DEVELOPMENT OF GUIDELINES FOR THE UTILIZATION OF HEALTH MANAGEMENT INFORMATION SYSTEM FOR QUALITY IMMUNIZATION SERVICE IN ETHIOPIA

by

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submitted in accordance with the requirements for the degree of

DOCTOR OF PHILOSOPHY

in the subject

PUBLIC HEALTH

at the

UNIVERSITY OF SOUTH AFRICA

SUPERVISOR: PROF C. PRINSLOO

DECEMBER 2025

DECLARATION

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DEVELOPMENT OF GUIDELINES FOR THE UTILIZATION OF HEALTH MANAGEMENT INFORMATION SYSTEM (HMIS) FOR QUALITY IMMUNIZATION SERVICE in ETHIOPIA

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DEDICATION

This study is dedicated to my family, specifically my wife, Nazrawit Yohannnes, my son, Motolomi, and my two daughters, Felicity and Sina (Tungaw), who persevered in their support throughout this long PhD journey. To the extent this study is dedicated in memory of my late father, Fanta TASSEW, who unconditionally loved and guided me to who I am today. While he supplied me with all he had, he tirelessly taught me self-sufficiency throughout most of his life in this world. My mother, Dalbe Fola, who persistently kneels with humility, vouchsafe me protection and praises the Lord for his incredible gift cherished by us in the family. The dedication goes to my kinship brothers and sisters, who always accept me with patience, love, and respect as their elder brother and pathfinder of the Fanta Family. My friends and colleagues shall be part of this, as they supported and encouraged me throughout the entire process of this work.

With due respect and accolades, the dedication reaches the Addis Ababa city health bureau, which ethically authorised this study without bureaucratic holdups, and certainly, a tremendous devotion is reflected in the study sub-cities health offices, and health facilities thereunder, who provide immunisation service, and implement HMIS and quality improvement at the capacity of frontline health workers and health managers for their wholehearted support of the study. Last but not least, the study is devoted to the study participants who made this journey and achieved success by sharing their workdays and leave hours.

ACKNOWLEDGMENT

Most of my acknowledgement goes to almighty God, who guided me through the long-standing ups and downs of this process; he instilled in me the spirit of zeal, interest, hard work, and resilience to achieve my ultimate desire. I am immeasurably grateful for his kept promises, which enabled me to pass through turbulent times of hopelessness and feebleness. Special thanks go to my adviser, Prof Carine Prinsloo, who successfully led this study here, where it was finalised. I am also indebted to my previous adviser, Professor MM Ramukumba, before her retirement from UNISA, who patiently provided quality scholarly guidance from proposal writing to the drafting of the results of the qualitative phase (Chapter 5).

The University of South Africa (UNISA) for providing necessary support, especially the UNISA Learning Centre in Addis Ababa, Ethiopia, for their timely responses that instantly addressed encountered constraints.

The Ethical Review Committee of the University of South Africa and the City Administration Health Office in Addis Ababa for authorisation of the study to be conducted without obstacles. Officers and authorities of the sub-city administration health offices for waiving participants from their routine and effectively engaging in the study. Facility managers, care providers, and health information technicians for their cooperation and willingness to participate in the study, which has made the most significant contribution to the successful completion of this study. All the data collectors and research assistants played crucial roles in all processes involved, as it was delivered within the set time. Experts across disciplines of immunization, health management information systems and quality improvement who participated in the review of draft study guidelines and validation of the guidelines,

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ABSTRACT

Health Management Information System (HMIS) is a major source of information for estimating immunisation service coverage; however, most studies argue that the Routine Health Management Information System (RHIS) inherently produces poor-quality data, which deters its wider use. Some literature asserts that no data from any source can prove the best quality; rather, using available information to provide quality service can sustain information use, thereby achieving higher data quality. This, in turn, promotes usability; nevertheless, the nexus between quality improvement and information use is not yet established. This study was intended to develop guidelines to improve HMIS use for quality immunisation service. The Performance of Routine Information System Management-Model For Improvement (PRISM-MFI) framework, guided by an explanatory sequential design, informed the mixed-methods data collection, analysis, and interpretation. The study was conducted in 42 health facilities in Addis Ababa, Ethiopia, enrolling 412 participants among health and HMIS workers. A multistage cluster, stratified with Probability Proportion to the Size (PPS) sampling, was used. Data collected through a self-administered questionnaire were entered and cleaned with EpiInfo version 7.2.5 and thoroughly analysed using SPSS for Windows 28. Qualitative strand applied Nested Criterion sampling. Data collected from

nine focus group interviews composed of Information Technicians (HITs), health professionals, and health managers. Each of the categories had three groups interviewed using a thematic guide, audio recordings, and notes were manually transcribed, and codes and themes were subsequently generated using the software ATLAS.ti version 24, and were detail-analysed applying a descriptive qualitative design. Integration of findings from two studies; used a narrative joint display table to generate meta-inferences.

The result revealed weak data management and data quality, hence the need to use information to ensure quality immunisation services. RHIS processes are affected by the use of hybrid, disaggregated data tools, redundant entry into the District Health Information System (DHIS2), and parallel reporting; they fail to systematically assess data quality, perform timely analysis, and interpret gaps and mitigation plans. The feedback mechanism is not constructive. The system update neglects frontline staff participation, worsening the complexity of forms, DHIS2 software, and indicators. Subpar HMIS staffing, training resources, and data use for budgeting and staff appraisal negate accountability. Data demand prioritises monitoring program output over improving service quality. Health staff lack self-reliance in interpreting and using data to evidence the design and implementation of quality initiatives. In sum, information is underused for immunisation planning, resource optimisation, supportive supervision, and community engagement in services. The interlinked guidelines were developed to address current challenges in data quality assurance and in the use of information to improve immunisation service quality.

Key concepts: HMIS, DHIS2, PRSIM, MFI, Data Quality, Information use, Quality Improvement, Immunisation, PDSA, determinants of RHIS process.

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LIST OF ABBREVIATIONS AND ACRONYMS

ANC	Antenatal care
DHIS2	District Health Information System 2 (web-based DHIS)
eHealth	Electronic Health
EMR	Electronic Medical Record
EPI	Expanded Programs of Immunisation
FMOH	Federal Ministry of Health, Ethiopia
FGD	Focus Group Discussion
HCP	HealthCare Professionals
HIS	Health Information System
HMIS	Health Management Information System
HITs	Health Information Technicians
ICT	Information Communication Technology
IR	Information Revolution
LMIC	Low- and Middle-Income Countries
LQAS	Lots Quality Assurance Sampling
MCSP	Maternal and Child Survival Program
MOH	Ministry of Health
MCH	Maternal and Child Health
M&E	Monitoring and Evaluation
NGOs	Non-Governmental Organizations
PHC	Primary Health Care
PMT	Performance Monitoring Team
QI	Quality Improvement
QIP	Quality Improvement Project
PRISM	Performance of RoutineInformation System Management
RDQA	Routine Data Quality Assessment
RHBs	Regional Health Bureaus
RHIS	Routine Health Information System
SDGs	Sustainable Development Goals

USAID	United States Agency for International Development
UNISA	University of South Africa
WHO	World Health Organization

CHAPTER 1: ORIENTATION TO THE STUDY

1.1 INTRODUCTION

Routinely collected HMIS data is a major source of information for estimating immunisation coverage; regrettably, such data from Low- and Middle-Income Countries (LMICs) are often likened to be of low quality (Bloland & MacNeil 2019:1; Nsubuga, Luzze, Ampere, Kasasa, Toliva & Riolexus 2018:1). Despite numerous studies and systematic reviews on RHIS, the evidence regarding the most effective strategies and settings for improving RHIS effectiveness remains inconclusive. Some studies and reviews have primarily focused on the technical aspects of producing high-quality data, while giving less attention to the use of this data for informed decision-making (Leon, Brady, Kwamie & Daniels 2015:3).

This chapter presents the background to the research problem, the research problem, and a brief description of the methodology adopted in this study. The aim, significance, definitions, and foundations of the study are detailed in the appropriate sections. The research scope and the thesis's structure are outlined.

1.2 BACKGROUND INFORMATION ABOUT THE RESEARCH PROBLEM

Good-quality healthcare across the continuum relies on quality-assured data to continually improve health services to the level that meets patient preferences and satisfaction (Lingamallu & Nayakvadi 2017:2). Such improvement is unlikely unless there is regular use of health information. Without continuous use, information will remain of poor quality (Teklu, Tilahun, Abebaw, Mancuso, Dessie & Zegeye 2018:5).

Poor data quality and limited use of available information remain major concerns for the Health Information System (HIS) in developing countries; the situation is worsened by gaps in health staff's knowledge and skills and the environments in which they operate (Dagnew, Woreta & Shiferaw 2018:1).

In response to the challenges, HIS reform implementation is underway to transform the system from mere data collection to action-oriented information use in service planning, implementation, and corrective actions. Worldwide, significant human and financial resources have been devoted to strengthening the routine health information system. However, attempts to improve the health information system have yielded little (Lingamallu & Nayakvadi 2017:5).

Thus HIS remains chronically inaccurate due to multiple factors, including the absence of a culture of information use, the improper use of existing HIS/IT, a mismatch between human capacity and the system, a lack of administrative commitment, as well as an adaptive system design (Kimani & Namusonge 2015:4).

A study by Tull (2018:2) concludes that, no matter how well-designed an information system is, it will not be effective unless there is internal desire, dedication, persistent motivation, and commitment from leadership. Focus on only infrastructure, and simply having the best information system alone does not lead to any success; what counts more is sharing and using the information to improve the quality of care for informed decision-making (Nutley & Reynolds 2013:7).

Quality of care is a driving force to the use of HIS; it compels value and satisfaction of patients, motivates managers and makes an organization more competitive and self-sustaining according to Lingamallu and Nayakvadi (2017:1). Despite significant recent investments in healthcare information systems' infrastructure, guidelines, and Human Resources (HR), the use of information to improve the quality of care has not been adequately achieved (Sligo, Guald, Roberts & Villa 2017:6).

Globally, immunisation service coverage has revealed enhancement in the past years; the validity of data used to measure change over time has been questioned (Teklu et al. 2018:2). Routinely collected data are the primary source of information for measuring immunisation coverage; unfortunately, such data from Low- and Middle-Income Countries

(LMICs) are often deemed to be of poor quality (Bloland & MacNeil 2019:1; Nsubuga et al. 2018:1).

The effective use of health data for informed decision-making and actions could strengthen accountability to immunisation data quality and achievement of intended coverage. A study by Ledikwe, Grignon, Lebelonyane, Ludic, Matshediso, Sento, Sharma & Semo (2014:6) states that the enhanced data use will improve data quality, in turn reinforcing accountability in the management of immunisation data.

Ethiopia has significantly invested in instituting and promoting health information systems to improve health service delivery, however; studies on quality of data and information utilization in the country depicted an insufficient culture of using information for decision-making (37%) at facility level, while there is a lot of evidence on quality of data and ways of its improvement, there is a gap in necessary evidence on why the use of information for decision-making across level of the health system is low (Teklu et al. 2018:1).

The Federal Ministry of Health, Ethiopia (FMoHE) has launched an Information Revolution, with a strategy to promote the use of data generated by peripheral healthcare systems. However, frontline management and service delivery points rarely use system-generated data to identify performance problems, develop mitigation plans, and track progress; the data is used solely for reporting, not for program and quality-of-care improvements (Dagnew et al. 2018:2).

Quality healthcare is universally appealing though deemed challenging to measure and attain (Akachi & Kruk 2017:1; Alhassan, Spieker, Ostenberg, Ogink, Amponsah & Wit 2013:1). Nevertheless, quality measure is information from health service clients' records or an operational process that is converted into a rate, percentage or time that indicates how well the providers are taking care of patients.

In Ethiopia, the HMIS reform was intended to meet expectations for delivering quality information to attain the goals and objectives of the Health Sector Development Program

(HSDP) and, now, the Growth and Transformation Program-Health Sector Transformation Plan (GTP-HSTP) 2015-2020, which includes excellence in quality improvement and assurance. The HMIS reform was implemented under the three overarching [technical] principles: standardisation, integration, and simplification (SIS) (Teklu et al. 2018:3).

Existing studies and reviews primarily focused on the technical aspects of high-quality data production and undervalued the use of this data for informed decision-making (Leon et al. 2015:6). In several Routine Health Information System research and systematic reviews, the evidence regarding which intervention works best in which context to enhance the effectiveness of RHISs remains varied and inconclusive;

Technical determinant analysis has not exhaustively explored how users bring about usability issues (use existing data in standardized form for identifying problems and opportunities to solve problems with data quality thereby, healthcare quality (Leon et al. 2015:6). A contribution of QI efforts to culture of information use and organisational success has not been included under **Organizational** determinants (Aqil, Lippeveld & Hozumi 2009:4). Interventions to add value and persistent motivation of information users are not indicated under **Behavioural** determinants (Dufera, Lamenew, Demissie & Guda 2018:2).

1.3 RESEARCH PROBLEM

Healthcare quality improvement and HMIS form the essential basis for establishing organisational management effectiveness and efficiency in healthcare. An effective HMIS is a determinant for a quality improvement program. Quality improvement initiatives regularly use information to make evidence-based decisions. Some studies on HMIS implementation in Ethiopia found neglected use of HMIS, especially at the peripheral level of the health system (Teklu et al. 2018:2). These studies identified gaps in information utilisation and in the incorporation of evidence-based decision-making to provide quality healthcare services, despite the standardisation of tools.

Although the literature acknowledges the impact of information generated at this front level on service quality, questions remain about the use of HMIS to improve immunisation services. The effective utilization of routine HMIS information to improve the quality of care has not yet been established (Abrampah, Syed, Hirschhorn, Nambiar, Iqbal, Garcia-Elorrio, Chattu, Devnani & Kelley 2018:4). Analysis of major determinants of RHIS (Technical, Organisational, and behavioural factors) has not clearly indicated the role of information use in the quality of immunization service and its effect on data quality.

Ethiopia is one of the countries repeatedly confronted with epidemics and outbreaks of vaccine-preventable diseases. The scientific literature in Ethiopia has listed various constraints to the nation's immunisation program (Manyazewal, Mekonnen, Demelew, Mengestu, Abdu, Mammo, Abebe, Haffa, Zenebe, Worku, Aman & Tigabu 2018:2).

Data discrepancy, as one of the challenges, raises questions about the HMIS data management processes. The Ethiopian Demographic and Health Survey (EDHS) 2016 reported coverage rates for Pentavalent, measles, and fully immunised children as 53%, 54%, and 22%, respectively, but the RHIS information (in the fiscal year) showed coverage rates of 97%, 96%, and 91%, respectively.

In Ethiopia, a policy is in place to regulate the generation of high-quality HMIS data and its use for decision-making. However, both the data quality and the use of information remain weak, particularly at the local level (Endriyas, Alano, Mekonnen, Ayele, Kelaye, Shiferaw, Misganaw, Samuel, Hailemariam & Hailu 2019:2). The current national immunisation plan requires improved information use at the local level and decision-making based on evidence to enhance the quality of immunisation service. The same study indicates that employing Continuous Quality Improvement (CQI) interventions. The potential of CQI to assess, improve and regularly follow up immunisation programme services is an effective and sustainable approach to achieve Ethiopia's national immunisation improvement plan (Manyazewal et al. 2018:2). This highlights the importance of quality improvement, which necessitates continued use of information to assess, improve and monitor program and sustain-

ing quality of services. This study might contribute to the continuous use of HMIS-generated information to improve immunisation service quality and, thereby, data quality.

1.4 RESEARCH PURPOSE

The purpose of this study is to develop guidelines to strengthen the quality of immunisation service using the Health Management Information System.

1.5 RESEARCH OBJECTIVES

The specific objectives of the study are:

Phase I: Quantitative objectives:

a. Assess data management processes in healthcare facilities and sub-city offices.
b. Identify the effect of Technical-Organisational-Behavioural (TOB) factors on data management.
c. Determine the extent of information use in the quality improvement of immunisation services.
d. Identify the effect of TOB factors on information use.

Phase II: Qualitative objectives

e. Explore the experiences of health professionals in data generation, information use, and quality improvement of immunisation services.

1.6 RESEARCH QUESTIONS

1. Quantitative questions:

1. What data management processes are implemented in healthcare facilities and sub-city offices?

2. How do TOB factors influence data management processes?
3. What is the extent of information use at healthcare facilities and sub-city health offices?
4. How do TOB factors influence information use?

II. Qualitative question:

5. What are the experiences of health professionals of data generation, information use, and quality improvement?

III. Integrated (hybrid) question:

6. How can HMIS be used to strengthen the quality of data?\

The intended assessment of data management processes will provide empirical evidence on how immunisation data are generated and where data quality gaps exist. Together with the assessment of information use practices, the study will establish a baseline for understanding the extent to which HMIS information is utilised for decision-making and service improvement. Additionally, identifying factors that influence both data generation and information use will produce measurable evidence regarding the determinants of these processes. The knowledge obtained from the quantitative objectives will be further enriched by the qualitative objective, which aims to explore the experiences and perspectives of health professionals regarding data generation, information use, and immunisation service quality improvement. Addressing the objectives of both phases collaboratively will help define the study's improvement agenda. Ultimately, the findings will inform the development of interlinked guidelines aimed at strengthening HMIS data quality and promoting the effective use of information to improve immunisation service delivery.

1.7 SIGNIFICANCE OF THE STUDY

Given the limited understanding of why health information is underutilised in making informed decisions to enhance service quality, it is essential to conduct a study on the use of information to improve immunisation services. In comparison, much more research has been conducted on the technicalities of producing high-quality data, but only a few studies have examined the principal factors that affect information use. Most often, low information use in the health sector is persistently attributed to the low quality of routine data.

Moreover, routine data is of poor quality, while survey data is associated with a larger collection of less useful data. This study examines data management processes and their pivotal role in ensuring data quality. The study investigates the key factors influencing data management processes and how these, in turn, affect data quality. Similarly, it explores the drivers of information use, even when quality-assured data is available. The research also addresses the demand for data to inform immunisation service quality improvement efforts and the contribution of these efforts to enhancing overall data quality. The information gained from the study may enhance the body of knowledge on information use to strengthen the quality of immunisation services. The study will provide a more detailed and systematic analysis of the TOB determinants of RHIS. This will indicate prioritised measures to improve information use. It is expected to enable immunisation service providers to improve both service quality and data quality. The knowledge elicited may inform policymakers' decisions on the factors to consider for improving information use in healthcare services. Proposed guidelines will empower professionals to use routine health information to improve the quality of immunisation services.

1.8 DEFINITIONS OF KEY TERMS

1.8.1 Definition of key concepts

The following key terms and definitions apply to this study.

Behavioural determinants of the RHIS process refer to knowledge, competence, confidence, and motivation for data demand and use (Aqil et al. 2009:3, 4). In this study, behavioural determinants refer to the personal attributes and attitudes of health workers that affect RHIS processes in immunisation programs, such as their level of knowledge and skills in data management, confidence in handling information systems, and motivation to utilise data for decision-making.

Data usability refers to the extent to which data are of the required quality (accuracy), completeness, and timeliness to support effective decision-making. Utilisation, or "Use," refers to the degree to which data are used in decision-making (Bloland & MacNeil 2019:2). In this study, data usability will mean the quality of immunisation data in terms of accuracy, completeness, consistency, timeliness, and integrity, to support program decisions. Data use refers to the actual application of this data by health workers and managers to guide planning, monitoring, and the improvement of immunisation services.

Health Management Information System (HMIS) refers to the system through which the health data are registered, warehoused, and retrieved, processed, and utilized in decision-making in improving immunization health service/programs (Endriyas et al. 2019:2). In this study HMIS refers to systematic execution of data management (RHIS) processes produce quality data and use of information for decisions that include the use for improving quality of health (immunization) service. It also refers to the availability of dedicated functional resources required for data quality assurance and the use of information.

Organizational determinants of the RHIS process refer to information culture, structure, resources and roles and responsibilities of key contributors at each level of the health system (Dufera et al. 2018:2). In this study, organisational determinants will mean the institutional factors that affect RHIS processes in immunization programs, such as the presence of training, a supportive information culture, clarity of roles and responsibilities among health workers, and the adequacy of resources and organisational structures for effective data management.

Quality improvement (QI) is an ongoing process in which organizations iteratively test and measure changes in work routines, and set and achieve ambitious aims using health information as a backbone (MOH, Ethiopian Health Care Quality strategy 2016-2020:13). In this study QI will mean the continuous efforts within immunization programs to improve service delivery and outcomes by applying data-driven approaches, monitoring progress, and implementing evidence-based changes to strengthen RHIS processes.

Routine Data Quality Assessment (RDQA) refers to an institutional process that involves regular data quality checks and use of RHIS information for decision-making by the institution itself (User Manual Routine Data Quality Assessment 2015:13). In this study, RDQA will mean the structured approach used within immunization programs to periodically assess the accuracy, completeness, and reliability of routine health data, and to ensure that this information is actively utilized for planning and improving service delivery.

Routine Health Information System (RHIS) performance means strengthened data quality and sustained use of information (Aqil et al. 2009:1). In this study, RHIS performance is defined as the production of quality-assured data through integrated data quality assurance mechanisms and the continuous use of information to improve immunisation health service quality.

RHIS processes refer to data generation, aggregation, data sharing, data analysis, interpretation, data visualisation, data quality check and feedback (PRISM Guide 2009:13). In this study, RHIS processes will refer to the systematic activities involved in routine health information management, including data collection, aggregation, analysis, interpretation, visualisation, quality assurance, and feedback for decision-making.

Technical determinants of the RHIS process refers to the design and complexity of health information systems, information technology, computer hardware and software, and reporting tools and methods (Leon et al. 2015:15). In this study technical determinants will mean the technological factors that affect the performance of RHIS processes in immunization

programs, such as the adequacy of IT infrastructure, user-friendly design of reporting tools, and the reliability of hardware and software used for data collection and analysis.

1.8.2 Operational definition

Use of information: the study defines information (HMIS) use as the recorded use of immunisation health information, as evidenced by the available monthly reports, the display of EPI monitoring charts, the availability of operational plans reflecting targets and actions, and Quality Initiative plans. It is the regular use of information for decision-making to improve the quality of immunisation services.

Data quality: In this study, it refers to dimensions of **accuracy**, **reliability (consistency)**, **completeness**, **timeliness**, **precision,** and **integrity**.

Accuracy, thus, in this study**,** refers to the precision of a measurement or estimate relative to the actual value of the item being measured. **Reliability (consistency)** refers to standards and methods that do not change due to changes in person, time, or frequency of use. Recurring estimates/measurements produce the same results in the same conditions, due to the proximity of the initial estimated value(s) to the following estimated values. **Completeness** refers to the inclusiveness of the information system from which the results are derived: it means a complete list of eligible persons or units, not just a subset.

Timeliness refers to temporal fitness; data is timely when the information is accessible by the expected time. **Precision** refers to the data having sufficient detail, for example, aggregated by sex, and to the degree of freedom from random error. **Integrity** refers to the system used to generate data not being subjected to intentional bias or manipulation for political or personal reasons.

Immunisation service quality in this study refers to organisational (health institutions) processes and mechanisms for reducing dropout rates and missed opportunities, and for raising the proportion of fully immunised children to at least 90%.

Health professionals refer to immunisation service providers, quality improvement officers, directors and managers at health facilities and health offices.

Health Information Workers refer to Health Information Technicians (HITs) and/or HMIS officers at health facilities and health offices.

1.9 FOUNDATIONS OF THE STUDY

1.9.1 Research paradigm

The Pragmatic Paradigm applies to this study, as it involves both subjective and objective inquiry (a mixed-methods approach). The pragmatic paradigm allows for a plurality of views and methods to be part of its overall research plan, unlike the known positivist/constructivist paradigms, which present an alternative lens that can be developed and utilised. According to pragmatism, the research question is the most important determinant of the research philosophy; as such, a study should be designed and undertaken in the best way that responds to the research questions, regardless of its associated philosophy (Kaushik & Walsh 2019:5, 11).

Ontological assumptions: The positivist belief in a singular reality, the idea that the only truth exists to be revealed by value-free inquiry, underlies quantitative research methods. It is weighed against the view that there is no such thing as a single objective reality and that ‘‘subjective inquiry is the only possible type to conduct’’ and for that reason constructivists favour qualitative research methods. Pragmatism breaks down the hierarchies between positivist and constructivist ways of knowing to investigate reality as multiple mind constructions that are bound by contexts (Shannon-Baker 2016:8).

This study accepts that the assertion, interpretation, and experience of participants regarding data quality and information use can be better investigated through a mixed-methods approach. The study will investigate TOB factors influencing data management and information use. Furthermore, the study will explore participants' experience with information

use. These will enable the researcher to gain knowledge and explain the nature of reality associated with data quality and information use for immunisation service quality.

Epistemological assumptions: Epistemology asks the question: How do we know what we know (Creswell & Creswell 2018:56). This study uses a pragmatic approach, both objective and subjective, to answer the study questions. The interaction between the researcher and the study participants was both objective and subjective in the process of eliciting knowledge. Thence, the knowledge gained from this study was triangulated across various forms of perception to clearly identify existing knowledge of information generation and use, and to investigate the systems that support information use, using an explanatory mixed-methods approach.

Methodological assumptions: a mixed-methods approach is relevant for providing a researcher with integrated research tools for problem-focused application. Information use can be affected by multiple factors, such as TOB influences on data generation and information use, the purpose of use, and the experience of information users. The researcher will collect and analyse data, integrate findings, and draw inferences (meta-inferences) about the status of HMIS data processing and information use for the quality of immunisation services, using a mixed-methods approach (Polit & Beck 2017:811).

1.9.2 Theoretical framework of the study

The theoretical framework for this study is the integrated Performance of Routine Information System Management and Model for Improvement (PRISM-MFI) framework.

The PRISM assumes that RHIS performance is affected by **RHIS processes**, which, in turn, are affected by **TOB** determinants (Aqil et al. 2009:1). TOB determinants are interrelated inputs to data management (RHIS) processes that provide improved quality of data and information use outputs.

Though improved data quality and continuous use of information are defining components of RHIS performance in the PRISM, this definition has not clearly specified which interventions can improve data quality or what purpose drives continuous use of information.

There is no explicit linkage between continuous use of information and improvement in data quality. Hotchkiss, cited in Leon et al. (2015:5), states that to achieve the generation of high-quality data and the effective use of information, one could focus on streamlining the RHIS for the purposes of planning, quality improvement, and evaluation processes. The PRISM component of the theoretical framework denotes RHIS inputs, processes and output of improved data quality and information use, while the MFI component of the framework shows continuity in use of information to the outcome of improved quality of (immunisation) service.

Thus, the Model for Improvement (MFI) was integrated into the PRISM framework to fully describe the quality improvement dimension of information use. Quality improvement (QI) is an iterative process that involves quality planning, improvement, and quality control. Each of these steps routinely uses data to measure and improve the quality of service in a cycle termed Plan-Do-Study-Act (PDSA) (also known as Plan-Do-Check-Act (PDCA). The PDSA cycle is clearly indicated in the Model for Improvement (MFI) (Knox 2018:10).

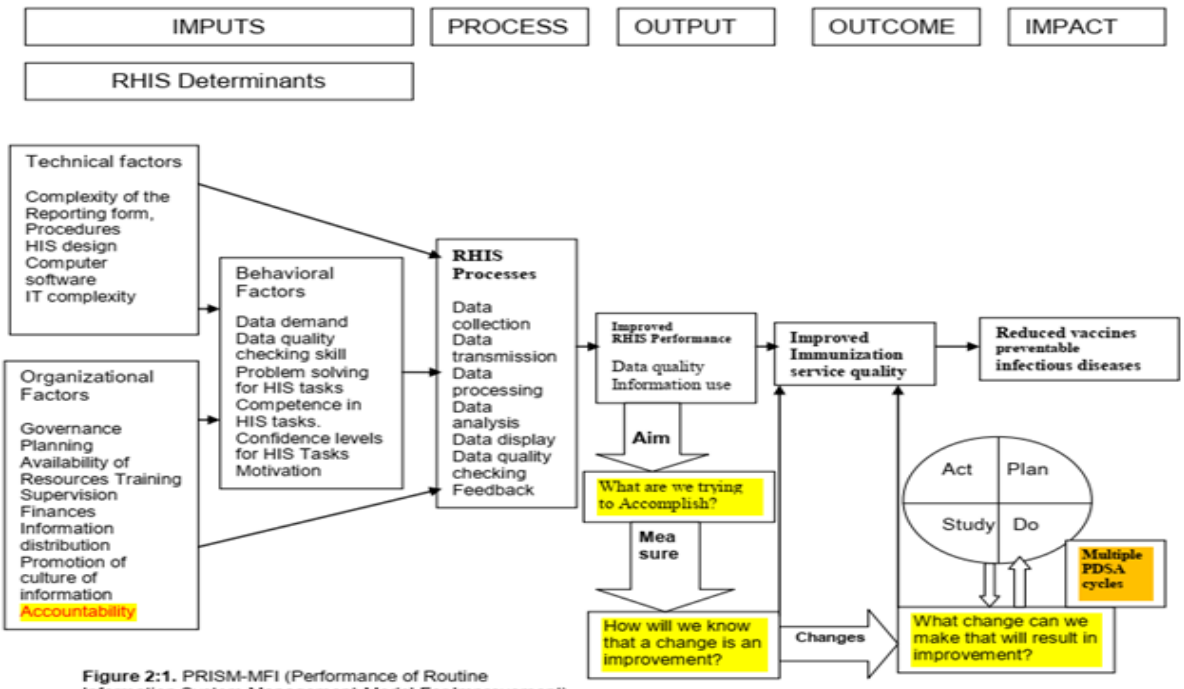

Figure 2:1. PRISM-MFI (Performance of Routine Information System Management-Model For Improvement).

Source: Aqil, Lippeveld & HOzumi. 2009; Largely & Nolan Cited in (Lyndee Knox. 2015 (8):10. Approaches to qualith Improvement.

Figure 1.1: PRISM-MFI Theoretical Framework.

MFI shows that QI is a driving force behind the continuous use of information and, in turn, leads to greater data demand. However, MFI lacks the details of the inputs, TOB factors, required for RHIS and a description of the functions involved in the RHIS process. The researcher thus used an integrated PRISM-MFI theoretical framework to assess the quality of HMIS-generated data and the Technical Organisational Behavioural (TOB) factors associated with the data generation process and information use to strengthen the quality of immunisation services. Refer to Figure 1.1, Theoretical Framework, above.

MFI sets an aim, tests if a change is an improvement, and either adopts the idea when it results in improvement or introduces a new change idea if a change was not an improvement. These cycles tenaciously use HMIS-generated data, consequently contributing to the quality of data. Therefore, the TOB factors (input), RHIS process (data management process), data quality and information use (outputs), and immunisation service quality (outcome) are related in the logic model.

The integrated theoretical framework applied and guided the study, with the problem definition of poor data quality and inadequate use of information situated more in the PRISM part of the framework, while the MFI part links data quality to the effective use of information. A literature review was conducted in the light of RHIS processes, inputs, and outcomes. A mixed-methods approach was used to better explore the behavioural factors underlying RHIS input. Overall, the data collection, analysis, interpretation, and conclusion, as well as the development of guidelines, were structured around the data process, TOB factors, and information use for immunisation quality improvement within the confines of the integrated theoretical framework. A systematic review by Adom, Hussain and Agyem (2018:2) avers that the theoretical framework should guide and resonate with every aspect of the research process, from the definition of the problem, the literature survey, the methodology, the presentation and discussion of the findings, to the conclusions drawn.

1.9.3 Research Methodology

The researcher employed Mixed-methods (MM) research. The mixed-methods approach included mixed questions about data quality and the complexities of TOB factors in HMIS data generation and information use. It also explored the experiences of health professionals in using information to improve immunisation quality. The mixed-methods approach provided opportunities to substantiate and verify data, thereby enhancing the trustworthiness and validity of the results (Polit & Beck 2017:836).

The Mixed-Methods design may help avoid the limitations of a single approach. Furthermore, it offers alternatives to a detailed understanding of the data, more in-depth probing of quantitative results, and explanations of difficult-to-interpret quantitative results (Polit & Beck 2017:812).

The MM research was the best for this study because it enabled the explanation of findings on the influence of TOB factors on the HMIS data management process and information use. It enabled the researcher to clarify the views and experiences of data generation, information use, and quality improvement.

1.9.4 Research Design

An explanatory sequential mixed-methods research design is applied in this study. This design was selected to lucidly explain the first quantitative phase result with the follow-up qualitative result. It was applied to unfold the depth of how quantitatively significant findings contribute to persistent use of information, alongside qualitative findings. Factors in TOB, data management, information use, and quality improvement are further explained through experiences in managing immunisation services. Following an explanatory sequential design, the researcher began data collection with the quantitative phase, analysed the data, and subsequently used the qualitative phase to explain and elaborate on the quantitative findings in greater depth (Subedi 2016:3).

The study has four phases: Phase I: Quantitative; Phase II: Qualitative; Phase III: Integration (quantitative and qualitative); and Phase IV: Development of guidelines. The following Table 1.1 depicts the phases of the study and the steps executed in each phase, and Table 1.2 provides a summary of the methodology for the study phases.

Table 1.1: Phases of the study

Phase	Steps
Phase I	Quantitative data were gathered using a self-administered questionnaire. The quantitative phase of the study was conducted to determine the degree of information use in managing immunisation services. It also Assesed data management processes and determined data quality at a particular point in time. Additionally, the study identified and analysed the influence of Technical, Organisational, and Behavioural (TOB) factors on the data management process and information use.
Phase II	Focus group interviews using an interview guide. Qualitative data were collected using a focus group discussion guide. This phase explored the experiences of health professionals and information workers regarding the use of HMIS to strengthen immunisation quality.
Phase III	The quantitative and qualitative data analysis results were integrated. Initially, the quantitative data were examined separately to identify the status of HMIS data management processes, data quality, information use, and the factors influencing the process and information use. The qualitative results were used to check the validity of quantitative data, providing a more in-depth explanation of quantitative results in the occurrence of extreme and outlier cases, unanticipated, insignificant and significant results, and significant predictors (Polit & Beck 2017:822; Creswell & Creswell 2018:288)
Phase IV: Guidelines development	A guideline of three interrelated sections was developed: (1) data quality assessment and improvement strategy guideline, (2) Information use guideline and (3) immunisation service quality improvement guideline. The activities, processes, and procedures required for each guideline were detailed. To validate the draft guideline, it was shared with experts, decision-makers, and frontline health workers.

Table 1.2: Methodology of the phases

Phase I, Quantitative component:	**Phase II, Qualitative component**:
Phase 1: Study (target) population: 1077. It comprises health professionals and health information workers. Health professionals are immunisation service providers at health facilities, and immunisation service managers at health offices. Health information workers are those	Study population (target population): The target population was purposively selected participants who had worked for at least 2 years in their current position as health professionals: either as service providers, health facility managers, or health information technicians. Nine focus group

who produce health data and information at health facilities and offices for at least 1 year. The average distribution of this target population is 9 per health centre, 16 per hospital, 9 per sub-city health office, and 9 per regional health office. Multistage (cluster) and stratified sampling with probability proportion to size (PPS) was used. Firstly, randomly selected Addis Ababa city was divided into clusters; then, five sub-cities were selected at random. Secondly, 39 centres (7-8 per sub-city health office) and three hospitals were randomly selected. The sample size decision was based on the single-population proportion formula, as shown below. Sample size: a computed sample size of 422. Used the single population proportion formula below. Accordingly **Inclusion criteria**: At the health facility level. Immunization service provider. Quality improvement focal person. Planning focal person. CDC and MCH heads. Head/Director of health facilities. At the health office level. Immunization officer. Quality improvement officer. CDC and MCH heads. Plan and program head. Head/director of the office. **Exclusion criteria**: Those health professionals and health information workers who do not serve at the above-specified levels and have less than the specified years of service in their current role were excluded. Additionally, those who were absent during data collection were excluded.	discussions (3 from each category) were conducted. In turn, 8-11 participants were enrolled in each focus group discussion. The FGs were conducted at the centre health facilities of the selected sub-cities. The participants included the senior-most immunisation provider, QI focal person, HMIS/HIT worker, and a director who had served at least 2 years in their current position. **Inclusion criteria**: At the health facility level: the senior-most: Immunization service provider. QI focal person. HMIS/HIT worker. Director of the health facility. **Exclusion criteria**: Those without the specified service year and engagement in the specified functions were excluded.

1.10 SCOPE OF THE STUDY

This study focuses on the extent of use of HMIS for quality improvement. It explores the perceptions and attitudes of health staff towards data quality, its contribution to information use, and the quality of care, with a focus on immunisation service quality. The information gained from the study may enrich the body of knowledge on using information to strengthen the quality of immunisation services. The study's findings would help policymakers consider, in their decision-making, how to improve the use of information in healthcare services. The guidelines prepared for the study are intended to empower professionals to use routine health information to improve the quality of immunisation services.

The structure of the thesis, organised in eight chapters, is illustrated in Table 1.3.

Table 1.3: Layout of the thesis

Chapter 1	The study's orientation includes a brief background in three sections: information use, data quality, and health service quality improvement.
Chapter 2	Literature Review: This involves using reference materials to base the study on existing knowledge of the study subjects. It exhaustively investigates research on data processing and quality, health information use, and service quality.
Chapter 3	Research Design and Method: This study employed an explanatory sequential mixed methods design. The quantitative (questionnaire) method is followed by the focus group discussion method. Chapter 3 thus presents the systematic execution of the study in four phases: quantitative, qualitative, integration, and guideline development.
Chapter 4	Analysis and presentation of Phase 1 findings: This chapter explains the whys and hows of quantitative data collection, analysis, and write-up. This chapter detailed the examination of the data management process and the determination of data quality at a point in time, along with the extent of information use in managing immunisation services.
Chapter 5	Analysis, Presentation of Phase 2 findings: This section involves the exploration of the experiences of health professionals and information workers on information use
Chapter 6	Integration of findings and development of guidelines. Separately analysed quantitative and qualitative findings are integrated in this chapter. The QUAN-qual data analysis was rigorously interpreted and used to infer the influence

	of factors on information use and quality improvement.
Chapter 7	Guideline development: three guidelines were developed: the data quality assessment and improvement guideline, the information use guideline, and the immunisation service quality improvement guidelines.
Chapter 8	Conclusions and recommendations: The study is summarised by a concise discussion of the information from the preceding six chapters. Recommendations about findings, interventions, limitations and future studies were provided at the end.

1.11 SUMMARY

This chapter provided an introduction to the study topic and a review of pertinent literature. The introduction section of this chapter presented HMIS as a tool for assessing the quality of immunisation services, along with the relevant contextual information. The problem statement narrated the scope of the problem, triangulating with related study results in the area. The purpose, question, and objective of the study are described. This chapter also provided definitions of key terms, outlines the theoretical framework, and presents the rationale in alignment with the study's scope and the chosen research procedures.

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

A literature review is a process of searching, reading, and investigative understanding of existing knowledge and knowledge gaps, thus providing an examined space to position one's scholarly contribution within a large body of knowledge. It is a write-up summarising evaluated works, either in support of or in refutation of, and it demonstrates the rationale for undertaking the current study (Snyder 2019:9, 11).

During this literature review, the UNISA website, Google Scholar, and EBSCOhost databases, for instance, Academic Search Premier, Africa Wide Information, Education Source, Global Health, were visited to identify literature relevant to HMIS and quality-of-care improvement. The researcher subscribed to the UNISA library website during enrolment as a thesis student. Subscription to the library guide platform on the website and how to use its various sources were covered in the project proposal development phase. The training was conducted by librarians from the University of South Africa. Moreover, research books on the lending service were accessed from the UNISA Learning Centre library in Addis Ababa, Ethiopia.

This chapter discusses what leaders in the field say about health data management, the use of Health Management Information System (HMIS) information, healthcare (immunisation) service Quality Improvement, and the contributions of each to the other. Health information, health service efficiency, and healthcare Quality Improvement are intertwined. The role of Quality Improvement efforts in improving information use and, thereby, service coverage is understudied, which underlies the rationale of this study.

In this literature review, section two focuses on the health information system (HIS) as a building block of the health system, with emphasis on its information use component. The following section provides details on the Health Management Information System (HMIS)

currently under investigation. This section also compares HIS and its components: the Routine Health Information System (RHIS), the HMIS, and the HIS.

The following sections describe aims, problems, determinants of data quality and information utilisation, and improvement plans. This is followed by the utilisation of HMIS information for healthcare quality improvement. The RHIS performance in healthcare (immunisation) services, the quality of these services, and the contribution of Quality improvement to healthcare organisational effectiveness and efficiency are detailed.

The utilisation of HMIS information specifically for immunisation service quality improvement is explained in section eight. The last section describes building the capacity of healthcare (immunisation) service providers, producing quality data, and continuously using information to improve the quality of immunisation services.

2.2 HEALTH INFORMATION SYSTEM (HIS)

An information system is a structure with a set of components dedicated to the collection of data (input), processing, storage, and retrieval of information (output) for dissemination and use to meet organisational objectives, with a mechanism for feedback. The primary goal of an information system is to use information to solve problems and improve access to and the delivery of quality products or services. Nevertheless, if information is not effectively utilised, the system's foremost goal is lost. Information use thus requires building an organisational culture of information over time (Prasetya 2017:57; Hailu 2017:15; Lippeveld 2017:1, 3; Karuri, Waiganjo, Orwa & Manya 2014:20).

The information system for health (HIS) is, hence, a system designed for the collection, processing (collation & analysis), use, and dissemination of health-related information. HIS is the most important of the six building blocks of the health system, as it produces high-quality data to inform decision-making across the five counterpart building blocks. It makes all levels of the health system organisationally effective and efficient, enabling better management, thereby achieving improved health outcomes through the use of necessary in-

formation (Nutley, Gnassou, Traore, Bosso & Mullen 2014:2; Dagnew et al. 2018:2). However, unreliable data quality and limited use of information within the health system components, especially for quality of healthcare, are unresolved challenges of the system (Gebretsadik, Belachew, Gebrekidan, Bayray, Lemlem, Dangew & Abebe 2025:1).

The primary source of HIS information is RHIS, yet the RHISs in many countries, particularly in low- and middle-income countries, do not work well. The data produced at the front lines of the health system are often stored in reports and on shelves and are not sufficiently utilised to improve healthcare. Poor data quality, inadequate skills, and a lack of organisational encouragement of information use limit the effective use of RHISs (Leon, Balakrishna, Hohlfeld, Odendaal, Schmidt, Zweigenthal, Watkins & Daniels 2020:19; Shiferaw, Zegeye, Assefa & Yenit 2017:2).

Effectiveness and efficiency in HIS and health systems are interdependent: an effective health system is built on a well-functioning HIS that produces quality health data; ensures analysis, dissemination and use of information for optimal healthcare delivery and decision-making, in turn, the successful functions of HIS depends on consistency and integrity of supplies and processes, signifies an RHIS interaction with people, process and technology to inform improving quality of healthcare (Yazdi-Feyzabadi, Emami & Mehrolhassani 2015:8; Mengistu, Taye, Ayele, Habtamu & Biruk 2021:1).

As the information system encompasses input, process, and output, the literature suggests tools to evaluate the HIS: address the resources dedicated (inputs), the work methods applied and the yields (processes and outputs), and the results in terms of data availability, quality, and use (output). The HIS processes of data collection, collation, analysis, and reporting in most LMICs are burdened by inadequate human resources and capacity to manage the tasks and the technology. Compounding the problem, there are persistent excessive and uncoordinated reporting requirements and a lack of ownership at the lower level (Karuri et al. 2014:4, 6).

Studies indicate interventions such as HMIS training on data analysis skills, standard indicator, good governance, regular supervision and feedback, and favourable attitude are factors related to RHIS utilization among health workers at public health facilities (Dagnew et al. 2018:7; Shiferaw et al. 2017:1). But current studies disclose that each of the trainings endeavours emphasize principally on conveying data analysis skills, and undermine enhancing essential knowledge and skills on improving data quality and information use through data management cycle (Kumar, Gotz, Nutley & Smith 2018:7).

However, effective use of information for decision-making and the production of quality data are the RHIS performance indicators. In addition, use of information for communication is the key among the four HIS functions (processes), the other three being data collection, compilation, analysis/synthesis (Blessing, Davé & Varnai 2017:14). In contrast, data collection, compilation, analysis, display and feedback, data transmission and data quality check are RHIS processes (Belay, Azim & Kassahun 2013:7).

On the other hand, the quality of data is a key factor in producing reliable health information for clinical and managerial decisions of the health system to be based on quality information (FMOH-E Information Revolution Roadmap 2016:9; Dagnew et al. 2018:2). However, a study in eastern and southern African countries indicates commonly persisted data quality issues shown by lack of consistency, and over-reported programmatic data: antenatal care services (Maïga, Jiwani, Mutua, Porth, Taylor, Asiki et al. 2019:5).

Inadequate coordination and hybrid reporting worsen data quality and information utilisation: Kebede, Adeba & Chego (2020:1, 3) report that poor coordination of HMIS at PHC units impedes the generation of timely, relevant data. A study in Nigeria by Prasetya (2017:7) identifies incomplete and inaccurate data in both paper summaries and electronic databases from the facilities. A similar study in Ethiopia reveals that the hybrid use of paper forms and computer-based recording/aggregate reporting from health centres to the district health office, in hard copies and using DHIS2, affects the utilisation of health information (Mengistu et al. 2021:9; Kefiyalew, Abay, Mamo, Abate, Chanyalew, Ayalew, Necho, Mekonnen, Teklu, Shababuddin & Tilahun 2021:6).

A high-quality HIS in primary healthcare requires multilayered interventions, such as establishing an organisational culture of information use in decision-making, eliminating infrastructural barriers, appointing qualified staff, and investing more in service delivery in urban areas. In addition, systematic assessment and reporting of data quality issues are among the critical interventions to improve the quality of health statistics generated from facility data (Yazdi-Feyzabadi et al. 2015:1; Maïga et al. 2019:7).

Quality of HMIS data is affected by financial, socio-political and HIS design related factors, more importantly HIS design barriers can significantly reduce data quality and limit ability in LMICs to use HIS data to inform healthcare decision (Kumar et al. 2018:2). The lack of trust in quality of data limits data use; yet literature emphasizes using available HIS information rather than waiting for it to become of 'good' quality, as data use and feedback process enhance this quality (Lemma, Persson, Janson, Wickremasinghe & Källestål 2020:2; Karuri et al. 2014:7).

2.3 HEALTH MANAGEMENT INFORMATION SYSTEM (HMIS)

The terms HMIS and RHIS are used interchangeably (Tull 2018:4), while each differs in the scope of information they provide under HIS. Kumar et al. (2018:3) cite the interchangeable use of HIS, RHIS, HMIS, Routine HMIS, and district HMIS in the same publication. HMIS, as its name suggests, provides information support to managerial functions across health institutions. The RHIS, a subcomponent of HIS, refers to routinely collected data at health facilities. The HIS is interpreted as an umbrella term with greater impact on nationally determined health decisions (Abera, Kidist, Letta & Tsegaw 2016:3).

HMIS is a component of HIS or a sub-system of a national HIS, and RHIS is a further subsystem (Chanyalew, Yitayal, Atnafu & Tilahun 2021:3; Prasetya 2017:10). The RHIS includes the system, activities and service user data to support short-term management, service planning and resource mobilisation (Mayston, Ebhohimen & Jacob 2020:2). Thus, the HIS continuum moves from broader to narrower in the system, which can be seen as HIS, HMIS and RHIS.

The HMIS has two complementing data sources, RHIS and Non-RHIS, the RHIS that regularly collects routine health information from public and private health institutions, and community health posts for information needs at predictable intervals, and the Non-RHIS, which serves ad hoc needs of HMIS information from sources such as Census, Demographic Health Survey (DHS) (Prasetya 2017:1, 3, 10).

HMIS responds to both routine health service and emergency response information needs: Arsenault, Yakob, Kassa, Dinsa and Verguet (2021:7) cite HMIS use for policy-making, program action, and research, and for setting program targets and improving healthcare management decisions across levels of the health system. It is so vital in preventing and curing diseases, improving patient safety, health outcomes, and quality of life, and reducing healthcare spending. Its RHIS component also tracks trends in service utilisation during crises, such as the Ebola epidemic and, more recently, the COVID-19 pandemic (Amouzou, Faye, Wyss & Boerma 2021:1; Lingamallu & Nayakvadi 2017:2; Leon et al. 2015:16).

The immunisation service is one of the important public health programs and relies extensively on facility-based coverage statistics for country- and global-level monitoring. Studies stress the quality of immunisation data at health facilities, but these data are often compromised by underreporting and overreporting (Ziema & Asem 2020:6).

Low data quality persists so long as lower levels of the health system report HMIS-collected data that is used minimally for service improvement. In contrast, the higher (conceptual) level concerns itself with transforming the data into information; analysing and providing feedback to the reporting level; and converting it into knowledge for decision-making (Muhindo, Joloba & Nakanjako 2016:3). However, the lower-level role should not be limited to data collection, neglecting the vital aspect of HMIS, utilisation of information for action at all levels to build information use culture and matching capacity at the lower level to process and utilise data (Endriyas et al. 2019:2, 5).

Interventions and sustained implementation of QI and new electronic data systems, for instance DHIS2, with motivation, training and support for managers to use the data for ser-

vice improvements better, might result in effective use of RHIS (Leon et al. 2015:1). Studies indicate a positive attitude of staff towards digitised e-health systems. The DHIS2 has the potential to improve reporting timelines and completeness over time. It has online and offline data entry options, quality checks and feedback loops, and it also has dashboard use at all levels (Begum et al. 2020:10).

2.3.1 The District Health Information System 2 (DHIS2)

The DHIS2 is a web-based Health Information System used in over 60 countries, including most Low- and Middle-Income Countries (LMICs), to collect, collate, analyse, report, store, and manage health data. The platform has a flexible interface for data management, with built-in data validation, visualisation, and analysis tools for users at all levels, and better data quality control measures (Bhattacharya, Umar, Audu, Felix, Allen & Schellenberg 2019:2; Begum et al. 2020:10). The DHIS2 implementation is believed to bridge gaps in data quality, resulting from recent efforts to strengthen health facility and community health information systems, which focus on digitisation, data quality, data analysis, and problem identification. The DHIS2 platform provides a dashboard for monitoring and evaluation of health programs at all levels; its tables and graphs assist in visually tracking data, then analysing and displaying key indicators of program performance and the quality of health delivery (Lippeveld 2017:2; Begum et al. 2020:6, 10).

Nevertheless, studies in most African and other LMICs demonstrate that the availability of an electronic HIS does not ensure data utilisation for decision-making. In addition, related studies reveal mixed results of data quality following digitisation (The Maternal and Child Survival Program [MCSP] Uganda 2016:19). Balakrishna et al. (2020:34-35) mention challenges in the implementation of the WHO-recommended digital information system for health system strengthening. The recommendation emphasises the importance of enabling the organisational environment and adapting interventions to local settings.

The use of e-HMIS in the healthcare setting facilitates access to information and improves the quality and efficiency of healthcare (Abdikadirova, Chukmaiitov, Yermukhanova, Kali-

yeva-Karabalina, Ktabalieva, Taushanova, & Turdalina 2018:1, 5, 12). A study, in opposition to this, shows that following DHIS2 deployment in Ghana, data quality has improved, but 93% health facilities that entered their data into the platform have not used it for decision-making, efforts skew towards data quality checks with less focus on examining findings and taking corrective actions to improve health service delivery (Odei-Lartey, Prah, Anane, Danwonno, Gyaase & Oppong 2020:12).

Evidence from Uganda and Kenya shows that DHIS2 implementation has improved data quality and coverage of immunisation, antenatal care, and delivery services, and a study in Sri Lanka states that DHIS2 data use for MNCH has improved the quality of care (Begum et al. 2020:1-2).

However, in general, DHIS2 does not demonstrate high data quality: the absence of DHIS2 use guidelines, the need for frequent training at sub-district and community levels, and limited internet access were challenges (Blessing et al. 2017:9; Odei-Lartey et al. 2020:13; Balakrishna et al. 2020:37).

Assessments of DHIS2's role in data quality yield conflicting findings: a study in Uganda reports improved data completeness from 36% to 86% over a year (MCSP 2016:19, 20). However, a study in Nigeria finds that facility-reported data in DHIS2 were incomplete at least 40% of the time and underreported 10%-60% of the events recorded in facility registers. A study in Tanzania reveals that DHIS2 at the district level does not reflect what exists at the facility level; thus, it recommends continuous data quality audits and innovative strategies for data management processes, indicator types, and human resource problems (Rumisha, Lyimo, Mremi, Tungu, Mwingira, Mbata, Malekia, Joachim & Mboera 2020:20).

In South Africa, 16 years following the implementation of DHIS2, from the major source of primary healthcare data, the information has not been sufficiently utilised to effectually inform policies and service delivery, leaving data producers with the perception that data collection is only for reporting purposes (Nicol, Bradshaw, Uwimana-Nicol & Dudley 2017:2, 5; Kebede et al. 2020:2, 7).

DHIS2 did not regularly meet the defined data quality standard. Optimising its high potential requires coordinated action to enhance data reporting and data flow, routinise data quality reviews, provide supervision and feedback, and ensure regular maintenance. Moreover, measuring achievement towards the SDGs using the platform requires data to be standardised, accessible, and transparent (Bhattacharya et al. 2019:13; Farnham, Utzinger, Kulinkina & Winckler 2020:69).

Studies in Ethiopia indicate challenges with e-HMIS (DHIS2) functionalities and possible interventions: Asemahagn (2018:7) cites 87.4% of health facilities adopting e-HMIS, but only a 58.7% functionality rate, mainly due to the absence of certified staff and training, system failures, skill gaps, computer problems, and power interruptions. A study by Gebreslassie, Below, Ashebir, Gezae, and Chekole (2020:4) on DHIS2 implementation found low data quality and limited use of data for decision-making. A study recommends supervision, training and motivation to achieve the expected utilisation rate of DHIS2 (Kanfe, Mengiste, Tilahun & Ahmed 2020:5, 15).

Computerised (web-based) information systems have the potential to significantly reduce the data collection burden via automated data aggregation, reporting, and real-time data access; however, studies indicate that this potential has not yet been realised. The electronic information system in place lacks integration and reliability, resulting in a burden of dual reporting as data are captured in both paper and electronic systems (Ledikwe et al. 2014:7). Achieving the potential of e-HMIS (DHIS2) requires strong government commitment; extensive donor support; and a favourable staff attitude towards technology, by ensuring the availability of user guides, standard operating procedures, and data dictionaries at all levels. Thus, future RHIS interventions should not only emphasise technological solutions but also target manifold factors to strengthen data quality and information use (Begum et al. 2020:10; Lemma et al. 2020:12).

2.3.2 Determinants of RHIS performance

Quality data production and persistent use of data/information for decision-making define performance of RHIS (Lemma et al. 2020:2). The RHIS performance is affected by the RHIS processes that encompass data collection, data quality check, data transmission, data processing, data analysis, data displays and feedback; which in turn are affected by TOB determinants of data quality and continuous use of information (Belay et al 2013:5, 7).

At technically inadequate knowledge, skill and specialized technical infrastructure can hamper the collection and use of high-quality data; while behaviourally reduced demand for RHIS data, lack of motivation and competency among health workers can impend its use; and organisationally inadequate governance and management, lack of training, supervision, resources and failure to promote information use culture affect data demand and use (Hoxha, Hung, Irwin & Grépin 2020:2, 3, 6).

The Technical, Organizational and Behavioural factors determine the data process, output and outcome (MEASURE Evaluation 2018:2). An effective persistent use of information requires response to information needs of decision makers (technical), intervention on TOB factors [such as] existence of specific policy aimed at improving the use and comprehensive guidance to improve data demand and use (organisational and behavioural) (Nutley & Reynolds 2013:3).

However, the challenges identified by the studies differ from those most targeted by the intervention. Organisational challenges are frequently cited as hurdles to data use, whereas technical challenges are most often addressed through strategies. Lack of motivation (behavioural) to use RHIS may relate to inadequate supervision and feedback (organisational), and RHIS performance assessment tools (technical) per se emphasise a system-based (organisational) approach for sustaining improvement in RHIS data use (Hoxha et al. 2020).

Thus, the connection among TOB determinants of RHIS data use necessitates combined comprehensive strategies to understand and address challenges for successful data quality and information use (Hoxha et al. 2020:11). A study in support of this emphasises addressing socio-political factors that often interrupt RHIS functioning; motivating staff who maintain RHIS data systems and data quality; improving coordination and transparency among stakeholders to streamline RHIS data process; and promoting sustained data quality assessment and use (Muhoza, Saleem, Faye, Gaye, Tine, Diaw, Gueye, Kante, Ruff & Marx 2021:1, 13).

2.3.2.1 Technical determinants of RHIS performance

Technical determinants of data quality include the complexities of reporting forms, procedure manuals, indicator definitions, HIS design, and information technology (IT) software. Thus, to use and improve data quality, the HIS (system) design must take user needs into account. User-responsive information system design demands knowledge of the information needed for managerial decisions and familiarity with available indicators, monitoring, and evaluation requirements (MEASURE Evaluation 2018:2, 14; Blessing et al. 2017:15)

Poor system design hampers data quality, yet the recent HIS efforts neglect skills in system design, such as requirements gathering, use-centred design, and usability evaluation. System design integration into system strengthening has the potential to overcome system design barriers and data quality issues, and to aid RHIS data use in informing healthcare decisions. In line with this system design, the overall design should address components such as indicator definition, data collection and aggregation, reporting tools and modules, user interface and behaviour, and the data required to meet the health system's information needs (Kumar et al. 2018:2, 5, 7).

Studies conclude that a better understanding of indicators improves information use. If the indicator is not understandable or relevant, the data collection forms will be difficult to complete, and it will reduce staff motivation to own and operate them. If computer software is

not user-friendly, it can affect the confidence and motivation of RHIS implementors. If software does not process data properly, data analysis fails to yield meaningful conclusions for timely decision-making (Aqil et al. 2009:6; FMOH-E Information Revolution Roadmap 2016:10).

The majority of technical issues occur across data collection, data transmission, data processing/analysis, and the dissemination of processed information. The issues are mostly related to limitations in data collection forms, which hinder the collection of high-quality data. Forms usually lack case definition and/or miss case identification (e.g., the patient's sex) and are not updated to include emerging diseases (Hoxha et al. 2020:5-6).

In general, barriers to system design, such as poor HIS architecture and usability, lack of policies and incentives for data use, inadequate human skills and data security, limit user engagement, data sharing, and use, and contribute to HIS failure. Studies on HIS argue that users make data usable: use available data in a standardised format, identify problems and opportunities, and address data quality issues. This eventually addresses the problem of healthcare quality, which the technical determinant analysis has not yet exhaustively explored (Leon et al. 2015:6).

Most policy makers do not understand the value-adding role of M&E tools in guiding future policy and programs (Muhindo et al. 2016:2). As end users, policy makers need to improve their use of health information in policy development; therefore, information needs to be effectively packaged and communicated. Packaging includes synthesis, visualisation, and policy briefs; in addition, modelling and simulation methods can be used to explore the behaviour and performance of processes and interventions (Blessing et al. 2017:4).

Information use of policy makers can be supported by four categories of knowledge translation mechanisms and tools: packaging tools, e.g. synthesis and visualisation; application tools, e.g. modelling and simulation; dissemination and communication, e.g. electronic, automated, and person-to-person methods; and linkage and exchange tools, e.g. knowledge platforms and brokering (Blessing et al. 2017:9, 20).

2.3.2.2 Organisational determinants of RHIS performance

The information culture, structure, roles and responsibilities, accountability, resources, training, supervision, and information dissemination represent organisational determinants of data quality and information use. Organisational information culture includes norms, values, attitudes, beliefs, and commitment, linked to strong leadership and the regular utilisation of information in decision-making at stages of the health system (MEASURE Evaluation 2018:2, 20). Accountability (obligation) means ensuring a task is done satisfactorily: checking the quality of and using data; and responsibility (duty) to satisfactorily perform a task: quality-checked data is used (McGrath & Whitty 2018:1).

