHIS2 implementations. They should advocate for the proper allocation of resources and the adherence to data quality standards.

5.4 Suggestion for Further Research

While this study provides valuable insights into the role of DHIS2 in COVID-19 vaccination efforts, there are avenues for further research to expand understanding of DHIS2 and vaccination coverage aspects. The study suggests further study that explores the user experience and challenges faced by healthcare workers and administrators when using DHIS2, aiming to improve system usability. Also, the study suggests further study that explores the adaptability of DHIS2 to other healthcare services beyond vaccination, such as disease surveillance, maternal health, or chronic disease management. Moreover, since this study focused on the Mwananyamala municipality located in an urban area. The study recommends further study to analyse DHIS2 implementation across different regions; specifically, in rural areas to identify best practices and factors influencing its effectiveness.

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APPENDICES

Appendix 1: Interview Guide

1. How do you rate the accuracy and completeness of COVID-19 vaccination data collected using DHIS2?
2. Do you find that using DHIS2 has improved the timeliness of data entry for COVID-19 vaccination records?
3. How often do you access and utilize COVID-19 vaccination data from DHIS2 for decision-making?
4. To what extent do you believe that the data from DHIS2 has influenced vaccination strategies and resource allocation for COVID-19?
5. Has DHIS2 helped in identifying vaccine distribution needs and ensuring adequate vaccine supply?
6. How do you perceive DHIS2's role in monitoring and managing vaccine stocks and wastage during the COVID-19 vaccination campaign?
7. Have you encountered any technical issues or difficulties in accessing and using DHIS2 for COVID-19 vaccination data?
8. Overall, do you believe that DHIS2 has positively impacted COVID-19 vaccination coverage and management at Mwananyamala Regional Referral Hospital?
9. Please share any additional comments or suggestions regarding the use of DHIS2 for COVID-19 vaccination management.

Appendix 2: Research Clearance Letters

THE UNITED REPUBLIC OF TANZANIA

MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGY

THE OPEN UNIVERSITY OF TANZANIA

Ref. No OUT/PG201702059 **24th August, 2023**

Chief Medical Officer In charge,
Mwananyamala Regional Referral Hospital,
P.O. Box 61665,
DAR ES SALAAM.

Dear Chief Medical Officer In charge

RE: RESEARCH CLEARANCE FOR MR. JOSEPH GASPAR HAKILI, REG NO: PG201702059

2. The Open University of Tanzania was established by an Act of Parliament No. 17 of 1992, which became operational on the 1st March 1993 by public notice No.55 in the official Gazette. The Act was however replaced by the Open University of Tanzania Charter of 2005, which became operational on 1st January 2007.In line with the Charter, the Open University of Tanzania mission is to generate and apply knowledge through research.

3. To facilitate and to simplify research process therefore, the act empowers the Vice Chancellor of the Open University of Tanzania to issue research clearance, on behalf of the Government of Tanzania and Tanzania Commission for Science and Technology, to both its staff and students who are doing research in Tanzania. With this brief background, the purpose of this letter is to introduce to you **Mr. Joseph Gaspar Hakili, Reg. No: PG201702059),** pursuing **Masters of Arts in Monitoring and Evaluation (MAME).** We here by grant this clearance to conduct a research titled **"Impact of Health**

Information System on Covid-19 Vaccination Coverage in Mwananyamala Municipality, Tanzania". He will collect his data at your office from 25th August to 31th September 2023.

4. In case you need any further information, kindly do not hesitate to contact the Deputy Vice Chancellor (Academic) of the Open University of Tanzania, P.O.Box 23409, Dar es Salaam. Tel: 022-2-2668820.We lastly thank you in advance for your assumed cooperation and facilitation of this research academic activity.

Yours sincerely,

THE OPEN UNIVERSITY OF TANZANIA

Prof. Magreth S.Bushesha

For: VICE CHANCELLOR

THE UNITED REPUBLIC OF TANZANIA
MINISTRY OF HEALTH

Telephone Address:

Telephone: 022-2760500

Mwananyamala Regional
Referral Hospital,
P.O.Box 61665
Dar es Salaam.

RE: NO.: MA. 240/341/01/84

DATE: 11th Sept, 2023

Vice Chancellor,
The Open University of Tanzania,
P.O.BOX 23409,
Dar es Salaam.

RE: MR. JOSEPH GASPAR HAKILI TO CONDUCT HIS RESEARCH IN MWANANYAMALA REGIONAL REFERRAL HOSPITAL

The captioned subject refers

2. May you be informed that your prescribed request for your bonafide student **Joseph Gaspar Hakili** to conduct his Research in our Institution through your letter dated **24th Aug, 2023**, is asserted.

3. The Institution charges **50,000/=**, as a Research fee each 4 weeks spent. The payments are to be made upon reporting.

4. May he report to the Administration and HR department head for further instruction.

Thanks.

Dr. Mkiwa Akida
RESEARCH COORDINATOR
FOR: MEDICAL OFFICER INCHARGE
MWANANYAMALA REGIONAL REFERRAL HOSPITAL

MEDICAL OFFICER INCHARGE
MWANANYAMALA HOSPITAL
P O Box 61665
DAR ES SALAAM

COPY:
Head of Int. Medicine - **MWANANYAMALA REGIONAL REFERRAL HOSPITAL**

Student - **Report to the head of Int. Medicine**