Inadequate use of information is rooted in organisational issues: lack of culture, trust in the data and inability of facility and program managers to analyse, interpret and use information (Nicol et al. 2017:1). Building an information culture by creating new perceptions, values, attitudes, and skills requires sustained behavioural change intervention at individual and organisational levels. It also requires sustained promotion of a culture of data quality assessment and its use. More importantly, it needs improved coordination between stakeholders to streamline the RHIS data process and enhance transparency (MEASURE Evaluation 2018:2).

Poor culture of data use results from inadequate engagement of health professionals. Staff data use behaviour improvement requires the creation of staff accountability through training, supervision and feedback for organisational and stakeholders' priorities (Bruce 2014:8). Data use culture promotes stakeholders' participation in the processes of data analysis, review, interpretation and use to generate quality information (Kebede et al. 2020:1-2; Gashu, Teklu, Mancuso, Tazebew, Endehabtu, Mekkonen & Tilahun 2019:2, 3).

A continuous data quality assessment, promoting HMIS data use for Quality Improvement (QI) in healthcare delivery at the health facility level, and training to address identified gaps, could help improve HMIS data use in program evaluation. Quality improvement in healthcare contributes to continuous learning and, hence, to a culture of information use

and organisational success (Nshimyiryo, Kirk, Sauer, Ntawuyirusha, Muhire, Sayinzoga & Hedt-Gauthier et al. 2020:4).

HMIS data can be used as organisational development tools, if data is converted and or used to service delivery improvement and staff find it to learn from in improving performance of their organisation (Muhindo et al. 2016:4). On the other side, innovative use of data would be hindered if organisational structure built on hierarchical reporting prioritises reporting compliance over analysis. Similarly, a centralised health system and a rule-based management style undermine district managers' ability to lead decision-making (Shiferaw et al. 2017:2; Evaluation 2018:16-18).

Though studies show sufficient evidence of success when data collection designs involve local stakeholders, there is insufficient decentralisation to facilitate local data-driven decision-making. The data collection tool is designed centrally by experts and pushed down to implementers, with little or no orientation to local circumstances in most LMICs. Moreover, centrally valued information attracts attention and funding, leaving minimal support for local information at the central level. Nevertheless, information is valued, generated, and used locally and is influenced by modes of local governance rather than by central-level influences (Scott & Gilson 2017:11).

All-inclusive training, enablement, and organisational support are essential to raise the level of routine information use and build self-efficacy and decision-making capacity among frontline health workers, or else data remain under-analysed and underutilised for policy and program improvement (Mekuria 2021:2).

When senior managers of organisations exert pressure on district health managers and care providers to reach unrealistic service delivery targets, this can lead to false reporting and the denial of existing service delivery problems. Unrealistic target setting encourages shortcuts (false reporting) and results in the delivery of poor (not evidence-based) service (Lippeveld 2017:2; Higgins, Schottenfeld & Crosson 2015:8). Lack of strategic institutional connections between performance data, planning and resource (budget) allocation pro-

cesses results in data use being overlooked in favour of such organisational constraints (MEASURE Evaluation 2018:16).

Inadequate management is characterised by a lack of a responsible unit, accountability, motivation, and performance incentives. It results in a lack of community engagement, continuous training, consistent supportive supervision, and feedback. In addition to these, incompatibility of HIS with the current work process affects desired behaviour and results in minimal use of HMIS data (Akachi & Kruk 2017:1; Shiferaw et al. 2017:7; Gashu et al. 2019:2).

Similarly, resource limitations such as a lack of HMIS materials and funding for IT, deficient organisational culture and vision, poor leadership, inadequate end-user engagement, and unrealistic timelines hinder the successful use of HIS information (Akachi & Kruk 2017:1; Hailu 2017:2; Sligo et al. 2017:3).

A data-use culture enhances the establishment of trusted partnerships, thereby increasing the prospects for reliable health information and its use (Blessing et al. 2017:11). Nutley et al. (2014:3) state that there is no single sufficient activity to achieve lasting improvements in data use. Data-driven QI interventions combined with organisational development will lead to data ownership and information use, and create and sustain demand for the timely collection of reliable data. Integration of interventions targeting both behavioural and technical factors strengthened data quality and use (Wagenaar, Hirschhorn, Henley, Gremu, Sindano, Chilengi, et al. 2017:2; Lemma et al. 2020:2).

The challenges facing HMIS are not inadequate resources, as many claim, but the system's failure to use the available data. A study argues that, in general, there are inadequate organisational incentives for the analysis and use of data and few penalties for not doing so (MEASURE Evaluation 2018:16; Muhindo et al. 2016:7). If all those who have a stake in the health system levels use and evaluate the data, data quality might improve (Teklu et al. 2018:3).

2.3.2.3 Behavioural determinants of RHIS performance

The data demand, data quality check skill, problem solving for HIS tasks, competence and confidence levels for HIS tasks, perception and motivation of people who collect and use data are behavioural determinants of data quality and information use (MEASURE Evaluation 2018:2). A study comment on that important interventions to add value and persistent motivation of information users are omitted under Behavioral determinants (Dufera, Lamenew, Demissie & Guda 2018:2).

Studies show that skills in data use as a core competency are often deprioritised compared to capacity-building initiatives that focus more on data management, verification, and validation. Motivations are usually focused on data collection, data quality, or reporting to demonstrate compliance rather than using data for program management (MEASURE Evaluation 2018:7, 14-17; Dufera et al. 2018:2). There are limited personnel with data analysis and presentation skills at the frontline, where both service delivery and data-related tasks are demanded. Health workers in LMICs are also less motivated to use health information at their work units (MEASURE Evaluation 2018:7, 23; Kebede et al. 2020:2).

The health workers' data-use behaviour is linked to perceptions of data quality. This perception determines whether stakeholders are likely to use HMIS data or not (MEASURE Evaluation 2018:11). Often HMIS produced data is perceived as of poor quality and is not effectively used for decision-making in LMICs, hence HMIS falls in to vicious trap of poor data quality and poor information use, an information not used means quality of data never improves just as information of low quality data will never be utilized (Dufera et al. 2018:1; Ouedraogo, Kurji, Abebe, Labonté, Morankar & Bedru 2019:2, 7; Prasetya 2017:15).

Inadequate competence in HIS tasks, a dysfunctional Performance Monitoring Team, and a lack of regular supervision and feedback were also commonly reported reasons for poor data quality (Haftu, Taye, Ayele, Habtamu & Biruk 2021:5). Frontline health staff believe that data analysis and interpretation responsibilities fall to the central level, where decision-making occurs. Subsequently, they perceive health workers as care providers rather than

as responsible for recording the care they provide to patients and for registering their work (Muhindo et al. 2016:4; Ledikwe et al. 2014:7).

On the other hand, a study in Ethiopia found that staff motivation, performance monitoring, and decisions based on superior directives were determinants of HMIS data utilisation (Yarinbab & Assefa 2018:1, 5). If data is not converted into information and information is not used by policy makers, planners and healthcare managers, the motivation to collect quality data wanes (Innocent, Onzima, Katongole & Govule 2016 :3). A study by (Alhassan et al. 2013:1) hypothesises that the extent of health workers' motivation is associated with the level of PHC efforts to quality improvement and recommends comprehensive staff motivation to QI and data quality.

Balakrishnan (2020:36) recommends, thus, future research questions should, among others consider technical, organisational and behavioural determinants: purpose and value of routine health information; factors affecting staff and managers' views of and engagement with routine data; motivators or de-motivators of routine data use; level of capacity (health information literacy) to analyse, synthesis and interpret, and influence their use of data.

2.3.3 Principles of Health Management Information System

HMIS encompasses two main sets of principles: Standardisation, Integration, and Simplification (SIS); and Flexibility, Innovation, Institutionalisation, and Sustainability **(**FIIS**)**. The SIS principle fits under technical determinants of RHIS, principle, it is informed by the FIIS principle, goes with organisational determinants, to accommodate HMIS development (FMOH-E HMIS and M&E strategic plan 2008:28; Muhindo et al. 2016:3).

2.3.3.1 Standardisation, Integration and Simplification (SIS)

Standardisation refers to the use of common (agreed-upon) definitions for indicators, data items, data sets, procedures, and data sources. The RHIS has many subsystems, for example, the Human Resource Information System (HRIS), the Financial Management Infor-

mation System (FMIS), which function unintegrated and unstandardized (Tamfon, Ndongo, Bataliack, Ngoufack & Nguefack-Tsague 2020:2). A recent study in Ethiopia cites the presence of vertical reporting as one of the hindrances to immunisation data quality, indicating 43% of health facilities did not have a standardised immunisation registration book, while another 50% did not use the standardised tally sheets (Kefiyalew et al. 2021:7).

Studies mention provision of standard reporting format that goes with manuals, training and supervision of staffs who collect, analyse, report and disseminate data may improve quality of data (Kagoya & Kibuule 2018:2). Standardization contributes to improve quality of data and informs rationalization of data collection, harmonization and dissemination of information system content leading to flexible application (Huser, Bon & Anifalaje 2021:11). On the contrary, inappropriate or unstandardized data collection tools, procedures, poor recording and reporting, and errors in data management affect the quality of data (Yourkavitch, Prosnitz & Herrera 2019:1).

A study in Botswana indicates that standardising Monitoring and Evaluation (M&E) practices increases responsiveness to time-sensitive information. Moreover, increasing health service management attention to timely information is critical to sustaining improvements in health service delivery (Ledikwe et al. 2014:1).

Integration (harmonisation) refers to a single HMIS channel from which all consumers receive their own share of data. Integration enhances optimisation, facilitates automation, and supports the development of electronic (data management) software. Software development, such as the District Health Information System 2 (DHIS2), requires standardisation of formats and procedures (Huser et al. 2021:11). The Integration of data has the potential to enhance accessibility and utilisation of RHIS for M&E, planning, and Quality Improvement (Schmidt, Colvin, Hohlfeld & Leon 2018:1).

On the other hand, siloed data systems caused by donors' mandates, and the lack of integration of data from the recent developments of digital health interventions, are some of the factors that affect the quality of data (Farnham et al. 2020:2). Vertical systems supported by

donor challenge integration claim that integration compromises reporting timeliness and data quality. This renders the integration goal challenging and unachievable (Mndeme 2010:5). Vertical programs often build their own vertical reporting information systems, aside from the national HIS, which, over time, results in multiple, uncoordinated, and fragmented data collection systems, leading to poor data quality. Though there are some research studies on HIS in LMICs, only a few have critically analysed the issue of fragmentation after integration (Karuri et al. 2014:5; Mndeme 2010:2, 14).

Integrated HMIS reduces duplication of efforts and improves capacity and performance of primary healthcare units and coordination among all levels of the healthcare (Kebede et al. 2020:2). Successful integration reduces data burden without missing important data, it enables to address emerging information needs in reporting of Ministry of Health (MOH) and its partners (Muhindo et al. 2016:3). Moreover; a fruitful integration assisted by operationalized management functions: planning, organizing, leadership and monitoring and evaluation ensures accessibility, availability, security and quality of data (Kyalo & Odhiambo-Otieno 2019:1, 8, 10).

Mayston et al. (2020:1) recommend that, for HISs to fully realise their potential to drive healthcare improvement, future research should focus on integrating context into the design of information systems. This can be achieved by building multisectoral partnerships, ensuring that newly developed indicators are well aligned with service models, and using technology compatible with local infrastructure.

Simplification involves collecting, analysing, and interpreting information relevant only to performance improvement. HMIS is a shared resource; as such, a trusted partnership is critical to ensure shared interests and reduce data burden. Thereby, **simplify** data collection requirements to regularly used data elements whose quality can be assured by standard indicators (Muhindo et al. 2016:3). Simplification, therefore, leads to evidence-based information use at the lower level by relieving data burden on health workers at the service delivery point (Farnham et al. 2020:2).

In African studies, a considerable number of mandatory registers and forms are found to be completed daily, consuming up to 30% of health workers' time (Amouzou et al. 2021:2). However, quality improvement studies recommend five key directions for HMIS data: improving data quality, utilising improved data, refining measurement techniques, ceasing the collection of unused data, and connecting local initiatives with global discourse to drive local action (Abrampah et al. 2018:4).

Generally, existing literature defines standards as adaptive strategies for the development of an integrated HIS in LMICs (Poppe, Sæbø & Braa 2019:2). However, a study by Mndeme and Nyella (2010:2) reveals the 'cast in stone' rigidity of the national HIS, to the extent that it does not meet the data needs of vertical health programs. There is also bureaucracy in incorporating new program requirements into the existing system, as well as a multiplicity of data needs posed by donors.

2.3.3.2 Flexibility Institutionalisation, Innovation and Sustainability (FIIS)

Flexibility refers to the process of flexible recognition of institutionally required information in relation to operational data, data analysis, and the linkage of information to support decision-making (Abu-Nahel, Alagha, Al Shobaki, Abu-Naser & El Talla 2020:1, 5). Flexibility comprises use flexibility, the adaptability of standards across different contexts, and change flexibility, which is step-by-step modularisation rather than a once-and-complicated standard change. An adaptive standard contributes to the sustainability of HIS and enables the use of information (Poppe et al. 2019:2, 4).

Information flexibility is a choice in building information systems that respond to changing customer needs and adapt to multiple users and applications. Studies indicate that information flexibility increases service quality (Abu-Nahel et al. 2020:5). **Institutional will and ownership** maximise resource mobilisation for HMIS and M&E sustainability. In fact, it improves staying power, which is more consistent than sustainability. The key principles are country ownership, leadership, and commitment to transparency and accountability, followed by adaptability to the country's changing needs. A strong political will and ownership

among health managers in Pakistan have sustained HMIS after the end of major funding (Amouzou et al. 2021:2; Tull 2018:6).

Moreover, critical components of sustainability include institutional assumptions, values, and norms that regulate information user behaviour. Institutionalised leadership, thus, is a necessity to realise the goal of data utilisation, and strategies should be designed to utilise data generated at each level (Sahay, Nielsen & Aanestad 2019:4; Muhindo et al. 2016:6).

Innovation involves two fundamental factors: innovative leadership and collaboration with health workers. Utilising reliable evidence from routine health information over time is crucial to promote innovation, improve health outcomes, address disparities, and enhance efficiency (Mekuria 2021:1).

Studies indicate that decentralisation enhances innovation and the sharing of best practices through regular use of information, whereas centralisation and fragmentation result in poor data quality and low information use. Innovative leadership shares vision, authorises integration, addresses practical needs, establishes a process for implementation, and monitors the achievement of objectives with a sustainable commitment. (Lippeveld 2017:1; Tull 2018:10, 11).

Sustainability: building an information-use culture requires promoting values and beliefs among health staff to use information in their routine decision-making for sustainable HMIS implementation**.** Additionally, building adequate technical, managerial, and financial capacity within an institution ensures the continuity of a program after the exit of donor funds (Sriram 2018:2; Moucheraud, Schwitters, Boudreaux, Giles, Kilmarx, Ntolo, Bangani, St. Louis & Bossert 2017:1).

Sriram (2018:2) argues that the lack of a technical approach, in itself, would result in instability in the information system and emphasises that user needs, evaluation, feedback, and future improvements should receive extra attention. Information generation and knowledge sharing within the sustainability strategy framework lead to health system stability.

To the extent possible, HIS performance should be measured by user evaluations of the data quality it produces. Lack of technical resources, system maintenance (repair), shared goals, and stakeholder agreement pose many challenges to the sustainability of the electronic HMIS (Lingamallu & Nayakvadi 2017:2; Moucheraud et al. 2017:1).

2.3.3.3 Indicators (Measurement) in HMIS

An indicator is a single, often quantitative, summary measure representing a key dimension of health status (Hyppönen, Ronchi & Adler-Milstein 2016:2). Performance indicators are captured through robust HIS-RHIS and measure the provision of services, including the globally shared goal of health in sufficient quality. Accordingly, the WHO sets the key HIS purposes and contexts for indicators to attain health policy goals, for instance, the Universal Health Coverage (UHC) goal. As such, the HMIS (RHIS) indicators are linked to program objectives and measures and monitor program implementation, performance management, and quality improvement (Sahay et al. 2019:2; Shikuku, Muganda, Amunga, Obwanda, Muga, Matete & Kisia 2019:1).

In addition, indicators reflect priorities across spectrum of services: coverage indicators, for example immunization service coverage, and health system indicators such as workforce, health information and quality and safety of care (World Health Organization 2018:9). The Methodology of indicator involves standard definitions of context, goals for measurement, selection and categorization of indicators, and collection, analysis and getting feedback on data (Hyppönen et al. 2016:2, 4; Sahay et al. 2019:2; Shikuku et al. 2019:1).

Indicators are subsumed under technical determinants of RHIS performance and are based primarily on routinely collected data. Regular measurement of the indicators enhances data quality and minimises duplicative reporting requirements. Definitions of the indicators are revised flexibly to align with program objectives. The Ethiopian health sector HMIS reform set 108 indicators in 2008, 122 in 2014, and 131 in 2018 for sector-wide program performance tracking. The latter set has included quality and equity indicators (FMOH-E Indicators Reference Guide 2018:9, 11).

Ethiopia follows the WHO recommendations and immunisation schedule for developing countries. The routine immunisation service is provided to children under 1 year of age and to women aged 15-49 years. BCG and OPV0 are provided at birth; OPV1-3, Pentavalent1-3 and PCV1-3 are at 6, 10 and 14 weeks; Rota Virus1-2 are at 6 and 10 weeks; Inactivated Polio Virus (IPV) at 14 weeks; and Measles Containing Vaccine (MCV) at the ninth month of a child's life. For women, Tetanus Toxoid (TT1) at 15 years, then TT2 after 4 weeks, TT3 after 6 months, and TT4 and TT5 are given 1 year apart. Protection at Birth (PAB) during pregnancy. The Human Papilloma Virus (HPV1-2) is given at 6-month intervals at age 9 years (FMHO-E cYMP 2016-2020:21).

Thirteen (10%) of the 2018 HMIS indicators in Ethiopia are immunisation indicators: 10 for children, 2 for women's vaccinations, and 1 to monitor the wastage rate. The indicators are Pentavalent-1, Pentavalent-3; OPV-3, PCV-3, IPV; Rota-2; MCV-1, MCV-2, full immunization coverage, PAB, HPV-1, HPV-2, and vaccine wastage rate. The proportion of children covered with vaccines among surviving infants in the same year, and their receipt of all immunisation antigens at the right schedule, measures coverage and system performance (full immunisation). High coverage is also considered a proxy indicator of good service quality (FMOH-E indicators reference guide 2018:29, 38).

Service coverage and immunisation quality are measured using access and utilisation parameters. High immunisation coverage of over 80% among children with DPT1 indicates good access, whereas a low dropout rate of less than 10% difference between Pentavalent1 and Pentavalent-3 indicates good utilisation of the service. Low dropout indicates good utilisation, whether or not accompanied by high coverage (WHO, Reach Every District (RED) 2017:114).

The process and outcome indicators were used to measure the piloted implementation of CQI in Ethiopia. The outcome indicators are coverage of antigens: BCG, Pentavalent-3, PCV, measles and full vaccination status. While process indicators included planning, resources, supply and logistics, documentation, and M&E (Manyazewal, Mekonnen, Demelew, Mengistu, Abdu, Mammo et al. 2018:8). However, FMOHE-Quality of Care

(2016-2020:84) recognises coverage of Pentavalent-3, measles, and fully immunised status as quality indicators of immunisation services.

2.3.4 HMIS in Low- and Middle-Income Countries (LMICs)

Ensuring that RHISs provide high-quality information for informed decision-making and planning remains a priority for countries. Optimal information support is increasingly seen as integral to high-quality healthcare delivery. However, too many data elements, a lack of adequate skills in data collection and analysis, fragmentation of information flow, and duplication of efforts are gaps in the HMIS reform agenda in LMICs (Manyazewal et al. 2018:12; MEASURE Evaluation 2018:10; Bogale & Rikitu 2019:2).

Traditionally, HIS in Primary Health Care in LMICs has predominantly focused on reporting from the local to the national level. Technologies were designed to enable upward reporting rather than strengthening local action (Sahay et al. 2019:4). The hierarchical (top-down) nature of planning significantly hindered operational-level managers in Rwanda from effectively utilising data (Innocent et al. 2016:2). Lower-level facilities were mainly focused on submitting data to higher levels due to the strong emphasis on data submission deadlines and the lack of robust supervisory and feedback processes in Ghana (Odei-Lartey et al. 2020:2).

Improvement of HMIS should focus on the use of information, as well as on collection and processing (Sriram 2018:2). The major challenge in information use is the shortage of trained staff. However, a study in Tanzania finds that 41.4% of the facility's personnel had not received any training in HMIS data management within 12 months of the survey (Mboera, Rumisha, Mbata, Mremi, Lyimo & Joachim 2021:1, 7). Studies in Uganda and Ethiopia confirm that health workers who lack training are unable to understand indicators and the quality of data; as a result, their use of routine health data is limited (Dagnew et al. 2018:5).

Additional challenges to information use are rare research evidence on legal support and the unavailability of guidelines that mandate staff to use information in decision-making in low-resource settings (MEASURE Evaluation 2018:17). Absence of up-to-date, appropriate guidelines and protocols is considered to limit the opportunity and scope of information to support hospital duties (Manyazewal et al. 2018:5).

2.3.4.1 Health Management Information System in Ethiopia

Ethiopia instituted HMIS reform in 2008 to support the successful implementation of the strategic plan (HSPD). The HSDP III evaluation identified HMIS weaknesses, particularly at the district and facility levels. The system was revised in 2017 (Chanyalew et al. 2021:1). "*Most often information was not utilised for performance monitoring, but for reporting to bi-lateral and multilateral donors, this has reduced the quality of HMIS data"* (FMOH-E HMIS and M&E strategic plan 2008:28). Fragmentation, the existence of multiple formats and definitions, parallel reporting, and duplication of efforts in data collection, as a result, low information use characterised Ethiopian HMIS (Ouedraogo et al. 2019:2)

Reporting data to the next level, without or with minimal processing, is a very common challenge (Teklu et al. 2018:2). Perceiving data as a need for a higher level is an effect of over-emphasis on reporting and disconnects the collecting facility from data utilisation. A study reports that facilities often become aware of their own data during supervision by higher-level authorities. Furthermore, studies in Ethiopia indicate that low ownership at lower levels raises questions about the quality of reported data (Endriyas et al. 2019:5).

The HMIS/M&E reform agenda in Ethiopia aimed to enhance evidence-based decision-making through harmonisation and alignment. Despite policies and guidelines that regulate the generation of high-quality HMIS data and information for decision-making, as well as reformed tools and indicators, both data quality and information utilisation remain subpar. There is limited evidence of routine health information being used for decision-making, particularly among department heads in health facilities (Endriyas et al. 2019:2; Chanyalew et al. 2021:2).

The Information Revolution (IR) of Ethiopia focuses on fostering an information-use culture. The IR envisioned a radical shift to a systematic information management approach powered by a matching level of technology. However, district and facility staff have rarely used routine data to inform decisions, plan, identify performance gaps, and monitor progress. Data is only for sending reports to monitor program outputs, not for program and quality-of-care improvements (FMOH-E Information Revolution Roadmap 2016:6; Dagnew et al. 2018:2).

Studies in Ethiopia also reveal low coverage of HMIS training at the lower level of the system, only 31.3% of staff trained on HMIS at the service delivery point (Alaro, Sisay & Samuel 2019:1). A similar study a year later identifies no change in coverage as 38.3% of lower-level staff are trained on HMIS in the previous 6 months of the study (Kebede et al. 2020:8).

The HMIS reform cost in Ethiopia was estimated at US$17 (12.8 million) per capita/annum (FMOH-E HMIS/M&E Strategic Plan 2008:28, 55). Asemahagn (2018:2) reports that Ethiopia spends USD 5.1 million annually on printing HMIS formats, yet the data quality is poor. The estimated HIS cost for large hospitals in the USA is about $50M, yet the overall costs and benefits of hospital information systems have rarely been assessed (Kimani & Namusonge 2015:4, 5). In Ethiopia, the number of hospitals and health centres has increased 10-fold since 2005 (Alebachew, Hatt & Kukla 2014:1).

Findings from studies on data quality in Ethiopia were inconclusive over time: limited capacity for data collection has negatively affected data quality (Alebachew et al. 2014:1). However, Abera et al. (2016:9) report improvement in information use for decision-making in planning. However, Ouedraogo et al. (2019:8) identify unresolved challenges in the use of information for decision-making. In contrast, Arsenault et al. (2021:6) note possible improvements in data quality resulting from interventions such as training.

An appropriate and timely use of health information is an essential element in transforming the health sector. Accordingly, information revolution, one of health sector transformation

agenda in Ethiopia focus on advanced data [quality] management and culture of information use at point of data generation (FMOH-E Information Revolution Roadmap 2016:6). However; studies persistently indicate a limited culture of using information for decision, with the studies report varying utilization rates in the range of 37-69.3%, the recent study reports 57.9% utilization rate (Kebede et al. 2020:7; Teklu et al. 2018:2).

Similar studies in Addis Ababa and Diredawa cities in Ethiopia indicate health facility level information use remained much lower than expected: 37.3% and 57.7% respectively (Mengistu et al. 2021:1, 13; Mekuria 2021:7). The above findings indicate the current utilisation rate in Addis Ababa health centres was less than 41.7% utilisation in a study 4 years back (Adane, Tadesse & Endazenaw 2017:7).

A culture change to embrace data-driven transformation and organisational (system) decision-making to attain desired objectives is necessary (Koster, Stewart & Kolker 2016:1, 3; Muhindo et al. 2016:6). Akachi and Kruk (2017:7) cite one of the policy recommendations as transforming health facilities through strengthening RHIS in order to improve quality of care measurement and amplify its policy impact for improved use of information. A strong RHIS can be achieved through improvements in both data production (accessible, high-quality data) and data use (the capacity and processes for effective, informed decision-making) (Balakrishna et al. 2020:19).

HMIS data in Ethiopia are collected during encounters between providers and service seekers at health facilities for service provision, disease treatment, and surveillance. The data are entered into standard individual medical records (patient charts) by administrative officers and respective service providers at the health facilities. Pertinent to indicators data are transferred to a standardised specific service register and tally sheet or electronic aggregation form, from which the HMIS report is generated by the Health Information Technician (HIT) or HMIS officer every month and quarter (FMOHE-HMIS Technical Standards: Area 3 2008:4). Figure 2.1 below depicts HMIS data flow in Ethiopia from health facilities to the Federal Ministry of Health (FMO).

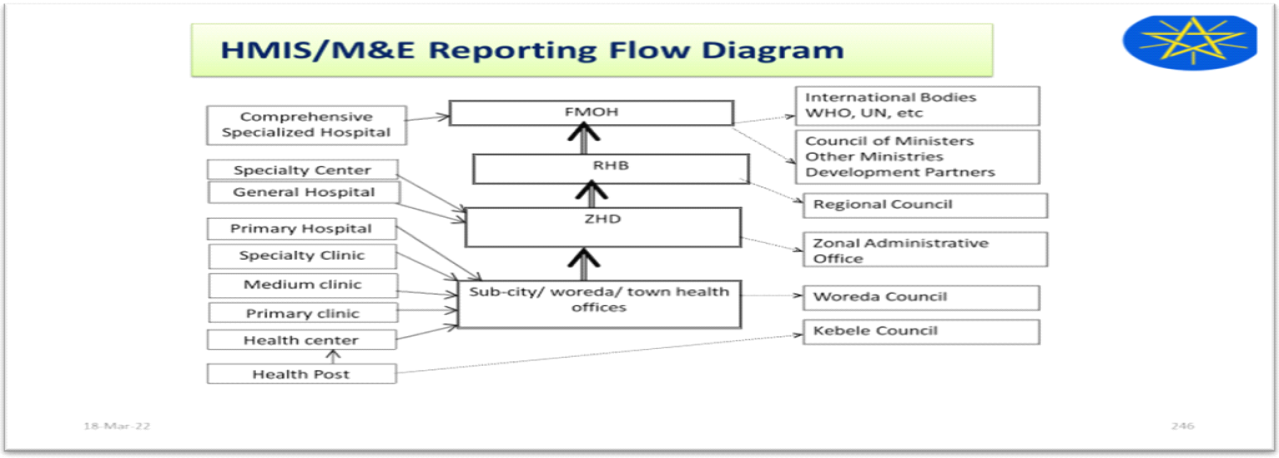

Figure 2.1: HMIS data flow in Ethiopia

Source: FMoHE Revised HMIS (2017:247).

Figure 2.1 above shows the vertical and horizontal flow of HMIS data across the levels of the health system and the corresponding levels of administrative councils.

The HMIS report flows vertically to the supervisory level and horizontally to the corresponding administrative council, using either a paper or an electronic form. In a rural setting, a community health post reports to a health centre and to the community (Kebele) administrative council. In towns, health services start at a health centre that reports to the woreda (district) or town health office, as applicable. The health office also receives reports from mostly privately owned primary, medium, and speciality clinics and sends compiled reports to the zonal health department and the woreda administrative council (FMoH Revised HMIS 2017:249).

The zonal or sub-city health office receives reports from general hospitals and speciality centres and reports to the regional (state) health bureau and the zonal or sub-city administrative council. In line with the existing trend, the regional or city administration health office receives reports from regional teaching hospitals and from sub-city or zonal offices, and submits them to the federal ministry of health and the regional administrative council. The federal ministry of health also receives reports from specialised teaching hospitals and shares the compiled health sector report with the council of ministers and other sectors, the

WHO (World Health Organization) and other UN agencies, and other national and development partners (FMoHE Revised HMIS 2017:247).

2.4 DATA QUALITY AND DATA MANAGEMENT PROCESSES

2.4.1 Data Quality

Data quality comprises multiple, but eight standard dimensions (attributes): accuracy, completeness, reliability, timeliness, confidentiality, precision, integrity and use (Davis, Zalisk, Herrera, Prosnitz, Coelho & Yourkavitch 2019:1). The WHO lists 10 data quality dimensions: accuracy, completeness, timeliness, reliability, availability, accessibility, validity, legibility, usefulness and confidentiality (Endriyas *et al* 2019:2). Whereas MEASURE Evaluation provides 7 dimensions, it considers accuracy and reliability as main dimensions, and precision, completeness, timeliness, integrity, and confidentiality as sub dimensions of data quality (User Manual Routine Data Quality Assessment 2015:42).

Some of the literature also provides a similar definition to different data quality dimensions: validity (trueness), accuracy (concurrence), usefulness (relevance), consistency (reliability) and integrity (legibility), while the dimensions like precision, completeness, timeliness, availability, accessibility, and utilisation are uniformly defined across the literature. Few studies consider availability and accessibility as an independent data quality dimension (Haftu, Taye, Ayele, Habtamu & Biruk 2021:7,11); however, the timeliness dimension can refer to timely availability and accessibility of data. According to Somi, Matee, Wengaa, Darcy and Perera (2017:7,10), availability refers to access, synthesis and communication instead of being considered as an independent dimension.

The accuracy. However, the literature lacks uniformity in the list of data quality dimensions and how data quality is best defined and measured. A study on immunisation data presents a definitional framework of data quality in terms of three key characteristics (9 dimensions): data quality (trueness and concurrence), data usability (completeness, consistency, timeliness, efficiency, relevance, and integrity), and data utilisation (B).

The WHO lists 10 data quality dimensions: accuracy, completeness, timeliness, reliability, availability, accessibility, validity, legibility, usefulness and confidentiality (Endriyas et al. 2019:2). MEASURE Evaluation provides seven dimensions, it considers accuracy and reliability as main dimensions, and precision, completeness, timeliness, integrity, and confidentiality as sub dimensions of data quality (User Manual Routine Data Quality Assessment 2015:42).

Some of the literature also provides similar definitions for different data quality dimensions: validity (trueness), accuracy (concurrency), usefulness (relevance), consistency (reliability), and integrity (legibility), while dimensions like precision, completeness, timeliness, availability, accessibility, and utilisation are uniformly defined across the literature. Few parts of the literature consider availability and accessibility as independent data quality dimensions (Haftu et al. 2021:7, 11); however, the timeliness dimension can encompass the timely availability and accessibility of data. According to Somi, Matee, Wengaa, Darcy and Perera (2017:7, 10), availability refers to access, synthesis, and communication rather than being considered an independent dimension.

Accuracy is often considered a prime dimension, though it is not a hallmark of data quality. Bruce (2014:8) refers to data quality as the accuracy or worth of information collected, and the data meet high standards set by internal and external data quality assurance or audit. MEASURE Evaluation mentions accuracy and reliability as the main dimensions. In contrast, accuracy, along with timeliness and completeness, is considered as an indicator of data quality improvement (Nsubuga et al. 2018:2). PRISM defines measures of data quality in terms of accuracy and completeness (Nutley et al. 2014:7). This study considers seven common and important dimensions concerning data quality, such as completeness, reliability (consistency), timelines, accuracy, integrity, precision, and utilisation. These dimensions are also aligned with the shared position in the existing literature and used for routinised checks of data quality. Prasetya (2017:16) sees completeness, consistency, timeliness, accuracy, reliability, and precision as cross-cutting dimensions, with emphasis, however, on the functional components of data management, including information use. The table below

presents definitions of the commonly assessed and applicable dimensions of data quality to this study.

Table 2.1: Commonly assessed dimensions of data quality and definition applicable to this study

Accuracy	Refers to the closeness of a measurement or estimate to the exact or true value of the thing that was intended to be measured. HMIS data accuracy depends on the accepted accuracy level of measurable indicators
Completeness	Completeness in HMIS data sense refers to representativeness and content completeness. Representativeness is a measure of whether aggregate data accurately reflect the expected report (data) from all reporting entities. Content completeness (all-inclusiveness) means that all relevant fields of data elements are filled in accordance with standardised recording and reporting tools.
Integrity	Refers to the system used to generate data is protected from deliberate bias or manipulation for political or personal reasons. HMIS data are routine records; if data are not entered during the encounter and digitised, they are likely to be exposed to manipulation (under-reporting and over-reporting) that would undermine integrity.
Precision	Refers to the fact that the data have sufficient detail, e.g., aggregated by sex, and degree of being free of random error. Standardised HMIS tools provide entry of age, sex, and other identification variables, which are indicated in the individual medical record. This enables disaggregation and further analysis.
Reliability (Consistency)	Refers to protocols and procedures that remain constant regardless of the user or frequency of use. Consistent estimates or measurements yield related results when conducted under similar conditions, demonstrating the proximity of the initial estimates to subsequent values. Consistency in HMIS data refers to similar readings across tools (registers, tally sheets, report forms). This dimension of data quality is easier to maintain when recording occurs simultaneously with the service encounter.
Timeliness	Refers to an up-to-date (current) state. Data are timely when the information is available at the expected time. HMIS data timeliness is measured against a set deadline for reported data received at a higher level
Utilization	The degree to which data are used in decision-making. This adds evidence that data are being used. The utilisation dimension of data quality refers to the actual, ongoing use of HMIS data/information in decision-making. First, data quality is checked against timelines, completeness, and consistency. Information is used against agreed-upon program indicators. Data quality checks and use are verified through management documentation for performance monitoring, quality improvement, and planning.

(Ledikwe et al. 2014:1; MEASURE Evaluation 2017:42; Bloland & MacNeil 2019:2, 5; Prasetya 2017:16, 17)

Though confidentiality is considered one of the data quality dimensions by the WHO, measuring it in the context of RDQA is difficult, as the existing data quality literature lacks acceptable standards for confidentiality. A study in Botswana reports few standard practices associated with confidentiality as a system limitation (Ledikwe et al. 2014:1). Another study argues that less restrictive, systematic access to data promotes transparency in data processing and quality (Maïga et al. 2019:7).

Confidentiality concerns may limit information sharing and lead to poor data quality. Moreover, a restrictive confidentiality-related policy for healthcare information hampers the opportunities presented by big data, as big data is a big deal in biomedical research to ensure meaningful use of the mushrooming Electronic Health Record (EHR) by healthcare providers, which is not yet achieved (Pepukayi 2016:14, 38).

The meaningful use of information demands purposeful use of objectives (Pepukayi 2016:14, 28). Data use intervention design needs to look at deliberate activities that “link data collection and decision-making processes;” information needs, capacity building, and policies to support an organisational culture of data use (Nutley et al. 2014:1). Improving the quality of care establishes an aim that serves the use objective.

In the current study in Ethiopia, the Lot Quality Assurance Sample (LQAS) is intended to include both report content and sites reporting on the completeness dimension of data quality, with report content completeness referring to the reports and representative completeness to the sites. However; current studies on the area shows lack of guideline for conducting the Data Quality Assessment and impracticality of using LQAS at health post level, as only 22% of health facilities were conducting the immunization data quality review in the last three months of the study (Chanyalew et al. 2021:7). In effect HMIS provides incomplete and often unreliable data and facility surveys collect too many indicators of uncertain utility, focus on a limited number of services and the data are quickly outdated. Though

survey data are considered more accurate than HMIS data, they do not provide continuous estimates of population-level indicators given their cross-sectional nature; they are also neither specific nor timely and are subject to inaccuracies (Akachi & Kruk 2017:5, 7; Bloland & MacNeil 2019:3).

Survey data also lack reliability in estimating the size of the target population at the local level, due to the complexity of identifying eligible individuals within the health facility catchment area. As the survey estimates are made at the regional and national levels, they result in implausibly high (over 100%) or low coverage estimates and discordant disaggregation at the local level (Maina, Wanjala, Kipruto, Droti & Boerma 2017:1; Dolan, Carnahan, Shearer, Beylerian, Thompson, Gilbert, Werner & Ryman 2019:1).

Available evidence on data quality was insufficient to inform the role of evidence-based local-level decision-making in improving data quality. A significant barrier to data use is the disconnect between data producers and data users to make decisions across [the processes of] data collection, synthesis, analysis, interpretation and use (Scott & Gilson 2017:1; MEASURE Evaluation 2018:14; Teklu et al. 2018:2).

2.4.1.1 Measures to improve data quality.

Designing and implementing intervention strategies based on root causes will help improve data quality and use (Gonete, Yazachew & Endehabtu 2021:2). Endriyas et al. (2019:5) recommend routine monitoring of data quality, both quantitatively and qualitatively, against its dimensions to achieve acceptable quality and use. Alas et al. (2019:2) suggest coordinated action across the health system to routinise data quality reviews, maximise reporting, supervision, and feedback. A study shows that maintaining an annual data quality assessment increased completeness from 88% to 95% over 5 years (Nisingizwe, Iyer, Gashayija, Hirschhorn, Amoroso & Wilson 2014:4).

Research advocates for routine data quality assessment. HMIS review in 24 USAID support countries suggest routine quality assurance activities as mechanisms to ensure data

quality and use (The Maternal and Child survival program (MCSP) (2016:19). Routinization of data quality assurance as organisational tool in M&E and managerial decisions (Muhindo et al. 2016:4). Routine Data Quality Assurance, can be used by an organization/donor as an essential procedure to determine data quality at a time and provides opportunity to prioritize, develop and implement strategies to address gaps (Bruce 2014:9; Prasetya 2017:18).

A study suggests that continuous data quality assessments and training are needed to address gaps and improve HMIS data quality (Nshimyiryo, Kirk, Sauer, Ntawuyirusha, Muhire & Sayinzoga 2020:2). On-job training, mentoring Performance Monitoring Team, supply of forms, and data audit have improved data quality: accuracy, completeness and timeliness of reporting and paved the way for continuous use of information (Hailu 2017:14). Similarly, training the program managers to routinely audit data quality linked to ongoing on the job mentoring at the point of service marks successful data quality improvement (Gimbel, Mwanza, Nisingizwe, Michel & Hirschhorn 2017:1). Coaching and mentorship approaches led to improvements in data-driven decision-making, leadership and accountability, the quality of clinical care, and staff satisfaction. Adaptation of the approaches to reflect local context encouraged adoption and improved the effectiveness and sustainability of the improvement (Manzi, Hirschhorn, Sherr, Chirwa, Baynes, Awoonoor-Williams, et al. 2017:5). Moreover, data quality assurance should also investigate data management, as the fate of data quality ultimately depends on data management, including data use. Hailu (2017:15) states that the quality of reported data and its use for action are dependent on the underlying data management system.

In summary, the approach to data quality improvement should be comprehensive, as the relative importance of individual barriers to data use outcomes is complex to understand. Multifaceted interventions may have multiplicative effects on sustained data use, as opposed to single-intervention approaches focused on specific barriers (MEASURE Evaluation 2018:22). Lemma et al. (2020:2) found that combinations of technology enhancement, capacity building, data quality assessment, and feedback systems helped improve data quality.

2.4.1.2 Data Quality Assurance and Audit

Data Quality Audits (DQAs) play a significant role in determining whether data meet the required quality for their intended use. Regarding studies in sub-Saharan African countries, routine HMISs were characterised by limited availability and inconsistent data, prompting the initiation of DQA. The DQA identifies gaps in data quality, factors that support or hinder data quality and use with improvement recommendations (Gimbel et al. 2017:6). A study on data quality using DQA in five African countries recommends strengthening staff skills as a place to begin data quality improvement, coupled with standardisation of reporting procedures (Yourkavitch et al. 2019:1-2, 6).

However, some researchers are sceptical that recent DQA approaches can enhance data quality in LMICs. There is limited knowledge of evidence-based interventions to improve the utilisation of this data for decision-making and enhance the quality, effectiveness, and efficiency of service delivery (Wagenaar et al. 2017:2). Therefore, the DQA should evaluate data collection, processes, and data utilisation (Davis et al. 2019:1, 2).

While data quality outcomes are incorporated into departmental performance metrics in some countries, data use is rarely included in these metrics (MEASURE Evaluation 2018:17). In Ethiopia, LQAS data quality is included among performance indicators; however, the use of this information is not given due consideration (FMOH-E Indicators Guide 2018:117).

The DQA is an indicator-specific external audit designed to evaluate a program's capability to report quality data from a sample of health facilities (Gimbel et al. 2017:2). On the other hand, the RDQA, a revised version of the DQA, can be utilised by programs to conduct self-assessments of their data and enhance their data management and reporting systems. The RDQA tool is employed to validate data quality, evaluate the system that generates the data, and formulate action plans to enhance both (MEASURE Evaluation 2017:7, 9).

The Data Quality Report Card (DQRC) tool can assess the quality of RHIS data inconsistencies and inaccuracies in terms of completeness of reporting; the internal consistency of reported data; the external consistency of population data and external consistency of coverage rates (Ouedraogo et al. 2019:3). The LQAS (sampling survey technique) method is used for health facility self-assessment of completeness, timeliness, and consistency of RHIS in Ethiopia. It is a quick and reliable method for comparing recorded and reported data (FMOH-E Indicators Guide 2018:117).

In conclusion, LQAS requires health facility records; DQA does not assess data management processes; RDQA is not applied to population data consistency; and DQRC requires survey data to be compared with routine data to ensure consistency in coverage rates. The approaches to improve data quality need to be based on broader support and scalable solutions used at all levels of the health system; otherwise, donor-initiated and disease-specific data quality assurance strategies undermine countries' efforts to use high-quality evidence for management functions and development of integrated and sustainable interventions (Gimbel et al. 2017:2; Ledikwe et al. 2014:7).

On the other hand, the accumulation of high-quality data means much effort is spent on collecting and improving data without culture of use of those data for health systems improvement (Wagenaar et al. 2017:1). Focusing on only infrastructure and simply having the best information system alone do not lead to any success, what leads to success is using and sharing the information to decision-making to improve quality of care. Assessment of the Technical, Organisational and Behavioural (TOB) determinants of decision-making is necessary for diagnosis and intervention to improve the demand for and use of data (Nutley & Reynolds 2013).

2.4.2 Data management process (Cycle)

Data management cycle involves a set of procedures for the collection, compilation, storage, and processing of data (Nwankwo & Sambo 2018:2). According to Bruce (2014:2, 6, 9), the six key stages that make up the data management cycle are data source, data col-

lection, data collation, data analysis, data reporting, and data usage. According to MEASURE Evaluation (2018:6), the six key components of HIS are: information resources; data collection; data compilation; data analysis and synthesis; data dissemination and use; and indicators.

On the other hand, the functional components of a data management system that ensure data quality include the M&E structure, indicator definitions and reporting guidelines, data collection and reporting forms (information resources), data management process, links with the national system, and the use of data for decision-making (MEASURE Evaluation 2017:9; Hailu 2017:43). Therefore, the data management cycle, HIS components, and the functional components of a data management system share defining elements.

Data management functions also remain weak at district health offices and primary health facilities in Ethiopia (Teklu et al. 2018:3). Staff motivation for data management is as low as 52.2%, a level crucial to ensuring data quality (Kebede et al. 2020:3, 8). Gaps in health workers' knowledge and skills in data management are a critical issue that influences data management processes and data quality. An ongoing HMIS training, incorporating HMIS and M&E into the school curriculum, and strengthening generic ICT training are planned interventions under the Ethiopian information revolution (FMOH-E Information Revolution Roadmap 2016:6, 9).

2.4.3 HMIS data quality and data management in Low- and Middle-Income Countries (LMICs)

At the facility and community levels, RHIS-generated data and information for evidence-based decision-making remain weak in LMICs (Lippeveld 2017:1, 2). Though there is increasing evidence of the matchless role of information use in improving data quality and in the attention given to developing strong HMIS, doing so has proved challenging, and information use is still a neglected part of the system (Dufera et al. 2018:1).

According to Mayston et al. (2020:2), poor data quality leads to poor information use in LMICs, but Nicol et al. (2017:12) argue that addressing poor data quality is one way to improve data quality through feedback to data producers. A study by Prasetya (2017:21) outlines additional factors affecting data quality in LMICs, including gaps in staff motivation, data collection tools and equipment, human resources, use of technology, data demand, routine data quality checks and use, feedback mechanisms, and robust RHIS policies.

A study in Uganda cites persistent challenges in data quality from the facility to the national level; the immunisation data quality indicator at the health centre level is as low as 62% despite intensive interventions. A study in South Africa reports that information was minimally used to inform decisions and planning at facility and district levels, but was selectively used for reporting and monitoring program outputs at the provincial level (Nsubuga et al. 2018:4; Nicol et al. 2017:1).

In Ethiopia, a study reports inconsistency in data reporting as well as poor support mechanisms to ensure data quality at the district level (Teklu et al. 2018:2). Another study by Kassa and Grace (2018:3) shows if people at a frontline health facility only pipeline the data to pass without using, the decisions they make is not based on evidence, besides, the data they produce will remain of poor quality, while on the flip side, an increased data use at lower levels ensures data quality, moreover it increases understanding of the staff about benefits and functions of the data they produce (Gashu et al. 2019:2; Nwankwo & Sambo 2018:2).

Poor data quality is both a cause and a consequence of the underuse of data (Innocent et al. 2016:3). Decisions based on inferior-quality data are poor-quality decisions, leading to low-quality health services and threatening the validity of program impact evaluations. The relationship between data quality, demand for and use creates a cycle that ensures improved health programs and policies (Gimbel et al. 2017:2).

In Ethiopia, the HMIS reform goal of using information for local action and decision-making is not yet realised; both data quality and information use fall short of the target. A facility-

based study indicates that only 43.8% of lower-level staff have ever used the data they generate through HMIS (Alaro et al. 2019:1). Related studies report stagnant information utilisation below 70%. Though some studies suggest improved data quality, this improvement remains questionable, as none of the reports meets the 90% national HMIS data quality target (Dagnew et al. 2018:2).

Moreover, studies in Ethiopia identify suboptimum data quality in terms of reporting timeliness, completeness, and data accuracy 70%, 78.2% and 48%, respectively (Yarinbab & Assefa 2018:6). A study by Bogale & Rikitu (2019:6) indicates overall data quality of 58% at the health facility and 21% at the district level. The inclusive regional data quality level was 76.22% in Addis Ababa (Haftu et al. 2021:1). Up to date national level study, however, shows data quality of timeliness, completeness, and accuracy of 72.2%, 86% and 47% respectively, being far less than the 90% target (Kebede et al. 2020:2).

Studies indicate that data producers are far from policy decision-makers and may not plan for the timely generation, synthesis, analysis, and presentation of data to meet decision-makers' needs. Data producers must ensure that the information they produce meets end users' needs. Users need to engage in priority information dissemination; otherwise, the data demand and use cycle would break (Blessing et al. 2017:10; Sligo et al. 2017:8; MEASURE Evaluation 2018:14).

Considerable investment has been placed by global health partners such as GAVI, the WHO, UNICEF and CDC in improving data quality including the WHO/UNICEF Estimate of National Immunization Coverage (WUENIC) to adjust for potentially poor data quality (Bloland & MacNeil 2019:1-2; Prasetya 2017:11). In practice, without active use of information, data will not improve, proving *"use brings usability"* (Gashu et al. 2019:3). Studies mention that there is no health data from any source that can be considered perfect (Endriyas et al. 2019:2, 5; Teklu 2018:5).

While there is much evidence on data quality and how to improve it, there is a lack of sufficient evidence on why the use of data for decision-making at each level of the health sys-

tem is low (Shiferaw et al. 2017:2; Abera et al. 2016:2; Teklu et al. 2018:3). The use of HMIS information for QI is not yet available. A study indicates that, even thus far, the limited use of data is only for reporting, planning, and resource monitoring at the local level (Alaro et al. 2019:1). Muhindo et al. (2016:2-5) stress that data utilisation at the point of data generation should be prioritised if the hunger to collect and report quality data is to be sustained.

In sum, usage of information is the most significant problem of HMIS, the possible remedy is building country capacity of program planners and policy makers to use the existing system and the facility staff for quality assurance and planning (Maternal and Child Survival Program MCSP 2016:19). Moreover, in response to the 5-point action call for measurement and accountability targets on better data use in support of the health-related development goal “by 2020,” countries need health information flows, including use of data locally to improve services and programs (Bogale & Rikitu 2019:2).

2.4.4 Improvement of RHIS data and Information use

RHIS strengthening means intervention either to the quality of data or to the effective use of information (Schmidt et al. 2018:1-2; Kebede et al. 2020:1). An intervention to the effective use of information for decision-making should specifically focus on motivation and capacity development, and integrating routine information into planning, quality improvement, and evaluation processes. Decision-making on QI requires not only understanding the policy process but also knowledge of data sources and the timely use and implementation of evidence; thus, incorporating quality information into policy evidence is recommended (Leon et al. 2015:5, 6; Blessing et al. 2017:2).

Lippeveld (2017:3) proposes a Human-Centred Design (HCD) intervention to build an information-use culture. His study states that HCD better understands users' needs and engages them early in the design of solutions to “how” and the “why” of a problem. Shiferaw et al. (2017:2) suggest that applying HCD can maximise data quality and information use. It applies organisational and behavioural interventions, combined with role modelling, as is

used in Ethiopia, or appraisal or performance-based financing, as used in other countries. However, there is no research evidence on the extent to which the application of HCD has led to sustained information use in Ethiopia.

A study argues in support of the Data Demand and Use (DDU) Logic Model intervention as a potential for application. The DDU describes barriers to and areas of data use. It specifies eight interventions for better data demand and use in three broader areas of data demand (Shiferaw et al. 2017:2). The MEASURE Evaluation (2018:5, 6, 21) also reveals the effect of DDU on continuous use of information, with evidence of improved information utilisation from 40% to 70% following a DDU intervention in Côte d'Ivoire. The logic model below shows how strengthening demand for and use of data leads to improved, sustained data demand and use for health system building blocks.

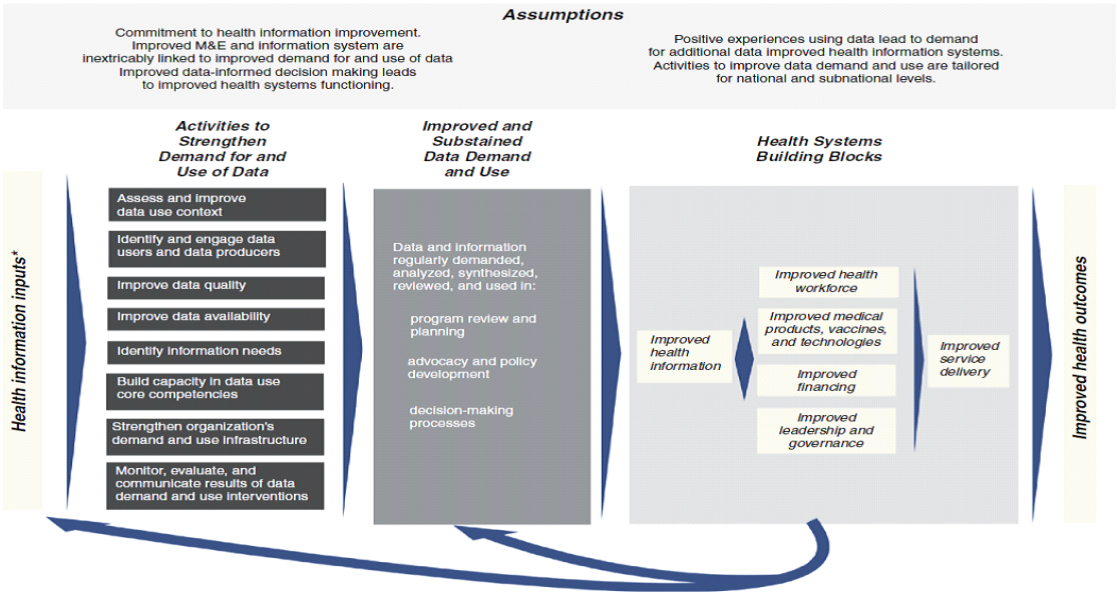

Figure 2.2: DDU conceptual framework for the use of health data in decision-making. Source: MEASURE Evaluation (2018:7).

2.4.5 Quality improvement models and tools

The PDSA model is an iterative model for learning, improvement, and problem-solving. In the PDSA application, even successful change leads us to a new starting point for continued improvement (Graban & Swartz 2012:40-42). Likewise, the Model for Improvement (MFI) consists of two parts: the “thinking” (setting the aim) and the “doing/testing” (trying to see changes). The testing part integrates MFI into the PDSA cycle (‘Improving Healthcare Quality in Europe 2019:3). Foaese and McIlhone (2017:1) reveal that MFI methodology ensured that a change of ideas is sustainable, measurable and results in beneficial change in healthcare provision and improvement in programs, including immunisation service.

QI thinking applies tools to answer each question: brainstorming and nominal group technique to generate ideas; an affinity diagram for categorising ideas; five ‘whys’ for determining root causes; a fishbone for determining cause and effect; a Pareto analysis for determining the cause that has the most significant impact; process mapping for redesigning the process and forced field analysis for identifying factors that can support or hinder a potential solution (Improvement Foundation Australia Ltd 2017:5).

2.5 UTILISATION OF HMIS TO IMPROVE HEALTHCARE (SERVICE) QUALITY

Quality healthcare and optimal patient safety are the goals of health systems and governments worldwide to achieve Sustainable Development Goal (SDG) 3 on health and well-being. However, many low- and middle-income countries (LMICs) are far from meeting this objective (Alhassan et al. 2013:1). Data-based practice and the quality of healthcare at the Primary Health Care level in LMICs are low, despite PHC being the primary strategy for UHC. UHC through PHC aims to deliver acceptable-quality healthcare to all without a financial burden, thereby achieving the SDGs (Kebede et al. 2020:2; Abera et al. 2016:2; Alebachew et al. 2014).

The WHO (2016:2) concludes that high service coverage alone is not enough to reduce mortality; therefore, the quality of healthcare has become a critical aspect of the unfinished

maternal and newborn agenda. Abrampah et al. (2018:4) concur with this, saying that the lack of systems strengthening and the absence of focus on cross-cutting entry points, such as Quality Improvement, result in uneven progress in health programs. Drawing on the lesson that quality of healthcare is considered an important part of SDG 3.8, this is a critical move to improve quality of care in LMICs (Akachi & Kruk 2017:5, 7; Manyazewal et al. 2018:12).

In the QI process, organisations iteratively test and measure changes in work routines, set and achieve ambitious aims, and shift whole-system performance (FMOH-E Healthcare Quality Strategy 2020, 2016:13). Achieving set aims through QI methods demands understanding and solving a problem, measuring the response in an iteration of sustained improvement. Ensuring sustainability in QI, on its part, requires commitment from top management, capacity, and a culture of using available data to measure quality and inform QI (Abrampah et al. 2018:4).

The QI methods improve the effectiveness of healthcare delivery and strengthen systems by permanently improving system function rather than supporting the system to produce better short-term outcomes (Wagenaar et al. 2017:2; Cunningham, Ferguson, Matthews & Bailie et al. 2016:2).

Using and sharing health information and adapting new information technology across a continuum of care have proven difficult (Kimani & Namusonge 2015:6; Koster et al. 2016:1). Poor patient care results from poor information. In contrast, improved healthcare delivery is achieved using QI methods; moreover, QI improves data quality and HIS at scale (Hagaman, Singh, Abate, Alemu, Kefale, Bitewulign, Estifanos, Kifilie, Mulissa, Tiyo, Seman, Tadesse & Magge 2020:1). Healthcare QI is determinant of HMIS usage, quality healthcare delivery is a product of informed decision-making which is based on proper HIS management (Tamfon et al. 2020:2; Hagaman et al. 2020:1; Kumar et al. 2018:5).

The Quality Improvement method utilises high-quality data to identify gaps in service delivery and enhance improvement (Wagenaar et al. 2017:2-3). QI approaches measure, ana-

lyse, and improve attributes; however, quality measurement in LMICs is inadequate. Nevertheless, quality can be measured by information from patient records converted into rate, percentage or time on how well care is provided (Kyalo & Odhiambo-Otien 2019:2; Thorpe, Gray & Cartwright-Smith 2016:1). For instance, patient satisfaction by quality of care can be measured through structure (input), process (interaction) and outcome (Lingamallu & Nayakvadi 2017:1; Lopes Sauers, Sauers & Valier 2017:3).

The use of HMIS data to QI increases client satisfaction, clients are satisfied when one speaks from records substantiated by clinical knowledge rather than asking them (Kebede et al. 2020:2). The QI assesses what works and what not in improving service quality and promoting visibility of care providers through use of HIS; while HIS improves quality of care by minimizing errors, reducing cost and raising efficiency and productivity (Lingamallu & Nayakvadi 2017:1, 3; Sligo et al. 2017:3).

The QI process can transform institutions to efficiently mobilise and utilise resources and to provide quality, responsive care to the public; hence, the focus on quality attracts greater funding for the belief in efficient use (Muhindo et al. 2016:2; Gutierrez, Teshome & Neilson 2018:1).

Quality functions using data for decision-making improve policies, programs, and outcomes, as evidence and analytics are essential parts of QI (Top Five Essentials for Quality Improvement in Healthcare 2017:2). QI is a driving force for the use of information. It ensures successful HIS integration into quality of care. To improve the quality of healthcare delivery, RHIS strengthening should involve streamlining data collection tools, data flow systems, and the motivation of data users (TOB components). Hence, improved healthcare quality is a unifying purpose among health systems, care providers, and service seekers (Lingamallu & Nayakvadi 2017:1; Balakrishna 2020:20).

However, the nexus in utilisation of routine HMIS information to improve quality of care and improve quality of data subsequently, has not yet been established (Abrampah et al. 2018:4). A recent study on the performance rate of the health system building blocks in

Ethiopia indicates 60% (53-69%), below the target of 80%. The HIS building block achieves the least at 53% in health workforce performance (Manyazewal 2017:2), followed by 55%.

For the WHO, the 2010 target standard commitment to HIS use was at 90% (Kanfe et al. 2020:10). But studies in Africa indicate low utilization of routine health information: 58% in Ethiopia, 42% in Tanzania, 59% in Uganda, 58% in Liberia, and 65% of the health workers in South Africa used routine health data only for planning, management of health commodities and detecting outbreaks (Dagnew et al. 2018:2; Shiferaw et al. 2017:2; Nicol et al. 2017:1; Gebreslassie et al. 2020:5).

In summary, quality and safety along access and coverage are considered as an intermediate goal to catch an ultimate goal of improved outcome, financial protection and improved efficiency ('Improving Healthcare Quality in Europe 2019:19). However; routine health data utilization for improving performance and quality of care was not well-studied in primary and secondary health facilities, hence evidence is sparse on use of facility data for local decision-making (Mekuria 2021:2; Amouzou et al. 2021:1, 2). Owing to this quality of healthcare, it is often unreliable and inconsistent in both public and private health facilities (FMOH-E Healthcare Quality Strategy-2020 2016:5).

2.5.1 Barriers to the utilisation of HMIS for QI of healthcare

Barriers to using data for quality improvement occur across strategic, cultural, technical, and structural dimensions. These barriers include a lack of time, inability to access data, difficulties in understanding statistical and data language, and a real or perceived inability to change practice (Wagenaar et al. 2017:2). Challenges of QI also arise in cascading documented improvements across a wider audience and ensuring frontline leaders have access to timely information. Nevertheless, the cascade of documented improvements has the maximal positive impact on service delivery (Abrampah et al. 2018:4).

Another study in support of this indicates that QI problems arise from reporting the achieved quality with simplified data on parameters for patients to decide on the choice of

healthcare organizations (Živaljević, Mitrović & Petković 2013:3). A study by Kassa and Grace (2018:3) indicates fast information screening and reporting enhance the quality of healthcare and availability of healthcare data that enable timely and appropriate decisions at all levels.

2.6 UTILISATION OF HMIS TO QI OF IMMUNISATION SERVICE

2.6.1 Quality improvement of immunisation service

Immunisation is the most effective and efficient public health intervention for preventing child morbidity and mortality (Yourkavitch et al. 2019:3). It is a key to UHC, the Routine Immunization (RI) service strengthening aims at ensuring all women, new-borns and children in need have equitable access to quality immunisation (Maternal and Child Survival Program [MCSP] 2016:2). However, universal immunisation coverage has been hindered by inequalities driven by differences in place of residence and socio-economic status stalling the achievement of sustained performance on immunisation indicators (Harrison, Rahimi & Danovaro-Holliday 2020:2).

Moreover, the Missed Opportunity for Vaccination (MOV) contributes to the reduction in childhood immunisation coverage at each level. Subject to an epidemic outbreak, studies indicate a significant number of eligible children who come into contact with health services are still missed by the immunisation subsystem, making 32.2% MOV in LMICs (Adamu, Uthman, Wambiya, Gadanya & Wiysonge 2019:3). On the other hand, overreporting or underreporting of immunisation data made the quality of data questionable for measuring changes over time, and resulted in impaired understanding of vaccination coverage (Ziema & Asem 2020:1; Teklu et al. 2018:2).

Globally, immunisation coverage has shown an increase during the past decades; however, it is still low in LMICs: DPT3 coverage stagnated below 80% (Bazos, LaFave, Suresh, Shannon, Nuwaha & Splaine 2015:3). Despite the Global Vaccine Action Plan (GVAP), the

immunisation DPT3 target of 90% in every nation and 80% DPT3 coverage in every district was achieved only in 28.6% of 194 WHO states (Yadita & Ayehubizu 2021:1).

Ensuring access to quality vaccination for all eligible women and children through the Reaching Every District/Children RED/REC approach has been under implementation since 2002. Data use (monitoring) for action is one of the five pillars of the REC approach (Reaching Every District [RED] 2017:12). However, studies indicate challenges in many districts and health facilities in implementing REC, due to a lack of guidance on how to fully and sustainably operationalise and access information by health workers for drawing REC immunisation micro plans (Maternal and Child Survival Program [MCSP] 2016:9; Yadita & Ayehubizu 2021; Mafigiri, Iradukunda, Atumanya, Odie, Mancuso, McGrath & Luzze 2021:2).

In general, immunisation relies on complex decision-making and strong local-level evidence essential for effectively and efficiently utilising limited resources; but poor quality of data poses challenges to obtaining an accurate immunisation coverage, particularly in LMICs (Harrison et al. 2020:2; Teklu et al. 2018:1). Poor monitoring and lack of locally available data on immunisation might affect full protection of children from VPDs. A study indicates that 85.0% of children aged 12-36 months received at least one vaccine, but only 52.4% were fully immunised (Yadita & Ayehubizu 2021:1).

Routine immunisation records provide valuable information on the timely receipt of vaccines. They can be used to evaluate the quality of childhood immunisation programs (Walton, Borja, Dezateux, Griffiths, Tingay, Akbari et al. 2017:1). The link between available data and improvement has remained as a critical system gap (Abrampah et al. 2018:4); however, measurement of improved quality depends on assessment of service performance. It entails the active utilisation of data and the quantification of gaps between reality and expectations in reference to set standards and guidelines (Akachi & Kruk 2017:1).

Being clear about standard indicators and deliberate about their choice, purpose, definition, methods and limitations; the data quality, its usability and use would yield more informed,

better decision-making (Bloland & MacNeil 2019:1). Health facilities should actively analyse and use routine immunisation data, and invest in community health strengthening to improve immunisation quality (Shikuku et al. 2019:1).

Data used to QI create an enabling environment at the national and, more importantly, at the facility level to institutionalise QI interventions. Studies recommend application of microsystems QI approach for generating local solutions to strengthen RI systems to reach unreached targets through implementation of improved registering, chart recording, and training staff, leaders and community on system thinking accompanied by intensive coaching (Abrampah et al. 2018:4; Lopes Sauers, Sauers & Snyder Valier 2017:3; Bazos et al. 2015:21).

An addition of QI to REC data use component offers iterative improvement approach in building strong immunization system to sustain high-coverage of RI (Maternal and Child Survival Program (MCSP) 2016:10). A study evidence indicates breakthrough improvement of immunization coverage from 75% to 90% following implementation of immunization QI intervention by health facilities (Livingood, Sabbagh, Spitzfaden, Hicks, Wells, Butterfield, Riley & Wood 2013:2).

Continuous Quality Improvement (CQI) implementation has a record of enhancing immunisation capacity and improving vaccination coverage following the pilot implementation of the CQI intervention in Ethiopia. The approach empowered zone, district, and health facility staff to take ownership of immunisation outcomes. The study emphasises the importance of locally innovative interventions that target local problems and dynamics to achieve optimal coverage, in line with a universal approach to improve routine immunisation (Manyazewal et al. 2018:10, 12).

There is limited information on how QI has been used within the immunisation system to reduce MOV in healthcare settings (Adamu et al. 2019:4). The literature suggests that studies have identified several types of change ideas to reduce MOV. These ideas have been broadly targeted at caregivers, health workers, and the healthcare system to address exist-

ing gaps in the application of QI in healthcare settings and reduce MOV. Another QI method, the Assessment, Feedback, Incentive and eXchange (AFIX) model, has been implemented in the USA, resulting in increased adult immunisation coverage by at least 20% (Borchardt, Mitchell, Larson, Ehlers & Schauer 2021:1).

The QI application can improve immunisation service quality and address MOV, DOR, and coverage issues; it differs from other activities aimed at increasing immunisation uptake. The application involves baseline data collection, testing iterative cycles of intervention packages to improve immunisation uptake, brainstorming progress, and periodic reflections on changes to the packages (Adamu et al. 2019:3).

Regarding types of QI models, the Model for Improvement (MFI) and CQI are commonly used in healthcare services, while alternative models include Lean, Six Sigma, and Kaizen. Both CQI and MFI use PDSA cycles (model). AFIX is a QI model that can be used, but in adult immunisation, Kaizen can also be applied; it is synonymous with CQI (Borchardt et al. 2021:1; FMOH-E Healthcare Quality Strategy-2020 2016:20, 22). A study indicates the possibility of using a quality improvement approach to bridge the RHIS task capacity gap by applying QI tools such as Model for Improvement" (Boadu, Adzakpah & Agyei-Baffour 2019:10).

Kaizen focuses on improving efficiency and demonstrates opportunities for improvement. The kaizen methodology empowers people to use creativity to improve their daily work (Graban & Swartz 2012:2, 3, 25). Kaizen is considered an engine driving improvement, while MFI, as the “vehicle,” provides structure for improvement, suggesting their integrated use. In fact, the MFI is widely applied in QI of immunisation services at FMOH-E (Healthcare Quality Strategy 2020:14). The quality of immunisation services can also be assessed by exploring the status of the parameters outlined in the immunisation improvement plan (Manyazewal et al. 2018:5).

2.6.2 Utilisation of HMIS information to improve the quality of immunisation service

High-quality information is a priority for populations experiencing a high burden of morbidity and mortality, such as women, newborns, and children. HMIS are a crucial source of timely health statistics and can help improve reporting in LMICs. However, concerns about data quality have hindered their widespread adoption in research and policy decisions. The RHIS data quality issues need to be addressed to realise progress in immunisation; otherwise, the global goal of universal immunisation coverage has stalled in LMICs (Arsenault et al. 2021:1; Harrison et al. 2020:2; Nicol et al. 2017:1)

Several approaches have been developed to evaluate the quality of routinely collected immunisation data and address challenges in simply defining “data quality” (Bloland & MacNeil 2019:1). As a result, the use of data for decision-making remained challenging. However, evidence is scarce on why information use is so low. Generally, literature advocates the use of available, complete and accurate data for evidence-informed decisions that could improve data quality (Teklu et al. 2018:2). Equally, ensuring proper data collection tools, increasing workers’ capacity and motivation through training, supervision and feedback on data will improve data quality (Harrison et al. 2020:2).

Priority problems in immunisation services can be addressed by applying the QI method, which breaks problems into parts and introduces small, rapid, and doable changes for adoption, adaptation, or abandonment at the local level. As data quality is a major problem, proper data collection, analysis, and use are set as priorities for country programs and immunisation partners (Nsubuga et al. 2018:2).

Studies conducted in Mozambique, Rwanda, and Zambia propose the use of the Plan-Do-Study-Act (PDSA) iterative cycle for QI as well as data-use improvement approaches. The essence of PDSA application is to ensure the availability of high-quality data, facilitate data interpretation and review, and use it to plan and allocate resources. Furthermore, in PDSA phases, identify understanding of the data culture and capacity needs; promote and change the data use culture through monitoring and action; evaluate the effects of the change us-

ing high-quality data and prompt change if the approach is ineffective (A Guide For Immunization RED-QI 2015:14).

Figure 2.3: Plan-Do-Study-Act (PDSA) cycle

2.6.2 Utilisation of HMIS to QI of immunisation service in Low- and Middle-Income Countries

Immunisation data remains an underutilised resource in decision-making by healthcare professionals in LMICs. Furthermore, there is a lack of consensus around how to define and measure immunisation data use, and data-informed decision-making is considered as an outcome intervention (Osterman, Shearer & Salisbury 2021:1).

Instead of measures on quality data collection at facility level, many of interventions focused on national, sub-national level or on new technology rather than on people or enabling environment for functional information systems (Scobie, Edelstein, Nicol, Morice, Rahimi, MacDonald, Danovaro-Holliday, Jawad et al. 2020:1). Strengthening it a study in

Uganda shows significant knowledge gaps among health workers at all levels concerning the Reach every child with immunization (REC) microplanning process (Mafigiri et al. 2021:1; The Maternal and Child Survival Program [MCSP] Uganda 2016:1).

Data utilisation is one of the REC components; however, limited attention to REC micro-planning at the facility level has contributed to the persistence of EPI problems, such as inadequate use of data for action, monitoring of vaccine stock and cold chain, supervision and feedback, and community involvement. Studies underline the importance of data use for CQI to system strengthening (Scobie et al. 2020:1).

2.6.3 Utilisation of HMIS for QI of immunisation service in Ethiopia

In Ethiopia, the immunisation program implements cyclic comprehensive Multi-Year Plans (cMYPs) to increase overall vaccine coverage, improve the equity and quality of the immunisation service, and introduce new vaccines. However, low coverage and quality of immunisation services persisted since their launch in 1980, forcing the country to implement various strategies such as Universal Children Immunization (UCI) and RED/REC since 2003 (FMOH-E National Expanded Program of Immunization-2015-2020:9, 29).

HMIS information has been used for monitoring and evaluation of immunisation services in Ethiopia since 2009, but improvements in immunisation reporting have been recorded since 2012. Poor documentation, dissemination of routine and other source information, and defaulter tracing persisted as challenges for immunisation services at the district and health facility levels. Currently, 10% (13) of HMIS indicators in Ethiopia are immunisation-related indicators; however, they are used only for monthly/quarterly reporting from facilities to higher levels, and the use of data for quality assurance mechanisms is not in place (FMOH-E National Expanded Program of Immunization-2015-2020:63).

Studies in the country indicate that functional HIS that documented required information raised full immunisation coverage among children by 22%, whereas poor documentation and missing cards affected the estimation of immunisation coverage. The same study re-

veals source document completeness of 85%, data quality of 63% and use of information for RHIS Quality Improvement of 45%, all of which are far from the expected 90% national target (Worku, Alemu, Belay, Mohammedsanni, Denboba, Denboba, Mulugeta, Omer, Abate, Mohammed, Ahmed, Wondarad & Abebaw 2022:6).

Scientific literature in Ethiopia further demonstrates that regional disparities, weak administrative capacity, poor reporting, and a shortage of skilled human resources are serious challenges for the nation's immunisation programme. Moreover, understaffing of health centres and scarcity of HMIS guidelines for recording tools, indicator reference and information use are persistent gaps (Manyazewal 2017:6). Data quality is compromised due to over-reporting of immunisation data from primary health facilities (Madebo, Gezie, Teklu, Mekonnen, Shahabuddin & Binyam 2020:1).

Without effective utilisation of micro-level health information, it proves difficult to promote and maintain the quality of health (immunisation) service across levels (FMOHE, Information Revolution Roadmap 2016:114). Data-driven CQI interventions enable the system to effectively assess, improve, and continuously follow up on immunisation programs. The integrated QI pilot implementation in Ethiopia has not only improved quality but also enhanced coverage of maternal health services; however, the intervention remained at the pilot level (Hagaman et al. 2020:1-2; Manyazewal et al. 2018:23).

A study, on the contrary, states that poor data quality is a substantial challenge to the quality initiative in Ethiopia. Health facility level information use remained at 46%. There also persisted poor agreement between HMIS and survey data. Studies indicate that HMIS over-reports coverage of key indicators, such as immunisation and antenatal care services (Nicol et al. 2017:1; Hagaman et al. 2020:1, 6, 9).

Discrepancy between HMIS and survey data is evidenced by the EDHS 2016 that reported Penta-3, Measles and fully immunized children coverage of 53%, 54% and 22% respectively, but RHIS report for the same year same vaccines showed the coverage rates of 97%, 96% and 91% respectively (FMOH-E ARM Performance 2016:34). Moreover; Ethiopia's

immunization coverage faces persistent discrepancies among administrative, survey and WUENIC data estimates which has characterized its immunization system unable to find trusted data source for estimation of immunization service (Pond, Bekele, Mounier-Jack, Teklie & Getachew 2021:1).

Limited use of data for action and less-than-optimal community involvement, along with irregular supervision, are findings of the EPI REC approach review in Ethiopia. The review further finds gaps in operationalising REC components, indicating vaccine stockouts and a non-functional cold chain (UI-FHS Ethiopia 2015:5, 8).

Ethiopia's immunisation system targets to protect 3 million annual births against VPD, service delivery follows the WHO immunization schedule and provides one dose of BCG, OPV0 at birth, three doses of Pentavalent (DPT-HepB, Hib) along with PCV at 6^{th}, 10^{th} and 14^{th} weeks of infant life and Rota-virus vaccine on 6^{th} and 10^{th} weeks and finally Measles, the indicator, of fully immunized status on ninth month (Yadita & Ayehubizu 2021:2). The country is still among those experiencing repeated outbreaks of VPD (Manyazewal et al. 2018:2).

The immunisation system achieved improvement due to concerted efforts, though these efforts have not been integrated and cultivated by locally fit QI systems to sustain the coverage. In addition, immunisation coverage is centrally monitored through casual visits, with less autonomy and fewer opportunities given to the district health office to resolve bottlenecks onsite. Yadita and Ayehubizu (2021:2) assert that a significant proportion of children have not been immunised, thus deaths at early ages from VPD in Ethiopia are among the highest in the world.

As opposed to this, a study proves interventions, namely, HMIS training, regular supportive supervision and feedback, and supplies have improved data quality and information use for decision-making (Gonete, Yazachew & Endehabtu 2021:10).

More studies recommend addressing the scarcity of training and capacity-building in data use. Another study emphasises the implementation of the human development model intervention. This model intervention includes competence-based training, mentorship, supportive supervision, experience sharing and QI initiative, and implementation of the initiative has improved data quality and information use both at health facilities and administrative levels (Ayele, Biruk, Habtamu, Taye**,** Sisay & Getachew 2021:2).

2.7 DEVELOPING DATA USE SKILL OF IMMUNIZATION SERVICE PROVIDER

Data management and information use would improve if data producers and information users had adequate skills, a favourable attitude, motivation, and were supported by an organisational culture that favours learning and development. Muhindo et al. (2016:4) support this, stating that if information is used for service delivery improvement and staff find it helpful to learn from to improve performance of their organisation, HMIS data can be used as an organisational development tool. Nwankwo and Sambo (2018:7) have more on this, stating that if staff have skills in analysis and interpretation, and understanding of why data should be used, the data use is likely to be improved.

Bruce (2014:8) emphasises ensuring staff accountability and strengthening staff data-use behaviour through training, supervision, and feedback aligned with organisational and stakeholders' priorities. Studies often cite that frontline health workers undermine their role in producing quality data and in using information effectively (Muhindo et al. 2016:4). Additionally, the capacity of information systems to improve quality, efficiency, and enable learning health systems remains an unanswered question (Leon et al. 2020:20).

Improving information utilisation in the system, including lower levels, will require transformation of health facilities and the health system to a learning organisation through change management (Teklu et al. 2018:3; Muhindo et al. 2016:3). HMIS data use in program evaluation, QI of healthcare contributes to a culture of information use and organisational success (Nshimyiryo et al. 2020:10; Aqil et al. 2020:4).

Strengthening the routine information system through the use of data to track quality over time and evaluate improvement efforts requires policy support to quality of care measurement (Akachi & Kruk 2017:4). A data-driven approach of QI in implementing, multiple testing and sustaining the changes would improve data use (Knox & Brach 2015:11). This continuous process of QI provides a typical opportunity for ongoing learning through application of individual creativity and sharing experience.

2.8 SUMMARY

Despite substantial investments in HMIS infrastructure and training in LMICs, including Ethiopia, utilisation of routine health data remains suboptimal. The Ethiopian HMIS reform of 2008 and the Information Revolution 2016 have produced less than the intended effect on the culture of information use, yet evidence is inconclusive about their effect on improving the quality of data. Studies consistently demonstrate that Ethiopian HMIS operates primarily as a reporting-driven mechanism rather than a tool for data-driven decision-making for programs and quality of care improvement. This literature review reveals a gap in integrated approaches addressing technical, organisational, and behavioural determinants of information use at the point of service. In particular, the role of HMIS in improving immunisation service quality through information utilisation has received insufficient attention, underscoring the need for a context-specific, mixed-methods study aimed at guideline development.

CHAPTER 3: RESEARCH DESIGN AND METHODS

3.1 INTRODUCTION

This chapter presents and discusses the research methodology of the study. This is a foundation of research credibility, validity, and clarity. It comprises the research design and methods for developing data collection tools, data collection, data analysis, interpretation, discussion, and validation. The methodology, results, and discussion rest on a theoretical framework linked to the study problem that guides the choice of research design, methods, and data analysis plan (Fox & Jennings 2014:5, 8; Adom et al. 2018:2).

The study problem of poor data quality and inadequate information use is situated in an integrated PRISM-MFI theoretical framework, which guided the selection of Explanatory Sequential Design of Mixed Methods. The theoretical framework provides a structure for expressing a study philosophically, epistemologically, methodologically, and analytically (Adom et al. 2018:2). Philosophically, this study applied the pragmatic "what works" philosophy; thus, it holds that true knowledge is gained through Mixed Methods complementarity (Creswell & Creswell 2018:56**).**

3.2 RESEARCH PARADIGM

A research paradigm is a system of beliefs and practices that shapes how researchers understand reality, formulate research questions, choose methods, and interpret findings. It provides a philosophical framework for addressing a research problem by offering guidance on what constitutes valid knowledge and how it can be acquired. In essence, a paradigm influences the entire research process, from problem identification to data interpretation, based on certain ontological and epistemological assumptions (Maarouf 2019:5; Shannon-Baker 2016:3).

This study is guided by the pragmatic paradigm, which prioritises the research question above philosophical purity. Pragmatism holds that researchers should adopt methods that

best address their specific questions, regardless of whether those methods are traditionally associated with qualitative or quantitative traditions (Kaushik & Walsh 2019:5, 11). As such, pragmatism supports methodological pluralism and promotes the use of mixed methods to generate comprehensive, practical, and actionable knowledge.

The pragmatic worldview was deemed most appropriate for this study, which seeks to understand the factors influencing the quality of routine health information systems (RHIS) data, the use of that data in immunisation service delivery, and the experiences of healthcare professionals in using Health Management Information Systems (HMIS). These complex, multifaceted issues require both quantitative analysis of patterns and relationships and qualitative insights into the contextual and behavioural dynamics that shape data use.

By embracing pragmatism, this study is able to integrate objective measurement with subjective interpretation, thus achieving a richer and more practical understanding of HMIS performance.

3.3 RESEARCH APPROACH AND DESIGN

3.3.1 Research approach

This study adopted a mixed-methods research approach, which integrates quantitative and qualitative approaches to comprehensively address complex research questions. Specifically, it examined the quality of routine health data and the influence of TOBfactors on the generation and use of HMIS data, while exploring healthcare professionals' experiences in utilising information to improve immunisation services.

Mixed methods research is particularly suited for health policy and systems studies due to the complexity of interventions and contexts. It enables triangulation, complementarity, and corroboration of findings, thereby enhancing trustworthiness and validity by combining numerical data with contextual insights (Polit & Beck 2017:836). The approach provides a deeper understanding of phenomena that would otherwise remain incomplete if investigat-

ed using a single method (Shannon-Baker 2016:3; Maarouf 2019:3; Shorten & Smith 2017:3; Guest & Fleming 2015:2). Its growing application in health systems research reflects pragmatic considerations, as it allows the use of multiple approaches to generate convincing evidence beyond epistemological debates (Allegri et al. 2018:2; Guest & Fleming 2015:2).

The rationale for mixed methods includes triangulation, development, initiation, expansion, and complementarity (Alatinga & Williams 2019:3). In this study, quantitative data provided a broad understanding of patterns and relationships, while qualitative data refined and explained these findings by exploring participants' experiences in depth, thereby contextualizing and enriching the results (Ivankova, Creswell & Stick 2006:3: Rose & Bowen 2017:3). This integration helped clarify complex influences of TOB factors on HMIS data management and information use and offered insights into how data-driven decisions support quality improvement in immunization services.

In Mixed methods' research approach within one study qualitative and quantitative data are collected and analysed by the researcher (Shorten & Smith 2017:2). The justification for both type of data within the same study is grounded in the fact that neither or nor quantitative and qualitative methods are sufficient by themselves to capture the trends and details of a situation (Rana & Chimoriya 2025:3). Many research questions in public health are more complex than to be adequately answered with a mono-method approach. Mixed Methods enable a researcher to practically address research questions of complex phenomena without rigid adherence to a single approach. Incorporating both qualitative and quantitative components in a research design can help address most of those research questions (Guest & Fleming 2015:3).

Neither a quantitative nor a qualitative approach alone can sufficiently address a research question of how HMIS can be used to strengthen data quality; thus, a hybrid approach of quantitative and qualitative inquiries is necessary. While research questions related to existing data management processes and the extent of information use can be effectively examined through quantitative inquiry, other dimensions—such as health professionals' lived

experiences with data generation, utilisation, and quality improvement, including underlying reasons for poor data quality and limited information use—require qualitative exploration. The mixed methods provide comprehensive and convincing evidence, encouraging inter-disciplinary collaboration and the use of multiple paradigms (Polit & Beck 2017:812; Howitt 2017:67).

This study adopted a sequential explanatory mixed methods design, which begins with the collection and analysis of quantitative data, followed by a qualitative phase (Guest & Fleming 2015:7, 11; Creswell & Creswell 2018:45). The initial quantitative phase provides a broad understanding of the research problem by identifying general patterns and trends through statistical analysis. The subsequent qualitative phase builds on these findings by exploring participants' perspectives in greater depth to clarify, elaborate, and contextualize the results (Wipulanusat, Panuwatwanich, Stewart & Sunkpho 2020:3). The theoretical framework, also, guides the type of data to be captured for a particular study and data analysis plan (Adom et al. 2018:2). The PRISM-MFI theoretical framework applied in this study guided the development of the survey (questionnaire) and Focus Groups Interview guides for the data collection in two phases, respectively.

3.3.2 Research Design

A sequential explanatory mixed methods design was employed for this study. The term ‘explanatory’ highlights the use of qualitative data to further interpret the quantitative outcomes, while sequential denotes the ordered structure of the two phases (Polit & Beck 2017:822; Creswell & Creswell 2018:47, 287, 303-304, 309). The research design functioned as a guiding framework for data collection, measurement, and analysis, enabling the generalisation of findings from the sample to the broader population (Uusitalo 2014:18; Sandy 2019:4). According to Creswell & Creswell (2018:39), research design occupies the third level in the hierarchy of research planning, following the research paradigm and approach. The hierarchy includes four essential components: research paradigm, research approach, research design, and research methods.

The explanatory sequential design is characterised by the collection and analysis of quantitative data in the first phase, followed by the collection and analysis of qualitative data to further explain or elaborate on the quantitative results, as explained by Molina-Azorín (2016:1). This design is particularly useful when quantitative results yield unexpected findings or require deeper insight. The qualitative phase, thus, essentially enhances the overall understanding of the research problem (Toyon 2021:2-6; Ivankova et al. 2006:3). Such a design may assign equal or unequal weight to each phase, depending on the nature of the research questions and the complexity of the phenomena being studied.

In this research, greater emphasis was placed on the quantitative phase, which allowed for a broad assessment of HMIS implementation, including performance levels and the influence of TOB-related factors. The qualitative phase was then used to clarify and deepen understanding of key findings by exploring participants' views in more detail (Wipulanusat et al. 2020:3).

Implementing the quantitative phase first aligned with the study's objectives: (1) to assess HMIS data management practices, (2) to determine the level of information use in immunisation services, and (3) to identify factors influencing both. Using a large sample size and statistical techniques, the researcher was able to detect significant differences in information use across variables such as professional category, years of service, and educational level, availability of standard tools and quality improvement initiatives. These quantitative results were then further clarified during the qualitative phase, which explored the contextual explanations behind the statistical trends (Molina-Azorín 2016, 1; Creswell & Creswell 2018, 287).

The strength of the Sequential Explanatory Method in this study was that quantitative results on data management in relation to the attributes (e.g., specific work experience, professional quality, etc.) of the participants were further explained by their attitude and practical experience in managing data using qualitative results. Quantitatively identified contributing factors of information use were further explained by participants' perceptions of barriers and enablers to information use for the quality improvement of immunisation services.

In summary, Sequential Explanatory Design is applied to better address research questions about the type of HMIS data management process in practice, the extent of information use, and the factors that favour or hinder data management and information use in managing immunisation services at frontline health systems, using quantitatively analysed data. Whereas the question of how the experience of information use among health staff to manage immunisation service quality is understood through qualitatively analysed data.

3.3.2.1 Quantitative research design

The quantitative phase applied a cross-sectional study design. Cross-sectional designs involve collecting data on individuals at a single time point. The study allows a researcher to draw inferences about the relationship between independent and dependent variables; however, it does not establish causality or establish a temporal relationship (Tapera 2021:25; Babones 2016:39). Quantitative data of this study were collected in a single time span of April 14 to 30, 2023, using a structured self-administered questionnaire and collected data from 412 study participants. The participants were randomly selected using probability sampling, specifically multistage (cluster) and stratified sampling with probability proportionate to size (PPS). Data analysis used descriptive and association testing, using SPSS software. Descriptive analysis was conducted to determine the extent of information use, and a chi-square statistic was used to test the relationship between the dependent variable (utilisation of RHIS information) and independent variables, including technical, organisational, and behavioural determinants of RHIS performance (information use).

3.3.2.2 Qualitative research design

The qualitative phase of the study employed a qualitative descriptive design, which is commonly used in nursing and healthcare research. This design typically focuses on understanding experiences of illness and related healthcare interventions. Descriptive qualitative design is frequently employed in mixed-methods research, where qualitative data helps explain quantitative findings in explanatory studies. It is well aligned with the pragmatic research paradigm, which underpins this study's methodological and philosophical approach.

The primary rationale for using a qualitative descriptive design is to provide straightforward descriptions of experiences and perceptions, particularly in areas where limited knowledge exists about the topic under investigation (Colorafi & Evans 2016:2; Doyle, McCabe & McCann 2020:2).

Using a qualitative descriptive design, the researcher described participants' experiences and perceptions regarding the utilisation of HMIS to improve the quality of immunisation (health) services. The clarity of the description and interpretation of the data closely reflects a summary of the participants' attitudes, perceptions, and experiences. The literature cites that studies applying a qualitative descriptive design provide clarity regarding the rationale and methods of the study; describe participants' experiences; and have findings that directly reflect the terminology used in the research questions throughout the study (Colorafi & Evans 2016:2; Doyle et al. 2020:2).

This study is implemented in four phases**.** Phase 1 began with a quantitative approach, involving the collection and analysis of quantitative data. The findings of phase one are used to refine the data collection tool in the second phase. In the second phase of the study, qualitative research was conducted through focus group interviews, engaging both data producers and users at the health facility level. In the integration (Phase 3), each phase of explanatory design was triangulated to synthesise the findings. Survey data provided general patterns and breadth, while focus group interview data reflected experience and depth. This process contextualised and enriched the quantitative findings. Moreover, integration connected the quantitative results to the qualitative data collection (Rose & Bowen 2017:3; Creswell & Creswell 2018:287).

The development and validation of guidelines are done in Phase 4. Three different interconnected practical guidelines are developed. These are:

1. Data quality improvement guideline,
2. Information use guideline, and

3. Immunisation service quality improvement guideline.

The guidelines development process, Phase IV, of this study created a group of experts and invited them to a subsequent discussion. The proposed guidelines were not only informed by qualitative and quantitative findings but also enriched by recommendations of experts in the field, and were validated by iterative expert reviews and a validation workshop. Thus, synthesis of evidence, feedback from experts and the validation process, as well as literature reviews, were translated into implementable strategies in the guidelines

3.4 RESEARCH METHODS

A research method is a systematic technique used to structure a study, collect data, and analyse information relevant to the research question (Polit & Beck 2017).

3.4.1 Study setting

Addis Ababa is the capital city of Ethiopia and one of the two city administrations at the level of regional state administrative autonomy in the country. Ethiopia is politically and administratively divided into 10 regions and two city administrations. The study selected the city administration and settings under a random multistage sampling procedure as described in the appropriate section below. The region is further divided into zones and districts. The city administration is divided into sub-areas and districts.

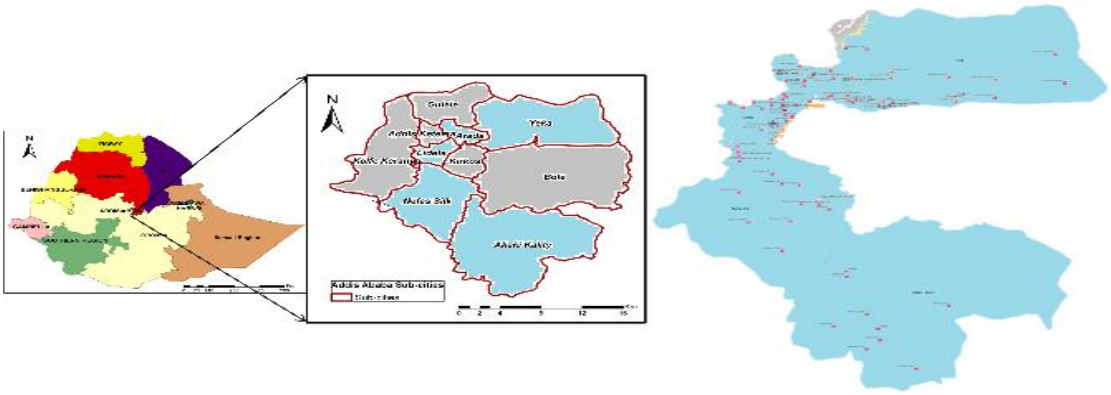

Figure 3.1: Location map of the study area in Addis Ababa, Ethiopia

Source: Seifu and Stellmacher (2021:3). Keys: SC (Sub-city), Hosp (Hospital), HC (Health Centres) and CADHB (City Administration Health Bureau). The light blue colour in the map represents the study subcities

This study was carried out in two settings: health facilities (health centres and hospitals) and health offices (sub-city and city administration offices) in Addis Ababa, as shown in Figure 3.1. The Addis Ababa region (city) has 10 sub-city health offices, 6 hospitals, and 98 health centres. The sub-cities' offices and hospitals are accountable to the Addis Ababa city health office, whereas the health centres are accountable to the respective sub-city health office.

The facilities implement both HMIS and Quality improvement initiatives. The health facilities and health offices began implementing the reformed HMIS in 2008 and the electronic HMIS (DHIS) in 2017.

3.4.2 Phase 1: Quantitative method and objectives

Quantitative research methods involve the collection and analysis of numerical data, offering advantages in terms of precision, objectivity, and generalizability (Ahmad, Irfan, Wasim & Gogoi 2019:3). These methods are particularly suited to measuring causal relationships between variables using a value-free, empirical approach, and rely on the application of statistical techniques for systematic analysis (Maarouf 2019:2; Polit & Beck 2017:260).

In this study, quantitative data were collected and analysed to assess the data management processes within the Health Management Information System (HMIS), determine the extent of information use, and assess the influence of Routine Health Information System (RHIS) determinants on both data management and information use. This phase addressed Objectives 1-4 of the study, using statistical analysis to test associations and predict outcomes.

The theoretical foundation of the study integrates the Performance of Routine Information System Management (PRISM) framework, which posits that RHIS performance is shaped by RHIS processes, which are themselves influenced by RHIS determinants. This theory guided the development of the first four objectives, enabling empirical testing of the connections between data processes, determinants, and performance outcomes. As Polit and Beck (2017:86) note, theory-driven research allows predictions to be tested and subsequently accepted, refuted, or modified.

However, a limitation of the existing PRISM framework is its implicit assumption that RHIS processes are sufficient to guarantee RHIS performance, particularly in the area of continuous information use. In practice, sustained information use also depends on the presence of a defined aim or purpose. To address this gap, the study draws on the Model for Improvement (MFI), which introduces the concept of setting an improvement aim and using the Plan-Do-Study-Act (PDSA) cycle for iterative quality improvement. Although MFI emphasises the importance of quality data for informed decision-making, it does not explicitly address the data generation processes required to support such improvement. The quantitative results of this study highlight the potential for an integrated PRISM-MFI framework to connect RHIS performance with quality improvement in immunisation services.

Objective 1: Assessment of data management processes

The first objective focused on examining data management processes in health institutions, including data collection, transmission, quality checking, analysis, display, and feedback. This objective also explored the knowledge and skills of staff and the availability of human and material resources necessary to execute these processes (Abu & Toyon 2021:6). The quantitative data quantified the types and frequencies of these processes, expressed as percentages and trends, and assessed the association between process effectiveness and input availability. These processes were analysed in relation to Technical, Organisational, and Behavioural (TOB) factors, which are widely recognised as influential determinants of RHIS functionality (Belay et al. 2013:5; Lemma et al. 2020:2).

Objective 2: Influence of TOB factors on data management outcomes

The second objective assessed the influence of TOB factors on the performance of RHIS data management processes. A quantitative approach is well-suited for identifying factors that influence outcomes, evaluating the utility of interventions, and determining the best predictors of performance (Creswell & Creswell 2014:50). The study statistically tested the association between each TOB component and the quality and effectiveness of data management practices. TOB factors are defined as independent variables, and data management processes: practices of data quality check, data analysis, data interpretation, and data feedback are dependent. The data management processes are independent variables, while information utilisation is a dependent variable.

Objective 3: Level of HMIS information use

The third objective sought to determine the extent of HMIS information use in the management of immunisation services. Existing literature shows that information use among health workers ranges between 37% and 69.3%, with only 45% of facilities reportedly using HMIS data for managing immunisation services (Kebede et al. 2020:7; Teklu et al. 2018:2). These levels fall significantly below Ethiopia's national target of 90% (Worku et al. 2022:6).

In this study, quantitative analysis was used to assess participants' knowledge and experience regarding data quality, information use, and quality improvement. The statistical analysis examined the relationship between the outcome variable (information use) and predictor variables such as data quality and purpose of HMIS data use (Yannis & Nikolaos 2018:2).

Objective 4: Effect of TOB factors on information use

The fourth objective examined the effect of TOB factors on the use of information in immunisation service management. In this analysis, TOB factors were treated as independent (predictor) variables, and information use as the dependent (outcome) variable (Babones

2016:24). The study tested the strength and significance of these associations through multiple layers of statistical analysis.

3.4.2.1 Study population

In research methodology, a population refers to the entire aggregate of elements of interest to a researcher, or to the characteristics of a specific group for which the researcher seeks information. It is subdivided into the target population and the study (accessible) population. Target population denotes the population group to which the results of the study can be generalised, whereas the study population is the accessible section of the target population from which the sample of the study is selected, based on its conformance to designated criteria (Omair 2014:2; Polit & Beck 2017:365; Prabhat 2017:41).

The target population of the study comprises health professionals and HMIS workers who were either producing HMIS data or using HMIS data to improve the quality of immunisation in Addis Ababa city. This study population comprised HMIS workers and health professionals engaged in either producing HMIS data or using its information to improve the quality of immunisation services in the study sub-cities of Addis Ababa.

The size of the study population was 1077, with segments of 734 (68%) health professionals and 343 (32%) HMIS workers serving at facilities and offices under the Addis Ababa city health bureau, that is, in ninety-eight health centres, six hospitals, and ten sub-city health offices and one city administration health office.

This population was appropriate for the study, as HMIS workers and officers were primarily engaged in producing data and information for decision-making across the stages (levels) of the health system in the study area. Likewise, the health professionals were generating HMIS data during client encounters at service delivery points or using HMIS information to improve immunisation service quality at their respective health institutions. Thus, they have shared experience and own the desired study information regarding data production tools,

data management processes, and data quality assurance mechanisms to improve immunisation service quality.

3.4.2.1.1 Sampling and sample size

Probability (random) sampling techniques that ensure every item in the universe has an equal chance of being included in the sample are applied in this study. Random sampling represents the population and allows the researcher to infer the sample results to the general population by generating data without bias. Type of probability sampling methods subsumes simple random sampling, systematic random sampling, stratified random sampling, cluster sampling and multistage sampling (Etikan & Bala 2017:3).

In multistage sampling, the researcher begins by identifying clusters, such as groups or institutions, then obtains the names of individuals within those clusters, and subsequently selects a sample from within them (Creswell & Creswell 2018:247). This sampling method can be used in combination with various methods of probability sampling for the most effective and efficient approach. It can also combine probability and non-probability sampling. e.g., the first stage can involve the non-random selection of study sites. Then, people within can be selected through random procedures (Etikan & Bala 2017:4).

This study applied multistage (cluster) and stratified sampling with probability proportion to the size (PPS) sampling technique. Multistage (cluster) sampling is a successive stage selection of random samples from large units (clusters) to smaller units or individuals by either simple random or stratified random methods.

In this study, the sampling process involved more than two stages, progressing from broader to more specific units: starting with the Addis Ababa City Administration (regional level), followed by sub-city health offices, health facilities, and finally individual health workers. This approach also involved cluster (subcities) selection. In multistage sampling, researchers may either rely on existing administrative divisions or subdivide areas into small-

er, equal units (Etikan & Bala 2017:2). A subset of these clusters is then randomly selected to form the overall sample.

Firstly, the Addis Ababa City Administration is randomly selected from among the twelve regional states and city administrations in the country. The city is administratively divided into ten sub-cities, of which five were randomly selected. Secondly, a total of 39 health centres and 3 hospitals were randomly included out of 98 health centres; 6 hospitals were found in the selected clusters. A stratified random sampling method was applied to select the study samples based on predetermined characteristics (for instance, assumed skill variation in the use of routine health information). This sampling technique confirms that the sample contains nearly the same proportion of the specified criterion as in the study population.

Lastly, individual study participants were selected using a stratified random sampling method, applying the Probability Proportional to Size (PPS) sampling technique to ensure representation of samples by facility size. Participants can be selected in proportion to the stratum's (different health institutions') population size using proportionate stratified sampling. This is important when the outcome variable being studied is directly related to that characteristic, for example, employees' employment satisfaction and income level (Omair 2014:6).

The study population was stratified into two strata: health information workers and health professionals, based on their employment category. The variable of interest (outcome variable) under study is health information use, which may be closely related to the employment category, namely, HMIS workers and health professionals. For example, a health professional's role may be more closely associated with information use, whereas that of HMIS workers may be more closely related to data quality assurance tasks through data management processes.

In PPS sampling, the chance of selecting each sample unit is equal to that in simple random sampling. But units often vary in size, and the probability of selecting a sample from a given unit depends on its size. The probability of selection may be assigned to the propor-

tion of the sizes referred to as the probability proportion to sampling size (PPS) (Alam, Sumy & Parh 2015:1). The study participants, health professionals and HMIS workers were a large population. The health professional unit (strata) is larger, comprising 734 (68%) of the study population, whereas the HMIS workers unit is smaller, comprising 343 (32%). Accordingly, the probability of selecting health

At the individual stage, selection of the multistage sampling, either all individuals within the selected entity can be enrolled, or a proportion of individuals within chosen areas can be selected at random (Fox, Hunn & Mathers 2009:9; Uusitalo 2014:52). As the study used stratified multistage sampling with probability-proportional-to-size sampling (PPS) techniques. Individuals were selected from strata representing health professionals and health information workers. This approach, therefore, constituted multistage, cluster-based stratified sampling (Rahi 2017:3; Polit & Beck 2017:376). Figure 3.2 illustrates a visual representation of the sampling process followed. Based on inclusion and exclusion criteria, 287 health professionals and 135 HMIS workers were enrolled in the sample, with probabilities of 0.68 and 0.32, respectively, and these proportions were maintained across health facility subclusters according to each population's size. Refer to Figure 3.2 below.

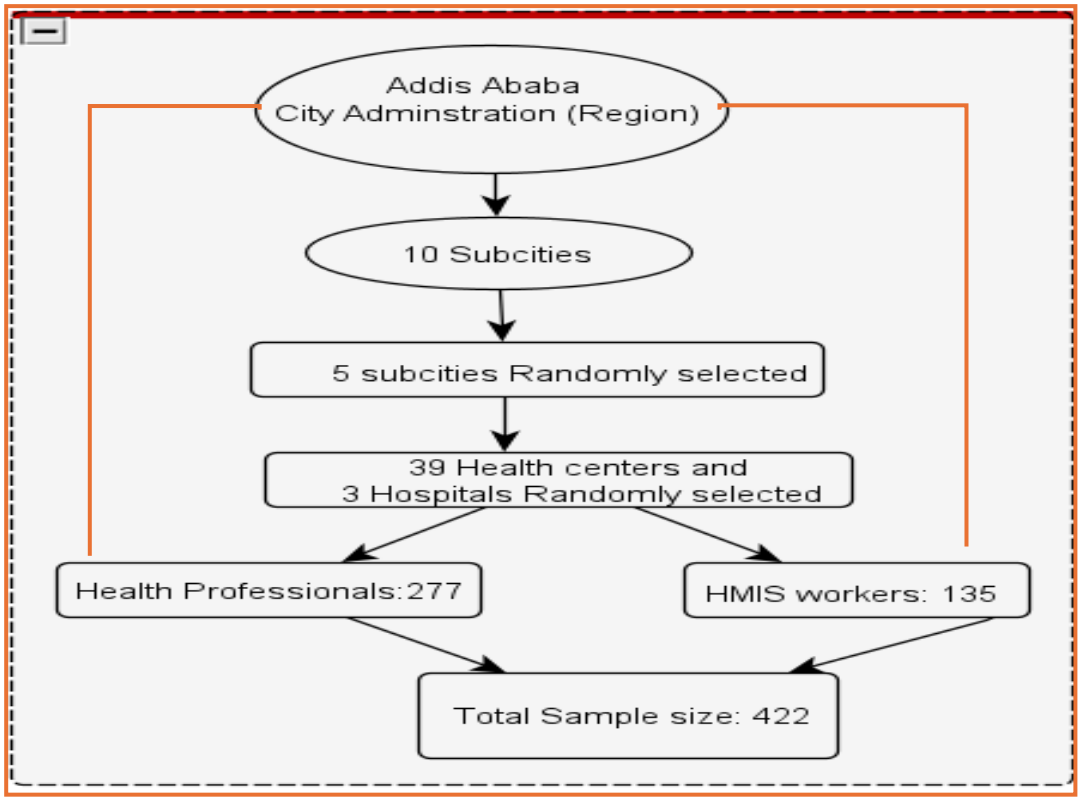

Figure 3.2: Sampling process followed

- **Inclusion criteria:**

At the health facility level, health staff who have been using HMIS for over one year include:

Immunization service provider.

Quality improvement focal person.

Planning focal person.

Communicable diseases control focal person.

Maternal and child health focal person.

Head or director of a health facility.

At the health office level, an officer or manager who has held a position for over one year as:

Immunization officer.

Quality improvement officer.

Communicable diseases control officer.

Maternal and child health officer.

Plan and program head.

Head or director of the health office.

- **Exclusion criteria.**

Health professionals and health information workers who did not serve in the above-specified levels were excluded.

Determination of sample size: The sample size of this study was based on a 50% prevalence of the single population proportion. There are no established figures regarding the prevalence of RHIS information use for health service quality improvement. We use a 50% estimate to compute the sample size. The 50% proportion represents the population proportion that possesses the skills and knowledge to use information to improve immunisation (health) service quality. This proportion applies to both the health professional and HMIS worker categories. The confidence interval was set at 95% and a 5% degree of precision to be the true measure of the general population from which the sample was drawn. Zα2 is the table value of the confidence interval, which is 1.96 at a 95% confidence interval and 'p' represents the population proportion. The single population proportion formula was used; the final determined sample size was 422 study participants, as follows.

$$n = \frac{Z\alpha 2\ P\ (1-P).}{d2}$$

Where Zα2 = 1.96. (P) is a proportion of health workers who have knowledge and skills in using information for immunisation service quality improvement = 0.50. D = 0.05 precision rate. 1.96^2 *0.5*0.5/0.0025 = 384 + 10% none-response 38, hence total sample size = 422.

The total sample size calculated was 422; however, the study population comprises two strata, as described above: 68% health professionals and 32% HMIS workers. Using the probability-proportionate-to-size sampling technique, 277 health professionals and 135 HMIS workers were included in the sample (Figure 3.2). The same PPS sampling allocation was maintained at every stage where sample units were selected.

For example, at the regional and sub-city health office level, 24 health professionals and 12 HMIS workers were randomly selected and enrolled in the sample. From 3 hospitals, 24 health professionals and 12 HMIS workers were selected randomly. Likewise, from 39 randomly selected health centres, 238 health professionals and 112 HMIS workers were enrolled (Figure 3.2).

3.4.2.1.2 Data collection approach and method

The quantitative data collection utilises a questionnaire (Annexure H). A questionnaire is a systematic compilation or written list of questions offered to a sample population from which information (answers) is required (Polit & Beck 2017:260). The structured self-administered questionnaire method is the most common technique of gathering quantitative data in health and social science research (Roopa & Rani 2012:1). The strengths of the questionnaire method include advantages of cost, anonymity, and minimal interviewer bias; it can be delivered at the workplace of the participants to result in a high response rate. Moreover, the self-administered questionnaire can be distributed to a group of people who complete the instrument at the same time. Administering a questionnaire in a group ensures a high return of completed questionnaires and allows respondents to ask clarification questions (Polit & Beck 2017:104, 260, 409).

The anonymity provided by the questionnaire method encourages more candid responses, often revealing socially undesirable viewpoints or behaviours that participants may be less willing to disclose during interviews. Moreover, the structured questionnaire method yields data that are relatively easy to analyse, as the data can be promptly quantified (Polit & Beck 2017:260, 405).

Questionnaire application requires a specific purpose related to the research objective and clarity from outset how findings will be used (Roopa & Rani 2012:1). The questions were established with an aim at collecting various types of data related to demographic information, personal opinions and facts about data formats, software and data management in practice, and satisfaction of the respondents in relation to a study problem (Aithal & Aithal 2020:4).

The questionnaire is used to address the quantitative phase's study objectives. Accordingly, it enabled the researcher to measure institutional efforts and individual knowledge and skills related to HMIS implementation. Additionally, to test the complexity of HMIS, HMIS data use, and the concepts, details, and practice of quality improvement.

3.4.2.1.3 Development and testing of the questionnaire

The research objectives, literature and PRISM-MFI theoretical frameworks informed the tools development process to properly address the study topic and objectives. The creation of the questionnaire was an iterative process. The questionnaire underwent several revisions by the researcher and supervisor. Some sensitive questions, likely the participant draws on hesitation, are either avoided or given prior explanation on their importance (Babones 2016:69). The questionnaire was pretested in a similar set-up in Addis Ababa city. The test health centre, hospital, and health office were selected from sub-cities not included in the study, unlike the setup where actual data collection took place.

3.4.2.1.4 Layout (characteristics and content) of the questionnaire

The questionnaire had seven Parts. The internal consistency of subparts was measured using Cronbach's alpha test. Part I, the identification section, comprised three open-ended questions. These include questionnaire ID number (anonymous), date of questionnaire completed, and the address of the data coordinator. The open-ended questions were used for self-completing the assigned questionnaire ID number and the date the completed questionnaire was returned by the participant. The data coordinator filled his/her address upon receipt of the enveloped questionnaire and checked the completeness of the questionnaire. The name of a respondent was not part of the request in the questionnaire (anonymity is maintained) throughout.

Part II, the socio-demographic status part of the questionnaire, contained one open-ended question and seven closed questions, with 'other: specify' options for completeness. These questions contributed to the study to obtain non-overlapping, mutually exclusive, and exhaustive responses for easier data analysis. This section of the questionnaire was intended to collect pertinent socio-demographic data relevant to the research questions.

Part III, data management process in relation to knowledge, experience, skill, and status of required resources. This part consists of eleven multiple-response questions and one 'Yes' 'No' response question with an 'I do not know (IDK)' option. Multiple questions contributed to the result of the study by measuring skill and practice among the participants in assessing the data management process, and dichotomous responses 'Yes' and 'No' contributed to the result. The third section of the questionnaire is directly related to the type of data management processes accomplished at health facilities, assessed by the study.

Part IV of the questionnaire was about technical determinants of the data management process: complexities of forms, IT use, computer software, guidelines, and HMIS design. This part involved fourteen closed-ended questions; three of them were Likert scale questions with a 5-point scale, and eleven were multiple-choice questions. The use of a 5-point Likert scale contributed to measuring the attitude of the participants to HMIS tools and data

software complexity. Parts four, five and six are related to the study question of what factors influence data management processes and information use for immunisation service quality improvement.

A Likert scale is a psychometric scale that has multiple categories from which participants select to show their opinions, attitudes, or feelings about a specific issue. It has most frequently been used in investigations of individual difference variables, such as motivation, anxiety, and self-confidence (Beglar & Nemoto 2014:2).

Part V data included organisational determinants of the data management process, such as management functions and resource availability, which had 11 questions, with six of them having multiple responses, and five 'Yes' or No' response questions with IDK options.

Part VI data focused on behavioural determinants of the data management process, such as data demand, areas of data demand, data quality-checking skills, and knowledge, skill, attitude, perception, and motivation related to data management. This part included 11 questions that are closed-ended multiple-choice and single response, 'Yes' or 'No' response and Likert scale questions.

Part VII covered the extent of information use, its purpose and frequency, knowledge and skills, organisational culture, and the experience of information use. This final part of the questionnaire had seven multiple-choice responses and one closed-ended question. These sections (IV and VII) were more closely aligned with the study questions of the extent to which HMIS information is generally used and its utilisation for immunisation service

3.4.2.1.5 Data collection process

Prior to data collection, the researcher obtained ethical approval from UNISA (Annexure B). The researcher prepared the information leaflet (Annexure F) and the Informed consent (Annexure G) and shared them, including the ethics approval from UNISA (Annexure C),

with the Addis Ababa city administration health office, specifically with the research and ethics clearance office.

The ethics clearance office, on its part, granted official connection letters (Annexure D to the selected sub-city offices and hospitals to ensure engagement of the study participants. The researcher, with the help of sub-city offices and hospital managers, identified and contacted the study participants and facilitated their consent to participate. The potential participants' profiles (the human resource list served as the sampling frame) were obtained from managers of health institutions. The participants were randomly selected based on the selection. Participants who volunteered and provided signed consent were given a self-administered questionnaire after the information session. The questionnaires were distributed by research assistants who had been previously oriented on the study objectives, ethical considerations, and data collection procedures to ensure consistency and reliability in the process. Participants who were randomly selected but absent on the initial data collection day were contacted upon their return to work to complete the questionnaire. Eight research assistants received training on ethical issues and the content of the questionnaire, including guidance on managing interactions with participants. The research assistants signed a confidentiality agreement (Annexure J) regarding the study information. They participated in pre-testing the tools and incorporated pre-test feedback, as well as distributing questionnaires to participants.

A total of 422 self-administered questionnaires were distributed and collected by research assistants between April 14 and 29, 2023, and this process was carried out over 15 days. This approach enabled the researcher to engage participants in person, facilitating immediate administration and resulting in a high response rate. This also provided an opportunity for trained research assistants to clarify the respondents' responses, which contributed to the collection of accurate data and the completion of the questionnaire. Each participant received a questionnaire in an unsealed envelope distributed by the research assistants. The questionnaire was administered in the workplace of the participants: the health centre, hospital, and sub-city health office, to access more participants at a time. The following day, the research assistants collected the completed and sealed questionnaires, verified

their completeness, and submitted them to the researcher. A high return rate was achieved, 97.6% (412) of the completed questionnaires were returned to the research assistants.

The researcher then entered the data into the study database and securely stored the physical questionnaires in a locked cabinet to ensure confidentiality, safety, and accessibility for potential verification or auditing. In accordance with the University of South Africa (UNISA) research data management policy, all questionnaires will be retained in secure storage for 15 years following completion of the study, after which they will be permanently destroyed through shredding. The participants were exempted from their work routine for completing the questionnaire. The facility managers authorised work hour participation in accordance with granted ethical clearance from the regional health bureau and the city health offices.

The study participants are well educated and could read and understand the questionnaire content. When in need of clarification, participants referred it to trained and self-tested research assistants, who clarified as needed based on the questionnaire instructions. Annexure H is the structured questionnaire for Phase 1 of the study.

3.4.2.1.6 Data analysis

Quantitative data analysis: quantitatively collected data were analysed in a stepwise manner. Data were dual-entered into EPI INFO software Version 7.2.3.1. The outliers and inconsistencies were cleared. The clean data were imported into IBM SPSS software Version 28 for detailed analysis. Univariate analysis was done using frequency tables and graphs. Bivariate and multivariate analyses were conducted by making a cross-tabulation and using an association test, applying the chi-square test. The IBM SPSS Version 28 software is applied for univariate, bivariate and multivariate analysis (Polit & Beck 2017:447).

A univariate (descriptive) analysis is conducted to measure the mean information utilisation rate among staff at health facilities and offices. Univariate analysis is about one variable analysis in a frequency table or graphically (Kumar 2011:265; Babones 2016:73), for ex-

ample, the percentage of staff with experience of data quality, information use and quality improvement (Polit & Beck 2017:304). Univariate analysis is conducted to determine the mean or percentage of individual variables or factors before considering their contribution or relationship to information use (Polit & Beck 2017:105). The association between variables affecting data quality and information use is assessed, and the degree of association between each variable is analysed using bivariate and multivariate analyses.

Bivariate analysis was conducted to assess the strength of association between each independent variable and the dependent variable (in this study, the extent of information use). It was used to determine the extent to which a percentage of information use was related to levels of Quality Improvement, performance monitoring, and the availability of indicators and standard tools. Chi-square test was used to determine whether there was an association between categorical variables, for example, the existence of Quality Improvement and information use. Chi-square is a non-parametric test which can be applied to a categorical variable; it gauges whether there are differences in a frequency table (Babones 2016:101).

Multivariate analysis was conducted to analyse (test) the relative effect (influence) of two or more independent (predictor) variables on a continuous dependent variable (Babones 2016:163). It was also done to examine the relative effect of the independent (predictor) variable on the outcome (response) variable. The combined effect of independent variables, for example, the knowledge and skill of staff and their implementation of Quality Improvement on information use, is analysed. The relative effect of a Quality Improvement initiative on information use was also assessed.

Linear regression and logistic regression analyses were done for continuous and categorical outcome responses to Quality Improvement, and the level of information use accordingly. The linear regression analysis was conducted to predict the extent of information use in relation to the implementation of a quality improvement initiative. The linear regression analysis was done for a continuous outcome response: the extent of information use in relation to the Quality Improvement initiative. The logistic regression analysis was conducted for dichotomous responses (Polit & Beck 2017:593). For the test of association and regres-

sion analysis, multiple responses to variables were coded and converted into binary format ('Yes', 'No' or '1', '0') responses using the version of the SPSS platform.

The chi-square test was used to assess the strength of associations and the level of significance at 0.05 (Kumar & Sharma 2016:25). It was chosen because it calculates observed frequencies and is a non-parametric test. In summary, the finalisation of statistical tests of the findings was completed using a guided mixed-methods approach.

3.4.2.1.7 Validity and Reliability

Internal validity: Internal validity is the degree to which findings from a study directly resulted from alteration in the independent variable(s), and are not the effect of unmeasured confounding variable (Fox & Jennings 2014:1; Kumar et al. 2018:7). It concerns the validity of response given that an empirical relationship exists, it is due to independent variable, rather than something other that caused the outcome (Polit & Beck 2017:318).

The study participants share similar experiences and settings. Items of the study instrument were cross-checked through pilot testing to confirm that they carry the same meaning to the study participants. Statistical tests were applied to assess the strength of association between the study variables. The researcher checked the accuracy of the findings by comparing the study results with those of similar studies in the literature.

This study explained findings on the influence of technical, organisational, and behavioural factors on the HMIS data management process and information use. The Mixed Methods enabled the researcher to clarify the views and experiences of data generation, information use, and Quality Improvement.

Randomisation: the randomisation technique helps to offset the confounding effects of known and unknown factors by randomly selecting the study participants (Babones 2016:65-67). The study settings and individual participants were selected using a multi-

stage random-cluster sampling design. The technique gives every individual in the study population an equal chance to be selected in the sample.

Control in place: Quality data production/information use for decision-making were the dependent variables, while TOB factors such as organisational culture of information use, performance of management functions, Quality Improvement, training, and supervision were independent variables. The researcher devoted most of their efforts to controlling for effects on the dependent variable. Besides the randomisation technique used, the participants were matched by inclusion and exclusion criteria.

External validity: It concerns whether observed relationships in a study sample can be generalised to a larger population (Van Elk & Fried 2023). Half of the sub-cities in Addis Ababa city were included in the study, and an adequate sample size from the target population was drawn to make inferences from the sample to the larger population. Thus, the results from the sample of this study can be generalised with reasonable confidence.

Content validity: the extent to which the items in the tool adequately represent the universe of content for the concept being measured (Polit & Beck 2012:723).

The set of items for the study instruments was adopted from the PRISM and Model for Improvement (MFI) tools and the literature review. The content validity of the PRISM tools was established by a number of research and health information specialists. Likewise, the content validity of MFI tools was established by studies and experts of the Institute for Healthcare Improvement (IHI). In addition, both the study instruments were substantiated by the literature to ensure high content validity and to measure the dimensions of the study concepts and definitions. Instruments were pilot tested to measure the characteristics they were intended to measure (Creswell & Creswell 2018:202).

Face validity denotes whether the instrument appears, *on the face of it*, or *looks like* it is measuring the target construct (Polit & Beck 2017:450, 473).

To ensure face validity, the instruments were informed by a literature review, standardised, and reviewed by other researchers, the supervisor, and colleagues. Besides, the study results were substantiated by the other studies' results reviewed in the literature.

Reliability: refers to the accuracy and consistency of information obtained in a study. In research, reliability is termed as 'repeatability' or consistency, a measure that yields the same result repeatedly. As such, statistical reliability refers to the probability that the result would hold with a wider group… the result supports an inference about what is true in a population (Polit & Beck 2017:447; Singh 2012:124).

In this study, items included in data collection tools were tested for their internal consistency. The norms and coherence among tools in relation to the study question were assessed. Cronbach's Alpha (α) value was used to test the internal consistency; the consistency result was in the range of 0.74-0.93. This statistic, coefficient (α), is widely used to estimate the extent to which subparts of items of an instrument reliably measure the critical attributes, as the greater internal consistency is obtained with a set of items highly intercorrelated (Polit & Beck 2017:447).

3.4.3 Phase 2: Qualitative Method

A qualitative research approach refers to a set of interpretive techniques aimed at exploring, explaining, and giving meaning to human experiences and social phenomena, rather than quantifying them. It is especially suited for investigating the opinions, values, beliefs, perceptions, and lived experiences of individuals and groups within their natural settings (Maarouf 2019:2; Kumar 2011:103; Basias & Pollalis 2018:4, 10; Imre 2015:23).

In this study, the qualitative method was employed to explain and deepen the findings of the quantitative phase and to address the fifth objective: to explore the experiences of health professionals regarding data generation, information use, and quality improvement in immunisation services. As Polit and Beck (2017:39) assert, qualitative methods are par-

ticularly useful for exploring little-understood phenomena, providing context-specific insights that may not emerge from quantitative analysis alone.

A key strength of qualitative methods lies in the interactive nature of data collection, allowing participants to freely share their perspectives without being constrained by predefined scales or structured tools. This flexibility enables researchers to adapt data collection and probe for deeper understanding, while participants are encouraged to engage meaningfully and express themselves fully (Maarouf 2019:2; Basias & Pollalis 2018:4; Creswell & Creswell 2018:243).

In this phase, Focus Group Discussions (FGDs) were conducted using semi-structured guides, which facilitated open, yet focused dialogue. Participants were purposively selected from health facilities that implement the HMIS and provide immunisation services, based on their experience and involvement in the earlier quantitative phase. The focus group approach enabled free and flexible interaction among participants, fostering rich discussions and uncovering shared and divergent perspectives. It also contributed to clarifying and contextualising the application of the integrated PRISM-MFI theoretical framework within the study setting (Basias & Pollalis 2018:6).

The Focus Group Discussions (FGDs) were purposefully designed to align with and address the qualitative objective of the study, which was to explore the experiences of health professionals in relation to data generation, information use, and quality improvement in immunisation services. By facilitating open and interactive dialogue among participants, the FGDs enabled the researcher to gather context-rich insights into participants' attitudes, perceptions, and challenges surrounding the implementation and use of the Health Management Information System (HMIS). The researcher explored the perceptions, attitudes, and user acceptance of HMIS tools, protocols, and system design. Participants also discussed barriers and enablers related to immunisation service delivery and offered recommendations to improve the use of HMIS for enhancing service quality (Basias & Pollalis 2018:10).

FGDs were held in mid-level health centres, where participants discussed interview topics in depth. The researcher and a trained moderator jointly facilitated the discussions and documented both the content and group dynamics through active observation and note-taking. This phase investigated participants' perceptions and feelings about HMIS design and its ability to meet user needs, from initial orientation to full system integration. Their insights into the culture of information use and challenges affecting data utilisation were systematically coded, interpreted, and categorised to inform practical recommendations (Creswell & Creswell 2018:264).

This method allowed the study to go beyond what was statistically observed in the quantitative phase and to uncover underlying beliefs, practices, and contextual barriers that influence information use and data quality. The FGDs thus provided the necessary depth and flexibility to capture participants' lived experiences and interpretations, ensuring that the qualitative objective was thoroughly addressed in a manner consistent with the study's pragmatic paradigm and mixed methods design.

3.4.3.1 Population

The study population of the qualitative phase focus group consisted of senior health professionals and HMIS workers with at least two years of work experience in providing immunisation service, and or producing and using HMIS information in implementing quality improvement of immunisation service at health facilities in the study area.

3.4.3.1.1 Sampling and Sample size

This study utilised purposive sampling based on the qualitative research principle of properness that necessitates purposeful sampling and a good informant. A good informant, being an individual or group deliberately selected, will provide essential information that might not be obtained from other choices. Purposive sampling is the selection of information-rich samples to have an in-depth view of a phenomenon to answer the research objective. Characteristics such as age, sex, experience, and functional role can serve as the starting

point for sample selection (Shaheen, Pradhan & Ranajee 2019:4). Sampling for a focus group does not include representativeness; participants are selected, largely to maximise productivity of discussion with the question in mind who would provide information-rich data for the study (Howitt 2017:114, 693).

The participants were purposively selected based on their extensive experience and the skills they possess.

To facilitate open and honest dialogue, health professionals were organised into two distinct focus groups: health facility managers and service providers. Grouping participants based on similar professional roles helped to minimise hierarchical barriers and encouraged a free flow of ideas. This structure created a safe environment where participants felt comfortable sharing their experiences and perspectives without fear of judgment or reprisal, which might have occurred if individuals of differing status levels, such as managers and frontline workers, had been grouped together. As a result, the discussions were more insightful, balanced, and detailed, enhancing the quality and depth of the qualitative data collected.

- **Inclusion criteria:**

Participants were eligible for inclusion in the study if they met all the following criteria:

Work experience.

Must have at least two years of work experience at the health facility level.

Professional role.

Must be currently serving in one or more of the following roles:

Health professionals or service providers involved in:

Immunization services.

Disease prevention and control.

Maternal and Child Health (MCH) services.

Quality Improvement (QI) initiatives.

or

HMIS/HIT worker.

or

Director of the health facility.

- **Exclusion criteria**

Those without the specified service year and engagement in the specified functions were excluded.

Nested (criterion) sampling of the purposive sampling strategies was applied to select samples that meet predefined significant criteria. In a nested relationship, the participants in the qualitative component are a subset of the participants in the quantitative aspect. The participants are selected from Phase 1 to Phase 2 for in-depth scrutiny. This sampling is common in explanatory design used in quality assurance efforts and in studies that require rich information that may reveal weakness, and provide areas for improvement (Shaheen et al. 2019:11; Polit & Beck 2017:824-827).

The strategy is appropriate for addressing the research question, ‘How can HMIS be used to strengthen the quality of data’ through the qualitative findings of this study. The study applied nested (criteria) sampling. Qualitative phase participants were part of the quantitative phase, purposively selected for having higher (more than 1 year) work experience in their current role than the rest, in consideration of the inclusion and exclusion criteria.

A unique sampling issue in Mixed Methods studies concerns whether the same people can be in both the qualitative and quantitative phases. The best strategy relies on the purpose and research design of the study; however, using embedded samples can be advantageous (Polit & Beck 2017:825).

The advantage of this sampling to the study was that the findings from quantitative data on problems of poor data quality and inadequate information use were further explored with the experience of the participants in data management, information use, and quality improvement. Having the same participants in both phases of the Mixed Methods study offers opportunities for convergence and comparison between the two data sets (Polit & Beck 2017:825).

3.4.3.1.2 Development and testing of focus group guide

The focus group discussion guide was developed in view of broad topics beforehand to provide a broad frame for discussion to follow. Hence, specific discussion points were developed for in-depth discussion. The focus group guide is just a guide, meant to provide and maintain clarity throughout discussion on related issues, as it is a more essential purpose of the guide than the follow-up probs. The interview guide confirms the needed coverage of the areas of enquiry and comparability of information across the respondents (Kumar 2011:152; Roller 2020:6).

Prior to the implementation of the study, the initial focus group discussion guide was developed and subsequently refined based on the results of the quantitative phase (Ivankova et al. 2006:11). Furthermore, the guide was continuously adapted and finalised in response to emerging findings from preceding focus group discussions. Whenever an important but unanticipated issue emerged, they were systematically included in the guide for the subsequent focus group meeting (Howitt 2017:69).

The preceding focus group meetings served as a pre-test of the focus group guide; the guide was duly modified based on newly emerging insights, and the adjustments were incorporated in the subsequent focus group discussions (Howitt 2017:70).

The focus group guide helped to progress with the interview towards saturation. The ruling principle is data saturation-sampling to the point when no new information emerges, and redundancy is attained (Polit & Beck 2017:529). The guide was prepared in English; how-

ever, participants were allowed to use Amharic whenever needed for greater clarity and more comfortable interaction. Points expressed in the Amharic language were back-translated into English during transcription. The researcher transcribed qualitative data from Amharic to English, and the translation was later authenticated (verse-by-verse) against the translation of the licensed translator.

3.4.3.1.3 Data collection approach

Participants for the focus group discussions were recruited through voluntary informed consent, and fulfilment of the study's inclusion criteria was verified by the researcher. All selected individuals had previously participated in the quantitative phase and were familiar with the study's overall objectives. They were informed that their initial participation was random and aligned with the sampling criteria for the quantitative phase, and that they might be purposively reselected for the qualitative phase to provide further insights. The purpose and nature of their involvement in the focus group discussions were clearly explained to ensure informed and ethical participation. The focus group relies on the self-stimulating power of group interaction to generate data which might not be possible through other methods. An interaction between group participants generates information that varies in specific aspects from that generated by an independent interview with each group member. The group dynamics generate ideas, and the participants make sense of issues through discussion and debate, which would otherwise be unlikely to occur with the conventional single-interviewing technique (Howitt 2017:89).

In focus group interviews, participants were asked to express their perspectives about a particular issue. The researcher facilitates and exhaustively draws out the event's interactive potential to produce rich data. Opportunities for interaction among members of the group when replying to the questions by the facilitator (moderator) are a key defining feature of a focus group (Howitt 2017:85, 88; Leedy & Ormrod 2010:386).

In this study, the focus group elicited shared information about experiences and views on HMIS data generation and information use for quality improvement of immunisation ser-

vices, which could not be obtained by quantitative methods alone. Collection of data on group perceptions, attitudes, beliefs, behaviours, and motivations of the study participants underlined the rationale for choosing a focus group for the study.

A semi-structured interview guide was used to facilitate open discussion among participants and between the researcher and participants. The researcher facilitated discussions. The agreed-upon and analysed focus group results were used to explain, in more detail, the quantitative findings on the experience of processes and factors affecting HMIS data management, information use, and quality improvement.

Using focus group viewpoints from many people is obtained quickly; participants take part in the decision-making process and provide a collective means of addressing problems. The focus group method permits the researcher to collect responses from the group regarding the expressed opinions, beliefs, feelings, and experiences of other group members, which might not be obtained through methods such as observation and interviews (Howitt 2017:101, 120; Polit & Beck 2017:721). The focus group in this study enabled understanding of experiences, feelings, and attitudes toward the HMIS data management process and information use among groups of health professionals, health information technicians, and facility managers.

The decision about how many group discussions to be conducted depends on any number of factors and will differ based on situation for each study, however the accepted rule of thumb is to plan for at least three or four focus groups with each type or category of individual (Roller 2020:19; Howitt 2017:88). Data saturation is the principle most often used to make decisions about when sampling can stop, thus the method has fewer cases (Polit & Beck 2017:826).

Data saturation is the point at which qualitatively collected data are adequate to support the study, when further coding is no longer feasible; as such, further data collection provides little in terms of additional themes, insights, perspectives, or information. Purposive sampling methods place primary emphasis on saturation, obtaining a comprehensive under-

standing by continuing to sample until no new substantive information is acquired. In purposeful sampling, the chances of data saturation are high, as it selects rich information cases (Etikan, Musa & Alkassim 2016:5; Shaheen et al. 2019:13, 28; Doyle et al. 2020:2).

Data saturation was achieved after the ninth focus group discussion, comprising three groups of HMIS workers, three groups of healthcare professionals providing immunisation services, and focal persons for quality improvement, as well as three groups of health facility managers (directors).

3.4.3.1.4 Focus group data collection process

Using semi-structured guides, the list of topics is covered rather than specific questions being asked. The researcher knew what he wanted to ask, but could not predict what the answers would be. This defines the role of the researcher in the process as somewhat structured, whereas that of the participants is not, thus semi-structured (Polit & Beck 2017:720).

Preparation for meetings: meetings were organised at three central locations, either at a sub-city or a middle health centre hall, based on the time and place that were convenient for the participants and facilitators**.** Each group, with 8-12 participants, was arranged in a size small enough for all group members to speak or express their opinions and large enough to capture a range of views and experiences, with allowance for non-show (Howitt 2017:60).

Each group consisted of participants with a comparatively similar background, as per the inclusion and exclusion criteria, to facilitate easier interaction and the free flow of discussion**.** Each category of individuals was organised into three groups: HMIS workers, health professionals providing health/immunisation services, quality improvement focal persons, and health facility heads (managers).

The facility managers' experience is more in HMIS information use and coordination of data generation and information use; the healthcare providers are both in data production and

information use; while the health information workers are more in monitoring data generation, data entry, and facilitating information use.

Table 3.1: Focus Group Discussion participants

Sub-cities	Category	Focus Group	Date	Duration	Number of participants
Akaki Kaliti	HMIS (HIT) workers	1	12/1/2024	1:31:35	9
	Health service providers and quality improvement focal point	2	27/03/2024	1:45:41	12
	Heads (managers)	3	15/01/2024	2:03:33	7
Yekka and Arada	HMIS (HIT) workers	4	13/01/2024	2:01:18	8
	Health service providers and quality improvement focal point	5	13/01/24	1:34:14	9
	Heads (managers)	6	13/01/2024	2:07:12	7
Lideta and Nifas slik lafto	HMIS (HIT) workers	7	17/01/2024	2:05:16	9
	Health service providers and quality improvement focal point	8	26/03/2024	1:41:16	11
	Heads (managers)	9	26/03/2024	2:04:06	8
Total		9			80

The audio (digital sound) recorder was prepared before each focus group meeting through checking battery status, placing the audio recorder in the centre position of the discussion table, and conducting test recordings to ensure audibility and clarity. The participants were given prior information to consent that their interview output is audio recorded for the purpose of transcription, and otherwise not to be shared with a third party.

Facilitation of focus group: The researcher directly facilitated the discussions, opened each discussion, listened attentively to the participants with minimal interruptions, allowed all participants to speak in an orderly manner, encouraged constructive comments and views of others, dealt with silence and kept track of the discussion. The facilitator secured ethical clearance for the study from the Addis Ababa City Administration Health Bureau prior to

Phase I of the study. Additionally, informed consent was obtained from purposively selected focus group (Phase II) participants. The participants were identified and enrolled by chance based on their current role, set selection criteria, potential to provide rich information and willingness that they confirmed through informed consent.

The purpose and objectives of the study were explained in detail to the study participants in a sequence of the prepared participant's information list. Field notes were taken during each focus group discussion by a trained research assistant, and the discussions were audio recorded after obtaining permission from the participants.

Greater attention was given to the interactive development of ideas and reflections on the understandings of the group process. The facilitation ensured active participation of all members, avoiding side talk; it focused on obtaining in-depth information for the intended detailed description of materials in constructing answers for the research question. Nine focus groups were conducted, three focus groups for each of the categories, for a period of 90 minutes to 2 hours.

The initial plan was to conduct up to four focus group discussions FGDs for each participant category. However, as data collection progressed, ongoing analysis indicated that data saturation had been reached after the second or third FGD within each group. At this point, participants were consistently repeating similar perspectives, and no novel information was being generated. Consequently, the researcher decided to discontinue further FGDs, as the criteria for data saturation had been met across both categories.

3.4.3.1.5 Data analysis

Thematic analysis was the preferred method of qualitative data analysis in this study. Thematic analysis (mainly an inductive approach) is one of the qualitative data analysis methods. It includes identifying, analysing, and reporting patterns (themes) that emerge from data. According to Gibson and Brown (2009, as cited in Harding 2019:105), thematic analysis involves three core aims: examining commonalities, examining differences, and examining

relationships across cases or participants (Harding 2019:104, 164). In this context, relationships denote the ways in which themes connect, influence, or contrast with one another.

Thematic analysis principally detects patterns, regularities, inconsistencies, and gaps; examines broad themes summarising the content of data completely, with more focus on what was said rather than how it was said. It employs central, practically overlapping processes that are: transcribing textual materials to understand (familiarise) and analyse data; an analytic effort to generate final themes; and identification of themes and subthemes depending on the amount and quality of analytic efforts put into analysis (Polit & Beck 2017:171; Howitt 2017:163-166).

The researcher transcribed audio-recorded data from nine focus groups through active, consistent listening, replaying it on digital tape on the same days as the interviews. The transcribed data was also backchecked with field notes captured by the research assistants. The notes and observation data were converted into text by the researcher and complemented the transcription. The data from the actual (Amharic) language of the participants was transcribed in English by the researcher and compared with the translation of the same data by a licensed translator who consented to the confidentiality of the research information.

Thematic analysis is a method of breakdown, categorisation and linking back to aspects of the data prior to final interpretation. Thematic (inductive approach) analysis is executed through steps of familiarisation with data, generating codes, generating and reviewing themes, and naming the themes and writing the report (Flick 2014:421, 422). The transcripts were reviewed extensively by the researcher, and the data were sorted and arranged by relatedness of the discussed statements (excerpts).

Reflexive thematic analysis was applied in this study, following Braun and Clarke's (2022:8) guidance, which emphasises the active role of the researcher in theme development and recognises the subjective and interpretive nature of qualitative analysis. Unlike coding reliability approaches, reflexive thematic analysis does not aim for consensus among coders

but instead values researcher reflexivity, depth of engagement with the data, and conceptual coherence (Braun & Clarke 2022:9). The data were organised, coded, and thematically analysed with the assistance of ATLAS.ti, Version 24, a Computer-Assisted Qualitative Data Analysis (CAQDAS), qualitative data analysis software that facilitates efficient management of transcripts, systematic coding, and the development of themes through visual mapping and categorisation. The analysis began with familiarisation through repeated, immersive reading of the nine interview transcripts to identify both explicit content and underlying meanings, allowing patterns and ideas to surface naturally from the data. In the second phase, 42 refined inductive codes were generated and grouped into subcategories, with equal attention given to each data segment (quotation), in line with Braun and Clarke's emphasis on giving full voice to all participants' contributions. These codes were then clustered into 14 broader categories based on conceptual similarities and interpretive patterns.

In the third phase, the categories were interpreted and mapped to develop four initial themes, each reflecting a meaningful pattern of shared meaning underpinned by a central organising concept. In the final phase, these were further refined into four overarching themes through a process of iterative review, deep reflection, and theoretical engagement, ensuring they represented coherent, rich interpretations grounded in the entire data set. Each theme was supported by illustrative quotations and analytical memos, providing thick description and interpretive depth. This reflexive, flexible approach allowed the researcher to construct meaning in an active, interpretive way rather than merely aggregating content, consistent with the constructivist ontology underpinning reflexive thematic analysis (Braun & Clarke 2022; Polit & Beck 2017:754; Campbell, Orr, Durepos, Nguyen, Li, Whitmore, Gehrke, Graham & Jack 2021:6).

The final step: the qualitative results were reported with a summary of key categories and themes, followed by a detailed description of steps taken to ensure the trustworthiness of the data. The result is organised in a sequence of data management processes, TOB factors, information use, and quality improvement. In addition, findings of the quantitative component (Phase I) data were explained in detail, and the data between the two phases were connected (Polit & Beck 2017:749, 958; Creswell & Creswell 2018:256).

To ensure confirmability, an independent coder was engaged, and a confidentiality agreement was signed (Annexure K). Additionally, interview transcripts, quotations, codes (subcategories), categories, and themes are properly filed, which can be accessed for an external data audit trail.

3.4.3.1.6 Measure to ensure trustworthiness

This study fulfilled the requirement of trustworthiness of the study. Trustworthiness in a qualitative study refers to the value of truth, which is the ability of a study to deserve trust and confidence. Trustworthiness is further divided into conformability, credibility, transferability and dependability principles (Gunawan 2015:1).

Confirmability: It concerns ascertaining that the data represents the information participants provided (Polit & Beck 2017:788). The quotes, phrases and proverbs reflected that the information represents the views of participants. The participants' responses were documented and audio-recorded. Transcribed responses were coded, and a data audit trial was done by systematically filing transcribed data, data analysis product using Atlas-ti, process (methods) of analysis, researchers' intention (reflexive notes), and piloted forms in a way that an independent auditor can audit the data. These prove that information/data are derived from the viewpoints of the participants, and are not invented by the researcher, nor are they biased and influenced by the perspectives of the researcher (Polit & Beck 2012:591).

Credibility: The depth, experience, and skills of the researcher in undertaking academic and applied research signify the trustworthiness of this study. Sufficient time to pilot tools was allocated, and rapport building with informants was established. Detailed discussion, debriefing, probing and validation with the participants (member check) were carried out by probing during data collection and communicating interpretive notes with some of the participants invited to follow-up meetings, and by calling the participants (Polit & Beck 2017:788-800).

Transferability: The extent to which qualitative findings can be transferred to other settings is an aspect of the study's trustworthiness (Polit & Beck 2017:837). The context of this study was fully described. The details of sampling, method, time, setting, number, and type of participants are clearly explained. Interactions between the participant and researcher were given rich transcription and translation. Hence, the findings may be extrapolated to other similar settings or groups of people (Polit & Beck 2017:806).

Dependability: It refers to the constancy (reliability) of data across time and conditions. It inquires whether the findings of the inquiry would be repeated if it were carried out again with the same participants in the same context (Polit & Beck 2017:787). Direct quotes and themes from the respondents were described in detail. Exclusion and inclusion criteria for sampling were described in depth. Development of tools, procedures and events of data collection and transparency of decisions made were described. Data audit trail and reflexivity (extensive capturing of data from field notes and audiotape) were explained in possible best depth (Polit & Beck 2017:805).

3.5 Phase 3: Integration of qualitative and quantitative data

Integration of quantitative and qualitative data occurred during the interpretation phase of this explanatory sequential mixed methods study. Initially, the quantitative component was analysed independently in the first phase to assess the status of HMIS data management processes, data quality, information use, and the influence of behavioural, technical, and organisational (TOB) factors on these variables. The results from this phase informed the refinement of the focus group interview guide and guided the purposive selection of participants for the qualitative phase, drawing from the initial sample.

In the second phase, qualitative data were collected from a subset of participants selected for their capacity to provide rich, contextual insights into the findings from the quantitative phase. This qualitative strand served several key integration purposes: to validate and elaborate on the quantitative findings; to provide explanatory depth for unexpected, non-significant, significant, or extreme statistical results; and to help interpret the role of signifi-

cant predictors in the context of HMIS implementation and information use (Polit & Beck 2017:822; Creswell & Creswell 2018:288).

The integration of the two data strands—denoted as QUAN → qual—occurred through a process of meta-inference, in which the results from both components were systematically compared, contrasted, and synthesised. This integrative analysis enabled a comprehensive understanding of the factors influencing information use and data quality improvement. The insights gained through this process were instrumental in guiding the development of practical, evidence-based guidelines aimed at strengthening the quality of immunisation services through more effective use of HMIS.

3.6 Phase 4: Guideline development

Three interrelated guidelines were developed: (1) data quality assessment and improvement strategy guideline, (2) information use guideline, and (3) immunisation service quality improvement guideline. Activities, processes, and procedures required in each of the guidelines were detailed. The data quality assessment guideline had two parts: part one, data quality assessment methods, and part two, quality improvement strategies. The study results and some published data quality assessment methods guided this guideline development (Bloland & MacNeil 2019:1; User Manual Routine Data Quality Assessment 2015:34, 45).

The development of the guidelines was grounded in a systematic, evidence-based process that integrated the quantitative and qualitative findings of the study. These findings were mapped across the Routine Health Information System (RHIS) framework, specifically focusing on inputs, processes, outputs, and outcomes, including the use of information to improve immunisation service quality. This integration allowed the guidelines to be shaped by both statistical insights and context-rich perspectives of health professionals.

To enhance the relevance and comprehensiveness of the guidelines, an extensive review of national and international literature was conducted in key focus areas of the study, in-

cluding HMIS strengthening, data use culture, and quality improvement in immunisation services. In addition, the process incorporated insights from frontline implementers, technical experts, policymakers, and stakeholders, whose experiential knowledge enriched the guidelines with practical applicability and contextual relevance.

Following the initial drafting, a validation workshop was convened with key stakeholders to critically review, refine, and finalise the guidelines. Participants in the workshop included health facility managers, HMIS officers, service providers, district supervisors, and subject matter experts. The validation workshop participants were selected and recruited based on their relevant service experience and expertise. During the workshop, the guidelines were examined for their feasibility, clarity, and applicability across various health system levels. Constructive feedback was gathered on structure, content, and implementation feasibility, leading to refinements that improved the coherence, usability, and alignment with health system priorities. The final validated guidelines reflect both the evidence base of the study and the consensus perspectives of end-users and decision-makers, ensuring both credibility and practical value. The information (data) use guideline section one has a definition of information needed at an institutional level. Section two provides a step-by-step instruction on information analysis and use in planning, self-assessment, monitoring, and evaluation. Directives on information use and sharing at district and facility levels are described based on the study evidence and User Manual RDQA (2015:34, 45, 47).

The immunisation service quality improvement guideline provides guidance to identify and prioritise problems of immunisation service quality based on information use. The second division encompasses stepwise instructions on PDSA cycle implementation in setting improvement goals, tracking changes and testing the change until it has resulted in sustaining improvement (Manyazewal et al. 2018:5; Knox 2015:10).

3.7 Ethical considerations

This study did not involve any form of experimentation or medical intervention. However, since it required direct involvement of human participants, it was considered to carry a me-

dium level of risk, in accordance with ethical research classifications. Participants dedicated a portion of their working hours to the study, which could have posed a potential disruption to their professional responsibilities.

To ensure adherence to ethical standards, the study obtained ethical clearance from the University of South Africa (UNISA) Research Ethics Committee (Annexure B), and a letter of approval was secured from the Addis Ababa Regional Health Bureau's Research and Ethics Review Office (Annexure D). Formal permissions were obtained from each participating health facility (Annexure D), and written informed consent (Annexure G) was obtained from all individual participants, following a clear explanation of the study's purpose, procedures, and voluntary nature of participation.

The study did not involve any physical examinations, testing, or medical procedures that could pose physical risks. Data collection was limited to participants' work-related experiences, professional practices, and perceptions, with no collection of sensitive personal or medical data. Although the involvement of participants in interviews and focus groups constituted a medium risk due to the demand on their time and the nature of direct interaction, specific measures were implemented to minimise all forms of risk.

Physical risk was minimised by scheduling data collection during regular working hours and clearly explaining the study's objectives, procedures, and participants' roles in advance. Trained research assistants were used to ensure respectful and professional engagement.

Psychological risk was mitigated by guaranteeing confidentiality, ensuring that participants felt safe and unpressured when responding to survey and interview questions. Participants were reassured that their responses would remain anonymous and would not affect their employment or professional relationships.

Social risk was addressed by conducting focus groups and interviews in neutral, non-threatening environments within participants' workplaces, while maintaining a balance between privacy and professional appropriateness.

3.7.1 Ethical principles (in consideration)

Beneficence: An ethical principle that maximises gains to the study participants and protects them from harm**.** The study enables healthcare professionals and information workers to find a path to generate high-quality data and sustain information use to improve the quality of immunisation services. Lessons learned from the proposed guideline can be applied to ensure data quality, improve information use, and enhance the quality of other health institutions (Polit & Beck 2017:100, 211).

Non-maleficence and autonomy: The principle of non-maleficence obligates researchers to "do no harm," ensuring that participants are protected from physical, psychological, social, or economic harm throughout the research process. This principle requires proactive measures to avoid, prevent, or minimise potential risks associated with participation. In this study, minor risks, such as time away from work, were addressed through careful scheduling and sensitivity to participants' professional responsibilities. No physical or psychological harm was anticipated, and all procedures were designed to uphold participants' safety and well-being (Polit & Beck 2017).

Autonomy emphasises participants' right to make informed decisions about their involvement in research. This was achieved through a comprehensive informed consent process, which provided participants with clear information about the study's purpose, procedures, and their rights. Participants were assured of their right to decline participation, omit responses to any questions they found uncomfortable, and withdraw from the study at any stage without negative consequences. These measures ensured respect for self-determination and voluntary participation, free from coercion or undue influence (Haneef & Agrawal 2024:3; Polit & Beck 2017:213, 233). The informed consent process was central to safeguarding autonomy. Written informed consent was obtained after participants were given adequate time to review the information sheet, seek clarification, and ask questions. This process ensured that participants exercised their autonomy by making informed decisions about their involvement in the study. By providing consent voluntarily, participants af-

firmed their right to self-determination and freedom from coercion, in accordance with established ethical principles (Haneef & Agrawal 2024:2).

Justice: The principle of justice in research ensures fairness in the selection, treatment, and protection of participants. In this study, all participants were treated equitably, without discrimination or preferential treatment. They were provided with clear, comprehensive information about the study's purpose, objectives, and procedures, enabling them to make informed decisions about participation. Enrolment was based on objective criteria and random selection methods, ensuring that participation was voluntary and free from coercion or undue influence. No participant was obligated or pressured to take part, and their autonomy was fully respected throughout the process.

Furthermore, the principle of justice was upheld by safeguarding participants' rights to privacy and confidentiality. Identifiable information was neither collected nor disclosed, and all data were anonymised to prevent any linkage to individual participants. This approach aligns with ethical standards that emphasise fairness, respect, and protection of participants' dignity (Polit & Beck 2017:211).

Confidentiality and anonymity: The principles were rigorously upheld throughout the study to protect participants' privacy and maintain trust. Participants were assured that their identities would remain anonymous, meaning that no personal identifiers were collected or linked to their responses. All data were coded and stored securely, ensuring that individual responses could not be traced back to specific participants.

In reporting and dissemination of findings, only aggregated data were presented, and no identifying details were included in any publications, presentations, or shared documents. This approach ensured that participants' information would not be publicly disclosed or accessible to unauthorised individuals, thereby minimising any risk of harm or reputational exposure (Polit & Beck 2017:223).

To reinforce these measures, all research assistants signed a formal confidentiality agreement (see Annexure J: Confidentiality Agreement), committing to maintain strict confidentiality and safeguard all data collected during the study. These steps align with internationally recognised ethical standards for research involving human subjects, emphasising respect for privacy and protection of sensitive information.

3.8 SUMMARY

This chapter provided a comprehensive account of the study's methodological framework. It began with an explanation of the research paradigm and the research approach. The research design and corresponding procedures were thoroughly discussed, outlining the rationale for adopting a sequential explanatory mixed methods design.

The chapter also provides a detailed description of the study population, sampling techniques, sample size, and the inclusion and exclusion criteria applied during each phase of the study. The processes of developing and testing data collection tools, as well as procedures for data collection, analysis, interpretation, and validation, were clearly outlined to ensure transparency and replicability.

Furthermore, strategies to ensure the trustworthiness and rigour of the research, such as attention to internal and external validity, credibility, and dependability, were adequately addressed. Ethical considerations were also carefully examined, with emphasis on voluntary participation, informed consent, confidentiality, and participant well-being.

The findings from the quantitative (questionnaire) and qualitative (focus group discussions) components of the study are presented and discussed in the subsequent chapters.

CHAPTER 4:ANALYSIS, PRESENTATION AND DISCUSSION OF QUANTITATIVE FINDINGS

4.1 INTRODUCTION

This chapter presents and discusses the findings from the quantitative phase of the study aimed at examining data management processes implemented, identifying the influence of TOB determinants on data management processes, determining the extent of information use in immunisation service quality improvement and identifying the influence of TOB on information use. The results are organised into seven main sections, each corresponding to key areas of investigation. Part I is not presented because it contains participants' personal information to ensure confidentiality. Information from this part is abstracted to inform the subsequent parts.

Part II describes the demographic and professional characteristics of the study participants, providing contextual background for interpreting subsequent findings.

Part III assesses the data management processes currently practised within the study health institutions, including data collection, quality assurance, analysis, and feedback mechanisms.

Parts IV, V, and VI present the findings on the (TOB) determinants of RHIS performance, with a focus on their role in influencing the production of high-quality data and consistent information use.

Part VII examines participants' experiences and practices in using routine health information to manage and improve immunisation services.

The analysis includes both descriptive and inferential statistics, with results interpreted in relation to the study's conceptual framework and supported by relevant literature. This

chapter provides a foundation for understanding the factors that affect routine data quality and information use at the health facility level.

4.2 DATA MANAGEMENT

Data were collected from 412 respondents, yielding a response rate of 97.6%. An overview of the key datasets collected and the corresponding variables is presented in Table 4.1 below.

Table 4.1: Response rate: questionnaire distributed and returned by name of institution

Code of Sub	Code of the facility/office	Questionnaire		
		Distributed	Returned	% Returned
Sub-city A	Health Office A	7	7	100.0
	Health Centre A-1	9	8	88.9
	Woreda 2A HC	9	9	100.0
	Woreda 5A HC	9	9	100.0
	Woreda 6A HC	9	9	100.0
	Woreda 9A HC	9	9	100.0
	Woreda 10A HC	9	8	88.9
	Woreda 11A HC	9	9	100.0
Subtotal		**70**	**68**	**97.1**
Sub-City B	Health office B	8	8	100.0
	Hospital B1	10	10	100.0
	Health Centre B1	9	9	100.0
	Health Centre B2	8	8	100.0

	Health Centre B3	8	8	100.0
	Health Centre B4	9	9	100.0
	Health Centre B5	9	8	88.9
	Health Centre B6	9	9	100.0
	Health Centre B7	9	9	100.0
	Health Centre B8	8	8	100.0
	Health Centre B9	9	9	100.0
Subtotal		**96**	**95**	**99.0**
Sub-city C	Health office C	8	8	100.0
	Hospital C1	10	10	100.0
	Health Centre C1	8	8	100.0
	Health Centre C2	9	9	100.0
	Health Centre C3	9	8	88.9
	Health Centre C4	9	9	100.0
	Health Centre C5	9	9	100.0
	Health Centre C6	8	8	100.0
	Health Centre C7	9	9	100.0
	Health Centre C8	9	9	100.0
	Health Centre C9	9	9	100.0
Subtotal		**98**	**96**	**98.0**
Sub-city D	Health office D	8	8	100.0
	Hospital D1	12	12	100.0
	Health Centre D1	8	8	100.0
	Health Centre D2	8	8	100.0
	Health Centre D3	9	8	88.9

	Health Centre D4	8	8	100.0
	Health Centre D5	9	9	100.0
	Health Centre D6	8	8	100.0
	Health Centre D7	9	8	88.9
Subtotal		**80**	**77**	**96.3**
Sub-city E	Health office 9	8	6	75.0
	Health office E	8	8	100.0
	Health Centre E1	9	9	100.0
	Health Centre E2	9	9	100.0
	Health Centre E3	8	8	100.0
	Health Centre E4	9	9	100.0
	Health Centre E5	9	9	100.0
	Health Centre E6	9	9	100.0
	Health Centre E7	9	9	100.0
Subtotal		**78**	**76**	**97.4**
Grand Total		**422**	**412**	**97.6**

The researcher ensured the accuracy, completeness, and clarity of the data through thorough verification procedures. All electronic data are securely stored on the researcher's password-protected computer, while hard copies are kept in a locked file cabinet. In compliance with the university's data management policy, the collected data will be retained for a period of 15 years. After this retention period, all electronic files will be permanently deleted, and physical documents will be securely shredded to ensure confidentiality and proper data disposal.

4.2.1 Data analysis

The data were systematically analysed using appropriate methods aligned with the nature of each dataset and the overall research design. Quantitative data were subjected to statistical analysis to identify trends, patterns, and relationships between key variables. The selection of analytical techniques was guided by the research questions and ensured a rigorous, credible interpretation of the findings. IBM SPSS software Version 28.0 was used to migrate closed-ended and Likert Scale question responses; they were entered into Epi-Info and cleaned of outliers.

Descriptive analysis results were produced using SPSS syntax and output. The frequency analysis output was presented in tables and graphs in the corresponding parts of the results chapter. Associations (relationships) of dependent and independent variables were tested using the Chi-Square (X^2) statistic. Bivariate analysis was done using linear regression and multivariate logistic regression analysis.

4.3 RESEARCH FINDINGS

4.3.1 Demographic characteristics of the study participants

Demographic characteristics part of the study results describes the age and gender distribution of the participants, the highest educational and professional statuses attained, their current work role (positions), service years in the current position and total years of service. Moreover, it narrates the types and levels of health institutions at which the study participants are working during the study. The detailed demographic characteristics of the participants are summarised in Table 4.2 below.

Table 4.2: Demographic characteristics of the study participants (n = 412)

Variable		Count (n)	Per cent (%)
Gender of the participants	Male	207	50.2
	Female	205	49.8
	Total	412	100
Age category of the participants	20 - 29 years	138	33.5
	30 - 39 years	207	50.2
	40+ years	67	16.3
	Total	412	100
Educational status of the participant	Diploma holder	40	9.7
	BSc/BA/MD degree	254	61.7
	Master's degree	118	28.6
	Total	412	100
Professional category of the participant	Nurse	125	30.3
	Health Officer	140	34
	Health Information Technician (HIT)	118	28.6
	Other	29	7.1
	Total	412	100
Responsibility (role) at the health institution	Immunisation provider/EPI officer	61	14.8
	Diseases prevention and control (CDC) officer	42	10.2
	Maternal and Child Health (MCH) officer	44	10.7
	HMIS (HIT) officer	136	33
	Quality Improvement (QI) officer	44	10.7
	Planning officer (coordinator or head)	41	10

	Facility director or head of the office	44	10.6
	Total	412	100
Years of service in current position	Less than or equal to 5 years	311	75.5
	6-10 years	85	20.6
	Greater than 10 years	16	3.9
	Total	412	100
Total years of service	Less than or equal to 5 years	95	23.1
	6-10 years	119	28.9
	Greater than 10 years	198	48.1
	Total	412	100
Health institutions of the participants	City Admin office	8	1.9
	Sub-city admin office	39	9.5
	Hospital (health facility)	34	8.3
	Health Centre (health facility)	331	80.3
	Total	412	100

Table 4.2 reveals that among the 412 study participants, 50.2% (n= 207) were males and 49.8% (n = 205) were females. There was gender-balanced representation among the participants in the study. This near-equal representation is beneficial for reducing gender bias in the study's findings, ensuring that the perspectives of both male and female healthcare professionals are adequately captured.

The age distribution of the participants is skewed to younger age categories, with 20 to 29 years of age participants represented by 33.5% (n = 138) and 30 to 39 years of age categories represented by 50.2% (n = 207). Therefore, 83.7% (n = 345) of the participants are in the age categories of 20 to 39 years. The mean age of the participants was 33.08, and the standard deviation was 6.28. This skewness towards a younger demographic might imply a

workforce that is relatively early in their careers, which might have implications for the adoption and adaptation to health information systems.

Regarding the highest educational status attained by the participants during the study, 60.7% (n = 250) reported that they held a bachelor's (first) degree, and 28.6% (n = 118) held a master's degree. Thus, 89.3% (n = 268) of the participants have achieved bachelor's and master's degrees. The rest, 9.7% (n = 40) were diploma holders. This indicates a well-educated workforce, which is likely to be beneficial for the implementation and utilisation of sophisticated health information systems. A study in support of this indicates that the higher educated personnel were more likely to enter data more effectively into eHMIS as compared to their counterparts (Lwoga, Sangeda and Mushi 2021:18).

The three professional categories were: health officers (public health graduates) at 34% (n = 140), nurses at 30% (n = 125), and Health Information Technicians (HITs) at 28% (n = 118), respectively. This diversity is important for a holistic understanding of the health information system from different professional perspectives.

The current professional role: 33% (n = 136) of participants were working as HIT/HMIS officers, versus a total of 67% (n = 276) who were health professionals directly providing and or managing the health service at the health institution. Among the health professionals, the immunisation service, disease prevention and control, and maternal and child health service workers constitute 35.7% (n = 147). At the same time, Quality Improvement Officers, planning heads or officers and facility directors constitute 31.3% (n = 129). This higher population, proportional to the size, represents the health professionals, which might imply comparison of practices of data quality assurance and information use across the categories.

Regarding work experience in the current role, 75.5% (n = 311) served for five or fewer years. Meanwhile, 24.5% (n = 101) were in the current role for over six years. This relatively short tenure might suggest a workforce that is still gaining experience and familiarity with

their roles. This indicates the need for better HMIS training and mentoring of the novice workforce to safeguard data consistency and reliability of data management practices.

With respect to total work experience, 48% (n = 198) of the participants had a total professional experience of 11 years and above, while 52% (n = 214) had work experience of 10 years and below.

4.3.2 Types of health institutions the participants are working in

Type **(**level) of health institution that the participants represented: 88.6% (n = 365) of the participants were from health facilities (health centres and hospitals), whereas 11.4% from health offices (city administration offices and sub-city health offices). Out of the health facility participants, the majority, 80.3% (n = 331), were from health centres.

The majority of participants were younger in age and newer to the HMIS role; in contrast, they held higher university degrees, implying that frontline health facilities had a better-educated workforce. This necessitates building the technical skill of the staff through targeted HMIS training, and organisational support through supervision and feedback, to handle technology and tasks of data management processes and use for informed decision making at the local level.

4.3.3 Data management processes analysis

In this part of the study, the data management processes that impact the performance of Health Management Information Systems (HMIS) and Routine Health Information Systems (RHIS) in terms of data quality and the sustained utilisation of information are examined. The researcher looked at participants' understanding of the concepts of data and data quality, as well as their use of appropriate data quality check mechanisms. The study believed that knowledge and application of HMIS design tools, such as Standardisation, Integration, and Simplification (SIS) procedures, are crucial to gaining a deeper understanding of data.

All the questions in Part III were multiple-response questions designed to measure multiple dimensions of the variables involved.

Table 4.3: Understanding of data, data quality and data quality check mechanisms

Variable		Multiple response: Yes	
		Count (n)	Per cent (%)
What do you understand by the term "Data"?	Information	196	27.7
	Raw fact	339	47.9
	Item	68	9.6
	Number	104	14.7
	Total	707	100
What is (are) the characteristic(s) of good quality data?	Accuracy/precision	361	18
	Completeness	371	18.5
	Reliability (consistency)	357	17.8
	Timeliness	355	17.7
	Confidentiality	294	14.7
	Integrity	265	13.2
	Total	2003	100
What mechanism do you use to check data quality at your health institution?	RDQA (Routine Data Quality Assurance)	118	18
	DQA (Data Quality Audit)	121	18.5
	LQAS (Lot Quality Assurance Survey)	343	52.4
	DQRC (Data Quality Report Card)	73	11.1
	No data quality check	14	2.1

	Total	673	100
Availability of Functional Components needed to ensure data quality: (Yes, no, I do not know (IDK)	M&E structure is adequately staffed and standard	339	15.9
	The indicator definition manual is available	378	17.7
	Data collection and reporting tools are regularly supplied	392	18.4
	Reporting guidelines are available	374	17.5
	Have a linkage with the national system	366	17.2
	Culture of data use encouraged	238	13.3
	Total	2132	100

Table 4.3 provides an overview of participants' understanding of data, the characteristics of good quality data, the mechanisms used to check data quality at their health institutions, and the availability of functional components necessary to ensure data quality.

Understanding of the term 'Data': Participants provided multiple responses regarding their understanding of the term "data." Out of 707 responses, 27.7% (n = 196) defined data as information. A larger proportion, 47.9% (n = 339), considered data as raw facts. A smaller proportion of responses, 9.6% (n = 68), defined data as an item, while 14.7% (n = 104) described data as a number.

These responses indicate a predominant understanding of data as raw facts, reflecting a foundational perspective necessary for data collection and analysis in health settings. However, there is also a significant recognition of data as information, highlighting its role in decision-making processes.

Characteristics of data quality: The data accuracy, completeness, reliability, and timeliness had, on average, 18% (n = 361 + 371 +357) of the responses. Meanwhile, confidentiality had 14.7% (n = 294); lastly, integrity presented with 13.2 % (n = 294) out of 2227 responses. The high frequency of responses emphasising accuracy, completeness, reliability, and timeliness suggests a strong awareness of the essential attributes of high-quality data.

Confidentiality and integrity, while slightly less emphasised, are still recognised as critical components.

Computed number of the participants: The participants who selected three characteristics: completeness, reliability and timelines of data quality had 81.3% (n = 337), and the participants who selected all the characteristics of data quality were at 67.7% (n = 279).

Data quality check mechanisms: Among the 673 multiple responses regarding data quality check mechanisms in use, the highest response was for LQAS at 54.4% (n = 343). Applications of RDQA and DQA data quality check mechanisms had an average of 18% (n = 118 + 121), respectively. The use of the DQRC mechanism for checking routine data quality had the least response, 11.1% (n = 73). The predominant use of LQAS indicates a preference for this method in ensuring data quality. The substantial but lesser use of DQA and RDQA mechanisms highlights their importance, though they are not as widely implemented. The minimal reliance on DQRC and the small percentage reporting no data quality checks suggest areas for improvement in standardising data quality practices across institutions.

Availability of functional components needed to ensure data quality: Participants responded 2132 times regarding the availability of functional components. Four out of the six functional components were adequately available: regular supply of HMIS data collection and reporting forms, indicators definition manual, reporting guidelines, and linkage with the national system had an average of 18% (n = 392+378+374+366) responses. The remaining two functional components of data quality: staffing of HMIS/M&E structure to the standard had comparatively less response, 15.9% (n = 339) and encouragement of a culture of data use for decision-making had the least response, only 13.3% (n = 238).

The high response rates for the availability of data collection tools, indicator definition manuals, reporting guidelines, and national system linkages reflect well-established data quality infrastructure components. The relatively lower response rates for adequately staffed M&E

structures and encouragement of a data use culture indicate potential areas for capacity building and fostering a data-driven environment.

For the availability of functional components question to ensure the data quality, the third option: I do not know, 'IDK' was available; however, less than 5% of the participants opted for IDK of the items involved. Accordingly, 1.7% (n = 7) IDK responses to 'M&E structure adequately staffed as per standard (HMIS/HIT staff)' and 'Indicator definition manual was available' items, and 4.9% (n = 20) to the regular supply of data collection and reporting form item. Thus, these low responses were excluded from further analysis.

Implemented data management processes at the health institutions.

Figure 4.1 illustrates the data management processes implemented at the study health institutions.

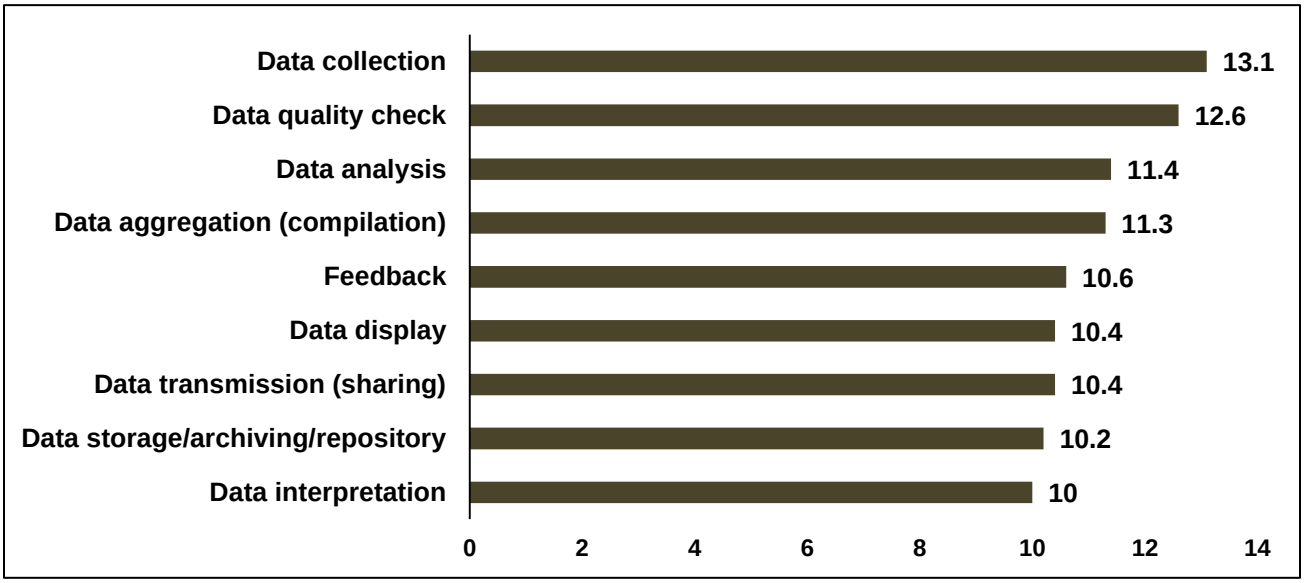

Figure 4.1: Data management processes implemented at the study health institutions

Data collection was the most frequently accomplished function of data management processes, representing 13.1% (n = 372) out of 2829 responses. This was followed closely by data quality checks, which accounted for 12.6% of the responses. Data analysis and data aggregation (compilation) were also significant, with 11.4% and 11.3% of the responses,

respectively. On the other end of the spectrum, data interpretation was the least accomplished function, with only 10% of the responses.

Data storage/archiving/repository, data transmission (sharing), and data display were also relatively low, with 10.2%, 10.4%, and 10.4% of the responses, respectively. Feedback was noted by 10.6% (n = 283+288+293+300) of the responses.

These results indicate suboptimal performance of data management processes, while data collection and quality checks are well implemented, other essential functions, such as data interpretation, storage, and sharing, require more attention and improvement. Limited staff experience might have contributed to low performance in data interpretation, storage, sharing, and quality assurance of the collected data. Addressing these areas will help enhance the overall data management practices within health institutions.

4.3.4 Data management processes and tools used in health institutions

Table 4.4 below summarises the various tools and processes used for data management within the health institutions, presenting the counts and percentages for each category based on multiple responses.

Table 4.4: Data management process and tools used

Variable		Multiple response: Yes	
		Count (n)	Per cent (%)
Which tool(s) is/are used for the routine data collection?	DHIS2 (database)	319	22.8
	Child health (patient) card	176	12.6
	Registers	316	22.5
	Tally sheet	316	22.5
	Reporting forms	275	19.6
	Total	1402	100
Which tool(s) is/are used to aggregate (compile) routine data?	DHIS2 (database)	343	40.1
	EHMIS software	80	9.4
	Tally sheet	216	25.3
	Reporting forms	216	25.3
	Total	855	100
Which computer (software) is (are) used to capture/store data?	DHIS2 (database)	389	54.9
	EHMIS	88	12.4
	EMR	160	22.6
	HFIS	72	10.2
	Total	709	100
What type(s) of tool(s) is/are used for data analy-	DHIS2 (database)	381	67.4
	EHMIS software	67	11.9

sis?	EMR	117	20.7
	Total	565	100
What is (are) tools used for routine data display?	DHIS2 (database) visualisation	327	36.1
	EPI monitoring chart	201	22.2
	Epidemic monitoring chart	138	15.2
	Performance indicators table/graph	239	26.4
	Total	905	100
Which step(s) is(are) followed in the monthly/quarterly routine data (results) interpretation	Compare the result with previous achievements	310	25.9
	Compare the result with the annual target (indicator)	325	27.1
	Describe significant findings (gaps)	279	23.3
	Develop an action plan	284	23.7
	Total	1198	100
What is (are) the tool(s) mechanism(s) used for the sharing of routine data?	Access to the DHIS2 platform, internally	293	28.4
	Electronic form sharing, externally	207	20.1
	Hard copy report sharing, externally	265	25.7
	Sharing data review meeting internally	266	25.8
	Total	1031	100
What feedback mechanism(s) is (are) given/received on routine data at this health institution?	Self-assessment of own data feedback	284	25.6
	Higher level RDQA feedback	243	21.9
	Data review day workshop feedback	190	17.1
	Stakeholder's data review feedback	179	16.2
	Peer data review meeting feedback	212	19.1
	Total	1108	100

Data collection tools:

The tools employed for routine data collection include the DHIS2 database, child health (patient) cards, registers, tally sheets, and reporting forms. Specifically: DHIS2 (database): Utilised by 22.8% (n = 319) of respondents. Registers: Employed by 22.5% (n = 316) of respondents. Tally sheets: Also utilised by 22.5% (n = 316) of respondents.

Reporting forms: Used by 19.6% (n = 275) of respondents. Child health (patient) cards: Utilised by 12.6% (n = 176) of respondents.

Data aggregation (compilation) tools: For the aggregation of routine data, the tools used include: DHIS2 database, which was used for data aggregation, had 40.1% (n = 343) responses out of 855 multiple responses. The use of HMIS tally sheet and reporting forms for data aggregation had the same proportion, 25.3% (n = 216+ 216) responses; meanwhile, the use of EHMIS software for data aggregation had 9.4% (n = 80) responses.

Computer software for data capturing/storage: The software tools for capturing and storing data are as follows: DHIS2 was the second highest response to computer software used for data capturing (storage) with 54.9% (n = 389) out of 709 multiple responses, followed by EMR software, which had 22.6% (n = 160) responses. EHMIS and HFIS use for data capturing had 17.6% and 21.5% (n = 72 and 88) responses, respectively.

Data analysis tools: The tools used for data analysis included: DHIS2 database use for data analysis had 67.9% (n = 381) responses out of 565 multiple responses, making data analysis the foremost data management function that uses DHIS2. Use of EMR and EHMIS for data analysis had 20.1% (n = 113) and 11.9% (n = 67) responses, respectively.

Data display tools: For displaying data, there were 905 multiple responses. Of these, DHIS2 for data display or visualisation had 36.1% (n = 327) of the responses. Performance indicators through graphs or charts were used in 26.4% (n = 239) of the responses, and data display using an EPI monitoring chart accounted for 22.2% (n = 201) of the responses.

Finally, epidemic monitoring charts were used in 15.2% (n = 138), as indicated in the responses.

Data interpretation steps. The steps followed for data interpretation included comparison of current achievement with annual target (indicator) as the main data interpretation mentioned with 27.5% (n = 325) out of 1198 responses; data interpretation through comparison of current performance with previous achievements accounted for 25.9% (n = 310) responses, while describing gaps and developing action plans in interpretation had an almost equal 23% (n = 279 + 284) responses.

Data sharing mechanisms: The mechanisms used for sharing routine data included direct access to DHIS2 for data sharing methods, with 28.4% (n = 293) responses out of 1031 multiple responses. Sharing data through paper form reports externally and through data review meetings internally had an average of 26% (n = 265+ 266) responses.

Data feedback mechanisms: Self-assessment was the main feedback mechanism in place, with 25.6% (n = 284) responses from 1108 multiple responses. Receipt of feedback after RDQA assessment by higher authorities had 21.9% (n = 243) responses; the use of peer (same level) facilities and or professionals review/meeting for feedback had 19.0% (n = 212) responses; while use of stakeholders'/partners data review feedback had the least, 16.2% (n = 179) responses.

The tools and processes used in data management within health institutions vary, with certain tools like the DHIS2 database being prominently used across multiple functions such as data collection, aggregation, storage, analysis, display, and sharing. The results also highlight areas where certain tools are less frequently employed, suggesting potential areas for improvement in data management practices.

The ‘others’ options were available for tools used for each of the data management processes questions; however, less than 1% of the participants selected the ‘other tools’ option in response to the processes: 0.1% (n = 1) for data sharing and 0.7% (n = 4) of the partici-

pants selected ‘others’ for data analysis tools used, this significant minority responses were excluded from further analysis.

4.3.5 Part IV: Technical determinants of data quality and information use

Part IV of the study identified technical determinants of the HMIS (RHIS) performance. The technical determinants include the complexity of the tools, methods, IT use (computer software), and specialised knowledge and skills of data management processes. It also includes specialised technological infrastructure and HMIS design: standardisation, integration, and simplification of forms and indicators.

Table 4.5: Complexity of data collection tools and level of agreement

Variable	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
HMIS reporting forms are complex	20.1 (n = 83)	47.1 (194)	7.3 (30)	21.6 (89)	3.9 (16)
HMIS data collection tool(s) is/are too lengthy	18.0 (= 74)	46.1 (190)	7.8 (32)	24.3 (100)	3.9 (16)
The computer software this HI uses for data capturing is complex	15.0 (n = 62)	55.6 (229)	8.5 (35)	19.2 (79)	1.7 (7)

Table 4.5 above shows that a quarter, 25.5% (n = 105) of participants, agreed or strongly agreed that HMIS reporting forms were complex, while 7.3% (n = 30) remained neutral. However, the computed mean value of the responses was 2.42 $\pm$ 1.15, which corresponds to disagreement with the statement ‘HMIS reporting forms are complex.’

More than a quarter (28.3%; n = 116) of participants agreed or strongly agreed that HMIS data collection tools were too lengthy. The mean value of the responses was 2.5 $\pm$1.15 and aligned with the disagree interval.

Similarly, 20.9% (n = 86) of the participants agreed or strongly agreed that computer software for data capturing was complex; the mean value of the response was 2.37 $\pm$1.01, which was consistent with the disagreement with the complexity of the software.

Table 4.6: Views about the complexity of HMIS tools and computer software

Variable		Multiple response: Yes	
		Count (n)	Per cent (%)
Which reporting form(s) is/are complex?	Immunisation reporting form	59	27.1
	The disease reporting form	85	39
	The MCH reporting form	49	22.5
	IDSR reporting form	21	9.6
	Other	4	1.8
	Total	**218**	**100**
Why reporting form(s) is/are complex?	No guidelines on the use of the reporting form	50	28.2
	Data elements are duplicative (redundant)	70	39.5
	Difficult to understand the contents	55	31.1
	Other	2	1.1
	Total	**177**	**100**
Which data collection tool(s) is/are too lengthy?	DHIS2 (database)	104	48.6
	EHMIS database	28	13.1
	Child health (patient) card	28	13.1
	The Immunisation Registers	33	15.4
	The Immunisation Tally Sheet	21	9.8
	Total	**214**	**100**
Why do you think HMIS data collection tool(s) is/are taking a long time?	No guidelines on the use of data collection tools	48	24.9
	Difficult to understand the contents	74	38.3
	The data elements in the tool are duplicative	69	35.8
	Other	2	1
	Total	**193**	**100**

Why is the use of computer software complex?	No guidelines on how to use the software	37	18.2
	Difficult to understand its operation	58	28.6
	It is very slow and time-consuming	63	31
	Data elements in the software are duplicative	44	21.7
	Other	1	0.5
	Total	**203**	**100**

Table 4.6 above shows views about, and reasons given for, the complexity of HMIS tools by the participants who agreed or strongly agreed that the HMIS reporting form(s) were complex. The highest deemed complex reporting form was the disease reporting form, with 39% (n = 85) out of 218 multiple responses. It was followed by the immunisation form at 27.1% (n = 59) responses, and the MCH form at 22.5% (n = 49) responses. Lastly, the IDSR form had 9.6% (n = 21) responses, and others at 1.8% (n = 4).

The reason for the complexity of the reporting form was that the reporting of data elements was duplicative, 39.5% (n = 70) out of 177 multiple responses; difficult to understand the contents mentioned had 31.1% (n = 55) responses; and no guidelines on the use of the reporting forms had 28.2% (n = 50) responses, and others at 1.1% (n = 2).

The majority, 48.6% (n = 104), of responses out of 214 multiple responses show that the DHIS2 software was too lengthy. Less than 15.4% (n = 33) of responses indicated that the immunisation register was too lengthy. The EHMIS and Child Health Card had similar responses; 13.1% (n = 28) responses said that these tools are too lengthy, while 9.8% (n = 21) responses to the immunisation tally sheet said that it is too lengthy.

The reasons that the HMIS data collection tools were too lengthy were as follows: it is difficult to understand the contents had 38.3% (n = 74) responses from 193 multiple responses; followed by the data elements in the tools were duplicative at 35.8% (n = 69) responses

and finally the absence of guidelines regarding use the data collection tools had the least, 24.9% (n = 48) responses, and others at 1% (n = 2).

The HMIS computer software on use was too complex, because there were no guidelines on how to use the software at 18.2 % (n = 37) out of 203 multiple responses; it took a long time (slow) according to 31.0% (n = 63) responses; difficult to understand its operation had 28.6% (n = 58) responses; and the data elements in the software were duplicative according to 21.7% (n = 44) the responses, and others at 0.5% (n = 1).

Table 4.7: Understanding and use of HMIS tools

Variable		Multiple response: Yes	
		Count (n)	**Per cent (%)**
What do you understand by the term standardised HMIS design?	HMIS data have a standard definition	297	28.8
	Similar HMIS tools at a similar level of the system	238	23.1
	HMIS Indicators are clearly defined	279	27
	Guidelines available on how to use HMIS tools	217	21
	Total	**1032**	**100**
What do you understand by the term integrated HMIS design?	Uniform (no duplicative) data registers/records	262	19.8
	Single channel (no parallel) reporting	193	14.6
	All health programs have a common data tool	291	22
	Data capture made easier	197	14.9
	Data analysis made easier	199	15
	Data use made easier	183	13.8
	Total	**1325**	**100**
What do you understand by the term simplified HMIS de-	The procedure/content of the HMIS tools is understandable	283	23.9
	Data capturing in HMIS tools is not lengthy	238	20.1

sign (tools)?	HMIS collected data are relevant to performance indicators at the health facility level	269	22.7
	Filling the HMIS reporting form does not take a long time	185	15.6
	Data sharing using HMIS tools has been made easier	211	17.8
	Total	**1186**	**100%**
Which of the HMIS tool(s) is/are standardised?	Child health card (individual medical record)	286	22.4
	Immunisation service registers	326	25.5
	Immunisation service tally sheet	297	23.2
	Immunisation service reporting form	295	23.1
	None of the above tools is standardised.	75	5.9
	Total	**1279**	**100**
Which of the HMIS tool(s) is/are Integrated?	Child health card (individual medical record)	271	21.6
	Immunisation service registers	315	25.2
	Immunisation service tally sheet	282	22.5
	Immunisation service reporting form	287	22.9
	None of the above tools is integrated	97	7.7
	Total	**1252**	**100**
Which of the HMIS tool(s) is/are simplified?	Child health card (individual medical record)	259	22.9
	Immunisation service register	276	24.4
	Immunisation service tally sheet	265	23.4
	Immunisation service reporting form	255	22.5
	None of the above tools is simplified	76	6.7
	Total	**1131**	**100**

Table 4.7 above shows the level of understanding of types of HMIS tools that are standardised, integrated, and simplified.

4.3.6 Understanding of standardised, Integrated, and simplified HMIS

Standardised HMIS: Approximately 28.8% (n = 297) of responses out of 1032 multiple responses indicated that the HMIS data have a standardised, agreed-upon definition. This was followed by 27.0% (n = 279) responses that the HMIS indicators were clearly defined and understandable. Having similar HMIS tools at a similar level of the health system was reported by 23.1% (n = 238) responses, and guidelines on how to use HMIS tools were mentioned by 21.0% (n = 217) responses.

Computed number of participants: Less than half, 47.6% (n = 196) of the participants mentioned all defining components of standardised HMIS design (indicator definition and tools).

Integrated HMIS: integrated HMIS means all health programs have common data tools, had 22.0% (n = 291) out of 1325 responses. The registers and report forms are uniform and have no duplicative data, was mentioned by 19.8% (n = 262) of responses. Having single channel (no parallel) reporting, data capture made easier, and data analysis made easier, obtained equal responses of 14.6 and 15% (n = 193 +199), and data use made easier, was mentioned by 13.8% (n = 193).

Computed number of participants: Less than half, 48.5% (n = 205) of the participants indicated all components related to the definition of integrated HMIS design.

Simplified HMIS: The simplified HMIS had 1186 multiple responses. The responses that indicated that simplified HMIS means the contents and procedure of HMIS are clear and understandable were 23.9% (n = 283). HMIS data collected are relevant to performance indicators, was mentioned by 22.7% (n = 269) of the responses. Data capturing on HMIS did not take time had 20.1% (n = 238) responses. Data sharing using HMIS forms made

easier had 17.8% (n = 211) responses. Filling in HMIS reporting forms does not take time, according to 15.6% (n = 185) of responses.

Computed number of participants: The majority, 56.8% (n = 234) of the participants showed all the defining components of the simplified HMIS design, and only **36.4% (n = 150)** of the participants showed all the components of the standardised, integrated, and simplified HMIS design.

- **The HMIS tools that are standardised, integrated, and simplified**.

Standardised HMIS tools: the immunisation service register was standardised as per 25.5% (n = 326) of 1279 multiple responses; immunisation tally sheet and its reporting forms, and child health (individual medical record) card were standardised with an average response of 23% (n = 286+ 295+297). None of the tools was standardised according to 5.9% (n = 75) responses.

Computed number of participants: The majority, 53.2% (n = 219) of the participants mentioned that all the HMIS tools in use were standardised.

Integrated HMIS tools: immunisation service register was integrated according to 25.2% (n = 315) of 1252 responses; HMIS immunisation tally sheet, immunisation reporting forms, and child health card (individual medical record) had on average 22.5% (n = 271+ 282+287) responses.

Computed number of participants: Nearly half, 49.8% (n = 205) of the participants reported that all HMIS tools in use were integrated.

Simplified HMIS tools: this variable had 1131 multiple responses. An immunisation service register was simplified as per 24.4% (n = 276) of the responses. Immunisation service tally sheet, child health card, and immunisation reporting forms were simplified, had an average of 23% (n = 255+259+265) of the responses.

Computed number of participants: Below half, 44.7% (n = 184) of the participants showed that all HMIS tools in use were simplified, and **only 35% (n = 144)** of the participants reported that all HMIS tools were standardised, integrated, and simplified in the health institutions. This statistic was further used to calculate the chi-square to determine the association between this view and selected data management processes.

Table 4.8: Association between the reported use of standardised, integrated and simplified HMIS tools and data management processes

Variable		Implement data management process		X^2, df, P-value
Reporting all the HMIS tools that are standardised, integrated and simplified.		Data interpretation Yes	No	
Yes	Total	119	25	X^2 = 38.72, df = 1, p = <.001
	Expected total	89.8	54.2	
	% reported all the HMIS tools are standardised, integrated, and simplified	82.6%	17.4%	
No	Total	138	130	
	Expected total	167.2	100.8	
	% reported all the HMIS tools are standardised, integrated, and simplified	51.5%	48.5%	
Reporting all the HMIS tools that are standardised, integrated and simplified.		Data quality check		
		Yes	No	
Yes	Total	140	4	X^2 = 22.04 df = 1, p = <.001
	Expected total	124.4	19.6	
	% reported all the HMIS tools are standardised, integrated, and simplified	97.2%	2.8%	
No	Total	216	52	
	Expected total	231.6	36.4	
	% reported all the HMIS tools are standardised, integrated, and simplified	80.6%	19.4%	

Table 4.8 shows the chi-square statistic test results of the association between the reported types of standardised, integrated, and simplified HMIS tools in use by the health institutions and data management processes.

The majority (82.6%) of participants who reported that all the HMIS tools are standardised, integrated and simplified performed data interpretation, compared to (51.5%) of the participants who performed data interpretation among those not reporting that all HMIS tools are standardised, integrated and simplified. This shows the participants' performance of data interpretation is significantly associated with their view of the HMIS tools (X^2 = 38.72, df = 1, p = < 0.001).

Likewise, a higher percentage (97.2%) of the participants who reported that all HMIS tools were standardised, integrated and simplified checked data quality, compared to 80.6% who checked data quality, yet did not report that all the HMIS tools were standardised, integrated and simplified. This showed that the participants' conduct of data quality checks was significantly associated with their views of the HMIS tools (X^2 = 22.04, df = 1, p = <.001).

4.3.7 Part V: Organisational determinants of data management processes and data quality

Part V of the study identified organisational factors affecting data management processes. This section involves the management functions an organisation conducts, data sources used to carry out the functions, staffing patterns, training, impact of the training, and supportive supervision. Additionally, the section identified mechanisms in place for internal and external data sharing. Moreover, the section includes beliefs among the participants about the responsibility to ensure the continuous use of information.

Table 4.9: Management functions conducted at health institutions

Variable	Response	Count	Per cent (%)
Developing a strategic plan	Yes	351	85.2
	No	49	11.9
	I do not know	12	2.9
	Total	412	100
Developing an annual work plan	Yes	383	93
	No	22	5.3
	I do not know	7	1.7
	Total	412	100
Performance monitoring	Yes	388	94.2
	No	22	5.3
	I do not know	2	0.5
	Total	412	100
Staff performance appraisal	Yes	327	79.4
	No	67	16.3
	I do not know	18	4.4
	Total	412	100
Quality of service improvement plan	Yes	367	89.1
	No	34	8.3
	I do not know	11	2.7
	Total	412	100
Supply request, use and distribution	Yes	338	82
	No	54	13.1
	I do not know	20	4.9

	Total	412	100
Resource mobilisation and allocation	Yes	335	81.3
	No	57	13.8
	I do not know	20	4.9
	Total	412	100
Immunisation service session plans	Yes	347	84.2
	No	52	12.6
	I do not know	13	3.2
	Total	412	100
Emergency (outbreak) response plan	Yes	325	78.9
	No	66	16
	I do not know	21	5.1
	Total	412	100

Table 4.9 above shows all management functions that were carried out by the health institutions under the study: developing a strategic plan was mentioned by 85.2% (n = 351) of the participants, while 11.9% (n = 49) reported not developing a strategic plan, and 2.9% (n = 12) mentioned that they did not know. Developing an annual work plan was mentioned by 93% (n = 383) of the participants, while 5.3% (n = 22) of the participants disagreed, and 1.7% (n = 7) reported that they did not know.

Most of the participants, 94.4% (n = 388), indicated that their health institutions conducted performance monitoring, while 5.3% (n = 22) disagreed, and only 0.3% (n = 2) did not know.

The third widely conducted management function was planning for quality-of-service improvement, reported by 89.3% (n = 367), while 8.3% of the participants responded ‘No’ and

2.4% responded ‘IDK’ to this management function. Development of a strategic plan was mentioned by 85.2% (n = 351), while 11.9% (n = 49) of the participants responded ‘No’ and 2.9% (n = 12) responded ‘IDK’ to the development of a strategic plan.

Execution of other management functions, including resource mobilisation and allocation, and supply request and distribution, was mentioned by below 82% (n = 338) of the participants. Staff performance appraisal is the least executed management function mentioned by 79.4% (n = 327), while 16.3% (n = 67) and 4.4% (n = 18) of the participants responded ‘No’ and ‘IDK’ to these management functions.

Four of the management functions conducted in relation to data management processes were analysed using Chi-Square test statistics, to analyse the association between accomplishment of management functions versus data management processes such as data storage, data sharing, data display, data interpretation and data feedback.

Table 4.10: Association between organisational functions and data interpretation

Variable **Conduct performance monitoring**		**Perform data interpretation**		**X^2 value, df, p- value**
		Yes	No	
Yes	Total	251	137	X^2 = 15.75, df = 2, p = <0.001
	Expected total	242.0	146.0	
	% within performance monitoring	64.7%	35.3%	
No	Total	5	17	
	Expected total	13.7	8.3	
	% within performance monitoring	22.7%	77.3%	
Plan for quality-of-service improvement				

Yes	Total	244	123	$X^2 = 25.85$, df = 2, p = <0.001
	Expected total	228.9	138.1	
	% within quality-of-service improvement plan	66.5%	33.5%	
No	Total	8	26	
	Expected total	21.2	12.8	
	% within quality-of-service improvement plan	23.5%	76.5%	
Develop an immunisation session plan				
Yes	Total	1	121	$X^2 = 10.31$, df = 2, p = 0.01
	Expected total	226	130.5	
	% within Immunisation service sessions plans	216.5	34.9%	
No	Total	87.9%	30	
	Expected total	22	19.6	
	% within Immunisation service sessions plans	32.4	57.7%	

Table 4.10 above shows that the majority of participants (64.7%) who conducted performance monitoring also performed data interpretation. This high percentage shows a strong tendency for performance monitoring to be associated with data interpretation. Conversely, a smaller proportion (22.7%) of the participants performed data interpretation and yet did not conduct performance monitoring; the association is significant ($X^2 = 15.75$, df = 2, p = <0.001).

Similarly, the chi-square test shows a high percentage (66.5%) of the participants who planned for health service quality improvement also performed data interpretation. This high percentage revealed that planning for service quality improvement was strongly associated with the performance of data interpretation. On the other hand, a smaller proportion (23.5%) of the participants performed data interpretation among those who did not plan for service quality improvement, revealing a significant association ($X^2 = 25.85$, df = 2, p = <0.001).

The majority (87.9%) of the participants who developed an immunisation session plan also performed data interpretation; this high percentage showed a significant association between the two variables. On the contrary, a smaller proportion (22.7%) of the participants performed data interpretation among those who did not develop an immunisation session plan, revealing a significant association ($X^2 = 10.31$, df = 2, p = 0.01).

Table 4.10: Association between organisational functions and data quality check and data analysis

Variable		Conduct a data quality check		X^2 value, df, p-value
Conduct performance monitoring		**Yes**	**No**	
Yes	Total	344	44	X^2 = 28.76, df = 1, p = < 0.001
	Expected total	335.3	52.7	
	% within performance monitoring	88.7%	11.3%	
No	Total	12	12	
	Expected total	3.3	20.7	
	% within performance monitoring	50.0%	50.0%	
Plan for quality-of-service improvement				
Yes	Total	319	48	X^2 = 0.75, df = 1, p = 0.39
	Expected total	317.1	49.9	
	% within quality-of-service improvement plan	86.9%	13.1%	
No	Total	37	8	
	Expected total	38.9	6.1	
	% within quality-of-service improvement plan	82.2%	17.8%	
Develop an immunisation session plan				
Yes	Total	301	46	X^2 = 0.21, df = 1, p = 0.65
	Expected total	299.8	47.2	
	% within immunisation service session plans	86.7%	13.3%	
No	Total	55	10	
	Expected total	56.2	8.8	

	% within immunisation service session plans	84.6%	15.4%	
Conduct performance monitoring		**Data analysis**		
Yes	Total	312	76	X^2 = 15.96, df = 1, p = < 0.001
	Expected total	304.2	83.8	
	% within performance monitoring	80.4%	19.6%	
No	Total	11	13	
	Expected total	18.8	5.2	
	% within performance monitoring	45.8%	54.2%	
Plan for quality-of-service improvement				
Yes	Total	295	72	X^2 = 7.81, df = 1, p = 0.01
	Expected total	287.7	79.3	
	% within quality-of-service improvement plan	80.4%	19.6%	
No	Total	28	17	
	Expected total	35.3	9.7	
	% within quality-of-service improvement plan	62.2%	37.8%	
Develop an immunisation session plan				
Yes	Total	278	69	X^2 = 3.83, df = 1, p = 0.05
	Expected total	272.0	75.0	
	% within immunisation service session plans	80.1%	19.9%	
No	Total	45	20	
	Expected total	14.0	51.0	
	% within data analysis	22.5%	13.9%	

Table 4.11 above shows conduct performance monitoring, plan for quality-of-service improvement and develop an immunisation session plan in relation to performance of data

quality check and data analysis. The chi-square statistic test between the conduct of performance monitoring and data quality checks shows that the majority of participants (64.7%) who conducted performance monitoring also performed data quality checks. This high percentage shows a high tendency for performance monitoring to be associated with the performance of the data quality check. At the same time, a smaller proportion (50%) of the participants performed a data quality check among those who did not, revealing a significant association (X^2 = 28.76, df = 1, p = < 0.001).

In terms of planning for quality-of-service improvement and performance of data quality checks, a greater proportion (86.9%) of the participants who planned for quality-of-service improvement also performed data quality checks, compared to 82.2% of the participants who performed data quality checks among those who did not plan for quality-of-service improvement. No statistically significant association was found between these variables. (X^2 = 0.75, df = 1, p = 0.39).

The higher percentage (86.7%) of the participants who developed an immunisation session plan also performed a data quality check, compared to 84.6% of those who did not develop an immunisation session plan, but the difference is not statistically significant (X^2 = 0.21, df = 1, p = 0.65).

A higher percentage (80.4%) of the participants who conducted performance monitoring also performed data analysis. In comparison, a smaller proportion (45.8%) of the participants performed data analysis among those who did not conduct performance monitoring, showing a significant difference (X^2 = 15.96, df = 1, p = < 0.001**).**

The majority (80.4%) of participants who planned for quality-of-service improvement also performed data analysis. This higher proportion shows a significant association between planning for quality-of-service improvement and data analysis. On the other hand, a smaller proportion (62.2%) of those who performed data analysis did not plan for quality-of-service improvement, revealing a significant association (X^2 = 7.81, df = 1, p = 0.01).

The majority (80.1%) of the participants who developed the session plan also performed data analysis, compared to 22.5% who performed data analysis and did not develop the immunisation session plan. The difference is significant ($X^2 = 3.83$, df = 1, p = 0.05).

Table 4.11: Management functions carried out, and data sources used

Variables and data sources		Multiple response: Yes	
		Count (n)	Per cent (%)
Developing a strategic plan	Routine HMIS	365	80.2
	Census	46	10.1
	Survey	44	9.7
	Total	**455**	**100**
Developing an annual work plan	Routine HMIS	364	82.5
	Census	51	11.6
	Survey	25	5.7
	Other	1	0.2
	Total	**441**	**100**
Performance monitoring	Routine HMIS	386	90
	Census	22	5.1
	Survey	21	4.9
	Total	**429**	**100**
Staff performance appraisal	Routine HMIS	340	80.4
	Census	22	5.2
	Survey	61	14.4
	Total	**423**	**100**
Quality of service improvement plan	Routine HMIS	357	80.8

	Census	26	5.9
	Survey	58	13.1
	Other	1	0.2
	Total	**442**	**100**
Supply request, use and distribution	Routine HMIS	347	80.9
	Census	36	8.4
	Survey	45	10.5
	Other	1	0.2
	Total	**429**	**100**
Resource mobilisation and allocation	Routine HMIS	334	77.3
	Census	44	10.2
	Survey	54	12.5
	Total	**432**	**100**
Immunisation service session plans	Routine HMIS	360	84.9
	Census	27	6.4
	Survey	37	8.7
	Total	**424**	**100**
Emergency (outbreak) response plan	Routine HMIS	313	70.3
	Census	38	8.5
	Survey	94	21.1
	Total	**445**	**100**

Table 4.12 above shows that HMIS is the major data source of information used to carry out all management functions. The HMIS data source was the highest used to conduct performance monitoring at 90% (n = 386) responses out of 429 multiple responses, and its source was the least used for outbreak (emergency) response plan with 70.3% (n = 313) responses out of 445 multiple responses.

The HMIS data source used for functions to develop immunisation sessions was the second highest, 84.9% (n = 360) responses, up on 424 multiple responses and developing an annual work plan was the third management function with 82.5% (n = 364) responses out of 441 multiple responses. The data source was also used to conduct staff performance appraisal, planning of quality-of-service improvement, and developing a strategic plan, which had an average of 81% (n = 340+357+365) responses out of 423, 442 and 455 multiple responses, respectively.

The highest use of survey data source was for the emergency/outbreak response plan, which had 21.1% (n = 94) responses, followed by its use for staff performance appraisal, 14.4% (n = 61) responses. At the same time, the highest use of census data source to develop an annual work plan had 11.6% (n = 51) responses, followed by its use to develop a strategic plan with 10.1% (n = 41) responses.

Table 4.12: Post for HMIS data process, training and skill status

Variable		Count (n)	Per cent (%)
Is the post for HMIS processes filled at this health institution?	Yes, the HMIS/HIT post is filled at this HI	336	81.6
	No, the HMIS/HIT field is not filled	26	6.3
	I do not know if the HMIS/HIT post is filled	46	11.2
	No HMIS/HIT post at this health institution	4	1
	Total	**412**	**100**
Have HMIS personnel	Yes, recently trained	256	76.2

assigned for the data management process been trained recently?	Yes, trained, but not recently	63	18.8
	No, not trained	17	5.1
	Total	336	81.6
	No response (NA)	76	18.4
	Total	**412**	**100**
Was the recent training need-based?	Yes, the training was needs-based	243	94.9
	No, the training was not needs-based	6	2.3
	I do not know if training was needs-based	7	2.7
	Total	256	62.1
	No response (NA)	156	37.9
	Total	**412**	**100**
After training, was there an improvement in data processing skills?	Yes, the training has improved skills	192	64.6
	No, the training has not improved skills	16	5.4
	I do not know if training has improved skills	89	30.0
	Total	297	72.1
	No response (NA)	115	27.9%
	Total	**412**	**100**

Table 4.13 above shows staffing of data management positions, training of the data management officers, and the current training impact on improving the skills of the trainees on data management processes. Assignment of HMIS/HIT personnel in posts was mentioned by 81.6% (n = 336) of the participants. HMIS personnel in the positions who have recently trained were mentioned by 76.2% (n = 256). There was training, but the training was not recent, was mentioned by 18.8% (n = 63) of participants.

The recent training was needs-based, according to 94.9% (n = 243) of participants who indicated that the training was recent, and the training has improved skills of the trainee

HMIS personnel on data management processes, according to 64.6% (n = 192) of the participants who reported that the HMIS personnel in position were trained on HMIS.

Table 4.13: Impact of recent training vs skill in data feedback and data interpretation

The recent training has improved skills among the trainees versus their performance of data feedback and data interpretation			**Perform data feedback**		**X^2 = df, p -value**
			Yes	**No**	
After training, was there an improvement in data processing skills?	Yes, the training has improved skills	Total	226	81	X^2 = 7.2; df = 2. P = 0.03
		Expected total	223.5	83.5	
		% within 'after training, was there improvement in data processing skills?'	73.6%	26.4%	
	No, the training has not improved skills	Total	7	9	
		Expected total	11.7	4.3	
		% within 'after training, was there improvement in data processing skills?'	43.8%	56.3%	
			Perform data interpretation		
After training, was there an improvement in data processing skills?	Yes, the training has improved skills	Total	219	88	X^2 = 4.98; df = 2. p = 0.08
		Expected total	210.9	96.1	
		% within 'after training, was there improvement in data processing skills?'	71.3%	28.7%	
	No, the training has not improved skills	Total	8	8	
		Expected total	11	5	
		% within 'after training, was there improvement in data processing skills?'	50%	50%	

A chi-square test was performed between the reported improvement in data management skills after the recent HMIS training and the performance of data feedback and data interpretation. The majority (73.6%) of the participants who reported the training had improved skills also performed data feedback, whereas fewer (43.8%) of the participants performed data feedback among those who reported the recent training had not improved data process skills. This shows that the performance of data feedback had an association with the improvement in data process skills, with a significant difference (X^2 = 7.2; df = 2; p = 0.03).

The participants (71.3%) who reported that the training had improved their skills also performed data interpretation. In comparison, fewer (50%) participants performed data interpretation among those who reported that the recent training had not improved skills; however, the result reveals no significant association (X^2 = 4.98; df = 2, p = 0.08).

Table 4.14: HMIS data use for supportive supervision and data sharing practice

Variable		Count (n)	Per cent (%)
How does this institution use HMIS data to conduct supervision?	To design a supervision checklist	292	29.5
	To verify the reported performance	317	32.1
	To provide feedback	295	29.8
	Not using HMIS for supportive supervision	48	4.8
	I do not know if HMIS is used for supervision	38	3.8
	Total	**990**	**100**
How does this institution share data internally?	Data is not shared due to external pressure	51	5.3
	Data is not shared internally	51	5.3
	Shared during monthly reporting	336	34.8
	Shared in the performance review meeting	308	31.9
	Shared through self-assessment of units	219	22.7
	Total	**965**	**100**

How does this health institution report data to external stake-holders?	Monthly/quarterly reporting	348	34.1
	Monthly/quarterly feedback	247	24.2
	Performance (peer) review meetings	242	23.7
	Upon request by the stakeholders	19	18.0
	Total	**1021**	**100**
Who is responsible for the continuous use of HMIS data at this health institu-tion?	HMIS/HIT staff	335	19.6
	Individual health service providers	228	13.3
	Management team	258	15.1
	Performance monitoring team	309	18.1
	Quality improvement team	320	18.7
	Head of the health Institution (facility)	259	15.2
	Total	**1709**	**100**

Table 4.15 above shows HMIS data use for supportive supervision, and the data sharing mechanism used internally and externally.

The report below describes the highlights of the findings.

Supportive supervision: had multiple responses of 990. The use of HMIS data to verify reported performance was selected by 32.1% (n = 317) of responses, to design a supervision checklist had 29.5% (n = 292) responses, and to provide feedback had 29.8% (n = 295).

Computed number of participants: around half, 51% (n = 210) of the participants, showed the use of HMIS data for all supportive supervision activities.

Data sharing internal (inside the institution): data sharing internally during monthly reporting was mentioned by 34.8% (n = 336) out of 965 multiple responses. Shared during

the performance review meeting had 31.9% (n = 308) responses, and through self-assessment was mentioned as per 22.7% (n = 219) responses.

Data sharing external (outside the institutions): had multiple responses of 1021. External data sharing through monthly and or quarterly reporting was indicated by 34.1% (n = 348) responses; and through monthly/quarterly feedback was mentioned by 24.2% (n = 247) responses. Sharing data, externally, through performance (peer) review meetings had 23.7% (n = 242) responses and sharing when the data (report) was requested by the external stakeholders represented 17.9% (n = 183) responses.

Responsibility of ensuring continuous use of information at health institutions: out of a total of 1709 responses, 19.6% (n = 335) responses attached it to HMIS/HIT staff, to the quality improvement team had 18.7% (n = 320), the performance monitoring team 18.1% (n = 306); and the head of the health institution (health facility) was indicated by 15.2% (n = 259) of the responses. Comparatively less, 13.3% (n = 228), attached it to individual staff to ensure continuous use of HMIS information at the health institutions.

A chi-square test was done to analyse the association between supportive supervision use of HMIS data and implementation of data management processes.

Table 4.15: Supervised use of HMIS data performance, data interpretation, data quality checks, data feedback and self-assessment

HMIS data is used for all supportive supervision activities			**Perform data interpretation**		
			Yes	No	X^2, df, p-value
Use of HMIS data for all supportive supervision	Yes	Total	179	31	X^2 = 54.54 df = 1 p = <.001
		Expected total	144.2	65.8	
		% within supportive supervision use of HMIS data	85.2%	14.8%	

activities	No	Total	104	98	
		Expected total	138.8	63.2	
		% within supportive supervision use of HMIS data	51.5%	48.5%	
			Perform data quality checks		
	Yes	Total	198	12	X^2 22.63, df = 1, p = <0.001
		Expected total	181.5	28.5	
		% within supportive supervision use of HMIS data	94.3%	5.7%	
	No	Total	158	44	
		Expected total	174.5	27.5	
		% within supportive supervision use of HMIS data	78.2%	21.8%	
			Provide data feedback		
	Yes	Total	183	27	X^2 = 44.42. df = 1 p = <.001
		Expected total	152.9	57.1	
		% within supportive supervision activities, HMIS data is used for	87.1%	12.9%	
	No	Total	117	85	
		Expected total	147.1	54.9	
		% within supportive supervision activities, HMIS data is used for	57.9%	42.1%	
	Yes	Total	162	48	
		Expected total	144.8	65.2	
		% within supportive supervision activities, HMIS data is used for	77.1%	22.9%	
	No	Total	122	80	

		Expected total	139.2	62.8	
		% within supportive supervision activities, HMIS data is used for	60.4%	39.6%	

Table 4.15: The above chi-square results show that the majority (79.5%) of the participants who used HMIS to conduct supportive supervision also performed data interpretation. This shows a significant association between the variables; however, fewer (44.6%) participants performed data interpretation among those who did not use HMIS information to conduct supportive supervision. The association is significant (X^2 = 53.65, df = 1, p = < 0.001).

Regarding data quality checks, the majority (94.4%) of participants who used HMIS information to conduct supportive supervision also performed data quality checks. This high percentage shows a significant association. Comparatively, 78.2% of participants performed a data quality check among the participants who did not use the HMIS information to conduct supportive supervision, revealing a significant difference (X^2 = 22.63, df = 1, p = < 0.001).

4.3.8 Part VI: Behavioural factors and data management process

Part VI of the study identified behavioural determinants of HMIS (RHIS) processes, which included attitude and perception of data quality produced from HMIS. Additionally, the data demand, data quality check skill and frequency of data quality checks were investigated. Furthermore, the motivation of data producers and users, competence, and confidence in HMIS tasks to carry out data management processes were tested.

Table 4.16: Data demand and frequency of data quality checks

Variable		Count (n)	Per cent (%)
How is the demand for routine data among the health staff in this health institution?	High demand for HMIS data	246	59.7
	Average demand for HMIS data	140	34.0
	Low demand for HMIS data	26	6.3
	Total	**412**	**100.0**
If HMIS data demand is high, what is/are the reasons?	For program planning	194	23.8
	To send a routine report on time	199	24.4
	To send the parallel donor (partner) report	142	17.4
	To program review	159	19.5
	To community engagement	120	14.7
	Total	**814**	**100.0**
If the demand is high, which unit has the highest demand for HMIS data?	Immunisation (EPI) unit	173	25.3
	Maternal and Child Health (MCH) unit	190	27.7
	Disease prevention and control (CDC) unit	176	25.7
	HMIS/HIT unit	145	21.2
	Other	1	0.1
	Total	**685**	**100.0**
In which data quality assessment mechanism are you skilled?	No skill(s) in data quality checks	44	6.5
	RDQA	158	23.3
	DQA	117	17.3
	LQAS	307	45.3
	DQRC	52	7.7
	Total	**678**	**100.0**

How often is the routine data quality check conducted at this health institution?	Data quality check is not done regularly	36	8.7
	Data quality check is done monthly	339	82.3
	Data quality check is done quarterly	36	8.7
	Data quality check is done annually	1	0.2
	Total	**412**	**100.0**
HMIS produces high-quality data in your institution	Strongly disagree	43	10.4
	Disagree	93	22.6
	Neutral	48	11.7
	Agree	182	44.2
	Strongly agree	46	11.2
	Total	**412**	**100.0**
Indicate problematic areas of data management processes at this health institution	Data collection	273	21.0
	Data quality checking	237	18.3
	Data analysis	193	14.9
	Data interpretation	185	14.3
	Data display	139	10.7
	Data sharing	133	10.2
	Feedback	138	10.6
	Total	**1298**	**100.0**
How does this health institution motivate data producers/ data users?	Managers provide directives on data use	264	22.1
	Managers use HMIS information	315	26.3
	Sufficient supervision and feedback provided	240	20.1
	Incentives (recognition) for data use champions	148	12.4

	Training and capacity building on data use	229	19.1
	Total	**1196**	**100.0**

Table 4.16 above shows that high demand for HMIS data at the health institutions was indicated by 59.5% (n = 246) of the participants, with average demand marked by 34% (n = 140) of the participants and a minority, 6.3% (n = 26), indicated a low demand for HMIS data.

The reasons for the high demand for HMIS data had multiple responses of 814. To send reports timeously had 24.4% (n = 199) responses. For program planning, it was considered by 23.8% (n = 194) of respondents, and for program review by 19.5% (n = 159) of respondents. The parallel donor or partner report had 17.4% (n = 142) responses.

The service delivery units with high demand for HMIS data had 685 multiple responses. The Maternal and Child Health (MCH) unit had high demand, as indicated by 27.7% (n = 190) responses. While the disease prevention and control (CDC) and the immunisation units had the second and third highest demand, according to 25.5% (n = 173 +176) responses, the HMIS/HIT unit had 21.2% (n = 145) responses.

Skill on the data quality check mechanism had 678 multiple responses. LQAS data quality check mechanism shows the highest at 45.3% (n = 307) responses, RDQA and DQA had 23.3% and 17.3% (n = 158 and 117) responses, respectively. DQRC had the lowest 7.7% (n = 52) response rate, while no skill in the data quality check mechanism had 6.5% (n = 44) responses. A small number, 39.8% (n = 164), reported a quality check mechanism.

Regarding regular data quality check: monthly data quality checks were mentioned by 82.3% (n = 339) of the participants; quarterly by 8.7% (n = 36), and no regular data quality check was mentioned by 8.7% (n = 36) of the participants.

Out of the total 1298 responses that indicated problematic areas of data management process at the health institutions, data collection was reported as the most problematic process to implement at 21% (n = 273) of responses. Data quality checks had 18.5% (n = 237) responses, data analysis and data interpretation on average, had 14.5% (n = 185+193), whereas data display, data sharing and data feedback on average, had 10.5% (n = 139+133+138).

“Motivation mechanism in place for data managers and or users” had 1196 responses. The manager's use of HMIS information for decision-making had 26.3% (n = 315) responses. The managers provide directives on how to use HMIS information according to 22.1% (n = 264) of responses. Motivation through adequate supervision and timely feedback had 20.1% (n = 240) responses. Training and capacity building were indicated by 19.1% (n = 229) and, at least, 12.4% (n = 148) responses marked motivation through incentives (recognition) of champion data users and producers.

Computed number of participants: The use of all mechanisms for motivation was mentioned by 71.4% (n = 287) of participants.

The level of agreement of the participants with HMIS produces high-quality data was further analysed to see the computed measure of their perception of the quality of HMIS data.

Perception that HMIS produces high-quality data:

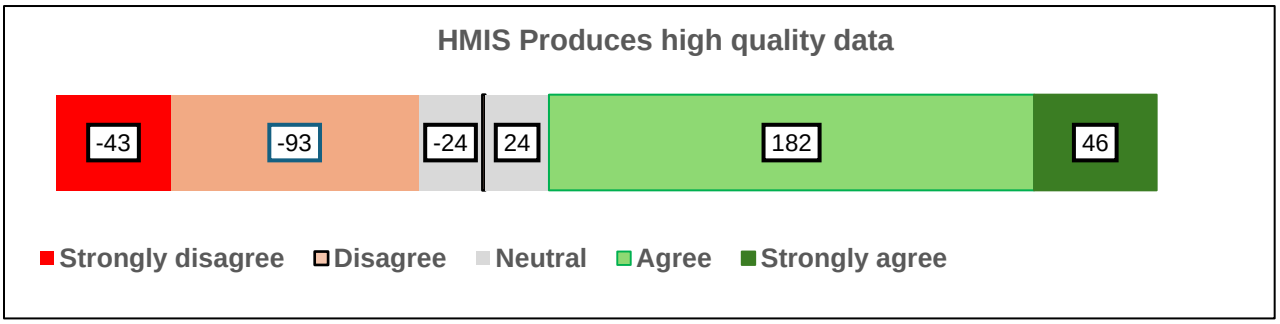

Figure 4.2 above shows how participants perceived the quality of data produced from the HMIS.

About 38.8% (n = 160) of the participants disagreed and strongly disagreed that HMIS produces high-quality data, while 11.7% (n = 48) of the participants neither agree nor disagree with the statement. The greater proportion, 44% (n = 182), agree, and 11.2% (n = 46) strongly agree with the statement that HMIS produces high-quality data. However, the completed mean response is 3.23 ± 1.22, which falls under neutral.

Level of confidence of the participants in data management processes:

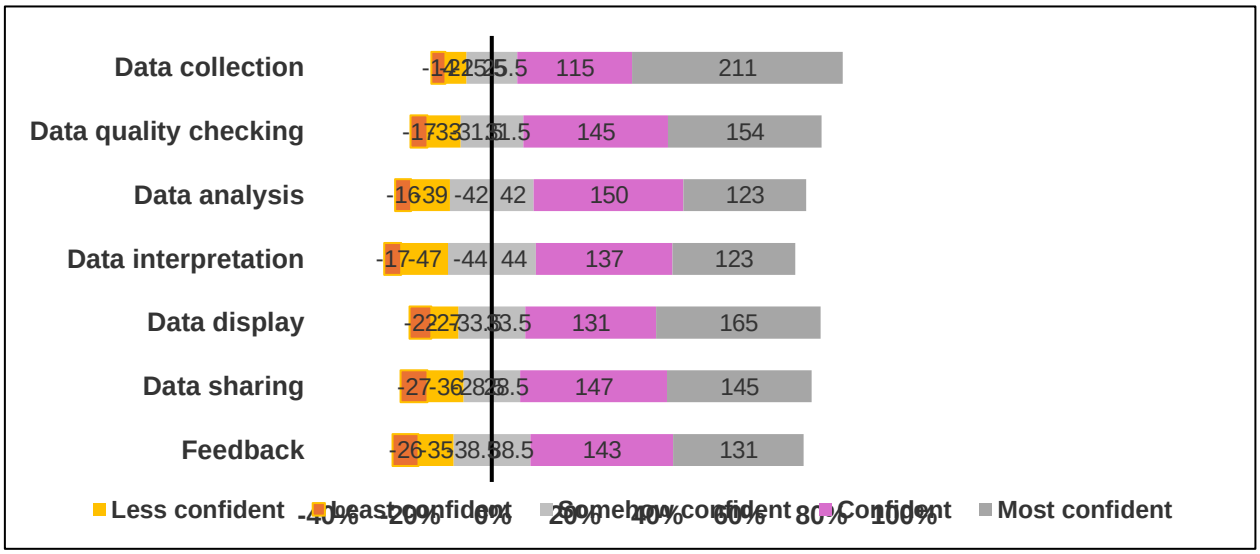

Figure 4.3: Level of confidence in data management processes

Figure 4.3 above shows the range is four, and the computed range in each interval is 4/5 = 0.8. Therefore, the first interval is 1.00-1.80, least confidence, 1.90-2.60, less confidence, 2.70-3.40 neutral (somewhat confidence), confidence 3.5-4.20 and 4.30-5.00, the most confidence.

The majority, 79.1% (n = 326), rated themselves as most confident and confident in data collection, while 8.5% (n = 35) of the participants were less confident and least confident in data collection. However, the computed mean value for data collection is 4.2, which corresponds to a confidence category; hence, the participants were found confident in data collection.

In checking the quality of data, 72.6% (n = 299) of participants mentioned that they are most confident and confident, while 12.1% (n = 40) are less confident and least confident.

In data analysis, 66.3% (n = 273) of the participants were most confident and confident, while 13.4% (n = 55) were less confident and least confident. Mean values of confidence for data quality check and data analysis were 3.9 and 3.6, respectively, corresponding to a confidence interval (3.50-4.20). Therefore, the participants are confident in checking data quality.

In data display, 71.8% (n = 296) of participants are most confident and confident, while 11.9% (n = 49) of the participants were less confident and least confident.

Data sharing, 70.9% (n = 292) were confident and most confident, while 15.3% (n = 63) of the participants were less confident and least confident.

In data interpretation: 63.2% (n = 260) of the participants rated that they were confident and most confident, while 15.5% (n = 64) were less confident and least confident.

Mean values of data interpretation, data display, data sharing, and data feedback were between 3.7 and 3.9, corresponding to a confidence interval. It shows that the majority of participants were confident in the implementation of data management processes.

A chi-square test was performed between those who have a high demand for HMIS data to send reports timeously and the performance of data interpretation.

Table 4.17: Association between high demand for routine data to send routine and donor parallel reports and data interpretation

Variables			Perform data interpretation		X^2, df, P-value
			Yes	No	
High demand for HMIS data to send routine reports timeously	Yes	Total	136	63	$X^2 = 4.99$, df = 1, p = 0.03
		Expected total	129.4	69.6	
		% within 'to send routine report timeously'	68.3%	31.7%	
	No	Total	24	23	
		Expected total	30.6	16.4	
		% within 'to send routine report timeously'	51.1%	48.9%	
High demand for HMIS data to send donor and or partner parallel report	Yes	Total	116	26	$X^2 = 40.95$, df = 1, p =< 0.001
		Expected total	92.4	49.6	
		% within 'to send parallel donor (partner) report'	81.7%	18.3%	
	No	Total	44	60	
		% within 'to send parallel donor (partner) report'	42.3%	57.7%	

Table 4.17 above shows that (68.3%) of participants who indicated that high demand for HMIS data was to send routine reports timeously also performed data interpretation, whereas (51.1%) of the participants performed data interpretation among those who did not report that reason, showing a significant difference ($X^2 = 4.99$, df = 1, p = 0.03).

Similarly, the majority (81.7%) of the participants who chose a similar reason also performed data interpretation; conversely, there were 42.3% of participants who performed da-

ta interpretation among those who did not have such a view, showing that there was a statistically significant difference (X^2 = 40.95, df = 1, p =< 0.001).

A chi-square was performed to determine the association between the views that HMIS produces high-quality data and reports on standardised, integrated, and simplified tools.

Table 4.18: Association between 'HMIS produces high-quality data' and reports that 'all HMIS tools are standardised, integrated, simplified'

Variables		HMIS produces high-quality data in your institution			
Reported that all HMIS tools were standardised, integrated, and simplified		**Disagree**	**Neutral**	**Agree**	**X^2, df, P-value**
Yes	Total	46	12	58	X^2 = 20.38, df = 4, p = < 0.001
	Expected total	32.5	16.8	63.6	
	% within 'report that all HMIS tools are standardised, integrated and simplified'	31.9%	8.3%	40.3%	
No	Total	47	36	124	
	Expected total	60.5	31.2	118.4	
	% within 'report that all HMIS tools are standardised, integrated and simplified'	17.5%	13.4%	46.3%	

Table 4.18 above shows that fewer (8.3%) of the participants who reported that all HMIS tools were standardised, integrated, and simplified remained neutral to the fact that HMIS produced high-quality data. At the same time, 13.4% of participants who remained neutral to the similar statement did report that HMIS tools were standardised, integrated, and simplified, showing a significant association (X^2 = 20.38, df = 4, p = < 0.001).

Table 4.19: Level of competence in the data management process and data use

Variable		Count (n)	Per cent (%)
Data collection: Do you understand the principles of good data collection?	Yes	393	95.4
	No	9	2.2
	Not sure	10	2.4
	Total	412	100
Data quality checking: Can you provide evidence of understanding data quality verification?	Yes	375	91
	No	21	5.1
	Not sure	16	3.9
	Total	**412**	**100**
Data analysis: Do you normally analyse data on your own without supervision?	Yes	326	79.1
	No	61	14.8
	Not sure	25	6.1
	Total	412	100
Data interpretation: Can you describe how you follow organisational processes in data interpretation?	Yes	338	82
	No	49	11.9
	Not sure	25	6.1
	Total	**412**	**100**
Information use: Can you provide evidence of how you use data in compliance with regulations and standards?	Yes	352	85.4
	No	37	9
	Not sure	23	5.6
	Total	**412**	**100**
Data sharing: Can you demonstrate proficiency in the use of HMIS electronic data transmission?	Yes	330	80.1
	No	63	15.3
	Not sure	19	4.6

	Total	**412**	**100**
Data display: Can you plot data on different graphs and update them accordingly?	Yes	348	84.5
	No	51	12.4
	Not sure	13	3.2
	Total	**412**	**100**
Data feedback: Can you advise/train others on data use?	Yes	333	80.8
	No	66	16
	Not sure	13	3.2
	Total	**412**	**100**

Table 4.19: Results are shown from highest to lowest frequencies. Results show that 95.5% (n = 393) of the participants reported that they were able to demonstrate understanding of principles of good data collection; meanwhile, 91% (n = 375) reported that they can evidence verification of data quality; almost 85.4% (n = 352) of the participants mentioned that they could prove use of data in compliance with regulations and standards; and 84.5% (n = 348) could demonstrate data display using different graphs.

Competence in data use and feedback: 82% (n = 338) of the participants indicated that they could describe organisational processes in data interpretation, and 80.8% (n = 333) of the participants could provide advice or train others on data quality checks and data use.

Data sharing and data analysis; 80.1% (n = 330) of participants could demonstrate proficiency in sharing data using HMIS electronic data transmission, and 79.1% (n = 326) could analyse data on their own without supervision.

A chi-square test to determine the association between motivational factors and data management processes was performed.

Table 4.20: Association between motivational factors and data management processes

Managers use HMIS information * Data analysis Crosstab			Perform Data analysis		
			Yes	No	X^2, df, P-value
Do managers use HMIS information?	Yes	Total	260	55	X^2 = 13.55 df = 1, p = <0.001
		Expected total	247.0	68.0	
		% within 'Managers use HMIS information'	82.5%	17.5%	
	No	Total	63	34	
		Expected total	76.0	21.0	
		% within 'Managers use HMIS information'	64.9%	35.1%	
Incentives (recognition) for data use champions			**Perform data interpretation**		
	Yes	Total	121	27	X^2 = 18.34, df = 1, p =< 0.001
		Expected total	101.7	46.3	
		% within 'Managers use HMIS information'	81.8%	18.2%	
	No	Total	162	102	
		Expected total	181.3	82.7	
		% within 'Managers use HMIS information'	61.4%	38.6%	
Sufficient supervision			**Perform data quality checks**		
	Yes	Total	218	22	X^2 = 9.59, df = 1, p = 0.00
		Expected total	207.4	32.6	
		% within 'Sufficient supervision and feedback provided'	90.8%	9.2%	
		% within 'Data quality check'	61.2%	39.3%	
	No	Total	138	34	

		Expected total	148.6	23.4	
		% within 'Sufficient supervision and feed-back provided'	80.2%	19.8%	

Table 4.20 above shows that the majority (82.5%) of the participants who reported that managers use HMIS information also performed data analysis. This shows the manager's use of HMIS data tends to motivate data producers/users to perform data analysis. On the other side, (64.9%) performed data analysis among those who disagreed that managers used HMIS data, showing a significant difference (X^2= 13.55, df = 1, p = <0.001).

The use of incentives for the data use champion and data interpretation. The majority (81.8%) of the participants who reported the existence of motivation through incentives also performed data interpretation. On the other hand, (61.4%) performed data interpretation, yet did not report the existence of motivation. The difference is significant (X^2 = 18.34, df = 1, p =< 0.001).

The association between sufficient supervision and the performance of data quality checks. The majority (90.8%) of the participants who reported the existence of motivation also performed a data quality check. This shows that motivation through sufficient supervision was associated with data quality checks. On the other hand, (80.2%) performed data quality checks among those who did not report the existence of motivation, showing a significant difference (X^2 = 9.59, df = 1, p = 0.00).

Impact of technical and organisational factors on the behaviour of HMIS users

Table 4.21: Influence of technical and organisational factors on demand for HMIS data

Variables			Demand for routine data among health staff?			
			High	Average	Low	X^2, df, P-value
Report that all HMIS tools are standardised, integrated, and simplified	Yes	Total	100	37	7	X^2 = 20.38, df = 4, p =< 0.001
		Expected total	86.0	48.9	9.1	
		% within 'Report that all HMIS tools are standardised, integrated and simplified'	69.4%	25.7%	4.9%	
	No	Total	36	47	36	
		Expected total	28.0	60.5	31.2	
		% within 'Report that all HMIS tools are SIS'	13.4%	17.5%	13.4%	
Develop a quality-of-service improvement plan	Yes	Total	224	122	21	X^2 = 9.84, df = 4, p = 0 .04
		Expected total	219.1	124.7	23.2	
		% within 'Quality-of-service improvement plan'	61.0%	33.2%	5.7%	
	No	Total	18	14	2	
		Expected total	20.3	11.6	2.1	
		% within 'Quality-of-service improvement plan'	52.9%	41.2%	5.9%	
Prepare immunisation (RED/C) plan	Yes	Total	118	47	8	X^2 = 23.56 df = 4,
		Expected total	103.3	58.8	10.9	

		% within 'Immunization (RED/C) micro plan preparation'	68.2%	27.2%	4.6%	p =<0.001
	No	Total	128	93	17	
		Expected total	142.1	80.9	15.0	
		% within 'Immunisation (RED/C) micro plan preparation'	53.8%	39.1%	7.1%	
After training, was there an improvement in data processing skills?	Yes	Total	194	99	14	X^2 = 12.09, df = 4, p = 0.02
		Expected total	183.3	104.3	19.4	
		% within 'After training, was there improvement in data processing skills?'	63.2%	32.2%	4.6%	
	No	Total	5	9	2	
		Expected total	9.6	5.4	1.0	
		% within 'After training, was there improvement in data processing skills'?	31.3%	56.3%	12.5%	
To provide feedback on the use of HMIS data	Yes	Total	187	93	15	X^2 = 6.67, df = 2, p = 0.04
		Expected total	176.1	100.2	18.6	
		% within 'To provide feedback'	63.4%	31.5%	5.1%	
	No	Total	59	47	11	
		Expected total	69.9	39.8	7.4	
		% within 'To provide feedback'	50.4%	40.2%	9.4%	
HMIS data sharing internally through the self-assessment of units	Yes	Total	153	55	11	X^2 = 20.12, df = 2,
		Expected total	130.8	74.4	13.8	

		% within 'Shared through self-assessment of units'	69.9%	25.1%	5.0%	p =<0.001
	No	Total	93	85	15	
		Expected total	115.2	65.6	12.2	
		% within 'Shared through self-assessment of units'	48.2%	44.0%	7.8%	
HMIS data sharing externally through the performance review meeting	Yes	Total	162	68	12	X^2 = 12.1, df = 2, p = 0.002
		Expected total	144.5	82.2	15.3	
		% within 'Performance (peer) review meetings'	66.9%	28.1%	5.0%	
	No	Total	84	72	14	
		Expected total	101.5	57.8	10.7	
		% within 'Performance (peer) review meetings'	49.4%	42.4%	8.2%	

Table 4.21 above shows the chi-square statistic test result between technical and organisational factors, and the demand for routine data among health staff. The majority, 69.4% of the participants, who reported that all HMIS tools in use are standardised, integrated and simplified, had a high demand for HMIS data, compared to 13.4% who did not indicate that all HMIS tools in use are standardised, integrated and simplified. The test shows use of standardised, integrated, and simplified HMIS tools to be associated with high demand for HMIS data (X^2 = 20.38, df = 4, p < 0.001).

A majority of participants who developed a service-quality improvement plan (61%) reported a high demand for routine HMIS data, compared with 52.9% of those who did not develop such a plan. This difference reflects a statistically significant association between the demand for HMIS data and the development of service quality improvement plans (X^2 = 9.84, df = 4, p = 0.04).

The health institutions' development of immunisation RED/C micro plans had a high demand for HMIS data reported by 68.2%, compared to 53.8% who reported high demand but did not develop a RED/C plan. The difference is significant (X^2 = 23.56, df = 4, p =<0.001).

Twice as many, 63.2% of the participants among those who reported improvement of skills in data processing after HMIS training, had a high demand for data, compared to 31.3% of the participants who had a high demand for routine data among those who did not report improvement in data processing after training. This shows a significant association between training on skills of data processing and demand for routine data (X^2 = 12.09, df = 4, p = 0.02).

The greater number, 63.4%, of participants among those who provided feedback on data use had a high demand for HMIS data, compared to 50.4% of the participants who had a high demand but have not yet provided feedback on data use showing a significant association between provision of feedback on data use and high demand of routine data (X^2 = 6.67, df = 2, p = 0.04).

Among the participants who reported sharing of data internally through self-assessment of units, 69% indicated a high demand for HMIS data, compared to 48.2% who indicated high demand for the data but did not report data sharing internally through self-assessment of units. The difference is significant (X^2 = 20.12, df = 2, p =<0.001).

The greater number, 66.9% of participants, among those who share data externally through performance review meetings, had a high demand for data, compared to 49.4% of those who do not share data externally through performance reviews, showing a significant association (X^2 = 12.1, df = 2, p = 0.002).

The association between technical and organisational factors and the monthly (regular) checks of data quality.

Table 4.22: Technical and organisational factors and data quality checks

Variable			Perform data quality checks month-ly/regularly		X^2, df, P-value
			Yes	No	
Report that all the HMIS tools are standardised, integrated, and simplified (SIS)	Yes	Total	137	7	X^2 = 4.17, df = 1 P = 0.04
		Expected Count	131.4	12.6	
		% within the report that all HMIS tools are SIS	95.1%	4.9%	
	No	Total	239	29	
		Expected total	244.6	23.4	
		% % within the report that all HMIS tools are SIS	89.2%	10.8%	
Share data inter-nally through self-assessment of units	Yes	Total	206	13	X^2 = 4.60, df = 1, p = 0.03
		Expected total	199.9	19.1	
		% within 'Shared through self-assessment of units'	94.1%	5.9%	
	No	Total	170	23	
		Expected total	176.1	16.9	
		% within 'Shared through self-assessment of units'	88.1%	11.9%	

A chi-square statistic is performed between the reported use of standardised, integrated, and simplified HMIS tools and the monthly checks of data quality.

Table 4.22 above shows that (95.1%) of the participants who reported that all HMIS tools were standardised, integrated, and simplified also performed monthly data quality checks. This statistic reflects an association between these variables. Conversely, (89.2%) of the participants performed monthly data quality checks among those who did not report that all

HMIS tools were standardised, integrated, and simplified, showing a significant difference (X^2 = 10.903, df = 1, p <0.001).

The association between sharing data internally through self-assessment of units and performance of monthly data quality checks shows that 94.1% of the participants who shared data also performed data quality checks. Conversely, 88.1% participants who performed data quality checks did not report sharing data internally, showing a significant difference (X^2 = 4.60, df = 1, p = 0.03).

4.3.9 Part VII: Information use

Part VII of the study determined the current experience of information use to carry out major management functions among the participants at the health institutions. It also examined the purpose for and evidence of continuous use of HMIS information in decision-making. Moreover, the section investigated the level of HMIS information use for immunisation service activities, especially to improve the quality of the service. Finally, the participants' suggested interventions that had the potential to improve continuous use of information are included.

Table 4.23: HMIS information use for health/immunisation service and quality improvement, and suggested intervention for continuous use of information

Variable		Count (n)	Per cent %
Indicate your experience of HMIS information use. Currently, I use general HMIS information for:	Planning of health service delivery	302	21.8
	Monitoring performance coverage indicators	334	24.1
	Reporting health/immunisation service progress	282	20.3
	Performing administrative functions	216	15.6
	Improving health/immunisation service quality	252	18.2
	Total	**1386**	**100.0**

How often does this health institution use HMIS(DHIS2) information for decision-making?	It uses information continuously	289	70.1
	It uses information, but inconsistently	114	27.7
	No, it does not use health information	9	2.2
	Total	**412**	**100**
If this institution uses information continuously, what evidence is available to indicate continued use of HMIS information?	Achieved the monthly immunisation service report	218	23.2
	Updated display of the EPI monitoring chart	196	20.9
	Current operational plan reflecting targets	168	17.9
	Documented performance monitoring minutes	190	20.2
	Ongoing quality improvement (QI) initiative	168	17.9
	Total	**940**	**100.0**
In your opinion, what should be done to continuously use HMIS information at this health institution?	Connect information used in the quality improvement process	328	29.4
	Connect information used in health service planning	295	26.5
	Agree on the needs of information use	260	23.3
	Ensure the quality of data before using it	230	20.6
	Other	1	0.1
	Total	**1114**	**100.0**
To which of the processes/activities of quality improvement is HMIS information used?	Plan (aim) for quality improvement	337	29.1
	Measure quality improvement indicators	315	27.2
	Monitor quality improvement implementation	301	26.0
	Assess changes in the quality of service	205	17.7
	Total	**1158**	**100.0**

Current experience of general HMIS information use among the participants:

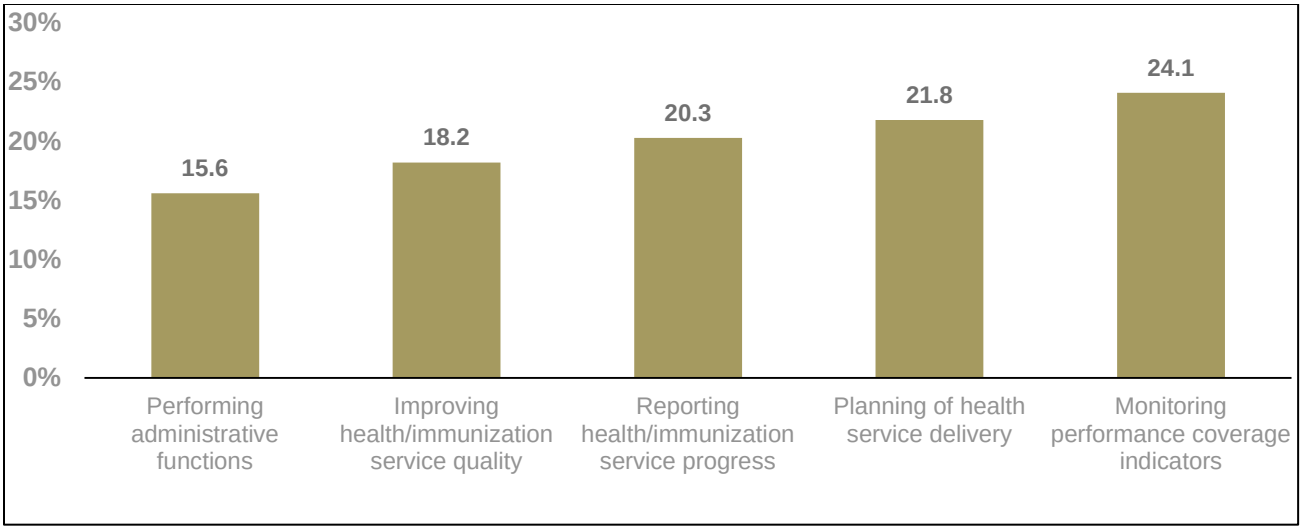

Figure 4.4: Current experience of general HMIS information use

Figure 4.4 above had multiple responses from 1386 participants. The majority, 24.1% (n = 334), of responses showed current use of HMIS information for performance monitoring, followed by its usage for planning health service delivery at 21.8% (n = 302) responses. Usage of information for reporting health and immunisation services progress was represented by 20.3% (n = 282) responses. The second-least, 18.2% (n = 252) responses indicate use of HMIS information for immunisation (health) service quality improvement and the least, 15.6% (n = 216) of responses show information use for governance (staff performance appraisal, administrative functions).

Continuous use of HMIS information for decision-making by the health institutions:

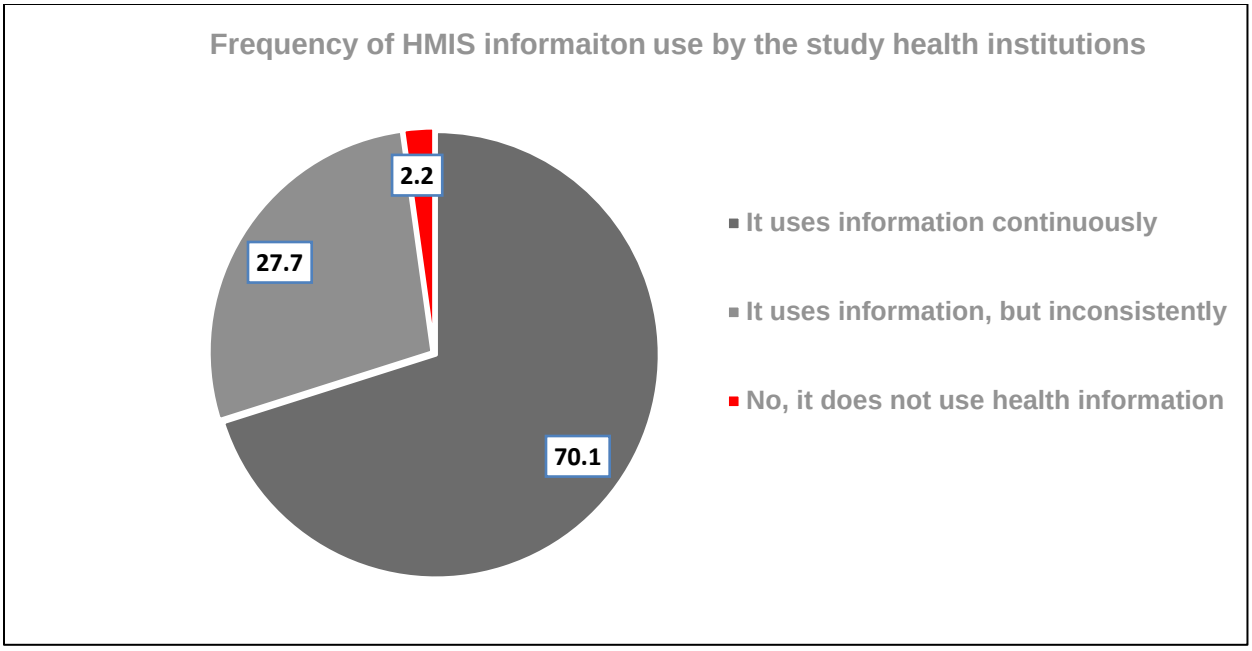

Figure 4.5: Regular use of HMIS information for decision-making

Figure 4.5 above shows continuous (regular) use of HMIS information; the majority, 70.1% (n = 289) of the participants, indicated that there was continuous use of HMIS information at the health institutions they represented, while 27.7% (n = 114) reported that HMIS information use was inconsistent. The minority, 2.2% (n = 9) of the participants, indicated no use of HMIS information.

Evidence of continuous use of HMIS information at the health institutions:

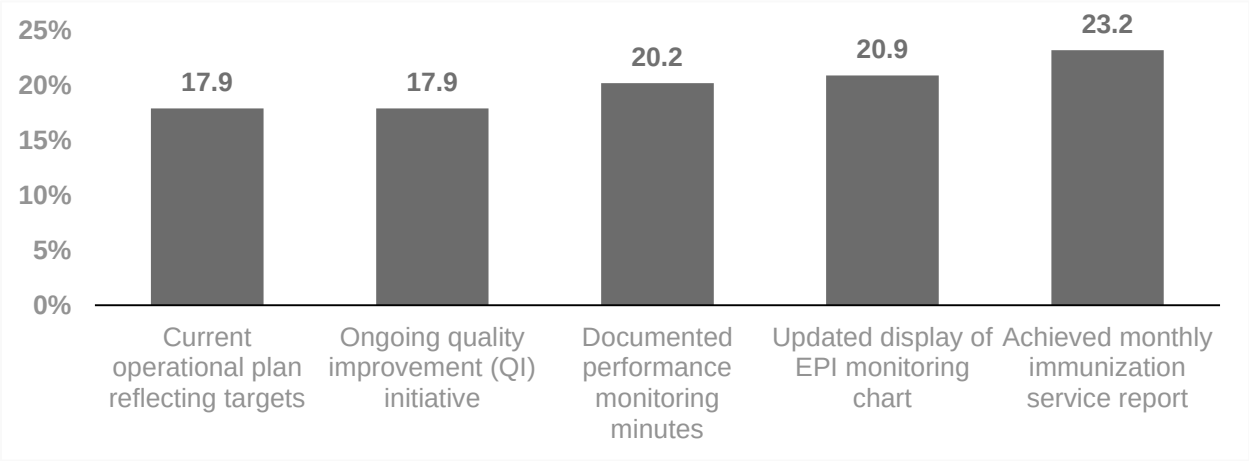

Figure 4.6: Evidence for continuous use of HMIS information for decision-making

Figure 4.6 above shows the available evidence of continuous use of the HMIS information. Out of 940 multiple responses, the monthly report, as evidence for continuous use of information, had 23.2% (n = 218) responses. An updated EPI monitoring chart, as evidence, had 20.9% (n = 196) responses; documented performance monitoring minutes had 20.2% (n = 190) responses. The current operational plan, reflecting the target and quality improvement (QI) initiative as evidence of continuous use of information, had an equal 17.9% (n = 168) response.

Suggested Interventions to improve the continuous use of information for decision-making:

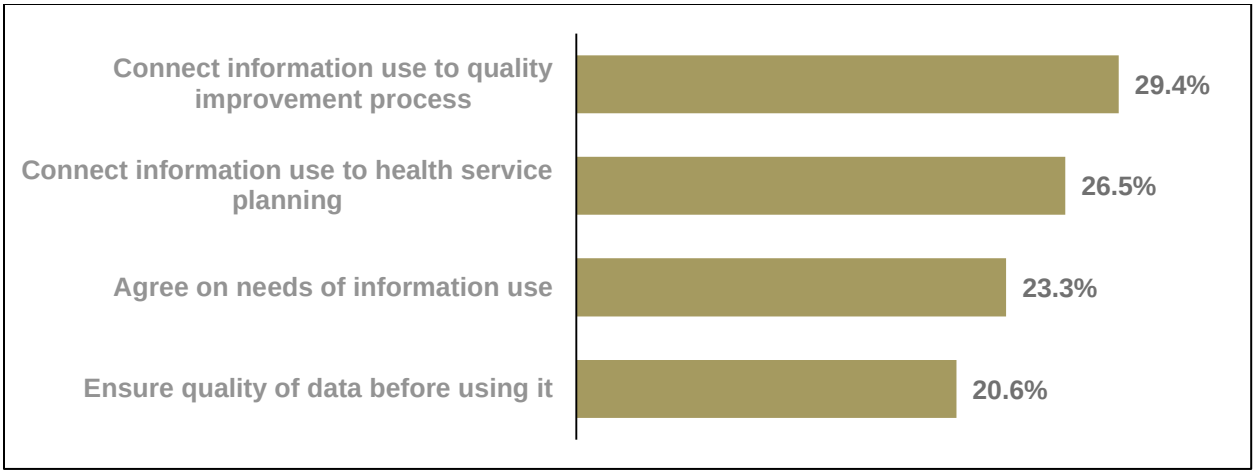

Figure 4.7: Interventions to improve continuous use of information according to participants

Figure 4.7 above shows the response of suggested interventions to improve continuous use of information at health institutions, which had 1114 multiple responses. Connection of information use to quality improvement processes had the highest, 29.4% (n = 328) responses, connection of information use to health service planning had 26.5% (n = 295) responses, and agreement on the needs of information use to improve continuous use of information was represented by 23.3% (n = 260) of the responses. Ensuring the quality of data before use of information can improve the continuous use of information, had 20.6% (n = 230) responses.

HMIS information used for quality improvement processes

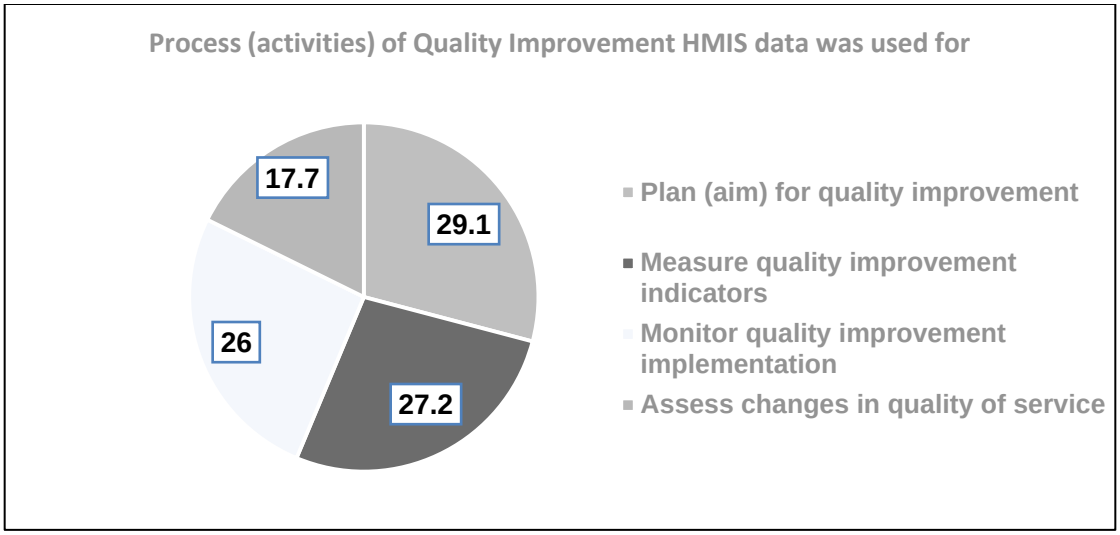

Figure 4.8: QI process executed using HMIS information

Figure 4.8 above shows that HMIS information was used for all of the quality improvement processes. The highest proportion, 29.1% (n = 337 1) out of 158 responses, shows the use of HMIS information to plan (aim) quality improvement, while the lowest proportion, 17.7% (n = 205) responses, indicates the use of HMIS information to assess changes in quality of service. Use of HMIS information to measure quality improvement indicators had 27.2% (n = 315), and to monitor quality improvement implementation at 26% (n = 301). However, the **computed mean** HMIS use for the quality improvement process was **43% (n = 177).**

A chi-square test was conducted to analyse the association between the current professional category (role) and regular data quality checks and information use.

Table 4.24: Regular data quality check and mean use of HMIS information versus professional category

Professional category versus data quality check crosstabulation			Data quality check		$X^{2,}$ df = 1, p-value
			Yes	No	
Professional category	Health professional	Total	235	44	X^2 = 3.49, df = 1, p = 0.06
		Expected total	241.1	37.9	
		% within professional category	84.2%	15.8%	
	Health information technician	Total	121	12	
		Expected total	114.9	18.1	
		% within professional category	91.0%	9.0%	
Professional category versus Information use crosstabulation			Information use		
			Yes	No	
Professional category	Health professional	Total	181	98	X^2 0.61, df = 1, p = 0.43
		Expected total	177.4	101.6	
		% within professional category	64.9%	35.1%	
	Health information technician (HT)	Total	81	52	
		Expected total	84.6	48.4	
		% within professional category	60.9%	39.1%	

Table 4.24 above shows the Chi-Square test statistic result between the conduct of data quality checks and continuous use of information in association with the current professional. The majority, 91% of the participants among the HIT (HMIS) worker category, do regular (monthly) data quality checks, compared to fewer, 84.2%, who do regular data quality checks among the health professional category. The X^2 test result indicated no statistically

significant association between the current professional category and regular data quality checks (X^2 = 3.492, df = 1, p = 0.06).

On the other hand, the higher percentage, 64.9% of health professionals reported general use of HMIS information, compared to 60.9% reported continuous use of HMIS information among the HIT (HMIS) workers. But the statistical test result showed no significant statistical association between the current general use of HMIS information and professional category at the health institutions (X^2 = 0.61, df = 1, P = 0.43).

A chi-square test of independence is conducted to analyse whether an association exists between the suggested potential intervention and continuous use of information for decision-making.

Table 4.25: Potential interventions to improve continuous use of HMIS information

Variables			Information used for quality improvement		X^2, df, P-value
			Yes	No	
Quality of service improvement plan	Yes	Total	26	8	X^2 = 7.12 df = 2, p = 0.03
		Expected total	19.4	14.6	
		% within 'Quality of service improvement plan'	76.5%	23.5%	
	No	Total	201	166	
		Expected total	209.3	157.7	
		% within 'Quality-of-service improvement plan'	54.8%	45.2%	
Developing an	Yes	Total	170	213	X^2 = 4.59
		Expected total	164.5	218.5	

annual work plan		% within 'Developing annual work plan'	44.4%	55.6%	df = 2 p = 0.10
	No	Total	5	17	
		Expected total	9.5	12.5	
		% within Developing annual work plan	22.7%	77.3%	
HMIS produces high-quality data in your institution	Strongly agree	Total	30	16	
		Expected total	19.8	26.2	
		% within 'HMIS produces high-quality data in your institution'	65.2%	34.8%	X^2 = 30.39 df = 4 p = <0.001
	Strongly disagree	Total	9	34	
		Expected total	18.5	24.5	
		% within 'HMIS produces high-quality data in your institution'	20.9%	79.1%	
HMIS Indicators are clearly defined and understandable	Yes	Total	144	135	
		Expected total	119.9	159.1	
		% within 'HMIS Indicators are clearly defined and understandable'	51.6%	48.4%	X^2 = 26.40 df = 1 p = <.001
	No	Total	33	100	
		Expected total	57.1	75.9	
		% within 'HMIS Indicators are clearly defined and understandable'	24.8%	75.2%	

Table 4.25 above shows there is an association between potential interventions and HMIS information use for quality-of-service improvement. Planning for quality-of-service improvement is associated with the use of HMIS information; 76.5% of the participants used HMIS information among those who had planned for quality-of-service improvement, compared to 54.8% of those who did not have a plan for quality-of-service improvement. The difference is significant (X^2 = 7.12, df = 2, p = 0.03).

Among the participants who develop an annual work plan and use HMIS information, a higher proportion, 44.4%, use HMIS information among those who develop an annual health service plan, compared to 22.7% among those who do not develop an annual work plan. However, the difference is not statistically significant ($X^2 = 4.59$, df = 2, p = 0.10).

Agreement to HMIS produced quality data is associated with HMIS information use. 65.2% of the participants use HMIS information for service quality improvement among those who strongly agree that HMIS produces high-quality data, compared to 56.5% who use HMIS information for service quality improvement among those who strongly disagree that HMIS produces high-quality data. The difference is significant ($X^2 = 30.39$, df = 4, p <0.001).

Having HMIS indicators clearly defined and understandable is associated with the current use of HMIS information. A majority, 51.6% of the participants, indicated that the HMIS indicators are clearly defined and understandable, currently use HMIS information, compared to 24.8% who use HMIS information, among those who did not mention that HMIS indicators are clearly defined and understandable for continuous use of HMIS information. The difference is significant ($X^2 = 26.40$, df = 1, p = <.001).

The computed mean HMIS use for the quality improvement process was **43% (n = 177).**

Table 4.26: Utilisation of HMIS information in immunisation service

Variable		Count (n)	Per cent (%)
For which immunisation service-related activity is HMIS information used at this health institution?	Planning and management of resources	327	23.2
	Reaching all eligible population	254	18
	Monitoring and data use for action	311	22.1
	Conducting supportive supervision	251	17.8
	Engage the community in the immunisation service	267	18.9
	Total	**1410**	**100**
What are the steps involved in using immunisation data?	Define the monitoring process schedule	306	19.8
	Select core indicators and targets	321	20.8
	Collect data and submit reports	336	21.8
	Analyse and interpret data	304	19.7
	Take corrective action	277	17.9
	Total	**1544**	**100**
What is(are) the aims of using immunisation data for quality improvement?	Minimise Missed Opportunity for Vaccination	320	20.5
	Reduce the vaccine dropout rate (DOR)	340	21.8
	Raise coverage of fully immunised children	327	21
	Monitor the stockout rate of vaccines/supplies.	304	19.5
	Monitor cold chain functioning	267	17.1
Total		**1558**	**100**

Table 4.26 above shows that HMIS information used in the immunisation service at the study health institutions received 1410 multiple responses. Usage of the information for planning and management of immunisation resources had 23.2% (n = 327) responses. The HMIS information used to monitor immunisation data use for actions had 22.1% (n = 311) responses, and its use to engage the community had fewer responses, 18.9% (n = 267); and to conduct immunisation supportive supervision, the lowest 17.8% (n = 251) responses.

Steps involved in using immunisation data for action had 1544 responses. The highest, 21.8% (n = 336) responses showed collecting data and submitting reports, while 19.7% (n = 304) responses indicated analysis and interpretation of data, and 17.9% (n = 277) responses showed the steps involved in using HMIS data.

The purpose of using HMIS data for the immunisation service received multiple responses of 1558. The data used to reduce vaccine dropout (DOR) had 21.8% (n = 340) responses; to raise coverage of fully vaccinated children had 21% (n = 327) responses, and to minimise the Missed Opportunity for Vaccination (MOV) had 20.5% (n = 320) responses. HMIS immunisation data used to monitor stock-out rate of vaccines/supplies and to monitor cold chain functioning had 19.5% (n = 304) and 17.1% (n = 267) responses, respectively.

Table 4.27: Extent of HMIS information use for health service, the service quality improvement, and immunisation service-related activities among study participants

Computed general HMIS information use experience for health service		
Response	**Frequency**	**Per cent**
0:00	3	.7
1.00	80	19.4
2.00	67	16.3

3.00	52	12.6
4.00	34	8.6
5.00	176	42.7
Total	**412**	**100.0**
Recoded general HMIS information use experience for health service		
Yes	210	51.3
No	199	48.7
Total	409	100.0
Computed HMIS information use for health service quality improvement cycles (process)		
0:00	3	.7
1.00	96	23.3
2.00	54	13.1
3.00	82	19.9
4.00	177	43.0
Total	**412**	**100.0**
Recoded HMIS information use for Service QI cycles		
Yes	**177**	**43.0**
No	235	57.0
Total	**412**	**100.0**
Computed HMIS information use for immunisation service activities		
0:00	4	1.0
1.00	84	20.4
2.00	48	11.7
3.00	59	14.3

4.00	32	7.8
5.00	185	44.9
Total	**412**	**100.0**
Recoded HMIS information use rate for immunisation service activities		
Yes	217	52.6
No	191	46.8
Total	**408**	**100.0**

Table 4.27 above shows the extent of HMIS information use in percentage for health service, the service quality improvement, and immunisation service-related activities among the study participants. The value zero indicates that no response was chosen by the participants out of the given responses, while the values 1-5 indicate the number of chosen responses accordingly. The detailed processes and accepted average usage of information for each of the service management functions are described below.

Purpose and extent of HMIS information use among the study participants:

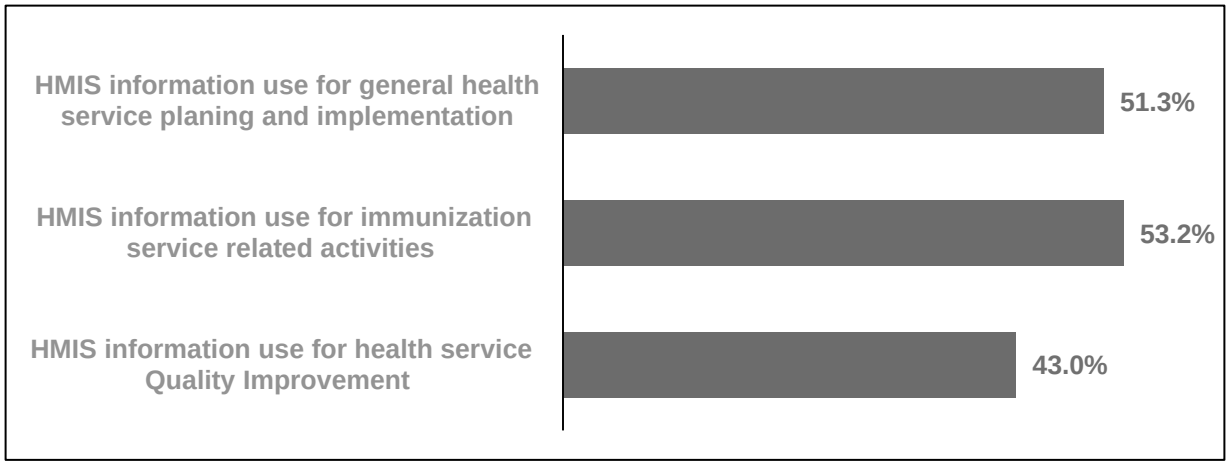

Figure 4.9: Extent of information use for health service, the service quality improvement, and immunisation service-related activities among the study participants

Figure 4.9 above shows the current experience (computed mean) of HMIS information use for health service activities, for immunisation service-related activities and health service quality improvement cycles (processes). The mean values of HMIS information utilisation for each of these areas were generated using the compute and recode functions of SPSS software. First, the participants' positive responses represented by '1' out of '1' or '0' dichotomous response values to each item of a question were computed to get the frequency.

For example, a question about the experience of HMIS information use for general health service planning and implementation included five items (functions): planning for health service delivery; monitoring performance coverage indicators; reporting health/immunisation service progress; performing administrative functions; and improving health/immunisation service quality. Table 4.27 shows the frequency of the responses, experience of HMIS information for only one out of the five functions had 19.4% (n = 80) of the participants, whereas experience of information use for all five functions had 42.7% (n = 176) of the participants.

Second, the values corresponding to the computed frequencies were recoded to get the average utilisation rate of HMIS information. For example, a positive response to only 1 to 3 functions was considered as 'No' (or below 80%) utilisation, whereas a positive response to 4 to 5 out of 5 functions was considered as 'Yes' (equal or above 80%) utilisation. The zero response in the table represented a system missing.

Figure 4.9 above shows the computed and recoded experience of HMIS information use. The experience of HMIS information use for health service planning and implementation was reported by 51.3% (n = 210) of the participants.

The use of HMIS information for immunisation service-related activities was reported by 52.6% (n = 217) of the participants.

Experience of HMIS information utilisation for health service quality improvement was indicated by 43% (n = 177) of the participants.

4.4 DISCUSSION OF KEY FINDINGS FROM QUANTITATIVE DATA

4.4.1 Data management processes

This study found a limitation in clarity about data and information among participants. More than a quarter (27.7%; n = 196) of the participants equated data with information. Data and information are not the same, though literature does not commonly provide standard definitions of these terms. Some studies, for instance, a study by Bratianu and Bejinaru (2023:1, 3) states that data has no meaning; it is the raw material for information. As such, healthcare data needs to be processed through RHIS processes to support decision-making. Similarly, the national data quality manual states that for data to become information, it must be contextualised, categorised, calculated and condensed (Democratic Republic of Ethiopia 2017:7).

Minimal skills and confidence in data interpretation reflected in this study might be associated with a lack of contextual understanding of the terms among participants. A chi-square test revealed a statistically significant association between conceptual clarity about the difference between ‘data’ and ‘information’ and performance in data interpretation ($\chi^2(1, N = 372) = 11.27$, $p = 0.001$), suggesting that those who equated the two concepts were significantly less likely to demonstrate confidence in data interpretation tasks. A study by Impey (2023:3) asserts that the data are “discrete entities that are described objectively without interpretation, whereas information is data that are interpreted, organised or structured.” The lack of clarity about the hierarchy of data and information requires clarifying these basic terms among data producers and users to enable efficient data capture, analysis, and interpretation in the production of quality information for immunisation services. Bifa (2024:219) notes the limited capacity of health professionals in data management processes and recommends that they be competent in all data management processes to enhance

their capacity to translate data into information and use it to manage maternal health services.

Persistent generation of quality data is one of the two indicators of PRISM. Strengthening this, a study by Endriyas et al. (2019:5) recommends routine monitoring of data quality quantitatively and qualitatively against its dimensions to achieve acceptable quality and use. However, this study's result shows that the routine data quality check considers only partial dimensions of data quality. The great majority, 81.3% (n = 337), of participants indicated only three dimensions: completeness, reliability, and timelines of data quality, neglecting important dimensions such as data integrity, considered by a smaller proportion, 13.2% (n = 294) of participants. Pearson's correlation analysis indicated a moderate positive relationship between the number of data quality dimensions correctly identified and overall data quality assessment scores ($r = 0.48$, $p<0.01$). Respondents who recognised more than four dimensions of data quality demonstrated significantly higher composite data quality performance ($M = 3.82$, $SD = 0.41$) compared to those who recognised three or fewer ($M = 3.12$, $SD = 0.53$), $F(1,338) = 9.45$, $p = 0.002$). Nevertheless, the three commonly considered dimensions constitute less than 50% overall dimensions in the Data Quality Assessment Frameworks. Literature recommends operationalisation of at least seven dimensions of data quality (Prasetya 2017:16).

On the other hand, minimal consideration of data integrity would expose data to deliberate manipulation for political or personal reasons. A study by Madebo et al. (2020:1) shows compromise of data quality due to overreporting of immunisation data from primary health facilities. Another study indicates that checking data integrity ensures the protection of data from unauthorised modification by authorised subjects and maintains the internal and external consistency of the object (Yesin, Karpinski, Yesina, Vilihura & Warwas 2021:3).

An incomplete understanding of the data quality dimensions would hinder the system's capacity to precisely measure and achieve high-quality data. A study underscores that the dimensions are crucial to understanding how data quality is measured (Al-Salim, Darwish & Farrell 2022:2). However, the literature highlights a common pitfall in measuring only a lim-

ited number of dimensions. Although data quality can be assessed through various aspects, completeness, timeliness, and accuracy are the most frequently used attributes (Hlaing & Myint 2022:9). This finding underscores the importance of enhancing staff skills to assess all dimensions in their practice of data quality assurance.

This study also shows predominant use of LQAS for data quality assurance, 54.4% (n = 343) responses, while other methods, such as RDQA and DQA, are significantly less used, 18% (n = 118 + 121) on average, respectively, with much less use of the DQRC mechanism, suggesting areas of improvement. However, the LQAS mechanism measures only those ubiquitous dimensions mentioned above. A chi-square analysis comparing facility types revealed a significant difference in preferred data quality assurance methods ($\chi^2(2, N = 582) = 15.62$, $p < 0.001$), with health centres relying predominantly on LQAS and health offices using RDQA more frequently. The literature cites that traditional measures of data quality, such as accuracy, consistency, completeness, and timeliness, are no longer adequate in the era of Big Data (Ridzuan & Wan Zainon 2024:6).

The study reveals that only 15.9% (n = 339) of responses indicate staffing M&E positions as per standard, and the lowest number, 13.3% (n = 238), shows encouragement of a culture of information use in decision-making. The gaps in required functional components, inadequate organisational encouragement of information use, and the lack of staff at HMIS posts would contribute to poor-quality data and a limited organisational culture of information in decision-making. A related study describes an understaffing of health centres and scarcity of HMIS guidelines for recording tools, indicator reference and information use are persistent gaps (Manyazewal 2017:6). A study by Karuri et al. (2014:4, 6) shows inadequate human resources and capacity in LMICs made data management and its technology a heavy burden.

The results show the highest performance in data collection, which accounted for 13.1% (n = 372), followed closely by data-quality checks at 12.6%. In contrast, data interpretation demonstrated the lowest performance at 10% (n = 282). The execution of data collection might be associated with redundant collection using hybrid forms, while the lower perfor-

mance of data interpretation might be associated with the cited minimal skills of the participants in data interpretation. However, both the low data interpretation and the high (burdenfull) data collection would negatively impact data quality, interpretation, and use. A simple linear regression confirmed this relationship, showing that data collection performance scores significantly predicted data interpretation scores ($\beta = -0.36$, $t = -4.19$, $p<0.001$), indicating that facilities emphasising data collection without parallel analytical investment experienced weaker interpretation capacity. The model revealed an inverse relationship showing that every one unit increase in data collection corresponds to a $\beta = -0.36$ unit decrease in data interpretation score ($t = -4.19$; $p<0.001$)

Concurring with this, a study by Wagenaar et al. (2017:1) states that an accumulation of high-quality data means much effort is spent on collecting and improving data without a culture of use of those data for health systems improvement. The findings highlight the need to digitise data collection tools, use standard integrated forms, and build skills of data interpretation. Literature in support reveals inadequate coordination and hybrid reporting worsen data quality and information utilisation (Kebede et al. 2020:1, 3).

The DHIS2 software is used for processes of data analysis, storage, aggregation, display and sharing in ranking order, including the fact that two-thirds of participants indicated use of the tool for data analysis. Similarly, literature cites wider use of the DHIS2 to collect, collate, analyse, report, store and manage health data (Alas et al. 2019:2; Begum et al. 2020:10). However, it is also indicated that the DHIS2 software is slow to start, which might have resulted in the delay of data analysis output and reporting, affecting the timely use of data for decision-making. In support of this, a study conducted in Ethiopia by Gebreslassie et al. (2020:4) on DHIS2 implementation indicates low data quality and data use for decision-making. Another study by Moloko (2021:232) asserts that the delay between data aggregation and submission to when data is analysed and shared with end-users hinders the use of reproductive health data for decision-making.

The data interpretation method primarily applies comparison of current achievement versus plan, and with previous achievement, which is mentioned by more than a quarter of partici-

pants. The least priority is given to interpretation and description of gaps and action plans; the interpretation method, by describing gaps and developing an action plan, accounted for an equal 23% (n = 284) of the responses. The users need capacity-building for a deep interpretation of identified gaps and a corresponding action plan. Nwankwo and Sambo (2018:7) state that if staff have skills in analysis and interpretation, and understanding of why data should be used, the data use is likely to be improved.

This study shows the hybrid, duplicative and parallel data sharing using paper form and DHIS2, internally, to the performance monitoring team and to the same sub-city. The external data sharing applies a stakeholder-specific format, mostly in paper form. The DHIS2 data sharing method was mentioned by 28.4% (n = 293), and paper form data sharing externally and through data internal review meetings had an average of 26% (n = 265+ 266) responses. Difficult data sharing with multiple tools would deter utilisation of information at the service delivery point. Chi-square results confirmed a significant association between hybrid data-sharing methods and limited information use (χ^2 (1, N= 293) = 9.74, p = 0.002). Regression analysis further showed that exclusive DHIS2 use predicted a 21% increase in reported data use frequency (β = 0.21, p = 0.018). The importance of reorientation on the integration of tools and a single reporting channel. Studies in support of this state that the hybrid use of paper-form and computer-based recording and reporting from health centres to the district health office in hard copies and using DHIS2 affect the utilisation of health information (Mengistu et al. 2021:9; Kefiyalew et al. 2021:6).

4.4.2 Technical determinant of HMIS data management and information use

Technically, duplicative data elements, difficulty of contents and slow functioning of computer software made the immunisation data collection and reporting forms lengthy and complex, respectively. Nearly half, 48.6% (n = 106), of participants reported lengthiness of the HMIS data collection tools and software (DHIS2); while over a third, 39% (n = 105) of responses indicated the disease reporting forms were complex. A chi-square test indicated a significant association between perceived complexity of HMIS tools and reported data

use frequency ($\chi^2(2, N= 211) = 10.84$, $p = 0.004$), confirming that facilities using more complex tools were less likely to report regular information utilisation.

This result underlines how the complex design of data management tools and slow DHIS2 performance negatively influenced data quality and the timeliness of information use which is consistent with findings by Ouedraogo et al. (2019:2). This finding aligns with existing literature emphasizing that inadequate software functionality compromises data analysis quality and delays the translation of findings into timely, evidence-based decisions (Aqil et al. 2009:6; FMOH-E, Information Revolution Roadmap 2016:10).

Below half**,** 47.6% and 48.5% (n = 196 & 205), of the participants properly defined HMIS standardisation and integration. Pearson's correlation analysis revealed a positive association between understanding of HMIS standardisation and self-reported data quality scores ($r = 0.41$, $p < 0.01$), suggesting that improved conceptual knowledge of standardised indicators is associated with better data management performance. This can be interpreted as the majority of the participants lack understanding of standard indicators, data items, and tools, which would result in the generation of poor-quality data and less use of information for decision-making. Similarly, a lack of clarity on having shared HMIS data management and reporting tools would favour the use of fragmented tools, duplicative data collection, and parallel reporting. Besides, it depletes motivation to process and use data for improvement.

This aligns with earlier evidence by Aqil et al. (2009:6), who emphasise that malfunctioning or overly complex software impedes data processing and delays actionable insights essential for timely decision-making. The result necessitates building the capacity of staff on the adaptability of standardisation to strengthen the application of integrated data tools, thereby resolving the burden of data collection, and consequently, to focus on information use. Literature states that an integrated HMIS reduces duplication of efforts and improves the capacity and performance of primary healthcare units and coordination among all levels of healthcare (Kebede et al. 2020:2).

The RHIS simplification is defined by a slight majority, 56.8% (n = 234), of the participants. Limitations in knowledge of what data are and how to collect, analyse and interpret only relevant information to improve without a data burden would affect motivation to use data at the point of data generation. The necessity is to encourage informed use of simplified HMIS tools to improve the quality of data and information use where data is generated. This finding resonates with Farnham et al. (2020:2), who contend that simplification of health information tools enhances evidence-based decision-making at peripheral levels by reducing data burden and improving the efficiency of service delivery processes.

In sum, the findings indicate both knowledge and application of standardised, integrated, and simplified tools are less than ideal. Only a third, 36.4% and 35% (n = 150 & 144), of participants mentioned complete components and acceptable extent of the application of standard, integrated and simplified HMIS tools, respectively. Binary logistic regression analysis further showed that facilities using integrated and simplified tools were 2.6 times more likely to demonstrate consistent information use (OR = 2.61, 95% CI: 1.34-5.09, p = 0.003).

The lack of understanding and application of standardised, integrated, and simplified HMIS tools would lead to the use of unstandardised parallel tools, worsening both data quality and information utilisation. Similarly, a recent study in Ethiopia cites vertical reporting as one of the hindrances to immunisation data quality, indicating that 43% of health facilities did not have a standardised immunisation registration book, and another 50% did not use the standardised tally sheets (Kefiyalew et al. 2021:7, 8). An intervention to address the problem should focus on strengthening skills and on using a uniform data source and a single reporting channel to improve data quality and information use. Consistent with this study's findings, Schmidt et al. (2018:1) emphasise that data integration has the potential to improve the accessibility and effective utilisation of RHIS data, leading to more evidence-informed M&E, planning, and quality improvement interventions. Strengthening standardisation and tool simplification within the framework of Ethiopia's Information Revolution Roadmap could enhance data accuracy, reduce reporting redundancies, and foster a culture of information-driven decision-making at the facility level. Within the PRISM framework,

these findings reflect weaknesses in the technical input components of the Routine Health Information System, particularly in standardisation and data processing infrastructure, which subsequently disrupt the feedback loop necessary for informed decision-making.

4.4.3 Organisational determinants of HMIS data management and information use

The result shows that performance (coverage) monitoring is the highest implemented management function mentioned by 94.4% (n = 388), while implementation of quality improvement is mentioned by relatively fewer, 89.3% (n = 367). This finding suggests that the system disproportionately emphasises service coverage expansion at the expense of quality improvement. However, this study also confirmed that quality improvement has higher potential to increase HMIS data demand, analysis, and interpretation. The observed association between health service quality improvement planning and elevated levels of data demand, analysis, and interpretation underscores the reinforcing role of QI in fostering information-driven management (X^2 = 9.84, df = 4, p = 0 .04); (X^2 = 7.81, df = 1, p = 0.01) and (X^2 = 25.85, df = 2, p = <0.001). Reorientation of managers and care providers to design, implement and monitor QI would sustainably improve coverage of service and performance of RHIS. This aligns with evidence from Nshimyiryo et al. (2020:10) and Aqil et al. (2020:4), who emphasise that effective QI processes foster continuous learning, promote a culture of information use, and contribute to overall organisational effectiveness. Within the PRISM framework, these associations reflect the influence of organisational processes, particularly planning, feedback, and supervision, on the generation and use of routine health information.

The RED/C microplanning and immunisation session plan has a higher potential to improve data demand and interpretation. There is a significant association between data demand and the development of RED/C micro plans (X^2 = 23.56, df = 4, p < 0.001). The HMIS data is better demanded and utilised when an organisation develops its work plan, such as a bottom-up approach of RED microplanning, for organisational and service delivery improvement. Literature cites that HMIS data can be used as organisational development tools, if data is converted or used to service delivery improvement, and staff can use it to

improve performance of their organisation (Muhindo et al. 2016:4). Another study suggests the use of local data to develop and implement comprehensive micro-plans is among the key components of the RED/C approach (Salisbury, Hossain, Oskouipour, Hong, Ebeling, Shearer & Grapa 2024:1-2).

Similarly, there is a significant association between developing an immunisation session plan and data interpretation (X^2 = 10.31, df = 2, p = 0.01), likely reflecting the analytical rigour embedded in session preparation, which requires staff to examine past trends, forecast demand, and identify service delivery gaps. A more detailed nature of the immunisation session plan requires data analysis and interpretation at the service delivery point. Studies indicate that the immunisation session practices employ thorough examination for successful implementation of regular vaccination services involving elements of session management, including reports, supervision, and so on (Qanbar, Jasim & Mahmood 2023:1).

The result depicts that data sharing internally through self-assessment and externally through performance review meetings has a high potential to improve data demand. The high demand for HMIS data is significantly associated with both data sharing through self-assessment and peer performance review meetings (X^2 = 20.12, df = 2, p =<0.001) (X^2 = 12.1, df = 2, p = 0.002), respectively. An improved demand for data has high potential to increase the chance of checking data quality. The association between high demand for data and data quality checks is significant (X^2 = 4.60, df = 1, p = 0.03). This implies the necessity of broad-based data sharing for self-assessment and peer review to improve demand for data and data quality assurance. A study suggests that users need to engage in priority information and dissemination, otherwise the data demand and use cycle would break (Blessing et al. 2017:10; Sligo et al. 2017:8; MEASURE Evaluation 2018:14). The association among data quality, demand for and use creates a cycle that ensures improved health programs and policies (Gimbel et al. 2017:2)

HMIS data sources were the highest used to conduct performance monitoring at 90% (n = 386), but relatively less used for outbreak (emergency) response plans at 79.2% (n = 313). Possible reasons for the low use of HMIS data sources for epidemic response plans might

stem from limitations of the RHIS system to accommodate emerging needs for data, as outbreak response data are recurrently changed. This would result in the development of parallel data tools; thus, an intervention should focus on the inclusion of epidemic response indicators and required data elements in the design and update of national HMIS. A study by Mndeme and Nyella (2010:2) reveals the 'cast in stone' rigidity of the national HIS, to the extent that it does not meet the data needs of vertical health programs.

Nearly a quarter, 23.8% (n = 98) of HMIS personnel in position were not trained on HMIS, while more than a third, 35.4% (n = 105) of responses did not indicate improved skills in data processing as a result of recent training. On the other hand, improvement in data processing skills following recent HIS training is significantly associated with the provision of feedback on data (X^2 = 7.2; df = 2; p = 0.03). The recent coverage of training is better than the persistently low coverage reported in previous studies in Ethiopia: 31.3% of staff trained on HMIS at service delivery points, and 38.3% of lower-level staff trained on HMIS in the previous six months of the study (Kebede et al. 2020:8).

The reported inadequacy of training in developing data processing competencies appears to have constrained trainees' ability to interpret and utilise data effectively. This observation corroborates evidence from MEASURE Evaluation (2018:7, 23) and Kebede et al. (2020:2), which highlight that limited analytical and presentation skills among frontline health workers impede the integration of data use within routine service delivery functions. The HMIS information used for supportive supervision was skewed to verification of reported performance, while comparatively less was used to provide feedback. Only 51% (n = 210) of participants mentioned using HMIS data for comprehensive supportive supervision activities. However, use of HMIS information in whole supportive supervision activities is significantly associated with performances of data quality checks and data interpretation (X^2 = 22.63, df = 1, p = < 0.001) and (X^2 = 53.65, df = 1, p = < 0.001), respectively.

The limited use of HMIS data in developing supervision checklists suggests a systemic disconnect between data systems and managerial oversight tools, constraining the ability of supervision to reflect on-ground realities. The lack of evidence-based supervision and

feedback contributes to low performance of data quality checks, interpretation and use. According to Strachan, Rawlins, and Levine (2021:27), effective supportive supervision relies on the availability of high-quality data, which is essential for informed program management, performance improvement, and the identification of capacity-building needs within health systems. The findings show that the use of HMIS data for staff performance appraisal was relatively less, mentioned by 79.4% (n = 327). On the other hand, most participants referred the responsibility of ensuring continuous information use at the institution to HMIS/HIT staff and quality improvement teams, mentioned by an average of 18.7% (n = 320) of responses. Comparatively less, 13.3% (n = 228) of responses attached this responsibility to individual staff. The low use of HMIS data for staff performance appraisal suggests the absence of a connection between anticipated performance in the staff job description and their responsibility for HMIS data quality and information use. The tendency to disown information use responsibility might be rooted in subpar accountability created at the individual health staff level for the HMIS task. This underscores the importance of holding individuals accountable for the ongoing use of HMIS information. Improving staff data use behaviour requires creating staff accountability through training, supervision, and feedback aligned with organisational and stakeholders' priorities (Bruce 2014:8).

4.4.4 Behavioural determinants of data management and information use

Although nearly two-thirds of participants reported a high demand for HMIS data, the demand was primarily administrative, which was intended to ensure timely reporting rather than analytical or decision-oriented. Nearly 42% (n = 331) of responses show a high demand for data for official and parallel reporting, while much less, 14.7% (120) of responses indicate a high demand for data to engage the community in service. This contrast underlines a prevailing pattern of compliance-oriented data demand, which focuses on reporting to authorities rather than developmental use, such as community engagement or service improvement. This shows continued high demand for HMIS data to transmit reports. A similar finding by Kassa and Grace (2018:3) states that people at frontline health facilities only pipeline the data to pass without using it, the decisions they make are not based on evidence, and the data they produce will remain of poor quality.

The findings reveal a strong interdependence between technical and behavioural determinants—suggesting that the presence and understanding of standardised HMIS tools can shape staff attitudes, motivation, and confidence in using data. The use of standardised HMIS tools was significantly associated with higher data demand and more frequent data quality checks ($\chi^2 = 20.38$, df = 4, $p < 0.001$), suggesting that standardisation may encourage more systematic data engagement. Similarly, performance of data quality checks and use of standard tools was significantly associated ($X^2 = 10.903$, df = 1, p =<0.001). However, limited understanding and inconsistent application of standard integrated HMIS tools reduce both the demand for data and the likelihood of performing systematic data quality checks. A study mentions reasons for poor data quality include use of inappropriate data collection tools and procedures that result in recording and reporting practices which undermine standardization (Moukénet, De Cola, Ward, Beakgoubé, Baker, Donovan, Laoukolé & Richardson 2021:2). This aligns with the literature emphasising that the behavioural component of data management is constrained not merely by motivation but also by inadequate technical orientation and inconsistent adherence to standardised tools.

Skill mix in the data quality check mechanism was mentioned by 39.8% (n = 164), while the majority of the participants had skills limited to the LQAS mechanism. The LQAS mechanism lacks metrics for self-assessment, while the RDQA for self-assessment is less used at the facility level. The need is to build comprehensive skills among healthcare providers to own and operate an integrated data quality assurance mechanism that comprehensively measures relevant dimensions of data quality. This finding underlines the behavioural gap between awareness and actual competence. Capacity-building should not only train staff in the use of tools but also cultivate intrinsic motivation and ownership of data processes. A study asserts that the RDQA can be utilised by programs to conduct self-assessments; its tool is employed to validate the quality of data, evaluate the system that generates that data, and formulate action plans to enhance both (MEASURE Evaluation 2017:7, 9).

Among data management processes, data collection emerged as the most problematic (21%, n = 273), likely reflecting duplication across hybrid paper and digital formats, parallel reporting requirements, and inconsistent adherence to standardised tools. The difficulty of

data collection processes might be due to the use of hybrid format data collection, high demand for data for duplicative and parallel reporting and less adherence to the standardised, integrated and simplified tools. The perception of data analysis and data interpretation as a problematic data management process was mentioned by relatively fewer participants. This might be due to the irregular conduct of these processes compared to data collection and quality checks. The result underscores the importance of reforming HMIS tools with non-redundant and understandable data elements, the utilisation of guidelines, training and mentoring of health workers. In alignment with this, a study result states that some of the data captured on the paper-based HMIS forms are not incorporated in the online DHIS2 in Uganda (Moukénet et al. 2021:12). The ongoing duplicative paper-based data collection was an important frustration for system users in Malawi, Zambia, and Zimbabwe (Moucheraud et al. 2017:7).

This study shows that the managers' directives on, and their use of HMIS information for decision-making, motivate staff to use information in their routine decision-making, expressed by 26.3% (n = 315) and 22.1% (n = 264) responses, respectively. When managers use HMIS data, the data producers perform data analysis. This finding demonstrates a modelling effect, where managerial use of data serves as a behavioural cue, motivating frontline staff to engage more actively in data analysis and use. The performance of data analysis by data producers and their motivation through managers' use of information are significantly associated (X^2 = 13.55, df = 1, p = <0.001). Staff motivation, performance monitoring and decisions based on superior directives were found to be determinants of HMIS data utilisation (Yarinbab & Assefa 2018:1, 5).

Fewer than 12.5% of respondents reported any recognition or incentive mechanisms for exemplary data users and producers. Despite this, the existence of incentives was significantly associated with improved data interpretation performance (χ^2 = 18.34, df = 1, p < 0.001). A study indicates that a lack of policy and incentives for data use, inadequate human skills, and data security limit user engagement, data sharing and use, and contribute to HIS failure (Leon et al. 2015:6). Motivation through supportive supervision is significantly associated with staff performance of data quality checks (X^2 = 9.59, df = 1, p = 0.001). The

need is to strengthen a comprehensive, integrated motivation mechanism through the consistent implementation of supervision activities, incentives, and managers' use of information and modelling. A study shows that low motivation and lack of incentives, poor infrastructure, inadequate resources to conduct comprehensive supportive supervision, and the lack of standard operating procedures are among the factors contributing to poor-quality HMIS data (Rumisha et al. 2020:19).

The findings from this study reveal that the participants have a neutral perception of the quality of HMIS-produced data, with a computed mean response of 3.23 $\pm$ 1.22. The uncertainty about the quality of HMIS-produced data implies less confidence in using information generated from this data. The result that the trust in HMIS produces high-quality data is significantly associated with the use of standard HMIS tools (X^2 = 20.38, df = 4, p = < 0.001). The uncertain perception of the participants about HMIS-generated quality data might have led to insufficient use of data for improvement. The need is to enhance confidence in the quality of HMIS data through strengthened use of available data and feedback for improvement. According to Mayston et al. (2020:2), the perception of poor data quality leads to information systems in LMICs failing to provide for information use. But a study by Nicol et al. (2017:12) argues that working on poor data is one way of improving data quality through feedback to data producers.

The study results show high confidence among participants in the overall data management processes. The computed mean in the range of 3.6-4.2, or 63.2% (n = 260) to 79.1% (n = 326) of participants, indicates confidence in data interpretation and in data collection, respectively. Observation of actual confidence in data management was beyond the scope of this study; the confidence revealed here is self-reported; an actual confidence would be less. Moloko (2021:231) in her dissertation mentions gaps between self-perceived and actual competence in the production of accurate data, citing that the healthcare providers self-rated a high confidence in collecting data correctly and checking data accuracy, though the majority did not understand the recording of data elements.

Likewise, the data shows 84.5% to 95.5% self-reported competence in four of the data management processes: demonstrating principles of good data collection is the highest; showing evidence of data verification/quality checks; data use and data display, 84.5% (n = 348), the lowest. This self-reported competence is likely to be much higher than the observed competence, and it contradicts the low skills of participants, specifically in data display and use, as indicated in this study. A study by Hlaing and Myint (2022:4) shows computed mean scores of perceived competence and observed competence for the HMIS tasks were 65.3±9.2% and 58.3±10.9%. They reported over 95% of competence in demonstrating good principles of data collection, which also conflicts with the reported difficulty of data collection as the most problematic data management process reported above.

The participants' self-reported competence in four other data management processes was comparatively lower, ranging between 79.1% (n = 326) in analysing data on their own without supervision and 82% (n = 338) in describing organisational processes in data interpretation. The data analysis and interpretation were persistently rated as problematic processes. Similar findings from a study state weak human resource capacity, lack of skills to analyse, disseminate, and interpret data as perceived barriers that limit uptake and use of data for decision-making (Chanyalew, Yitayal, Atnafu & Tilahun 2023:7).

Behavioural determinants such as motivation, confidence, and competence substantially influence HMIS data management and use. These are shaped by technical conditions (availability of standard tools), organisational leadership (managerial modelling and supervision), and individual-level motivation. Strengthening behavioural capacity through targeted mentorship, recognition systems, and supportive supervision can reinforce a culture of information use in line with the PRISM-MFI framework.

4.4.5 Information use

The results show that HMIS information is most frequently used for performance (coverage) monitoring (24.1%, n = 334), followed by health service planning (21.8%, n = 302). However, use of information for improving the quality of immunisation services was lower (18.2%,

n = 252), indicating that HMIS remains primarily a tool for measuring output rather than quality improvement. But use of information for health (immunisation) service quality improvement had relatively fewer, 18.2% (n = 252) responses. This proves the persistent focus of HMIS information on planning and raising coverage over improving the quality of service. The findings are backed by Sligo et al. (2017:6), who state that the use of information to improve the quality of care has not been adequately achieved.

The HMIS information used for governance (performance appraisal) was the least indicated by 15.6% (n = 216) of responses. The limited use of information for performance appraisal (15.6%, n = 216) suggests a disconnect between data accountability and individual performance evaluation. This weak linkage perpetuates a culture in which health workers perceive HMIS as someone else's responsibility rather than an integral part of their role. The healthcare providers need to be reoriented on accountability and the importance of the information used to improve the quality of service as part of their job description. Bruce (2014:8) emphasises the need to ensure staff accountability and strengthen data use through training, supervision and feedback.

In this study, nearly a third, 29.9% (n = 123), of participants indicated inconsistent use of HMIS information. Although most participants claimed continuous use, their primary evidence of such use was archived monthly reports (23.2%, n = 218), with few demonstrating use in ongoing quality improvement initiatives (17.9%, n = 168). This pattern reinforces the compliance-oriented nature of data practices, where reporting substitutes for active problem-solving". This is further proof of the RHIS's focus on sending reports rather than using information for program and service delivery improvement. The need to ensure continuous use of information through using it for evidence-based quality-of-service improvement. This is supported by Dagnew et al. (2018:2), who state that front-line management and service delivery points hardly use system-generated data to identify performance problems; data is merely for sending reports and not for program and quality of care improvements.

Participants identified potential strategies to enhance continuous use of information, notably: integrating HMIS data into quality improvement (29.4%, n = 328), linking data use to

service planning (26.5%, n = 295), and ensuring data quality before utilisation (20.6%, n = 230). These suggestions demonstrate staff recognition of QI's role in promoting meaningful information use, although practical implementation would require capacity-building for designing, executing, and monitoring QI projects. These findings confirm that while awareness of QI principles exists, the operational use of HMIS data across the full quality improvement cycle remains limited, reflecting a gap between conceptual understanding and practice. The third suggested intervention was ensuring the quality of data prior to its utilisation, which possibly improved the continuous use of information mentioned by 20.6% (n = 230). The suggestion by the participants implies a better understanding of the role of QI to improve the use of HMIS information. It, at the same time, highlights the need to equip individual health workers to design, implement and monitor QI projects. Similarly, a study suggests an intervention to effectively use information for decision-making by integrating routine information into planning, quality improvement, and evaluation processes (Leon et al. 2015:5-6).

Currently, the predominant use of HMIS data within QI initiatives occurs during the planning or 'set aim' phase (29.1%, n = 337). Far fewer facilities use HMIS data to assess outcomes or track changes in quality (17.7%, n = 205), suggesting partial implementation of the PDSA cycle and limited emphasis on continuous monitoring. The finding is inconsistent with the study by Magge, Kiflie, Nimako, Brooks, Sodzy-Tettey, Mobisson-Etuk, Mulisa, Bitewulign, Abate, Biadgo et al. (2019:6) that states facility QI activities, clinical processes targeted by QI and clinical outcomes were monitored and analysed routinely using data from the HMIS.

Slightly less than half of the participants (43%, n = 177) indicated use of information for whole QI processes (phases) that include set aim, measure indicators, monitor improvement and assess changes. Strengthening information use for the entire PDSA cycle of quality improvement is required. Embedding HMIS data analysis throughout all PDSA stages would transform information from a retrospective reporting tool into a real-time driver of service improvement. A study indicates that the QI teams were expected to use the Model for Improvement to test changes using PDSA cycles in their local settings (Hagaman et al.

2020:3). PDSA is an iterative cycle applied in the QI process throughout quality planning, improvement, and quality control (Knox 2018:10).

The HMIS information used for service quality improvement was significantly associated with the positive perception of the quality of HMIS-produced data (X^2 = 30.39, df = 4, p = <0.001). This indicated that users' confidence in data reliability directly influences whether they employ it for decision-making. This concurs with a study that states that health workers' data use behaviour is linked to the perception of data quality, and this perception determines whether stakeholders are likely to use HMIS data or not (MEASURE Evaluation 2018:11). Similarly, the HMIS information use was significantly associated with a clear understanding of indicator definition (X^2 = 26.40, df = 1, p = <.001). The need is to focus on building health professionals' confidence in the quality of HMIS-produced data and on clarity around indicators for continuous use of information for quality improvement. A study by Bloland & MacNeil (2019:1) states clarity is needed regarding standard indicators, specifically their selection, purpose, definition, methods, and acknowledged limitations, which enhances data quality, usability, and overall information use.

The result also indicates that the highest use of HMIS information for immunisation service was its use for planning and management of resources, mentioned by 23.2% (n = 327), followed by the use of information to monitor data use for actions of immunisation service, stated by 22.1% (n = 311) responses. The result implies better use of information for microplanning and monitoring data use for action, though this study was not meant to examine competence in and utilisation of EPI (RED/C) microplanning. However, literature cites a lack of updated micro plans, reporting that the complex and bulky nature of the planning tool contributed to only 57 per cent of health facilities having an updated micro plan (Salisbury et al. 2024:5).

The HMIS immunisation data is less often used to engage the community in immunisation services (18.9%, n = 267). Improper use of HMIS information to engage the community in immunisation services would make the improvement of coverage and service quality far from reach. There is a need to refocus on information use to engage the community in im-

munisation services and enhance their coverage and quality. A study states that successful micro-plans need to involve community members and community-based organisations to help with outreach (Salisbury et al. 2024:7).

The HMIS EPI data used for supportive supervision were the least, with 17.8% (n = 251) responses. The meagre use of immunisation data for supportive supervision would neglect the positive impact of supervision on data quality improvement and effective use of information for immunisation service quality. The result highlights the need to improve the use of HMIS information to conduct supportive supervision so as to improve immunisation data quality and information use for action. A study by Chanyalew et al. (2021:9) indicates that regular HIS supervision might help health workers improve their capacity for health data analysis, interpretation, and use to make evidence-based decisions at lower levels of the healthcare system.

The emphasis in immunisation data use is more on collecting and submitting reports than on analysing and interpreting data. This shows an over-persistent focus on collecting data and sending reports rather than analysing, interpreting, and using the information. The need is to strengthen frontline capacity to analyse, interpret, and use immunisation data. This is strengthened by a study that refers to the RED approach, which focuses on monitoring and use of HMIS data for action, implying not only the timely collection of data at the district level, but also the use of data to solve problems (Strachan et al. 2013:14).

The purpose of immunisation data use to reduce vaccine dropout (DOR) was 21.8% (n = 340). This is closely followed by the use of data to raise coverage of fully vaccinated children, indicated by 21% (n = 327). The purpose of immunisation data use to minimise Missed Opportunity for Vaccination (MOV) had 20.5% (n = 320) responses. HMIS immunisation data used to monitor vaccine/supply stock-outs and cold chain functioning had 19.5% (n = 304) and 17.1% (n = 267) responses, respectively. The higher use of HMIS to reduce DOR and raise coverage of fully immunised children aligns with the focus of the system on monitoring and improving coverage of immunisation services. The need is to

strengthen immunisation data for the entire spectrum of immunisation activities, and specifically to monitor and take action for cold chain functioning.

Fewer than half of the participants (43%, n = 177) reported using HMIS information across all phases of the QI process, which include setting aims, defining and measuring indicators, monitoring progress, and assessing changes. This finding suggests that the majority of health workers engage with HMIS data only at selected points in the QI process, most commonly during the planning or target-setting stages, while neglecting later phases such as monitoring and evaluation. The limited use of information throughout the full QI cycle implies a fragmented approach to continuous improvement. It reflects a behavioural pattern where data are primarily viewed as tools for compliance or reporting rather than as evidence to drive iterative learning and service enhancement.

The result may also indicate capacity and structural gaps, such as inadequate analytical skills, weak supervision, or the absence of feedback loops that prevent consistent data use in measuring performance and assessing change. Embedding HMIS data utilisation across all stages of the PDSA cycle would therefore strengthen evidence-based decision-making and foster a sustained culture of quality improvement within health facilities. Overall, the extent of HMIS information use remains below expectations for effective service delivery, management, and quality improvement. Barriers such as fragmented data tools, unclear indicator definitions, limited confidence in data quality, insufficient supervision, and low motivation constrain utilisation. Strengthening integration of data quality improvement, information use, and QI guidelines could simultaneously enhance data reliability and foster a sustainable culture of evidence-based decision-making.

4.5 SUMMARY

This chapter presented and interpreted the study findings on data management processes, data quality, and information use within the Health Management Information System (HMIS), with specific reference to immunisation service quality improvement. The results indicate that the overall implementation of HMIS data management processes remains in-

adequate, resulting in uncertain data quality and limited utilisation of information for decision-making. The performance of the system is affected by interrelated technical, organisational, and behavioural determinants.

Overall, the findings indicate that HMIS data management and information utilisation fall short of the expected standard for effective service delivery, management, and quality improvement. Weak technical capacity, inadequate organisational support, and behavioural limitations such as low motivation and limited confidence in data quality continue to constrain performance. Strengthening training, supervision, and motivation; improving data management tools; and developing practical guidelines for data quality assurance and information use will be critical to improving data utilisation and enhancing immunisation service quality.

CHAPTER 5: ANALYSIS, PRESENTATION AND DISCUSSION OF QUALITATIVE DATA

5.1 INTRODUCTION

Chapter 5 presents the qualitative data analysis, the findings from data collected through focus group discussions. The chapter begins with an overview of the participants' demographic information. Then it delves into the themes, categories, and subcategories that emerged from the analysis of the focus group interview transcripts. Drawing directly from the participants' own expressions, this analysis explores their experiences related to Health Management Information Systems (HMIS) data generation, information use, and quality improvement of immunisation service at facilities of the study area, Addis Ababa.

A qualitative approach was applied to further explain and contextualise the quantitative findings. Nine Focus Group Discussions (FGDs) were conducted with purposively selected participants from the initial quantitative sample, categorised into three groups: HMIS workers, service providers, quality improvement focal persons, and health facility managers. A semi-structured focus group guide was refined iteratively throughout data collection, facilitating in-depth discussion on data generation, information use, and quality improvement practices. Data saturation was achieved after the ninth FGD.

5.2 DATA ANALYSIS

Thematic analysis (TA) was a preferred method of qualitative data analysis in this study. The TA method principally detects patterns, regularities, inconsistencies and gaps in the data, employs overlapping processes of transcribing textual materials to familiarise with and analyse data, and analytic effort to generate final themes through identification of themes and subthemes depending on the amount and quality of analytic efforts put into analysis. Finally, it examines broad themes summarising the content of data, fairly and completely (Polit & Beck 2017:171; Howitt 2017:163, 165, 166). The method executes

steps of familiarisation of data, generating codes, generating and reviewing themes, and naming the themes and writing the report (Flick 2014:421, 422).

Thematic analysis has been classified into three subtypes by Braun and Clarke (2022): Reflexive thematic analysis, codebook thematic analysis, and coding reliability thematic analysis (Campbell et al. 2021:5). The reflexive thematic analysis method was identified as the most suitable analytical approach for addressing the objectives of this study. The method is inductive as analysis and interpretation commence from specific data and proceed to a concept. The researcher applied this method, supported by Atlas-ti Version 24 qualitative data analysis software, and identified patterns, regularities, and implicit and explicit meanings in the data. The reflexive thematic analysis is an easily accessible and theoretically flexible interpretative approach to qualitative data analysis that facilitates the identification and analysis of patterns or themes within a given data set (Byrne 2022:2).

Qualitative data drawn from healthcare (immunisation) staff were transcribed, reviewed extensively, sorted and arranged by relatedness of the stated quotes (excerpts). The Reflexive Thematic Analysis (RTA) is an interpretive method firmly situated within a qualitative paradigm. As such, a viable analytic option for qualitative health researchers (Campbell et al. 2021:4). The transcripts were coded using the software. The codes were grouped into themes according to relatedness, without overlap across initial themes; thus, the themes were depth-analysed and interpreted to comprehensively address the research questions. A study states that the reflexive thematic analysis approach allows for explicit (surface-level) and implicit (latent) knowledge and theme generation (Vandecasteele, Robijn, Willems, De Maesschalck & Stevens 2024:3). Direct quotes, whether explicit or participants' statements, were narratively described. At the same time, the underlying implications, ideas and concepts were analysed and interpreted in detail, as presented in the qualitative result report below.

The researcher transcribed a total of nine audio-recorded focus group discussions by actively listening to the replay on digital tape. The transcribed data were backchecked with field notes captured by the research assistants. The data from notes and observations were

converted into text by the researcher, which enriched the transcription. The details of language accuracy during the interview and back-check of the transcripts are outlined in the methodology chapter of this study. Finally, results were reported with a summary of key categories and themes followed by a detailed description and interpretation along with steps taken to ensure trustworthiness of data (Polit & Beck 2017:749, 958; Creswell & Creswell 2018:256). All transcripts were de-identified to protect participant confidentiality. This included removing any personal identifiers such as names, workplaces, or location-specific information that could reveal the identity of participants. Each transcribed piece of data was assigned a neutral coding label, enabling traceability without compromising anonymity. The following labelling system was used:

FGD X to indicate the focus group number.

P Y to indicate the participant number within that group.

For example, a quote from Participant 1 in Focus Group Discussion 1 was labelled as FGD1-P1. This systematic coding ensured that all data remained anonymised while still allowing the researcher to identify patterns and relationships within and across the focus groups.

5.3 PRESENTATION OF FINDINGS

Data saturation was achieved after the ninth FGD. From the data, four themes, 14 categories and 42 subcategories emerged. Overall, the participants expressed a favourable attitude towards the benefits of HMIS. They highlighted that the HMIS has a dedicated structure and unit, resources, and assessment tools for its implementation. The information is primarily used for performance monitoring, action plan development, and, currently, for designing and implementing quality improvement. However, the participants identified several challenges in HMIS implementation. These challenges include a lack of communication during the redesign phase of HMIS at the facility level. Periodic updates to HMIS are performed at a higher level, with rare orientation at the implementer's level. Unreliability of DHIS2 software is also among the challenges; the data on the software can be altered due

to an erroneous internet connection, and its real-time data access is deterred. The HMIS training is inadequate; it does not involve facility managers, does not cover DHIS2 for healthcare professionals, lacks training and reference manuals, has undigitized data collection tools, duplication of data aggregation software and reporting channels, and inadequate ownership of quality improvement processes.

Participants noted that the central level completes the HMIS rewrite independently and implements it at the local (facility) level during training. The DHS2 software is unreliable whenever the internet connection is weak, leading to issues such as data being added, deleted, or multiplied erroneously. The HMIS TOT lacked reference material, and facility-level training lacked incentives, which affected the interest of the participants. There is a limited budget at the health facility level to reproduce HMIS recording and reporting tools.

5.3.1 Participants' demographic data

The demographic data from the qualitative phase provides a detailed overview of the participants' characteristics. The qualitative phase involved 80 participants selected across three professional categories: health information technicians, health professionals providing immunisation services, and facility managers. Most participants had under 10 years of work experience, and a range of age groups were represented, primarily between 26 and 45 years. Both male and female health workers participated, ensuring a diversity of perspectives in the discussions (Table 5.1).

Table 5.1: Demographic background of the qualitative study participants

Age of the participants	Number
<20 years	00
21-25	11
26-30	18
31-35	15
36-40	16
41-45	12
46-50	06
-55	02
>55	00
Years of experience of the participants	
≤ 5 years	42
6-10	27
11-15	8
16-20	03
>20 years	0
Number of participants in each category	
Health Information Technicians (HITs)	26
Health professionals	32
Facility managers	22
Gender of the participants	
Male	49

Female	31

5.3.2 Themes, categories and subcategories

The researcher collected qualitative data from nine focus group discussions and analysed the data to explore the experience of health workers in data management, information use and quality improvement of immunisation services.

Four themes, 14 categories, and 42 subcategories have emerged from the focus group data. Table 5.2 below presents these themes, categories and subcategories.

Table 5.2: Themes, categories and subcategories

Theme	Category	Subcategory
1. HMIS implementation	1.1 System update	• HMIS update and tools production • Implementation method • Orientation to the system • System support
	1.2 Role of the health facility manager	• Ensuring functional resources/structure and coordination/responsibility
	1.3 Role of department managers/professionals	• HMIS tools delivery and coordination • Implementation assessment and data quality check • Information use and quality improvement
	1.4 Role of HIT	• Availability of functional HMIS tools • Data management and mentoring
2. HMIS Training	2.1 Training of Trainers (TOT)	• Master trainers' skills and materials • Participants and length of TOT
	2.2 Facility(cascaded) training	• Needs assessment. • Materials adequacy and focus • Participants and attention to the training setup
3. Data management and quality assurance	3.1 Data aggregation	• Data aggregation software • Integration of data aggregation software

mechanism	and reporting software	
	3.2 DHIS2 software	• Flexibility and functionality • Connectivity and update • Data authenticity (reliability) • User-orientation of the DHIS2 design
	3.3 Data interpretation and sharing	• Data display and interpretation • Complexity of HMIS tools • Data sharing (reporting) • Data feedback
	3.4 Data quality assurance mechanism	• Data quality gaps and ad hoc interventions • EPI data discrepancy • LQAS/RDQA data quality check mechanisms
4. HMIS information use for decision-making	4.1 Culture of information (data) use	• Extent of HMIS information use • Knowledge and skills of HITs • Perception and motivation to HMIS/HITs • Values and commitment to information use
	4.2 Planning and performance monitoring	• Annual planning and performance monitoring • Action plan (PIP) and implementation review
	4.3 Quality Improvement Project (QIP)	• QIP design standard • QIP implementation and graduation • Enablers of quality improvement • Barriers to quality improvement
	4.4 Managing immunisation service	• RED/EPI micro-planning and coverage monitoring. • Immunisation quality improvement • Structure/organisation of immunisation service. • Ways to improve immunisation service quality

5.4 THEME 1: HMIS IMPLEMENTATION

Within Theme 1, four categories and 10 subcategories emerged. This theme highlighted the importance of regular updates to the HMIS and its effective implementation.

5.4.1 Category 1.1: System update

5.4.1.1 Subcategory 1.1.1: HMIS update and tools production

The majority of participants identified several challenges related to the provision and implementation of updated HMIS tools at the health facility level. A key issue highlighted was the lack of timely and effective communication between higher administrative levels and facility-level staff. While updates to the HMIS, including tools and indicators such as those used in DHIS2, are introduced approximately every five years, the dissemination and implementation process appears fragmented. Participants reported that facility managers are often informed of HMIS updates during training-of-trainers (TOT) sessions. However, this occurs after updates have already been finalised, limiting the ability of health facilities to prepare adequately.

> *HMIS is updated every five years at a higher level. The facility level is contacted only during TOT to cascade the training and implement HMIS.* However, the *responsibility of producing renewed HMIS tools lays on health facilities. Due to lack of early communication, facilities print new HMIS while discarding already stockpiled annual consumption (FGD2-P1).*
>
> *Because the managers were not trained on HMIS, due to unawareness of changed tools, they already had printed older registers with our entire budget" (FGD8-P).*
>
> *Previously the regional health bureau used to provide tools, now softcopies are sent to health facilities to print and implement, then long delay in printing process and higher financial burden at health facility, as the result HMIS tools are not adequately printed (FGD8-P3).*

The data shows that recently, health facilities were required to procure HMIS implementation materials; however, health facility managers have not been part of TOT, nor had early communication of updated HMIS tools. Absence of early communication and engagement

in HMIS update caused wastage of resources on duplicate printing and procurement of materials, while in the older version, the tools were not yet utilised.

5.4.1.2 Sub-category 1.1.2: Implementation method

These findings underscore the need for structured communication channels, training for facility managers, and coordinated planning for HMIS updates to ensure efficient resource use and uninterrupted service delivery.

The participants indicated that the execution of HMIS is by individual service departments. The system has tools, software (EMR: Electronic Medical Record and DHIS2), indicators and HMIS/M&E structure (unit). The health professionals record and register data during their encounter with service clients. The data are transferred to a tally sheet on a daily basis, and data entry to the DHIS2 happens on a monthly basis. The HITs enter data to DHIS2 with the support of respective department heads:

> *We collect data using register, transfer reportable data into tally sheet on daily basis and fill report forms from the tally sheet on monthly basis (FGD4-P4) …. we enter data into DHIS2 through HMIS (HIT) unit (FGD5-P5).*
>
> *If we see, HMIS has its independent HMIS unit, professionals, infrastructure, software, and activities; various tools: tally sheet, registers, report formats (FGD4-P7) (availability).*
>
> *It also has DHIS2 and EMR software and mainly updated 177 HMIS indicators. The tools are currently produced by a health centre and health professionals are trained in the indicators, tools and data elements, and implement (FGD 9-P10).*

The participants reported that service departments actively implement the HMIS using its functional components, and the continued reliance on hybrid reporting systems, both paper-based and electronic, persists. Data are first recorded manually during client encounters, aggregated internally on paper, and later transferred monthly to the HMIS unit for en-

try into DHIS2. This process reflects a duplication of effort that increases workload and exposes data to potential errors during manual collation and transfer.

5.4.1.3 Subcategory 1.1.3: Orientation to the system

Most participants report the provision of cascaded regular orientation at the health facility level in a phased approach. The orientation is meant to uniformly create awareness of system implementation among managers and staff. Considering findings from the internal assessment and supportive supervision, the orientation emphasises updated relevant indicators, disease coding and service provision.

> *We consistently provide orientation to staff on the essential or basic knowledge and or concepts of HMIS relevant to their role/job related such as ICD code monthly (FGD1-P2).*
>
> *We also orient each department and conduct internal supportive supervision, identify knowledge gaps, and provide gap-filling training or orientation (FGD6-P5).*
>
> *First the Senior Management Team is oriented by TOT received staff and then others according to the need assessment (FGD8-P1).*

The participants emphasise how orientation, training, and supervision practices are integral to maintaining a knowledgeable and capable workforce in health management information systems (HMIS). The quotes collectively underline a structured approach to training that includes regular orientation, knowledge gap assessments, and the use of supportive supervision. Though the process is generally proactive, some areas, such as refresher training, appear under-resourced.

On the other hand, one participant indicated that there has been no training provided lately.

> *Recently there has been no refresher (on the job) training even for those who missed training, and those who trained long ago, but might have forgotten etc (FGD5-P3).*

The result goes with a study finding that indicates lack of training and refresher courses contribute to unreliable information and therefore poorly informed decision-making (Kasambara, Kumwenda, Kalulu, Lungu, Beattie, Masangwi, Ferguson & Morse 2017:1).

5.4.1.4 Subcategory 1.1.4: System support

Most participants acknowledge adequate support from higher levels and partners. The higher levels provide support in the areas of data quality, training on and implementation of DHIS2, performance monitoring and design and implementation of quality improvement projects. The support includes the temporary assignment of experts to health centres for technical support. Partners also support these priority areas, with one of the partners (DHA) supporting the process; however, its support is limited to facilities in two sub-cities and selected facilities in other sub-cities.

> *We say the support is excess compared to training! The city admin health bureau and sub city health office support health centers: a professional can be assigned from sub city and sit with health center Performance Monitoring team (PMT); the DHA (Digital Health Agency), an implementing partner support (FGD4-P8).*
>
> *DHA, an implementing partner (IP), has an HIS assessment tool filled quarterly, the IP supports internally our health facility assessment and externally do its level assessment. on quality documentation, to improve quality at all facilities of the two sub cities and selected facilities in eight sub cities of Addis Ababa (FGD4-P3).*
>
> *Addis Ababa university is also supporting partner now…. in collaboration we reviewed our QIP in MRU, conducted a data quality assessment, and departments with major gaps in data quality were trained (FGD7-P5).*
>
> *Checking all data elements instead of to LQAS data quality check limited to selected 12 data elements is customized practice from best experience sharing from Mikililand institute supporting HMIS implementation (FGD5-P1).*

The result indicates appreciated system support from the higher levels and partners in areas of data quality, performance monitoring and training, including assignment of a technical expert to health facilities. However, a few partners are closely supporting the HMIS implementation, for instance, the Digital Health Agency (DHA) specifically provides training on data quality assurance and QIP designing, though its support covers limited health facilities and sub-cities.

5.4.2 Category 1.2: Role of health facilities managers

5.4.2.1 Sub-category 1.2.1: Ensuring functional resource/structure and coordination

The participants revealed that the role of facility managers is to ensure adequate supply of hard copy HMIS formats and software, including procurement of new gadgets, monitoring assurance of data quality, checking completeness, timeliness and consistency. The managers also oversee self-assessment, development of an action plan and ongoing review of its implementation by the department team. They lead performance review by the facility performance monitoring team and plan for and monitor HMIS training with emphasis on data interpretation and feedback to improve data quality and data use.

> *The facility managers' biggest role is ensuring adequate supply of hard copy data tools, availability and functionality of HIT unit and computers, check if data is complete, timely and correct, thus investigate problems and act accordingly (FGD5-P1).*
>
> *A manager leads PMT meetings. With the main-PMT reviews and endorses action plan of individual department on monthly meetings. PMT has logbook in which previous month, previous quarter and previous year performances are logged (FGD4-P2).*
>
> *The self-assessment on data is irregular; the facility managers had to verify whether the departments have discussed on data quality and performance (FGD5-P6).*
>
> *Heads focus on use, but we are there in data management processes starting from interpretation of increased or decreased performance to action plan developed,*

monitored and reviewed. After data has been shared with the sub city, we finally give feedback to departments (FGD4-P1).

… there is a gap in PMT functionality, thus a gap in data interpretation and use (FGD1-P3).

The participants mention the irreplaceable role of facility managers who ensure the availability and functionality of hard copy HMIS tools, computers, data management and use. They provide feedback on data and quality improvement. Managers play a central role in leading performance monitoring teams, ensuring data accuracy, and fostering a culture of shared responsibility. Some participants reported limited functionality of s-PMT and irregular conduct of LQAS and self-assessment. These might have contributed to inadequate data interpretation and use for informed decision-making.

5.4.3 Category 1.3: Role of department heads/professionals

5.4.3.1 Sub-category 1.3.1: HMIS tools delivery and coordination

Most participants described the crucial role of department heads, who ensure the availability of data management tools and their proper application to the production of quality data. The head of the quality improvement department provides standardised hard copy formats, monitors effective data management, data quality checks, performance review and data use for action by the department performance monitoring team. The department heads ensure functionality of computers and software, and the department performance monitoring team. They cross-check recording and tallying day and night, identify gaps in performance and quality of data in focus to common dimensions of data quality and address the gaps.

As a head of quality department, I ensure the 3 HMIS structures are functional throughout the month: my first role, dispense and ensure availability of HMIS registers, reporting forms, and DHIS2 computer connection (FGD7-P7).

The quality improvement team makes around on data every day, and is assigned in night duty, talks with departments team in person and corrects any findings (FGD5-P1).

If we find registration with problems of completeness and consistency, we refill (correct) them; All the HMIS work including HMIS diagnose, data quality, register, tally, report form issues are managed by QI department (FGD7-P2).

The priority thing is to strengthen s-PMT if data quality must be improved, functionality of s-PMT by far minimizes data quality issues, for instance, MCH has three teams dividing the department's data elements among and checking entire data elements (FGD4-P9).

Department heads check data quality before reporting; participate in PMT meetings that identify gaps and develop action plan; facilitate s-PMT meeting; discuss on causes of data quality and performance problems; leads action plans and presents to PMT (FGD2-P4).

Participants explained that department heads play an active role in strengthening data quality and performance monitoring, primarily through their leadership of sub-sub-performance monitoring teams (s-PMTs). They participate in PMT meetings to review performance, oversee data recording and tallying, ensure the functionality of computers and HMIS software, and lead the use of information for departmental self-assessment. They also guide the development and implementation of action plans based on analysed data, demonstrating their central role in fostering accountability and a data-use culture within departments.

5.4.3.2 Sub-category 1.3.2: Implementation assessment and quality assurance

The participants mentioned that the department heads regularly assess HMIS implementation using the IR and HIS checklists. The Information Revolution (IR) checklist is used to assess the functionality of data management, data quality, visualisation, utilisation for decision-making, and performance monitoring teams. The IR assesses functionality of software,

understanding of tools, data elements and indicators, quality assurance and use of information. Whereas the HIS focuses on HMIS staffing as per standard, data consistency and data use. With respect to data quality assurance, the QI department assesses data recording of each department, data errors and the LQAS application. Departments conduct LQAS prior to reporting to the HMIS unit, and with the HITs, they enter data to DHIS2. The findings are addressed through an action plan.

> *The IR checklist is used quarterly to assess Infrastructure looking into three components; data management: data quality, the functionality of s-PMT and PMT, and the utilisation of data for decision-making. Additionally, it assesses data visualisation of plan versus achievement of a given department (FGD6-P6).*

> *The HIS checklist is to assess availability of human resources at card rooms, computer and software functionality, concurrence of registered, tallied and reported data (FGD2-P7).*

> *The HIS mentorship checklist reveals detailed information starting from data recording to data use level. The IR checklist to broadly assesses overall activities from cardroom to individual delivery point, from data elements to indicators understanding, from plan versus achievement display, functionality of software (FGD9-P2).*

> *My role in HMIS starts with checking data quality using LQAS and submitting the report to the HMIS unit (FGD2-P8).*

> *I am working under the EPI unit, and my roles include sending the report to the HMIS unit monthly and entering data to DHIS2; daily check registration in each of the service units (FGD9-P1).*

The system assessment of HMIS implementation uses both IR and HIS checklists, without clearly indicating which tool is used for each. Data quality assurance redundantly uses the three common dimensions of data quality and the LQAS mechanism. Health professionals

endure the burden of data management processes, as they collect, aggregate and report data in hard copy and are expected to co-enter data to DHIS2 with the HITs. This might deplete care-providers' motivation. Systematic assessment and reporting of data quality issues is among the critical interventions to improve the quality of health statistics generated from facility data (Yazdi-Feyzabadi et al. 2015:1; Maïga et al. 2019:7).

5.4.3.3 Sub-category 1.3.3: Information use and quality improvement

Most participants revealed that the QI department heads oversee data quality and ensure the conduct of LQAS at each of the departments. The department heads supported by the quality department visualise the data in graphs and charts and use the information for decision-making. The Quality Improvement department designs QI projects for all other departments. The departments exhibit high interest in and implement the QI project as it improves their individual and departmental performances.

> *Yes, the quality office is the owner of the QI projects of all the departments, making arounds on data every day (FGD5-P4).*
>
> *Quality improvement projects are designed by the quality department (FGD6-P2).*
>
> *All departments now require their work to be seen by the quality department or QIP to be designed for them to see performance improvement of their respective departments; in my role as a quality department head, I check on departments to see if they have conducted the LQAS or not (FGD9-P6).*
>
> *My third role is on information use; once data is collected and entered DHIS2, we present data using graphs, tables to decision makers (PMT) (FGD7-P5).*

Participants mentioned that the Quality Improvement (QI) department plays a central role in ensuring data quality and supporting performance improvement initiatives. It leads initial data verification, continuous monitoring, and supervision of LQAS checks. However, most health professionals outside the QI unit lack the technical skills to design QI projects, limiting their participation to implementation rather than planning. Despite this, departments

show strong motivation and ownership during QI implementation, driven by the tangible performance gains these projects yield. The QI department assists in the routine display of charts and graphs to visualise departmental performance, further reinforcing a culture of data use for decision-making.

5.4.4 Category 1.4: Role of Health Information Technicians (HITs)

5.4.4.1 Sub-category 1.4.1: Availability of functional HMIS tools

The participants verbalised that the HITs play important roles in the implementation of HMIS; they are responsible for the actual monitoring of the availability and application of HMIS tools. The standard HMIS formats are not yet digitised; thus, they regularly assess and dispense the formats to service departments in advance of monthly reporting. The HITs also ensure functionality of data aggregation software, mainly SmartCare and EMR:

> *My role as a HIT is distributing report format in 17-18 each month, data entered until 23rd of the month by the departments (FGD1-P1).*

> *As an HIT officer I prepare HMIS data tools, ensuring the availability of data recording and reporting tools in each of the service departments; Standardized HMIS formats are kept at the HIT unit, the formats are not digitized into individual department (service unit) computers; thus, we distribute the hard copy before 21st of each month (FGD3-P3).*

> *My day-to-day role is following the full functionality of the SmartCare and EMR systems in each service area (FGD6-P1).*

The participants indicate that the QI department plays a pivotal role in maintaining data quality and driving performance enhancement across departments. It oversees initial data verification, continuous monitoring, and the supervision of LQAS checks to ensure data accuracy and reliability. However, most health professionals outside the QI unit lack adequate

skills in designing QI projects, restricting their engagement mainly to the implementation phase rather than the planning and design processes.

5.4.4.2 Sub-category 1.4.2: Data management and mentoring

Most participants have shown that HITs mentor data collection, verification, visualisation, and provide feedback. They initiate and conduct LQAS data quality assurance. The HITs do data entry, analysis, interpretation, and presentation for decision-making.

> *After all we, the HITs enter both service and disease data into DHIS2; interpret data by comparing plan versus performance; HITs discuss data recording weekly with the MRU and another service area; We conduct LQAS and see 12 indicators from OPD, IPD, and MCH services (FGD1-P1).*
>
> *We enter the data, analyse data, and present it to the head of the health center. So, my role begins with recording (entering) (FGD3-P2).*
>
> *Involved in LQAS. If there is a need, we modify; if everything is acceptable, we enter the data to DHIS2 (FGD6-P4).*
>
> *Collaborating with the quality department, we also mentor departments to check their data quality; We also support the case team (service unit) using their individual dashboard and display its report after aggregating it; HITs supervise and evaluate their data recording, and history taking, starting from the medical record unit. We use data quality evaluation checklist (FGD 6-P7).*

The participants confirmed that most of the data management processes and information use tasks are performed by the HMIS officers (HITs). They execute data entry, quality checks, analysis, interpretation, visualisation and presentation (sharing) information to decision makers. They also initiate discussions on data quality within the departments and take corrective measures, double-checking the quality of entered data before external data sharing.

5.5 THEME 2: HMIS TRAINING

Under Theme 2, two categories with five related sub-categories emerged. The theme focused on pre-implementation training on updated tools and indicators, and challenges associated with preparation, capability, motivation and resources.

5.5.1 Category 2.1: Training of Trainers (TOT)

5.5.1.1 Sub-category 2.1.1: HMIS TOT facilitators and materials

Most participants revealed the low quality of HMIS training, both TOT and cascaded training. The master trainers were not adequately skilled; training materials were only in soft copy, with a lack of practical sessions and reference materials, and focused on the theoretical aspect. Shorter time was given to practice on DHIS2, and statistical analysis and reporting, due to problems with the internet connection. The trainees were not equipped with skills of DHIS2 data visualisation, data analysis and interpretation. It did not provide details on how to enter ICD codes by HITs, as they know diseases only by codes, and did not provide information on complex health indicators to HITs, as they have a non-health background and have difficulty understanding and entering data.

> *The master trainers were not knowledgeable. Due to this, the staff failed to further analyse and display data applying different techniques (FGD1-P1).*
>
> *I have received TOT, but the training focused on theory, when it came to practical sessions only 1 day was allocated. At least 3 days should have been allocated for training on* a computer. Second, the training given on HMIS data analysis and interpretation using statistical methods (Per cent, proportion etc.) was not adequate (FGD8-P2).
>
> *The HMIS TOT has a shortage of printed training materials, only power point tools; register, tally sheet, report form for practice were provided in soft copies (FGD2-P4).*

TB control and prevention data has many inconsistencies when we enter DHIS2; the training is theoretical, when it comes to practice on DHIS2 we are usually told that there is no connection (FGD3-P8).

We are challenged with a lot of indicators when HITs enter data, we explain (DH FG4-P3). We (HITs) know diseases by their ICD code, whereas health professionals know by disease name not by ICD code. Yet some diseases have no ICD code (FGD6-P9).

The data indicated that the HMIS training facilitated by low-capacity master trainers, insufficient training materials and a reference manual for self-reading that impacted understanding of indicators, disease coding, and quality of data to enter DHIS2. The situation, compounded with inadequate time allocated to the course, lack of practical and trainee-oriented methods, and low focus given to statistical analysis and reporting, left the trainees with inadequate skills in data entry, visualisation, analysis and interpretation.

A similar study reveals the statement of most participants about the unavailability of hard copies of training manuals or reading materials available in health facilities … at the local level. However, an e-copy of the training manual was accessible within DHIS2 (Bhatt, Bhandari, Adhikari & Gahatra 2024:8). Studies in Uganda and Ethiopia confirm that health workers who lack training were unable to understand indicators and quality of data, as a result, their use of routine health data is limited (Dagnew et al. 2018:5).

5.5.1.2 Sub-category 2.1.2: Participants and length of training of trainers (TOT)

Most of the participants mentioned that HMIS TOT enrols specific categories of professionals repeatedly. While the invite rarely engages staff from services departments, it excludes the facility managers. The five days allocated for TOT were too short to understand the whole content of the training and cascade it in less than 2 days. Few participants doubted whether the HITs had been adequately trained, could handle DHIS2 and transfer knowledge in cascade training.

The TOT mostly engages Quality head, HIT, and sometimes department heads from Emergency, OPD and MCH which are related with more data (FGD8-P1).

Facility managers excluded from the TOTs, thus variations in views and understanding of indicators will persist (FGD3-P6).

*The facility leaders should also be well informed/oriented on QIP. Otherwise, it is difficult for the QI office to work smoothly with other departments (FGD9-P8)***.**

It is difficult for the trainers to understand all indicators and explain their definitions numerators, denominators, data elements etc., and train all staff just in one or two days The TOT was given for 5 days (FGD5-P1).

There is no clarity whether all HITs are trained on and experts adequately using DHIS2 or not. The capacity of HITs should be assessed. DHIS2 is not easy, nor user-friendly. I have reservation, about the HITs understanding and transfer of knowledge…. We face the challenges when TOT call comes specific to them (FGD5-P4).

The findings show skewed recruitment of HMIS TOT, with specific invites coming to the QI department and HITs from the organisers. The TOTs seldom invite and even exclude facility managers. Disengagement of facility managers in HMIS and QIPs TOT led to persistent variation in understanding of indicators and failure to support implementation of DHIS2, and a lack of ownership and regular monitoring of the QI project. The five days for the TOT were insufficient to understand the definition of indicators, data elements and grasp knowledge to cascade the training within less than two days. Though the HITs often partake in TOT, they are unable to handle DHIS2 and transfer knowledge in cascaded training.

5.5.2 Category 2.2: Facility (cascaded) training

5.5.2.1 Sub-category 2.2.1: Needs assessment

Most participants proclaim doing a needs assessment and providing training biannually to bridge gaps in HMIS implementation and procedures. A few participants oppose this, men-

tioning the lack of regularity and uniformity of the assessment. The implementers' level training also lacks a budget, unlike previously, which was funded by the higher level**.**

> *We also do need assessment when there is data fallacy on the reporting and provide need based HMIS training 2 times per year for health professionals on HMIS (FGD2-P8).*
>
> *The gaps are identified every 6 months, and an action plan is developed to fill the gaps; for example, why we allocate the same number for a client who lost the medical record was unclear among the MRU staff (FGD9-P3).*
>
> *In between the HMIS updates training need assessment is not uniformly specific HMIS. Previously cascaded training courses were owned by the sub city with the budget from the regional health bureau, but recently health centers themselves allocated budgets (FGD8-P7).*
>
> *It is important to centralize the system and provide continuous need based adequate training to make DHIS2 tool user friendly (FGD5-P1).*

The findings indicate an irregular need assessment of training and a shortage of funds to motivate the participants and comprehensively cascade the training at the facility level. These might have contributed to the provision of non-need-based and suboptimal facility-level training. A study states the Training Needs Assessment (TNA) is the method of determining if there is a performance capacity gap, and the approach preferred by the people to fill the identified gap (Adewole, Salawu & Begun 2020:2). Similarly, a study by Draghici, Fistis and Carutasu (2021:9) recommends that the TNA should lead to the identification of the main training subjects being of employees' interest to support their professional sills development.

5.5.2.2 Sub-category 2.2.2: Materials adequacy and focus

The participants agree that facility-level training is scarce, it lacks material, time and due focus. These training materials lack hard copy for reference, depth and completeness, and

are not fine-tuned; “one-size-fits-all”-type. The training is theoretically driven and not comprehensive to equip with the computational skills of indicators. Diseases coding, data analysis and reporting session is facilitated by the HITs. Inadequate training on DHIS2/HMIS might worsen persistent gaps in practice. Insufficient time for facility-level training forced the focus of training to be on priority indicators and data elements.

> *The facility training has time, focus and material shortage. As there is not adequate training on DHIS2/HMIS the practice gap is still existent (FGD2-P1).*
>
> *Yes, training was given, I cannot dare say the training was enough, leave alone for health center managers, even for someone working around, no clarity with indicators means work by guessing, problem in data quality (FGD5-P2).*
>
> *During the training HITs primarily focused on disease coding, data analysis and reporting (FGD9-P9).*
>
> *…. The practical training is omitted, mostly theoretical part is focused (FG8-P1).*

Training materials are not adequate, when updated all things change, softcopy is sent, and health centers are obliged to print them (FGD8-P4).

The participants indicated limited HMIS training at the facility level, suggesting complacency with the status of HMIS implementation. Insufficient time was allocated, training materials were only in soft copy, and they lacked depth and detail, forcing the training to focus on a few prioritised indicators and data elements. The approach that lacked a practical session left the trainees with continued uncertainty in the computation of indicators and diseases (ICD) coding, as well as data analysis and reporting. In summary, the inadequate training on DHIS2/HMIS might have exposed persistent gaps in practice. Studies reveal that insufficient attention to staff training is one issue that can trigger other challenges in the implementation of DHIS2 (Dehnavieh, Haghdoost & Aghamohamadi 2019:12).

5.5.2.3 Sub-category 2.2.3: Participants' attention to training setup

The participants described that health facility training was provided without major interruption of routine service delivery, while half of the staff were on training, the other half maintained service provision. Health professionals train on health indicators, whereas the HITs train on data management, including the conduct of LQAS and information use. However, the training receives little attention due to a lack of incentives and is interrupted by work routines that seek the attention of a specific person. However, when the training is conducted off-site, it is considered a job in itself; in part, it has incentives and is conducted away from routine work; otherwise, trainees give low attention to on-the-job (facility) training.

> *…dividing the training content based on the TOT participant's expertise (discipline), We, the HIT, train on diseases classification, recording and reporting, LQAS, PMT procedures, data analysis and use (FGD1-P2).*
>
> *When training is off work, it is a job, and when it is on the job it is interrupted by work routines, personal issues and time factors such as providing medical and police certificates; Training at facilities means no incentives while outside duty station trainings are more focused mainly due to the issue of incentives (FGD9-P1).*
>
> *The quality improvement officers are professional and trains health and clinical related indicators (FGD8-P2).*

Participants reported that training delivered at the facility level often receives limited attention, primarily because it offers no financial or non-financial incentives to attendees. Moreover, the training sessions are frequently interrupted by competing service delivery demands, as specific staff are called away for routine duties. Conducting sessions with only half of the workforce at a time also reduces opportunities for experience sharing and in-depth discussion among participants. Additionally, when Health Information Technicians (HITs) independently facilitate sessions on data analysis, interpretation, and use, the depth

of understanding among participants may be constrained, given that facilitators often have limited knowledge of disease-specific indicators and clinical terminologies.

5.6 THEME 3: DATA MANAGEMENT PROCESS AND QUALITY ASSURANCE MECHANISM

Theme 3 had four categories and 13 subcategories. The theme focused on data management processes, burden of parallel data aggregation and reporting, and the drawbacks of DHIS2 software. Additionally, emphasis was placed on enhanced checks of data quality and on methods of data visualisation and interpretation. Moreover, persistent low-quality EPI data and a lack of a proven data quality assurance mechanism, which led to the use of multiple ad hoc methods, were verbalised under this THEME.

5.6.1 Category 3.1: Data aggregation and reporting software

5.6.1.1 Sub-category 3.1.1: Data aggregation software

The participants reported utilisation of hybrid and parallel data aggregation tools. The duplicative data aggregation software use pursues the interests of programmatic donors or partners, who would prefer to receive parallel reports directly from departments, even without knowledge of facility managers. Though the EMR, the only preferred official tool for data aggregation with individuals' health details, is not yet fully developed.

> *We use multiple data aggregation tools. SmartCare generates parallel reporting to donors; Some parallel tools are implemented just by a department, not by the entire health facility, the tools are implemented even without knowledge of the facility managers. We use a tally sheet, register, and SmartCare (specifically for ART), DHIS2 and EMR (FGD2-P6).*
>
> *Currently, EMR has reached at least one health centre in a sub-city, and all hospitals. EMR is meant to replace paper-based recording and reporting. However, health professionals prefer entering data into EMR, but the EMR is not yet fully developed.*

It is further developed in response to further requests from the users. The EMR is for detailed activity recording, not for reporting, like SmartCare is (FGD4-P4).

DHIS2 for diseases and service data, DAGU for pharmaceutical data, these 2 are the main data aggregation software (FGD5-P1).

Each tool was designed by different donor interests, like 'SmartCare' by the CDC and 'Dagu' by some pharmacy company (FGD7-P1).

The findings reveal the use of multiple hybrid and parallel data aggregation tools. This is mainly to meet the requirements of parallel programmatic reporting to different agencies. Different donors developed differing data tools. While DHIS2 lacks some programmatic data and does not yet capture individual-level medical records, the EMR is not yet scaled.

5.6.1.2 Sub-category 3.1.2: Integration of data aggregation software

In the statement of participants, differing ownership, lack of roadmap and willingness to harmonise tools, as well as failure to scale up some piloted integration efforts, are challenges of HMIS integration. DHIS2 is used to aggregate reportable data for most programs without individual-level disaggregate data. The parallel tools capturing individual records, such as SmartCare, are not interoperable to readily integrate with DHIS2. Previous trials of integration with DHIS2 were interrupted without documented lessons. The donors do not favour integration of tools, yet the MOH has no roadmap to centralise and integrate parallel tools.

Now there is a trial to connect DHIS2 with EMR (FGD3). Some software does not necessarily go with DHIS2 like SmartCare, it is only for ART data (Managers FG8-P1).

There was a pilot software called DANY, it integrated all data entered to computers get connected to DHIS2, but it was abandoned after piloting (FGD7-P1).

The EMR, SmartCare and DHIS2 ownership is by different entities. Integration should be done at MOH level and ownership must be centralized (FGD2-P3).

Software has different ownership to meet different purposes. The owner of Smart-Care does not want to add anything to it, the owner of EMR might be at a higher level or it may be an NGO. To bring them together, ownership should be centralized (FGD4-P2).

Except the DHIS2, others aggregation tools have individual service data, DHIS2 and other parallel tools should be centralized, the centralisation experiences should be sought even from other countries (FGD5-P1).

Lack of leadership coordination and strategic direction affected HMIS integration. Additionally, the absence of a clear national integration plan, interoperability between program tools and DHIS2, willingness among stakeholders to harmonise existing systems and failure to scale up piloted integration initiatives continue to challenge HMIS integration. Similarly, the underdeveloped Electronic Medical Record (EMR) impedes full integration. The lack of a ministry-led integration framework continues to contribute to fragmented data aggregation systems and parallel reporting structures, undermining data consistency, completeness, and the overall efficiency of health information management.

5.6.2 Category 3.2: DHIS2 software

5.6.2.1 Sub-category 3.2.1: Flexibility and functionality

Most participants expressed that DHIS2 lacks reliability, as it does not allow correction of miss-entered data, or else it provides exaggerated values, in the case of family planning and mortality data elements. The platform lacks ICD codes for some diseases. Its lack of interoperability resulted in the inaccessibility of data in the previous e-HMIS. Due to its weak automation, the output of data analysis takes longer than a day. However, a few participants described that DHIS2 flexibly captures and aggregates data online and offline; customises emerging data needs and updates by version. Generally, the strength of DHIS2 in detecting data error validation and easier data visualisation were its acknowledged gains; it has the potential to run the LQAS mechanism and trend analysis.

DHIS2 flexibly accommodates emerging data needs. Previously, data entry DHIS2 was offline, but now can be entered online, but you cannot trust the customisation of DHIS2. Most participants questioned flexibility of DHIS2, mentioning its less interoperability to migrate previous e-HMIS data, to be precise, the older data before the start of DHIS2 is not accessible (FG4D-P2).

The DHIS2 software itself is interesting, enables trend analysis back up to 5 years data (FGD5-P6).

DHIS2, some cases like mortality data are not modified once error entered (FGD2-P8).

DHIS2 is updated by versions, recently DHIS2 version 3.6, however there is no regular review meeting on or nor it has comment or dialogue section in DHIS2 for continuing improvement (FGD3-P5).

DHIS2 has its validation mechanism. It makes a 'red' shade in the cells if the dose of vaccines is not equal to number of children vaccinated (FGD7-P6).

If you enter data today, the output (report) tomorrow, after 24 hours. DHIS2 does not automatically run data analysis by period. For example: to see annual data, we must touch each month manually and sum it up (FGD5-P7).

But DHIS2 does not necessarily have all NGO required indicators, not possible (FGD7-P1).

The findings reveal that the DHIS2 platform lacks interoperability, flexibility, reliability, automation and completeness. Besides, the data in older e-HMIS is not accessed via DHIS2, so the edition of mis-entered data would result in faulty figures. It lacks ICD codes for some of the diseases. Its data analysis process slows output. Some strengths of DHIS2 include detection of data errors, easier data visualisation, trend analysis and the LQAS mechanism. However, these functions might be underutilised due to limited knowledge of DHIS2 among end users and a lack of training on the tool for health professionals.

5.6.2.2 Sub-category 3.2.2: Internet connection and DHIS2 data reliability

Most of the participants indicated that the DHIS2 function is dependent on internet connectivity. Weak connection results in slow data retrieval, loss of entered data, disrupts reporting timeliness, and excessive error messages. Some participants ascribe this to dependence on one server for the entire country. The software also lacks ownership, responsive maintenance and timely updates.

> *An interruption of connection causes loss of data entered DHIS2. Thus, we go back to register and re-enter the data from the report form. Hard copy HMIS tool is being updated, but the DHIS2 of our facility is not functional now, not updated on time (FGD1-P2).*
>
> *frequent error message, miss some data and says 'server error' during data visualisation, the HITs reason out this due to internet interruption (FGD2-P4). A single server does not capture all data (FGD1-P3).*
>
> *When the internet is weak, the system is busy in giving output, the problem frequently reported but solution/update comes during next update/version of HMIS (FGD6-P5).*
>
> *Whenever the server is not functioning it must be corrected first, it is not known whom to report to in such event. Our Selam Fire health center, disappointingly, reversed to hard copy reports. We do not know origin of DHIS2 problems why data entered system changes itself, entry problem, server problem or virus (FGD4-P2).*
>
> *So far who comes in touch with and trying to fix DHIS2 problem were not looking like the software specific professional (FGD5-P1).*

The finding indicates that the functionality of DHIS2 is dependent on internet connectivity and server capacity. A weak internet connection can result in loss of data entered into DHIS2, causing re-entry of the whole dataset. The participants expressed that the DHIS2 software had data integrity and security problems. The system unpredictably changes the entered values of some indicators and displays discrepant data at the entry point and re-

ception level. Some of the participants associate this discrepancy in the software with the time for entry of voluminous backlogged data due to COVID-19. Due to a lack of trust in DHIS2, some program officers from higher levels of the system prefer to receive reports on hard copy.

> *There is no full trust in DHIS2 as a higher level still requesting paper based parallel report, as the software adds or deletes data by its own (FGD6-P5).*
>
> *One of the participants expressed his experience with DHIS2, once supervision from ministry of health meant to verify our community level TB case detection reported 900, but actual entered data to DHIS2 from tally was only 9 (FGD5-P4).*
>
> *We were under COVID-19, and back logged data of 3 months entered DHIS2, it started to duplicate, misses (hides) some indicators like mental health (FGD4-P2).*
>
> *We at the health center and officers at sub city office can see different figures for the same data entry (FGD-P6).*
>
> *The DHIS2 can multiply data of emergency and EPI by 3 or 4 folds (FGD5-P2).*
>
> *For example, we miss hypertension and diabetes Meletus (DM) data. Sometimes ANC1 is lost after entry and only ANC 4 appears (FGD1-P8).*
>
> *It hides some data elements e.g. currently on family planning, on contrary, it increases currently on ART (FGD5-P9).*
>
> *The problem with DHIS2, its data disappears as if there were entry problems (FGD6-P1).*

The finding depicts that the DHIS2 software had data integrity and security problems. The data archived in DHIS2 data can be hidden, deleted, duplicated or discrepant at the point of entry and reception level because of weak internet and server. This resulted in mistrust and accounts for the preference for paper form HMIS among end users.

5.6.2.3 Sub-category 3.2.3: User orientation of the DHIS2 design

The participants attributed the DHIS2 problems to the absence of a user-oriented design, mentioning that many of the DHIS2 problems would have been easily fixed if both the developer and implementor had participated in the design phase. The DHIS2 data is inaccessible without HITs, health professionals are not trained in the system and facility managers have not yet owned it. The participants suggested capacity building and an ongoing interaction between the system users and developers as ways of improvement.

> *There should have been involvement of health professionals in the design phase of DHIS2 to comment on the content and design of the tool, the use-oriented design. The higher official's attention to data and DHIS2 is very poor (FGD6-P1).*
>
> *There also should be ongoing capacity building of the HITs on the further use of DHIS2, as there might be capacity limitation to fully explore and use the software (FGD1-P2).*
>
> *DHIS2 is not yet used by health professionals due to capacity limitations. We health professionals are not skilled to enter data on DHIS2. On the other hand, health facility management does not control DHIS2, this responsibility is rather left to HITs (FGD2-P2).*
>
> *Health professionals also need to be trained on DHIS2, as they are the ones doing on data (FGD3-P6).*
>
> *The software developer and implementer read each other, make the system editable (FGD 4-P8).*
>
> *The DHIS2 is with DHIS2 officer, only accessed when the HITs are around, thus parallel report is required (FGD8-P4).*

The data shows the absence of a user-oriented design of DHIS2, and its training is inadequate for HITs, and even misses health professionals, including facility managers, which contributed to challenges of its ownership and application.

5.6.3 Category 3.3: Data interpretation, sharing and feedback

5.6.3.1 Sub-category 3.3.1: Data display and interpretation

The participants verbalised that tables, graphs and charts are commonly used to display key performance indicators (KPI) and the 10 top diseases. Banners and brochures for community awareness, and DHIS2 direct visualisation as applicable. The data interpretation analyses trends, compares performance versus plan or standard, verifies internal consistency of consecutive and simultaneous service data, and triangulates data from different sources.

> *Tables and graphs/charts comparing performance versus plan at health facilities. We use large banners to display our performance to the community (FGD1-P1).*
>
> *We display the hospital data by using the DHIS2 visualisation directly connecting to DHIS2 with the TV (FGD7-P2).*
>
> *The HITs print out the graphs from DHIS2 and post them for visualisation on the board (FGD8-P9).*
>
> *The HITs use brochures to transmit our performance to the community members. I also display data by charts and tables (FGD6-P1).*
>
> *Monthly performance data of facility is displayed to PMT members and service units by the HIT (FGD2-P7).*
>
> *We interpret data by comparing current month performance with previous month and same month previous year's performance, trend analysis, also use triangulation of data source (FGD4-P3).*
>
> *We compare continuing services, e.g., ANC 1 with ANC 4, to check whether there is a dropout rate or not. The planned emergency unit attendants are 800, but the actual attendants can be 1200 because of casualties attending. We also use national targets to compare our performance (FGD7-P2).*

We also use community scorecard standard, which include MCC ('Rirhahe'), supply, CASH (nitsuh, michu), ambulance, waiting time, and staff entry and exit time (Daily work hours) … each scorecard result client satisfaction rate should be greater than 85% (FGD7-P1).

The participants mentioned inadequate data visualisation and data interpretation. The data display is limited to ordinary tables, graphs and charts, with fewer facilities for applying electronic data visualisation. The data displayed in hard copy delays the update of ongoing changes and decision-making. The display focuses only on key performance indicators, and the 10 top diseases would undermine the monitoring of inputs to improve performance and reduce the burden of diseases. The data interpretation compares performance versus plan, internal versus external consistency of service data and analysis of trends. This would preclude the interpretation of the causes of performance gaps and actions to bridge the gaps.

5.6.3.2 Sub-category 3.3.2: Complexity of the tools

Most of the participants revealed that the HMIS paper formats are not complex; however, some participants mentioned that ART and TB reporting forms are relatively complex. Some Balanced Score Card (BSC) indicators and their target setting are complex too. DHIS2 is not used by health professionals as they were not trained in it.

BSC reporting and measurement are complex (proportion of 100, 000 etc.), planning an activity to achieve 0 like in still birth, maternal mortality etc (FGD2-P4).

Out of all report forms the ugliest report form is the ART report form (disease report), it is so complex. It would have been more complex If ART data had been reported from register and dedicated data clerics are not there (FGD4-P5).

ART, chronic TB reporting forms (disease reporting forms) are complex, all agree. These paper-based reporting recording tools are not complex. It is just a matter of

reading and understanding. But in DHIS2, unless few people trained would try, others are not using DHIS2, only trained ones are using it (FGD5-P3).

This result shows that the Anti-Retroviral Treatment (ART) and Tuberculosis (TB) reporting forms involve multiple data elements, and their reporting formats are difficult to fill; especially, hard copy formats are complex and time-consuming, given that health professionals were untrained on and unable to capture and enter data to DHIS2.

5.6.3.3 Sub-category 3.3.3: data reporting (sharing)

The participants indicated duplicate data entry and hybrid data sharing to the same receiver. The same HIV data is entered into SmartCare, printed out, and entered into DHIS2 for donor and official reporting, respectively. The DHIS2 does not capture some services (BSC) data either. Electronic data is shared with direct access to DHIS2 or uploaded to Telegram. However, some stakeholders prefer to share data in their own format, direct from departments, bypassing DHIS2 data submission. Similarly, those who mistrust DHIS2, at higher levels, choose hard copy reports. Differently shared data through paper form and DHIS2 became discrepant as they were shared prior to the final cross-check. Generally, the use of hard copy is still extant due to fear of system interruption.

Data are sent to higher levels without entry to DHIS2, correcting those discrepancies over burdens the HITs, the issue stemmed from limitations of DHIS2 (FGD1-P7).

Above 90% of data in different forms are again in DHIS2. Unfortunately, inconsistencies sometimes arise between these hardcopies and DHIS2 reports, especially when the hard copy report is submitted without verse checking with the one in DHIS2 (FGD1-P5).

The ART report has been done 2 times, from SmartCare for donors and from DHIS2 computer for routine reporting. Data entered from the SmartCare computer, printed, and entered DHIS2 computer (FGD2-P1).

I don't see any difference between PTQIT and HIV SmartCare data components. The PTQIT data is smaller, but what surprises me is the HIV (SmartCare) data, the whole content is printed from SmartCare computer by the data clerk and entered the DHIS2 computer by the HIT (FGD1-P8).

Yes, we use parallel reporting systems, indicators like family planning to NGOs like ICAP, CDC reports are sent by the paper format, in addition reporting via DHIS2 and hardcopy.

parallel reporting in response to donors' interests etc. parallel reporting cannot be avoided for now (Managers FG8). in general, very disorganized parallel reports are there forbid us not to focus on DHIS2 (FGD5-P4).

We (HIT) also fill out the BSC reporting form and send it to the sub-city (FGD3-P5).

A health facility uses hybrids reports even to sub city, DHIS2 and paper-based (FGD4-P6).

SmartCare challenges, whereas DHIS2 is not complete to display some data (FGD7-P2).

If we stop using the paper-based register switching to EMR, this might affect data when the EMR interrupts suddenly (FGD6-P4).

we use a telegram platform to share or if the report requesting body has own format, then we fill it into the format from DHIS2 and send (FGD3). For example, DHA has their own reporting tools, the hard copies (FGD4-P9).

The result shows duplicate data entry and hybrid data sharing, even to the same receiver, which is due in part to low trust in DHIS2. These duplicative data entry and multichannel reporting would hinder internal data sharing for self-assessment and lengthen the transition to digitised data recording and reporting. The DHIS2 lacks some programmatic and services data, which contributes to donor interest in receiving data in their own format, undermining DHIS2 data submission. Not streamlined donors' reporting and mistrust would challenge the integration of tools and usage of DHIS2.

5.6.3.4 Sub-category 3.3.4: Data feedback

Feedback on data was described as being provided by facility managers and higher-level officers. Any oversight by the facility management is picked up at a higher level. However, the feedback from the higher level is neither adequate nor constructive, rather fault-finding, and even worse is that the managers expose the HITs instead of providing backup. Supportive supervisions are irregular and are not based on standard checklists.

> *Another problem in HMIS is the feedback from sub-city and regional health bureaus is not usually constructive, sometimes fault finding. Supportive supervision is not adequate, not using standardized checklist (FGD1-P5).*

> *Health facility heads do not defend, instead they personalize blame the HIT for the mistake instead of he/she solves the problem (FGD3-P3).*

> *Before the due date, all relevant officers at sub city level give feedback on their corresponding program, issues skipped by PMT will be corrected according to the feedback received (FGD4-P1).*

> *Post PMT is feedback session for heads of health facility at end of the month (FGD-P9).*

The data shows insufficient non-constructive data feedback, which is often personalised and fault-finding instead of fostering learning and improvement. Supportive supervisions are irregular and not based on standard checklists.

5.6.4 Category 3.4: Data quality assurance

5.6.4.1 Sub-category 3.4.1: Data Quality gap and ad hoc intervention

The participants expressed their belief about low attention given to data quality among health professionals, as they submit inconsistent and imprecise data. The questionable

quality of HMIS-generated data continues. Some ad hoc intervention by their own, health facilities assign a data committee, HMIS focal per department, and engage heads of departments to crosscheck and jointly enter data to DHIS2 to minimise errors that would happen if HITs alone enter data, as they lack understanding of some health indicators.

> *Sometimes there is a discrepancy between registered and reported data. They are, incautiously, reporting unspecified diagnoses, for example, just report 'burn' without specifying it (FGD1-P1).*
>
> *The health professionals are sitting together with HMIS officers for accountable data entry. Data entry is crosschecked using print out, not due to the HITs knowledge gap (FGD2-P3).*
>
> *Department heads, too, make corrections on their report while entering data onto DHIS2, for shared accountability and avoid blaming HITs whenever data is fallacy (FGD1-P2).*
>
> *Now we have formed a 'Data Committee' with members from department heads and quality officers, to check data quality daily from the source. Besides, the department heads check data while co-entering data onto DHIS2 with HIT professionals (FGD5-P4).*
>
> *We assigned an HMIS focal per case team, responsible for data (FGD7-P9).*
>
> *When HIT alone enters there always is a data fallacy. HITs are not professionals. They do not understand some indicators and miss data entry, which is why they are supported by the health professionals in data entry (FGD8-P9).*

The participants reported questionable HMIS data quality and a lack of a trusted data quality assurance mechanism. These have forced health facilities to apply unstandardised, duplicative data quality assurance mechanisms, including health professionals entering data to DHIS2 jointly with HITs, as the latter lacks clarity with health data elements.

5.6.4.2 Sub-category 3.4.2: EPI data discrepancy

Most of the participants reported that the immunisation service unit uniquely faces data discrepancies. The problems involve duplication of data, difficulties in recording multiple antigens at a time, and locating registers to record measles after 6 months of Pent-3. Additionally, inadequate infrastructure (EPI room) and mothers' preference for morning jobs lead to overcrowding, hence faulty recording and tallying. Besides the fluctuation in the catchment population figure, stockout of vaccines, and change of health facilities for continuing services, these add up to the EPI data discrepancy.

> *…. almost all times data problem is related to EPI unit, several antigens like polio 0, BCG etc. to be registered at same time but the figures do not match…. duplicate reporting and data discrepancy almost every month complicating data interpretation and use (FGD5-P2).*
>
> *Health professionals, thus, are catering for client satisfaction, a tendency of not focusing on data. Then after they sit and make numbers, that kind of weakness is there, this is why the EPI unit data is challenging to record (FGD6-P3).*
>
> *The reason for this poor quality is due to the crowd in the vaccination room, the service seekers come once, especially in the mornings. no mother/care giver will show up if you appoint them in the afternoon for vaccination (FGD5-P7).*
>
> *In addition, measles vaccination is once reported after 9th month of infant. By the time 3 or 4 EPI register could have been changed locating an infant to its vaccination start register would be more challenging (FGD5-P9).*

> *A persistent challenge arises from discrepancies between projected catchment area population and actual service user population. Knowing about population catchment is always a problem (FGD6-P3).*
>
> *This is due to the reason that some clients come from other health facilities to complete the vaccination, likewise others go from our health center to another to complete the vaccination if the vaccination is not available here (FGD5-P4).*

There is a gap in registration, tallying and use of information, even the register is challenging to simply document (FGD6-P1).

The immunisation service faces chronic data discrepancy. Uncertain figures of the catchment population and interruption of immunisation service contribute to over- or under-reporting. In addition, multiple doses recording; difficulty to locate a child data entry line in an immunisation start register after a long interval (to record measles vaccination after 6 months of Pent-3); and specific service time preference by caretakers, prone to overcrowding, result in faulty recording and tallying, are contributors to immunisation data discrepancy. A study result in agreement with this indicates that factors associated with data inaccuracy included high workload and the unavailability of required data collection tools (Lal & Sehgal 2024:1).

5.6.4.3 Sub-category 3.4.3: LQAS/RDQA data quality check

The participants confirmed that LQAS is a standard routine data quality check mechanism at health facilities with a 90% level of acceptance. However, the LQAS lacks representative samples and is subject to bias in some programs. Thus, a recent initiative is to recount (check) whole data elements at service units.

We check data quality using LQAS every month facility, it is standard, while the RDQA at the sub city level is quarter based. The RDQA also has LQAS component (FGD1-P9).

Based on the standard, if the LQAS result is less than 90%, then the report (data) has a problem. If its functionality is regularly assured, the LQAS is still better (FGD4-P8).

Sometimes the LQAS method is forced to selection bias, certain programmatic supervisors, for example, if TB indicators are not selected for the last 3 months, then they force them to add one of TB indicator, push the system into unscientific method (FGD5-P2).

This LQAS method of selecting only 12 data elements out of 177 indicators, over 800 data elements do not indicate the quality of data, sometimes data pass all the channel up to MOH level and quality is questioned, asking about individual data elements, e.g. how this much post-partum haemorrhage etc. questions come (FGD5-P8).

But now we see all of data entry briefly (wof barer) …., more indicators are evaluated each month; all data seen at EPI team, all teams come to s-PMT to check data quality using LQAS method, if LQAS result is less than 90%, the process repeats. Repeated means reports form, register and tally sheet are re-checked (thus case team check all data) s- PMT do LQAS, and the PMT does final LQAS (FGD8-P3).

Generally (zoro, zoro) what we need to be convinced is we have problems with data as a country, that is why we have a lot of committees (FGD5-P1)!!

The result highlights the low acceptance of the LQAS data quality assurance mechanism among implementors; they would say it is ineffective to determine the quality of routine data. The sample size of LQAS is limited to only 12 data elements; its sampling is not free of bias, and sampling is repeated when the result is rejected, with no tips on the number of times to repeat sampling to attain its accepted score of 90%**.**

5.7 THEME 4: HMIS INFORMATION USE FOR DECISION-MAKING

Under Theme 4, four categories and 14 subcategories emerged. The focus of this theme was culture and the extent of information use. Some participants acknowledged that information use has improved. However, most participants disregard this, saying that information used for action-oriented decisions is still nascent. There is limited capacity building and a lack of evidence for improved quality of services using data. Having regularly quality-checked data and an independent infrastructure are enablers of quality improvement.

HMIS information is used to develop the RED (immunisation) micro-plan. However, QIP to immunisation is challenging as indicators are overachieved, and QIP designed by low

achievement of conversion factors have no record of success. Generally, proper documentation, family reminder, staffing and training, supply and logistics, regular supervision, and evidence-based feedback would improve the quality of immunisation service.

5.6.5 Category 4.1: Culture of information use

5.6.5.1 Sub-category 4.1.1: Extent of information use

Most participants indicated that information use is still immature at all levels. Decisions are not yet evidence-based, and individuals lack motivation, capacity and accountability to utilise information to address health problems. The information is less commonly used specifically for budgeting and responding to disease outbreaks. Some participants, however, believe the magnitude of information use for the development of plans, both annual and action plans and quality improvement projects.

> *We, the HITs provide information to use for planning and presentations, therefore information use culture is improving. The health center managers can even access DHIS2 on their phones and easily follow their performance and identify gaps (FGD3-P1).*
>
> *HMIS data is inadequately used for budget allocation, outbreak response (PHEM) (FGD2-P2).*
>
> *Accordingly identify what should be our essential drugs (vital drugs). By interpreting the data, we evidence our data use (FGD4-P3).*
>
> *We generate the top 10 diseases from the DHIS2 and procure drugs accordingly using stock data, this also is evidence of information use. We use data for action plan development and to design quality improvement projects for persisted low performing indicators (FGD5-P8).*
>
> *Though not 100% information is used by every worker, visible ongoing improvement in the use of information. PMT reviews performance and assigns roles and responsibility to individual health workers, however use of information for self-assessment of performance has limitations. Failure to see improvement while using information causes query*

against the person responsible, is it skill gap? Or what else is the gap with a person? (FGD4-P4).

Still, there is a gap in data quality, especially in data use (FGD1-P1).

Executing responsibility has a gap, for instance we identify low performance of family health indicator, thus, listing activities to be done in a definite period, taking responsibility, and doing it on time has persistent gaps (FGD4-P7).

The information use is still immature from service providers to policy makers. The decisions are still made by conjecture. For example, if maternal mortality happens, use information, develop action plan and make maternal death zero in our health facility would be evidence of information use but this is not happening (FGD7-P9).

The participants reported a lack of purposeful evidence-based information use, which is less common both among policymakers and implementers. Allocation of resources, budgeting and outbreak response are among management functions with specifically low utilisation of HMIS information. Similarly, utilisation of information for self-assessment and development of an action plan for prioritised problems has persisted in gaps among health professionals.

5.6.5.2 Sub-category 4.1.2: Knowledge and skill of Health Information Technician

The health professional and facility manager groups described that the HITs have a low understanding of health terminologies, indicators and data elements. They often find it difficult to understand some health indicators, such as maternal mortality rate, vaccine wastage rate, and diseases without an ICD code. On the other hand, there is no ongoing capacity building to HITs in data management and information use, thus the HITs cannot independently cascade the HMIS training.

> *HITs have a knowledge gap in the areas of health (clinical) indicators (medical terminologies); therefore, they are twined with the health professional to provide training, they focus on data capturing tools: tally sheet, register, report form (FGD2-P6).*

As HIT professionals are not health professionals, they face challenges in using the tools, with content that the health professionals know, but the HITs do not (FGD4-P7).

But no one knows whether the HMIS staff are knowledgeable of all the indicators. There is a need to provide training and orientation. For example, in disease classification, we have a lot that we do not know such as ICD codes etc (FGD6-P8).

Yes, HITs are not health professionals, they report maternal mortality where there is no maternal mortality indeed (FGD5-P9). They also reported 400 children developmental delay mistaken for no developmental delay and vaccine damage rate for vaccine wastage rate (FGD9-P4).

Professionals write diagnosis without ICD code, due to this when we enter data, there will be problems like illegibility and incorrect ICD codes (FGD6-P6).

Participants reported that Health Information Technicians (HITs) often demonstrate limited understanding of health terminologies and indicators, which reduces their competence to independently deliver HMIS training, manage data effectively, and promote information use. This skill gap reflects the lack of a structured, needs-based capacity-building program aimed at enhancing HITs' proficiency in interpreting health indicators, performing accurate data management, and applying information for decision-making.

5.6.5.3 Sub-category 4.1.3: Perception and motivation of HITs

The HITs focus group participants perceive that health professionals still undermine the benefits of data, miss the ICD code, and do not accept HITs' feedback on data. On the other hand, lack of constructive feedback, career promotion, capacity building and low salary impacted the motivation of the HITs (HMIS officers).

They mentioned Amharic proverb ማሯን እየፈለጉ፡ 'ንቧን መጥላት አይቻልም "equivalent 'You cannot dislike bees while you like honey".

The work interaction between the health professionals and HITs is not smooth, not taking the HITs feedback positively…. They react/assume as if the HITs were interfering or overburdening them with unnecessary work. They would say we know these; no difference is not worth making, all the system has no respect for the HIT professionals (FGD1-P2).

Motivation package for HIT is very poor, even data and documentation officer position of QI not given to HITs lack of job satisfaction caused by low incentives among the HITs (FGD1-P2).

Though the HITs are backbone of the facility (health) data, the attention given is very low, the benefit package QI officers are better favored than the HITs in the same department, low salary regardless of our being backbone of data (FGD1-P3).

Nobody capacitates the HITs, not constructive feedback from the higher, instead blames, the HITs are looking for other jobs. We kindly request you, the researcher, to inform the higher officials to pay attention to HMIS professionals and data. "ማሯን ቶየፈለጉ፡ 'ንቧን መጥለት ኣይቻልም (HITs FG3-P5) (equivalent 'You cannot dislike bees while you like honey).

The data depict that the lack of smooth interaction between health staff contributes to inadequate information use. The HITs perceive that health professionals miss record and report, undermining the importance of data. On the other side, health professionals blame the HITs for the erroneous entry of data to DHIS2, resulting from their limited understanding of health indicators, and additionally, from the HMIS officers' lack of motivation to perform HMIS processes due to low benefits and career options.

5.6.5.4 Sub-category 4.1.4: Values and commitment to HMIS information use

The participants described that health professionals do not recognise the benefit of HMIS information in policy decisions and budget allocation. They are less willing to register and

enter data, saying HMIS is the work of others. There is no self-initiation of information use; s-PMT is underperforming, thus, without supervision, information use would fail. Opposing views indicate that information use accountability is in place to address the commitment gap.

> *Health professionals lack a positive attitude towards documenting data in the register, perception problems not considering data as an input for decision-making, not sure if the sub-PMT is fully functional, its strength determines the quality of data (FGD1-P3).*
>
> *They do not think of data as a power that can affect policies and healthcare budget allocation, knowledge gap (FGD6-P4).*
>
> *Information use culture in our health institution is better, accountability and responsibility systems have been established, needs follow-up to engage individuals at the same level of health information use (FGD4-P2).*
>
> *The culture of information use is immature. I have participated in planning activities many times, but our plans, policies, etc. are not based on data (FGD7-P1).*
>
> *Willingness problem, lack of knowledge, as they do not routinely do on data (FGD9-P1).*
>
> *The self-initiated use of information is not there; professionals always need to be initiated by the head of health institute (FGD4-P1).*
>
> *There were two General Practitioners unwilling to record their work, saying recording and tallying work is for nurses, but after discussion on accountability, now they record and tally, accountability for commitment and orientation for problems of understanding (FGD9-P6).*
>
> *The health staff, even after training, do not consider recording as their business. Accountability of HMIS work is not ensured at individual health professional level, they would say I do my work, the work of HMIS is not my business (FGD9-P7).*

The health professionals trained does not mean they work independently, check data quality or report, pressure is still on focal person of the unit, compromises quality of data, in our woreda 5 written feedback is provided for accountability problems (FGD7-P8).

Without supervision, information use will fail, thus there still is no culture of information inbuilt among health professionals (FGD7-P9).

The findings reveal that health professionals are persistently less valued and less committed to information use, even after being trained in HMIS. They are unwilling to record and report data, and have less self-initiation to use information and perform s-PMT functions. Generally, without supervision, information use would fail. Whereas opposing views indicate information use accountability is in place to address the commitment gap.

5.6.6 Category 4.2: Planning and performance monitoring

5.6.6.1 Sub-category 4.2.1: Annual planning and implementation

The participants described that health facilities use HMIS information either to endorse a woreda-based annual plan or develop their own plan, performance monitoring, develop an action plan and monitor its implementation, and design a quality improvement project for those indicators that fail to improve by all measures in the action plan. The information is also used to prioritise the top ten diseases. The information is less often used to develop and conduct health education and awareness-raising. There is an irregular use of information for monitoring the vaccination stock and cold chain.

Each facility develops a woreda based plan in consideration to its overall capacity, last year's performance was used as data producers (HITs) are not participating in the process of planning (FGD3-P3).

Hospitals depend on the previous year's performance. The plan for the hospitals is developed by adding 10-15% to the previous year's achievement (FGD8-P7).

We use EPI monitoring chart for monitoring performance and dropout rate. The stock (vaccine) data is less used to prevent stockout (FGD2-P1).

Thus, performance gaps are identified. A due action plan is developed by the PMT and given to the specific department. Action plan implementation is reviewed in the next month PMT meeting. If the performance is still low, those indicators will be linked with a quality improvement project (FGD3-P9).

If you ask staff about their report, like the top ten diseases, they are aware of it. The health professionals less frequently prepare flyers and provide health education based on their top ten diseases (FGD6-P5).

Findings show that health facilities' level of information use focuses on planning, performance monitoring and prioritisation of the ten top diseases. It is used for designing quality improvement projects that focus on the indicators failing to improve through interventions of an action plan. However, the information usage is limited to developing and conducting health education and awareness creation, and monitoring the vaccination stock and cold chain.

5.6.6.2 Sub-category 4.2.2: Action plan and performance monitoring

The participants indicated the use of information for action plan (PIP) development to fill identified and prioritised gaps in KPIs and in data quality. The data is further used to follow up on the PIP implementation by responsible units and review the effect of the action plan on a monthly basis.

After conducting the LQAS monthly, we will have PMT meeting, any gaps will be identified discussed, and an action plan is developed (FGD1-P1).

The are 12 KPIs at health facility level and these indicators are monthly assessed, gaps are identified, prioritized according to severity (FGD2-P2).

Every 15 days there is monitoring on how the service units are performing, materials needed, and the workforce engage effectively and find root cause (FGD2-P3).

Gap identification means a gap either in quality of data or in performance, the reasons are assessed, is it skill gap or other? We interpret using data (FGD4-P7).

If performance is low, then interventions like campaign mode of service delivery are carried out (FGD8-P9).

The implementation status of the previous month action plan is reviewed in the following months (DHs FG2). Feedback is given during follow up of PIP implementation (FGD1-P7).

Specific department is assigned responsibilities of implementing the activities based on the action plan. The PIP is monitored based on a set timeline, there is an action plan for days, a week, or a month. We map solved unsolved problems, design intervention (FGD9-P6).

The data reveals that the information is used to monitor performance, causes of performance gaps, and develop and follow up on an action plan to improve key performance indicators.

5.6.7 Category 4.3: Quality Improvement Project (QIP) design

5.6.7.1 Sub-category 4.3.1: QIP design standard

In the statement of the participants, the HMIS data is used for setting standards for QIP design. An indicator is considered for QIP when it fails to attain 85% coverage for three consecutive months or when its improvement requires involvement of more than one department. Consistently high (over 100%) achievement of an indicator does not necessarily mean high quality, but the set criteria exclude it from enrolment to QIP. The use of information on discussion to assess process, satisfaction, compliance and under- or over-

reporting is not practised. However, there is a lack of an agreed-upon standard for the enrolment of an indicator in the QI project.

> *There is a prime responsible QIP team with SOP and the team uses HMIS data to design a QIP by eligibility criteria of indicators such as magnitude of the problem for minimum score between 85% - 100% to be addressed through action plan, whereas less than 85% are considered in the QIP. However, there is no general standard as which level of indicators to be addressed through QI project (FGD2-P8).*
>
> *A report of 100% performed indicators does not necessarily indicate high-quality of service rendered. The process of service delivery, clinical audit, use of guidelines and client satisfaction are also investigated. However, it is not feasible to investigate and design QI projects for such overperformed indicators (FGD3-P4).*
>
> *If overachieved, this may indicate planning problem and needs justification (FGD7-P2).*
>
> *Consecutively low performed indicators are linked with QIP. Let us say the delivery (birth) service report has not improved by the action plan for 3 consecutive months, the quality department and MCH department together design a QIP (FGD3-P6).*
>
> *On the other hand, when root cause analysis is done and the low performance appears to involve more than one department, then QI project is designed. Now both coverage and process problems are involved in QI project design (FGD4-P3).*

The result shows the absence of a systematic approach to the application of a quality improvement project. The high coverage (100% achieved) indicator is not considered for QIP, though it does not necessarily indicate high quality. On the other hand, there is low practice of information use to assess the process of quality improvement, satisfaction with services, compliance with standards and under- or over-reported coverage. The system lacks an agreed-upon standard for the enrollment of an indicator in the Quality Improvement project.

5.6.7.2 Sub-category 4.3.2: Quality improvement project implementation and graduation

The interaction of participants shows that a run chart is applied to monitor QIP instead of PDSA. A quarter of the data is reviewed as a project takes 3 to 6 months to graduate, and its sustainability is tested to determine if the change is a real improvement. However, most of the QIP projects are not regularly monitored and not commonly graduated. The participants recommended proper QIP planning to reduce the failure rate.

> *The QIP monitoring is not regular, and relies on the HIT (FGD1-P9).*
>
> *Run chart monitoring is used to see changes over time until the project is completed in a maximum of 6 months (FGD3-P1).*
>
> *We also use the PDSA cycle, but now not that much used to it (FGD5-P7).*
>
> *We use a fishbone diagram for root cause analysis and develop an action plan with a responsible person and time (FGD6-P5).*
>
> *We monitor them weekly if we achieve QI graduates, if not achieved it fails (FGD5-P2).*
>
> *Each department is supposed to implement a minimum of 1 QIP each quarter (FGD2-P8).*
>
> *We do not have much culture of graduating Quality Improvement Projects at the health center level (FGD7-P1).*
>
> *We know that the probability of the project's success is extremely low when we consider only low performance, we tried in delivery, but the QI project failed (FGD7-P3).*
>
> *After shifting a provider not caring for clients, our ANC-4 coverage has shown improvement, and it still is maintained (FGD4-P2).*
>
> *Because of the QI, the card room waiting time has been reduced, the clients are satisfied, complaints resolved (FGD8-P4).*
>
> *We make the project graduate after conducting a sustainability test. We will assess it to find out whether the change is due to chance or its real improvement (FGD6-P6).*

Project solution changes and sustainability test are done with checklist, if there is no change, accountability, answerable, the person responsible is assigned (FGD9-P2).

Participants indicate that the QI lacks the use of standard tools for continuous monitoring to assess whether change is an improvement; on the contrary, although the run chart is not consistently used, PDSA cycles are interrupted. This underlies the reasons why QI projects are not regularly monitored, nor commonly graduated. This highlights the failure of QI projects to achieve sustainable improvement due to a lack of regular monitoring. The necessity is to ensure the sustainability of QI through regular use of proper QI monitoring tools.

5.6.7.3 Sub-category 4.3.3: Enablers of quality improvement

The participants mentioned a list of QI enablers: availability of a dedicated department, supportive supervision, feedback, training, guidelines, motivation of staff and accountability system. Additionally, the availability of data quality (LQAS) assured data and information use assessments and regular identification of coverage problems.

availability of continuous updates, following up from sub city, training, and supportive supervision and feedback (FGD1-P3).

Quality assured HMIS data for services including EPI data through regular IR data, and improved service coverage through graduation of QIP (FGD2-P3),

availability and use logbook at every department to conduct the LQAS (FGD3-P5).

The QI itself being a new concept, independent QI department (FGD4-P4).

A culture of designing and graduating quality improvement projects (FGD5-P2).

Motivation to identify gaps and see improvement. Established trend of coverage assessment to begin our QIP, and availability of QI guidelines (FGD6-P2).

Facility heads are paying attention to QIP, if there is no change, there is accountability (FGD9-P1).

5.6.7.4 Sub-category 4.3.4: Barriers to quality improvement

The participants reported several barriers to QI: inadequate capacity building and a lack of evidence to attribute QIP gain to data use. Additional barriers include insufficient monitoring of change ideas, a long time taken to graduate a QIP, limited ownership, collaboration, coaching and motivation, unknown catchment population, and campaign-based QIPs implementation. The little use of HMIS data for community awareness and reminder techniques contributes to the DOR of the immunisation service.

> *inadequate HMIS training, limited capacity building to QI officers, supervision irregular and not based on checklist. Limited collaboration between QI officers and HITs in QIP (FGD1-P3).*
>
> *Only QI departments (excluding HITs) are trained in QI. The responsibility of QIP, in some health facilities is dropped to QI department team leaders to plan, follow, evaluate, intervention. To monitor infrastructure problems, shortage of work force, thus long waiting hours (FGD2-P5).*
>
> *QIP success taking long and lack of evidence-based feedback on how QI (change) achieved is/are attributable to data use, no such feedback, means persisted gap in data use (FGD3-P2).*
>
> *Service department professionals cannot design QI projects, e.g. professionals working at MCH unit, Lack of timely monitoring of change idea, there is interruption of monitoring, when more than one QIP is designed per service unit (FGD4-P9).*
>
> *QI plan based on coverage of catchment population that always varying in size, limited knowledge/ownership of the leaders on QI project, Lack of adequate coaching and motivation. The low involvement of community in vaccination service. Disbelief that the QIP brings about change, sustainability issues due to lack of ownership (FGD7-P3).*
>
> *Main barrier is still QI work is dropped to QI department. QIP, sometimes, is implemented in a campaign, with no teamwork at the health center (FGD9-P5).*

5.6.8 Category 4.4: HMIS information used to manage immunisation service

5.6.8.1 Sub-category 4.4.1: RED/EPI micro-planning and coverage monitoring

The participants verbalised that, currently, Reaching Every District/child (RED/C) micro-plan is prepared targeting 8% increment on the previous year's achievement, considering population dynamics. It is top-down prepared and adapted by EPI units, targets unimmunized and defaulted children, but is usually unachievable. The EPI monitoring chart is used for tracking the coverage. The data is used to reach the real target, minimise dropout and Missed Opportunity for Vaccination (MOV), request and audit vaccines, and calculate Turn Around Time at EPI.

> *The EPI plan is developed based on the cascaded plan from the sub cities (FGD1-P1).*
>
> *The RED micro plan is embedded in woreda based plan; we calculate eligible population using conversion factors (FGD5-P3).*
>
> *If Penta-1 is planned to vaccinate one thousand children, MCV also is planned to vaccinate one thousand children (FGD4-P2).*
>
> *The micro plan focuses on unimmunized and defaulter children disaggregated by site, based on baseline and catchment population (FGD5-P6).*
>
> *There are bottom-up, and top-bottom plans reconciled when needed, it is an exaggerated plan. The higher-level do not engage EPI focal and others during planning (FGD7-P5).*
>
> *Recently in Addis Ababa EPI micro plan adds up 8% on baseline data considering immigration and natural growth (Managers FG8), not conversion factor for the last 2 - 3 years (FGD9-P9).*
>
> *HMIS data is used for EPI plan and coverage monitoring. To analyze over coverage whether the outreach session vaccinates traveller at bus station or real target, reach*

night school for HPV vaccination. HMIS data is also used to trace dropout (FGD2-P6).

The EPI unit service providers plot on the EPI monitoring chart and update it monthly, if dropout rate due to distance, a community outreach vaccination campaign will be held by prioritizing village and Vaccine wastage rate is monitored using DHIS2 data (FGD3-P2).

Participants highlight challenges faced by the facilities in the development and implementation of the Reaching Every District/Child (RED/C) micro-plan. Often, RED/C is prepared in a top-down approach, not based on local data, but rather on the conversion factor of the old census, the non-RHIS component of HMIS, and data results in under- or over-targeting the eligible population. The approach targets an 8% increment on the previous year's achievement, which is usually unachievable. The EPI data use prioritises interventions to improve coverage and use of the EPI monitoring chart, but it is not regularly updated.

5.6.8.2 Sub-category 4.4.2: Immunisation quality improvement

The views of the participants are split over the applicability of QIP to the immunisation service. QIP aim to set a low immunisation coverage from the conversion target, failing to graduate. On the other hand, most immunisation indicators are overachieved or over-reported. A few participants indicate that QIP may be applicable to EPI if it aims to reduce the dropout rate and vaccine wastage rate. However, currently, Penta-3 coverage is an immunisation service quality indicator.

For example, wastage rate, full immunisation or drop-out can be linked to QIP (FGD6-P4).

So far, we have not designed a QIP in the EPI, because we have not found any gap that needs a Quality project, we fix all things through action plan (FGD7-P1).

We designed a quality project, but the project still failed. We do not have anything that we succeed in meeting the aim we set due to conversion factor-based planning problem (FGD7-P3).

This year we planned for QI at the EPI unit 4 times, and all the projects were failures. In fear, this year no QIP has been designed in EPI to fix all issues by action plan (FGD7-P6).

The QI project for EPI in Addis Ababa may not be applicable. No, the QIP is applicable to EPI because the Dropout rate can pass under the QI project (FGD7-P2).

Penta 3 coverage is used as a quality indicator of the EPI service, as Penta 1 is access and Penta 3 is utilisation (FGD5-P8).

The participants reported that QIP for immunisation service has not been uniformly implemented at health facilities. There is a doubt about the applicability of QIP for the EPI indicators, which are reported as highly achieved, usually due to targets not being based on local data, whereas the QIP considers persistent low coverage. The QIP based on conversion factor data fails to graduate. The recommendation is that the design of QIP for EPI service would be applicable if it aims at reducing DOR, vaccine wastage rate and MOV.

In relation to this, a study reveals that the quality of immunisation service can also be assessed through exploring the status of parameters indicated in the immunisation improvement plan (Manyazewal et al. 2018:5).

5.6.8.3 Sub-category 4.4.3: Structure/organisation of immunisation service.

According to the description of participants of the EPI unit under the MCH or paediatric department, who collect data by hard copy from static, outreach and campaign immunisation services. The data is analysed through s-PMT and submitted to the HMIS unit. The EPI unit has four providers on average, and outreach service is provided by selected officers from departments. The campaign service is organised by surveillance teams in some sub-cities.

The immunisation/EPI service unit is structured and organized under the MCH department of health centers; it is under paediatric department in hospitals (FGD5-P1).

The immunisation services are provided in static and outreach strategies, and in campaign mode of service delivery whenever needed (FGD3-P3).

In health facilities under some of the sub cities campaign mode service delivery is organized by the surveillance team (PHEM) with a workforce plan from MCH (FGD3-P2).

EPI unit collect data on hard copy, analyze it through s-PMT and submit to HMIS (HIT) unit to enter data on DHIS2 (FGD2-P7).

The structure of EPI has 4 (3-6) workforces on average responsible for cold chain, registration, provision of adult vaccination and other services integrated (FGD3-P9).

Whenever there is an outreach service, professionals who are trained and have experience are selected from around the departments and deployed (FGD4-P1).

Findings show the unit is uniformly organised and functions under the MCH department in health centres, paediatric department in hospitals, with four service providers on average. The unit owns routine immunisation sessions and, in some of the sub-cities, aligns with the surveillance unit in administering campaign immunisation. The EPI data is analysed through s-PMT and submitted to the HMIS unit.

5.6.8.4 Sub-category 4.4.4: Ways to strengthen quality immunisation service.

The participants indicated that emphasis on healthcare providers, the health system and caregivers would improve the quality of immunisation service. EPI data quality can be improved through enhanced capacity of HITs and QI officers, with the application of EMR, DHIS2, and the digital child health card. This, further, can be strengthened through evidence-based training, supervision and feedback. Additionally, readiness assessment of HMIS, adequate HMIS tools, vaccines, defaulter tracing and linkage of services, and use of community reminder technique would improve coverage and quality of EPI.

The PMT should be strengthened. knowledgeable person should be assigned to QI data and documentation officer position. QI project be monitored by the HITs, the HITs not only be asked for baseline data. Strengthen use of electronic child health (EPI) card (FGD2-P3).

Community awareness creation through reminder technic is also necessary to strengthen the quality of immunisation services, families not to miss due services like immunisation drop out, give feedback to service providers on their work, regular training to service providers who had dated training, and work to improve the coverage rate (FGD3-P1).

Well trained health professionals, Joint supportive supervision, transportation as it has outreach services and adequate staffing (FGD4-P2).

DHIS2 should be improved, TOT should be given to managers, EMR should be implemented at all facilities supplying computers, Tools: registers … should be supplied (FGD4-P4).

System readiness assessment should be done before deployment/update of any system to minimize wastage (FGD8-P5).

The result shows that improving the quality of immunisation service requires a focused approach to health systems, healthcare providers and caretakers. A steady supply of vaccines, defaulter tracing with linkage to services, and the use of the community reminder technique would improve coverage and quality of EPI. Readiness assessment of HMIS; strengthening EMR, DHIS2 and use of digital child health (EPI) card; building capacity of HITs and QI officers would improve EPI data quality. Evidence-based supportive supervision and feedback, and training can improve both services and data quality.

5.8 DISCUSSION OF KEY FINDINGS FROM QUALITATIVE DATA

5.8.1 Theme 1: System update and support for HMIS implementation

Participants reported that HMIS updates in Ethiopia remain largely centralised and top-down, with minimal engagement of facility-level managers or data personnel during tool revision and indicator changes. Although revisions of HMIS tools and indicators occur periodically, the absence of structured communication and participatory planning mechanisms creates implementation challenges. This lack of engagement leads to delays in tool adoption and disruptions in service delivery, as end-users are often unprepared for changes. These findings align with Scott and Gilson (2017:7), who argue that centralised design of data tools in LMICs often neglects contextual realities, resulting in poor ownership and usability. This misalignment causes implementation delays and weak ownership. Comparable findings were observed by Belay et al. (2013:3), who noted that despite extensive investments in capacity-building, decentralised participation in system redesign remained limited across eleven Ethiopian districts. Similarly, Arsenault et al. (2021:8) identified insufficient feedback loops between national HMIS teams and facilities as a persistent governance bottleneck.

From the PRISM perspective, these weaknesses represent organisational determinants, specifically, inadequate communication and accountability structures. Embedding joint planning, structured feedback, and pre-update orientation could foster shared ownership and readiness for change, thereby enhancing the sustainability of HMIS tools.

Despite national DHIS2 rollout, health facilities continue to employ hybrid reporting systems, with data first recorded on paper and later uploaded electronically. This dual dataflow increases transcription errors and delays (Zerfu, Asressie, Begna, Habtamu, Wekneh, Nigatu, Ibido & Genta et al. 2024:1, 17) found similar hybrid persistence in primary healthcare units, noting that limited ICT infrastructure and low digital literacy constrain full electronic capture. The duplication of tasks observed here aligns with the technical and organisational determinants in PRISM system design and resource adequacy.

Furthermore, repetitive manual aggregation reduces staff motivation, a behavioural determinant essential for data-use culture. Transitioning to interoperable, user-friendly digital platforms and offering hands-on mentorship, as recommended by Belay et al. (2013), would improve accuracy and timeliness while restoring professional engagement.

Participants highlighted the lack of structured, continuous training for health professionals following HMIS revisions. Facility-based sessions often suffer from interruptions, the absence of incentives, and insufficient content depth. Similar challenges were identified in a national evaluation by Belay et al. (2013:2), which reported that tailored, competency-based training significantly improved data analysis and interpretation skills.

Inadequate and irregular training following system renewal, and facility-based sessions interrupted due to service demands, resulted in insufficient comprehension of new indicators and weakened accountability. Kasambara et al. (2017:5) similarly found that the absence of refresher training compromises data reliability and decision-making.

From a PRISM perspective, insufficient capacity development constrains both organisational (support structures) and behavioural (confidence, competence) determinants. Establishing regular, need-based training cycles would improve both data quality and staff empowerment. The absence of systematic refresher courses in this study emphasises a gap in the organisational enabling environment of PRISM.

Without regular reinforcement, staff confidence and data-use competence diminish, compromising both behavioural engagement and data quality. Establishing need-based continuous professional development, emphasising indicator literacy and analytical reasoning, would directly strengthen the behavioural pillar of HMIS performance.

Facilities continue to rely on hybrid reporting systems in which data are first recorded on paper and later entered electronically into DHIS2. This duplication increases transcription errors, workload, and reporting delays. Similar hybrid persistence has been documented by Zerfu et al. (2024:2), who attribute it to limited digital infrastructure and low ICT literacy.

In PRISM terms, these are technical determinant gaps, system design and resource adequacy issues. Moreover, repetitive manual work erodes motivation, a key behavioural determinant. Transitioning to fully digital, interoperable platforms and providing continuous mentorship would enhance data accuracy and morale (Belay et al. 2013:1).

Support from higher administrative levels and implementing partners, such as the Digital Health Agency (DHA), was appreciated but unevenly distributed. Some facilities benefited from targeted mentoring and data-quality audits, whereas others received little oversight. Arsenault et al. (2021) confirm that inconsistent supervision contributes to variability in data completeness and timeliness across Ethiopian regions. Overreliance on donor-driven initiatives further threatens sustainability.

According to PRISM, effective RHIS performance depends on organisational reinforcement mechanisms—supervision, feedback, and resource allocation. Institutionalising supportive supervision within government structures, rather than project-based cycles, would ensure equitable system strengthening.

Health facility managers play a pivotal role in ensuring HMIS functionality by securing resources, coordinating data management activities, and leading Performance Monitoring Team (PMT) meetings. However, irregular self-assessment practices and weak PMT functionality undermine systematic data interpretation and use. Similar gaps have been reported in other LMICs, where managerial oversight focuses on compliance rather than evidence-based action (Nicol et al. 2017:7). Strengthening managerial accountability through clear guidelines, performance-linked incentives, and leadership training can institutionalise data-driven decision-making and improve immunisation service quality (Nutley & Reynolds 2013:5).

Within PRISM-MFI, managers act as organisational drivers who link technical inputs (tools, computers) with behavioural outcomes (motivation, teamwork). Strengthening their leadership through targeted management training can reinforce internal data governance.

Department heads were described as central to operationalising HMIS processes: they strengthen s-PMTs, verify data tallies, ensure software functionality, and lead departmental reviews. Such active engagement cultivates a culture of evidence-based dialogue. The study indicates that data is often viewed as a reporting requirement rather than a decision-making tool—a finding consistent with previous research in Ethiopia and South Africa (Teklu et al. 2018; Nicol et al. 2017). Behavioural determinants such as confidence and motivation significantly influence data use practices. Targeted capacity-building and embedding data-use responsibilities into job descriptions can foster accountability and promote a culture of continuous improvement (Nutley & Reynolds 2013). This exemplifies PRISM's behavioural determinant; leadership commitment fosters motivation and accountability.

The QI department was reported to perform continuous monitoring, initial data checks, and LQAS supervision. However, non-QI staff lacked the skills to design QI projects and therefore primarily participated in implementation. Alhassan et al. (2013:9) demonstrated that participatory QI processes enhance staff motivation and service quality. Integrating cross-departmental QI design participation would expand ownership and strengthen organisational collaboration determinants.

Departments exhibited strong motivation to engage in QI activities due to visible improvements in coverage and performance. The routine display of charts and dashboards further reinforced the data-driven nature of reflection. These behaviours signify positive shifts in the behavioural determinant of PRISM, motivation and data-use culture. Embedding feedback-driven learning cycles can sustain this momentum.

HITs are central to HMIS implementation, performing critical tasks such as data entry, validation, and routine data quality assessments. Despite their technical role, HITs face challenges including inadequate staffing, limited IT infrastructure, and insufficient refresher training. These constraints compromise data integrity and hinder proactive engagement in quality improvement initiatives. Studies in Ethiopia confirm that HITs often lack structured mentorship and advanced analytical skills (Asemahagn 2018:17). Strengthening HIT capacity through structured training, mentorship, and provision of user-friendly tools will en-

hance data quality and foster a culture of information use (MEASURE Evaluation 2018:4, 6). This issue reflects a technical determinant gap within PRISM resource sufficiency and system reliability. The HITs also perform data entry, validation, visualisation, and dissemination, often acting as de facto mentors for other staff. However, their limited clinical knowledge constrained holistic data interpretation. Belay et al. (2013:2) emphasise that targeted mentorship markedly improves HITs' analytical competency. Strengthening HIT capacity addresses both technical (skill adequacy) and behavioural (confidence) determinants, ensuring sustained data quality and informed decision-making.

Theme 1 demonstrates that successful HMIS implementation relies on harmonising technical systems, organisational structures, and behavioural engagement. The study highlights recurring constraints of centralised updates, hybrid reporting, inconsistent training, limited supervision, and uneven capacity. In PRISM-MFI terms, Ethiopia's HMIS performance is hindered by misaligned determinants across all three domains.

Improvement, therefore, requires participatory governance, continuous capacity building, full digital integration, and motivation-enhancing leadership to embed a lasting culture of data-driven quality improvement.

5.8.2 Theme 2: HMIS training

Participants indicated that the competence of master trainers and the adequacy of training materials varied widely. In some sessions, facilitators were well-prepared, while in other sessions, they were largely theoretical and lacked practical engagement with DHIS2 or data-quality tools, analysis and interpretation skills. Similar disparities were noted in national evaluations, where inconsistent mastery among trainers led to uneven skill transfer downstream (Belay et al. 2013:4; Arsenault et al. 2021:5).

Within PRISM, this reflects a technical determinant, the capacity of human resources to deliver system content accurately. Ensuring that national and regional trainers are certified

through competency-based assessment and provided with standardised curricula would strengthen vertical consistency and learning outcomes.

Many participants viewed the training of trainers (TOT) duration as insufficient to master the complex indicator definitions and analytic tasks required for cascading training. Short sessions constrained interactive practice and limited opportunities for peer feedback. Evidence from large-scale HMIS capacity studies shows that short, massed training yields lower knowledge retention compared to distributed, mentorship-based models (Zerfu et al. 2024:4, 6; Belay et al. 2013:5).

This weakness illustrates an organisational determinant gap, planning and scheduling that prioritise coverage over depth. Extending TOT sessions and integrating post-training follow-up would enhance both competence and confidence among facilitators.

Participants explained that facility-level training often proceeds without a prior assessment of staff needs or a baseline of competence. As a result, training content may repeat prior sessions or overlook actual gaps in data analysis and interpretation. Targeted pre-training assessments are crucial for aligning learning objectives with contextual needs (MEASURE Evaluation 2018:4).

From the PRISM lens, this gap constrains organisational determinants, specifically, planning and alignment of interventions to system needs. While training materials were generally available, participants noted that manuals and slides emphasised indicator listing rather than practical data use. This imbalance discourages analytical thinking and limits behavioural change. Similar observations have been made in HMIS programs across sub-Saharan Africa, where theoretical training rarely translates into improved data utilisation (Kasambara et al. 2017:3).

Embedding hands-on exercises using facility data and visualisation dashboards can foster applied learning and directly influence the behavioural determinant of motivation to use data for decision-making.

Participants reported that facility-level training received limited attention and priority because it offered no incentives and was frequently interrupted by clinical duties. Sessions often involved only half of the workforce at a time, reducing opportunities for shared learning. When Health Information Technicians (HITs) facilitated sessions independently, their limited knowledge of disease indicators occasionally hindered deeper understanding. Comparable findings from Malawi and Tanzania link low training incentives and work interruptions to poor learning outcomes (Kasambara et al. 2017:3). These constraints affect both organisational determinants (inadequate planning and resource allocation) and behavioural determinants (motivation and perceived value of training). Institutionalising protected training time and modest recognition mechanisms could markedly improve attendance, engagement, and post-training performance.

Theme 2 highlights that Ethiopia's HMIS training ecosystem faces intertwined organisational and behavioural challenges. Inadequate preparation of trainers, short course duration, lack of needs assessment, and low motivational incentives collectively limit learning outcomes and the translation of knowledge into practice. The findings align with PRISM's assertion that technical tools alone cannot sustain system performance without corresponding investments in human and organisational capacity (Aqil et al. 2009:1). Strengthening HMIS training therefore requires:

- Competency-based certification for master trainers.
- Extended, practice-oriented TOT and cascading programs.
- Systematic pre- and post-training assessments; and
- Incentive and recognition schemes that nurture motivation and retention.

Collectively, these strategies would transform HMIS training from a compliance activity into a continuous learning process, enhancing both data quality and information use.

5.8.3 Theme 3: Data management and quality assurance mechanism

Participants noted that health facilities primarily rely on DHIS2 for reporting but continue to use manual registers and tallies for daily and monthly aggregations. This duplication increases the risk of transcription errors and delays. Zerfu et al. (2024:2) confirmed similar hybrid practices in Ethiopian primary care units, linking them to infrastructural limitations and partial digitisation. Within the PRISM framework, this reflects technical determinants, including insufficient interoperability, hardware, and connectivity. Streamlining aggregation into a single electronic platform would strengthen data consistency and timeliness.

Participants highlighted the absence of a national integration roadmap. Program-specific tools such as SmartCare and vertical surveillance databases remain non-interoperable with DHIS2, forcing parallel reporting. Arsenault et al. (2021) similarly observed that fragmentation of health information subsystems in Ethiopia undermines efficiency and data completeness. From a PRISM-MFI perspective, this represents a failure of organisational governance, namely, a lack of stewardship and policy direction. Developing a ministry-led interoperability framework would enhance integration and accountability.

The DHIS2 system was viewed as functional yet rigid in customising local indicators or generating ad-hoc reports. Limited user privileges restrict adaptability at the facility level. Such rigidity reduces user satisfaction and motivation, key behavioural determinants under PRISM. Enhanced configuration rights and training on data analytics modules could empower local managers to use DHIS2 as a decision-support tool rather than a reporting obligation.

Frequent network interruptions and delayed system updates hinder the timely reporting of information. Belay et al. (2013:2) found that inconsistent internet connectivity contributed to late DHIS2 submissions in 47% of the facilities studied. Reliable connectivity is a technical determinant crucial for sustained data flow; introducing offline-sync functions and local server caching could mitigate disruptions. Participants reported discrepancies between paper summaries and electronic entries, often due to hurried data transcription or inadequate

cross-checks. Farnham et al. (2023) emphasise that verification at each aggregation level, register, tally, and upload, improves reliability. Embedding automated validation rules within DHIS2 aligns with PRISM's technical and organisational reinforcements for data quality.

Several respondents felt that DHIS2 interface complexity and English-only terminology hindered comprehension. Limited orientation sessions compounded these challenges. User-centred design and localisation of terms would reduce cognitive barriers, strengthening the behavioural determinant of perceived ease-of-use and confidence.

Departments displaying charts and dashboards demonstrated greater engagement with performance monitoring. Visualisation fostered peer learning and evidence-based dialogue. The multitude of forms and indicator definitions was cited as confusing and time-consuming. Complexity discourages frontline users from thorough completion, a pattern echoed by Belay et al. (2013:5). Simplifying indicator sets and providing visual job-aids would address the technical determinant of design simplicity. Routine upward reporting occurs monthly through DHIS2, yet lateral sharing across departments is limited. The absence of internal dissemination meetings restricts cross-learning. Institutionalising intra-facility data-sharing forums would strengthen organisational communication channels envisaged in PRISM. Feedback from higher levels was often delayed or absent, reducing learning opportunities.

Participants described data audits as irregular and largely partner-driven. When conducted, they focused narrowly on specific programs. Such fragmented efforts fail to institutionalise continuous quality assurance. Embedding data-quality reviews into routine supervision, as recommended by Belay et al. (2013:2), would create consistent organisational reinforcement. Frequent inconsistencies between facility immunisation tallies and district reports were noted, often due to transcription errors and differing denominators. Where implemented, LQAS and RDQA tools improved awareness of data-quality dimensions but were inconsistently applied. Regular coaching and standard checklists can embed these practices as routine *organisational reinforcements*, aligning with PRISM's quality-assurance determinant.

Theme 3 underscores that while Ethiopia's HMIS has made substantial progress in digital reporting, systemic weaknesses in software integration, data validation, and supervision persist. Hybrid dataflows, limited interoperability, and weak feedback loops constrain data reliability. Applying the PRISM-MFI framework, these problems stem from intersecting determinants:

- Technical — fragmented systems, poor connectivity, and complex tools.
- Organisational — weak supervision, ad-hoc quality checks, and an absent integration policy.
- Behavioural — low user confidence and limited motivation.

Strengthening DHIS2 functionality, establishing a unified interoperability roadmap, and institutionalising continuous data-quality reviews would significantly enhance data credibility and its use for decision-making at all levels.

5.8.4 Theme 4: Information use

Participants reported that data use was largely restricted to mandatory reporting rather than internal performance analysis or strategic planning. This "reporting culture" rather than a "learning culture" is consistent with findings from Belay et al. (2013:2), who observed that only 38% of facilities used routine data for decision-making despite 90% reporting regularly. This gap highlights the behavioural determinant of the PRISM framework, namely, limited motivation and weak institutional incentives for data use. To foster a data-driven culture, health facilities must establish accountability systems that link decisions to performance outcomes.

Participants reported that HITs often misunderstood health terminologies and indicator definitions, limiting their ability to independently train others or guide data interpretation. This finding aligns with Belay et al. (2013), who found that limited technical literacy among HMIS officers was a key bottleneck for data-use quality. This represents a dual technical and behavioural gap within PRISM, skills deficiency and low analytical confidence. Continuous

professional development programs focusing on health indicators, data visualisation, and the use of analytics are crucial for building capacity and ownership among HITs.

Low motivation among HITs was associated with high workloads, limited recognition, and insufficient supervision. In PRISM terms, strengthening the behavioural determinant—motivation and self-efficacy—is critical for sustaining system performance. Although senior managers expressed a strong value for evidence-based decision-making, translating it into consistent practice remained weak. This disconnect between intent and action reflects organisational culture barriers. Zerfu et al. (2024) highlight that institutionalising data-review meetings and rewarding evidence-based innovations can embed long-term behavioural change.

Findings indicate that annual plans were not always informed by data analysis, with limited use of trend monitoring and local indicators. As Arsenault et al. (2021) noted, planning processes in many low-income settings are still input-based rather than evidence-driven. Within PRISM-MFI, this reflects an organisational weakness in linking information systems with planning cycles. Routine data reviews during planning can strengthen accountability and ensure that resource allocation responds to identified gaps.

While performance review meetings occurred, they were often descriptive rather than analytical, with minimal follow-up on implementation of action plans. Embedding clear accountability frameworks within PIP reviews can reinforce organisational and behavioural determinants—ensuring that insights from data translate into tangible improvements.

Participants reported that QI departments exclusively designed QIPs, with limited involvement from other staff. Although this centralised approach ensured technical accuracy, it restricted broader participation and ownership. Bifa (2024) observed that participatory QI design enhances motivation and cross-departmental learning. Integrating department heads into the QI design phase would strengthen organisational collaboration and behavioural engagement. Participants expressed concern about the long timeframes required for QIP graduation and the weak monitoring of change ideas.

These delays diminish enthusiasm and continuity of learning. Motivation increased when staff observed visible performance improvements and recognition for QI success. Displaying charts and dashboards reinforced this positive feedback loop. Such visible reinforcement strengthens both organisational and behavioural determinants within PRISM. Participants reported barriers including a lack of evidence linking QIP success to data use, limited monitoring of change ideas, and weak collaboration, coaching, and motivation. Additionally, campaign-based implementation and poor use of community reminders contributed to inconsistent performance. Bifa (2024) identifies similar behavioural and organisational constraints, emphasising the importance of regular feedback, mentorship, and recognition in sustaining QI initiatives. These barriers highlight misalignments across all three PRISM determinants.

Participants observed that micro-planning for immunisation coverage was often conducted as a one-time campaign rather than a continuous process. Data on target populations were outdated, limiting accurate coverage monitoring. This represents a technical determinant gap affecting planning and service delivery. Quality improvement for immunisation was mainly reactive, triggered by performance declines rather than proactive continuous improvement. Embedding QI within routine EPI reviews could address this limitation. Belay et al. (2013) advocate integrating data-driven QI into routine health programs to maintain sustained improvement cycles. The organisational structure for immunisation remained fragmented, with parallel reporting to vertical programs. Such arrangements hinder integrated data use and collective accountability. Arsenault et al. (2021) argue that harmonised structures enhance coordination and data consistency, a core organisational determinant under PRISM.

Theme 4 reveals that information use for decision-making remains the weakest link in the HMIS performance chain, despite significant progress in data collection and reporting infrastructure. Organisationally, weak feedback loops, fragmented accountability, and insufficient planning integration constrain data utilisation. Behaviourally, motivation and analytical capacity remain underdeveloped among HITs and departmental managers. Technically, challenges persist in indicator literacy and real-time visualisation tools. Applying the

PRISM-MFI framework, effective data use depends on aligning these determinants through:

- Institutionalising data review and reflection meetings at all levels.
- Embedding continuous mentorship and recognition systems.
- Simplifying and automating analytic dashboards; and
- Cultivating leadership accountability for evidence-based action.

By transforming data from a reporting product into a decision-making tool, HMIS can evolve from procedural compliance toward a genuine learning health system that drives service quality and efficiency.

5.9 SUMMARY

This qualitative phase of the study has produced four themes: HMIS implementation, HMIS training, Data management and Quality assurance, and HMIS information use for decision-making. The four themes have 14 categories and 42 subcategories. The HMIS implementation uses sanctioned resources and tools; the tools, indicators, and data elements are updated every five years. However, the update has not engaged the implementation level, which is mandated to procure (reproduce) the renewed data management tools. Absence of participation of the lower level resulted in low understanding of tools and indicators, in turn resulting in inadequate financial preparation, thus frequent shortages of recording and reporting materials.

Findings on data management processes show inefficient and improper implementation. The data flow includes undigitized data collection, collation and reporting and non-integrated electronic data aggregation software. The DHIS2 software is unreliable, and health staff lack competence in data analysis, interpretation and display, including DHIS2 data visualisation. The data quality (LQAS) assurance mechanism in place is less trusted, and data use for self-assessment is minimal. A combination of these factors contributes to

low-quality data and insufficient use of information for immunisation service improvement. This highlights the importance of digitisation of data collection tools and application of integrated data aggregation, quality checks, analysis, and display software, along with learning-oriented data feedback to improve data quality, interpretation and use.

The results on TOB factors indicate system design barriers: the HMIS update fails to involve users (implementors); the DHIS2 is unreliable and low in flexibility; and the complexities of diseases and the BSC service report forms. Health indicators and data elements are less understood by the HITs. The HMIS information use focuses more on raising coverage of services than on improving quality. Performance monitoring is the highest management function that uses the HMIS data source, while allocation of resources and performance appraisals are the least used functions that source HMIS data. Supportive supervision is irregular, while feedback is not constructive. Both master (TOT) and facility-level (cascaded) training are inadequate. Motivation of data producers and users is negatively impacted by deficiencies of work interaction, feedback, career options, capacity building and wage. The attitude of the participants towards the quality of HMIS-generated data was neutral. There is a need to design user-oriented tools, participant-centred training and enhanced motivation for the data management process and information use.

HMIS information used for health (immunisation) program implementation focuses more on enhancing coverage (performance) than on improving service quality and developing an action plan. The utilisation of information for quality improvement lacks standard indicators to design and tools to regularly monitor the Quality Improvement Project. The need is to set the purpose of and define the indicators of information use, and build capacity and accountability of information use at the individual level.

CHAPTER 6: INTEGRATION OF QUANTITATIVE AND QUALITATIVE FINDINGS

6.1 INTRODUCTION

This chapter presents the integration and discussion of the quantitative and qualitative findings using a merging strategy guided by the PRISM_MFI framework. Creswell & Creswell (2018:1) define integration as an intentional process by which the researcher brings quantitative and qualitative data together in one study. By intentionally integrating data, the researcher can access knowledge or insights unavailable to a quantitative or qualitative study undertaken independently (Moseholm & Fetters 2017:1). The purpose of integration is to compare and explain how organisational, technical, and behavioural determinants interact to influence HMIS, RHIS, and performance.

This study applied an explanatory sequential mixed methods approach. The explanatory sequential design is one of the three basic designs of mixed methods, it involves the collection and analysis of quantitative data to determine the results that warrant further exploration using a qualitative research approach (Skamagki, King, Carpenter & Wåhlin 2024:2). In phase one, quantitative data was collected through a self-administered questionnaire distributed to healthcare professionals and health information technicians at health facility and offices levels.

The quantitative data were analysed using SPSS and EPI-Info software. Phase II (qualitative) data were collected through focus group interviews from purposively selected participants constituting groups of healthcare professionals (facility managers and department heads), and health information technicians. The qualitative data were analysed using thematic data analysis with the assistance of Atlasti-24.

Moseholm and Fetters (2017:3) state that quantitative results, usually from questionnaires, are typically presented first in exoplanetary sequential mixed method studies reports, fol-

lowed by a necessarily brief thematic analysis of interview material or answers to open-ended questions. In this study, the results from each phase are presented in separate chapters: the quantitative data analysis and interpretation are presented in Chapter Four, while the qualitative data thematic analysis and interpretation are presented in Chapter Five. The quantitative phase data analysis and findings guided the qualitative phase data collection and analysis. This chapter integrates and interprets the main findings from both phases of the study. The quantitative findings are explained by qualitative data.

The PRISM-MFI theoretical framework was applied in the study to inform the interpretation of integrated findings. The main findings from quantitative and qualitative phases are jointly discussed using a narrative triangulation process with emphasis on identifying new insights that emerged from both data sets, and are explanatorily integrated.

6.2 THE PRISM-MODEL FOR IMPROVEMENT (PRISM-MFI) FRAMEWORK

The PRISM-MFI integrated theoretical framework of the study guided the integration of qualitative and quantitative data. The PRISM part of the framework encompasses input for the RHIS processes that emanate from Technical Organisational and Behavioural (TOB) factors. The RHIS (data management) processes affect RHIS performance (outcome) indicators that are improved data quality and continuous use of information. The study assessed data management processes, determined the extent of Information use and identified the effects of TOB factors on both data management processes and information use in the quantitative phase (Phase 1) of the study.

A Model for Improvement (MFI), on its part, involves setting an aim (the purpose for continuous use of information) and testing changes using data in the Plan-Do-Study-Act (PDSA) cycle to achieve the set aim. It ensures that changes in information use are sustainable and measurable to the extent that they result in a beneficial change, for instance, quality improvement of health programs, including immunisation services.

The RHIS input is recognised as the TOB factors. Technical inputs include the complexity of the forms and DHIS2 software, and suboptimal users' competence. Organisational aspects include things such as training, resources for training, supervision and use of information for governance, as well as service quality improvement. And behavioural aspects are the demand for data and the perception of the quality of HMIS-generated data. The RHIS processes that are processes of data management; data generation (collection), data aggregation, data quality check, data analysis, data display and sharing, data interpretation, and use, and output subsumes data quality, and information use were investigated in detail. The inputs, processes and outputs make up the PRISM component of the study framework. Additionally, the RHIS outcome: information use for quality improvement part, the MFI component, was involved in the analysis; however, the outcome (changes in quality of service) and the RHIS impact (reduced morbidity and mortality from vaccine-preventable diseases) are beyond the focus of this study, hence, are not examined since examining the effect of intervention might take a long time. The analysis and interpretation, as well as consequent integration of the results, focused on input, processes and output, but not the final outcome and impact**.**

6.3 RHIS INPUT, PROCESS AND OUTPUT

As part of the RHIS performance determinants, the study examined the technical, organisational, and behavioural factors that influence data management processes at the selected health institutions. In Phase I of the study, the technical factors related to complexities of software, indicator definition, the organisational factors, for example, availability and adequacy of training, implementation tools, supervision, and the behavioural factors, such as perception and motivation of data producers, were included. In Phase Two of the study, the experiences of health professionals regarding functionality and flexibility of HMIS tools, including DHIS2 and other data aggregation software, in using HMIS information for immunisation service quality improvement, and thereby data generation, information use, and quality improvement were explored.

The integrated result, in view of PRISM, indicated that implementation of each of the data management processes has unique gaps that contributed to the uncertain quality of data and low utilisation of information. The processes involve duplicative, hybrid and parallel data generation, aggregation and sharing. Data quality assurance lacks a trusted mechanism; the LQAS method in use is unreliable to ensure the quality of routine data. The data analysis and interpretation, respectively, fail to provide output on time and explain performance gaps and action plans. Feedback on data skewed to fault-finding, lacking constructive input on data quality. The data visualisation overrelies on paper form (charts), which poses challenges to timely updates.

The complexity of some diseases and service data forms, less user-friendly DHIS2, lack of frontline engagement in HMIS design, limited knowledge and skill in standard integrated tools, indicators and data elements, deters production of quality data. Lack of adequate training, accountability, supervision, and HMIS data sources, mainly for performance monitoring, contributes to less utilisation of information for quality improvement. The difficulty of the data collection process, escalating demand for data only for sending reports, and a lack of a structured motivation mechanism to data producers and users impede sustained production of quality data and utilisation of information for the quality of immunisation service.

In summary, the implementation of data management processes in the study setting is affected by technical, organisational and behavioural factors, resulting in uncertain quality of data and low utilisation of information for informed decision-making, including the usage of information for quality of immunisation service. The RHIS processes are the main determinants of the RHIS performance: data quality and use of data for decision-making. The integrated findings demonstrate that suboptimal RHIS input contributed to subpar RHIS performance, resulting in limited utilisation of information for improved quality and programs.

6.4 THE INTEGRATION PROCESS

A merging strategy was applied whereby findings from both quantitative and qualitative approaches were compared, contrasted and synthesised to provide a comprehensive under-

standing of HIMS performance. The purpose of this integration is to explain *how and why* the technical, organisational, and behavioural determinants interact to influence data quality, use, and system (processes) effectiveness at the facility level. Through this approach, convergence, complementarity, and divergence between quantitative and qualitative data were identified to produce meta-inferences that inform the study's overall conclusions.

This study integrated the findings at the interpretation and discussion level, applied a narrative joint display technique and presented the data set from each phase in a table and formulated meta-inferences. One of the core characteristics of a mixed methods study is the integration of data during either the study design, data collection, analysis or interpretation stages or, preferably, at different dimensions (Ahuja Nasr, Fawcett, Whitfield & Mclean 2015:1).

The integration and synthesis of findings of the different datasets can reveal significant patterns and associations that would not have been apparent without a mixed methods design (Skamagki et al. 2024:2). The integration of both quantitative and qualitative data minimises the weakness and maximises each strategy's strength (Cresswell, Klassen, Plano Clark & Smith 2011:5).

The interpretation level integration can be either through narrative, data transformation, joint displays, and visualisation (Ahuja et al. 2015:1). [In turn], when integrating through joint displays, researchers integrate the data by bringing together the data through a visual means to draw out new insights beyond the information gained from the separate quantitative and qualitative results. This can occur through organising related data in a figure, table, matrix, or graph (Moseholm & Fetters 2017:3).

Ahuja et al. (2015:1) state that the smaller number of studies used methods presenting a joint display of qualitative and quantitative findings using a triangulation protocol. A triangulation protocol involves the integration of data when all sets of data have already been analysed individually. The literature identifies four types of triangulations (methodological, data, theoretical and investigator) (Tonkin-Crine, Anthierens, Hood, Yardley, Cals, Francis, Coenen, Van der Velden, Godycki-Cwirko, Llor, Butler, Verheij, Goossens & Little 2016). The current study used data triangulation as qualitative and quantitative data were integrated at

the interpretation level; it used a narrative joint display that portrays the data in Table 6.1 below.

The integration addressed the Integrated (hybrid) question:

How can HMIS be used to strengthen the quality of data?

The Key findings of the Phase One quantitative data analysis and interpretation results show low understanding of data and data quality characteristics, a lack of integration of tools and overreliance on hard copy data collection tools. This phase also indicated inadequate skill in and use of technical determinants, limited execution of organisational determinants, low demand for HMIS data for decision-making and inadequate information use for quality improvement. The Phase II of the study data was analysed thematically, and the themes that emerged were of HMIS implementation, HMIS training, data management, data quality assurance, and Use of HMIS information for decision-making.

Figure 6.1 below shows the objectives and key findings of the study across its two phases and meta-inferences.

STUDY OBJECTIVES OF PHASE 1:

1. Examine data management processes in healthcare facilities and sub-city offices.
2. Identify the effect of TOB factors on data management.
3. Determine the extent of information use in managing immunisation services.
4. Identify the effect of TOB factors on information use.

Key Findings of Phase I Statistical Analysis:

- Minimal capacity of data management and limited application of data quality dimensions.
- Disintegrated, hybrid and undigitized data management processes and tools.
- Varied views, skills and application of technical determinants.
- Inadequate execution of organisation determinants.
- Mminimal demand of data for decision making.
- Mminimal information use for immunisation service quality improvement.

STUDY OBJECTIVE OF PHASE II

5. Explore experiences of health professionals of data generation, information use and quality improvement of immunisation services.

Key Findings of Phase II: Thematic analysis: Emerged themes:

1. HMIS implementation.
2. HMIS Training.
3. Data management and quality assurance.
4. HMIS information use for decision making.

Meta-inferences

Data management (RHIS) Processes

❖ **Data collection/entry and data aggregation**

- Burdensome data collection & undigitized tools.
- Fragmented parallel data aggregation systems; DHIS2 challenges.
- Unclear roles and authority structures.

❖ **Data quality assurance and functional components**

- Good awareness of data quality assurance measures.
- Consideration of partial dimensions of data quality.
- Challenges of LQAS and multiple ad hoc data quality assurance mechanisms.
- Inadequate functional components required to ensure data quality.
- Potential burnout due to low staffing.
- Data-driven decisions need a higher priority.
- Minimal competence in data quality checks.

❖ **Data Analysis and Data Interpretation:**

- Data analysis and interpretation are not at the accepted level.
- Willingness and capacity of care providers.
- Minimal integration of various systems.
- Paper-based reports provide backup in emergency situations.

Organizational factors

❖ **Data Source for management functions**

- No evidence of evidence-based decision-making.
- Inadequate supportive supervision.

❖ **Training, Responsibility and Accountability**

- Sub-optimal master HMIS training, challenges of cascading HMIS training.
- The capacity for data management needs to be enhanced.

Improve Participation, Time, Skill and Materials.

- Lack of accountability for data management and information use.

❖ **Data sharing, Data display and Feedback**

- Challenges with interoperability of systems.
- Hybrid and parallel reporting to different agencies.
- Structural challenges with DHIS2.
- Unsatisfactory data display.
- Inadequate data sharing through self-assessment and feedback on data.

Technical factors

❖ **Flexibility/Functionality and Complexities of HMIS tools**

- DHIS2 has limited archive functionality, flexibility and access to real-time.
- Complex diseases reporting forms.
- Lack of competence in DHIS2 technical aspects.
- Unreliability of the DHIS2 software and limited server capacity.

❖ **Standardisations, Integration, Simplification**

- Poor interoperability.
- Suboptimal engagement, understanding and use of HMIS standards

Behavioral factors

❖ **Data demand, Problematic processes and Motivation**

- Persisting low demand for HMIS data to improve the quality of EPI (health) services.
- The use of undigitized data collection tools poses difficulties in data collection.
- Inadequate confidence in data management.
- Low incentives/ motivation among data producers and users.

➢ **Continuous use of information and evidence**

- Inadequate use of information for quality improvement and performance appraisal.
- The HMIS data is least used for staff performance appraisal and budgeting.
- The QI project is not regularly monitored using HMIS data.
- Sub-optimal capacity of health staff to design and monitor the QI project.
- Less confidence in the HMIS-produced data.
- Low understanding of HMIS indicators contributed to low use of information.

➢ **Utilisation of HMIS data for immunisation service.**

- **I**nadequate HMIS information use for EPI supportive supervision.
- Lack of electronic tools for EPI data capturing.
- Persistently low use of HMIS information

Figure 6.1: Objectives, key findings and meta-inferences

Table 6.1: Narrative joint display integration of quantitative and qualitative findings

Overarching theme	Quantitative findings	Qualitative findings	Meta-inferences
Data management (Generation) process. Data collection/entry and Data aggregation.	Slightly more than a quarter, 28.3% (n = 116) of participants agreed that HMIS data collection tools were too lengthy. The use of hard copy registers, tally sheets and DHIS2 for data collection was revealed by equal proportion, 22.6% (n = 316 + 319) out of 855 responses.	A larger number of participants indicated that the data is collected using a register, reportable data is aggregated in a tally sheet daily and filled into report forms monthly. The DHIS2 is used only for data entry for official reporting.	Various data collection tools.
	Data collection was the most frequently accomplished data management process reported by 13.1% (n = 372), while the least implemented was data interpretation by 10% (n = 283) out of 2829 responses.	A high proportion of participants indicated that the department heads enter data into DHIS2 monthly, together with HITs. The DHIS2 data is lost when the internet connection is weak, and the whole dataset is re-entered.	Burdensome data collection.
	Most responses showed use of multiple data aggregation tools: 40.1% (n = 343) used DHIS2; equally, 25.3% (n = 216) used tally sheets and reporting forms for data aggregation out of 855 responses.	The participants reported the use of multiple parallel tools for data aggregation besides DHIS2: the tally sheet, register, SmartCare for ART and EMR for individual medical records; the EMR is not yet scaled.	Parallel hybrid data aggregation tools.
	The reasons for high demand for HMIS data: 'to send parallel donor report' was indicated by 17.4% (n = 142) out of 814 responses.	Most participants expressed that parallel data aggregation tools were designed to meet the interests of donors. Parallel tools, sometimes, are implemented with-	Data collection and reporting aligned with different agencies' needs

Overarching theme	Quantitative findings	Qualitative findings	Meta-inferences
		out the recognition of facility managers. The HITs' daily check functionality for the multiple tools	
Data quality dimensions and quality assurance.	The majority, 81.3% (n = 337) of participants selected the 3: reliability, completeness and timelines as dimensions of data quality.	The majority of the participants mentioned that the role of facility managers includes verification of completeness, timeliness and consistency.	Partial application of data quality dimensions
	Fewer, 13.2 % (n = 294) responses indicated data integrity as one of the data quality dimensions. out of 2227 responses	Most of the Quality Improvement officers agreed that they would give more attention to completeness and consistency, and they would correct it if they found a missing record.	
	Most, 45.3% (n = 307), indicated skills only on the LQAS data quality check out of 678 responses.	The majority of participants mentioned the application of only the LQAS mechanism for data quality check, indicating that the LQAS is unreliable to ensure data quality, as it draws a smaller sample.	Low competence in data quality checks.
	The minority, 39.8% (n = 164) of participants, reported having skills in multiple data quality check mechanisms.	The majority of the participants expressed that the sampling is repeated if the LQAS result falls below 90% threshold, but no clarity on the optimum number of times for resampling.	Challenges with the LQAS sampling technique
Functional components required for data quality assurance	Out of 2132 responses to the six functional components required to ensure data quality, the two, staffing of HMIS/M&E structure to the standard,	HITs reported that they are discontented with their current job due to high workload and low motivation, thus they are looking for other jobs	Potential burnout due to low staffing.

Overarching theme	Quantitative findings	Qualitative findings	Meta-inferences
	had comparatively fewer responses, 15.9% (n = 339). Encouragement of a culture of data use for decision-making had the least response, 13.3% (n = 238)		
		Health professionals do not think of data as a power that can affect policymaking and health budget allocation.	Data-driven decisions need a higher priority.
Data Analysis and Data Interpretation.	Relatively less, 11.4% (n = 292) indicated that they carry out data analysis and the least, only 10% (n = 256) implement data interpretation out of 2829 responses.	The majority of participants mentioned weakness in data interpretation and attributed this to limited capacity among the staff, weak functionality of the performance monitoring team and inadequate training given on HMIS data analysis and interpretation.	Low capacity in data analysis and interpretation.
	Comparatively low, 23% (n = 279 + 284) indicated data interpretation in the description of gaps and developing an action plan out of 1198 responses.	The facility and department managers reported that they interpret data of achievement versus plan, trends and similarity of figures of related services. But identification of gaps, listing reasons and activities with defined responsibilities and time have challenges.	
Data sharing, Data display and Feedback:	Nearly a third, 28.4% (n = 293), indicated that data sharing through direct access to DHIS2, and 26% (n = 265+ 266) indicated sharing through paper form report out of 1031 responses.	Most participants mentioned data sharing with partners either in Telegram or, mainly, in hard copy format. Sending the same report in two channels: ART data through SmartCare for donors and through DHIS2 for line reporting. Departments report directly, bypassing	Hybrid and parallel reporting to differ-

Overarching theme	Quantitative findings	Qualitative findings	Meta-inferences
	Most of the external data sharing is done through DHIS2 monthly and quarterly reporting, indicated by 34.1% (n = 348) responses. Whereas external data sharing through performance and peer review meetings is indicated by equally low, 23.7% (n = 242) out of 1021 responses	DHIS2, due in part to mistrust of the tool, then call for correction of the mismatch, which burdens the HITs. Both papers from and DHIS2 reporting to the same sub-city. The DHIS2 software becomes busy and fails to retrieve data, and delays reporting when the internet connection is weak or interrupted.	ent agencies Structural challenges with DHIS2.
	Performance indicators displayed through graphs or charts were used in 26.4% (n = 239) of the responses, and data display using the EPI monitoring chart accounted for 22.2% (n = 201) out of 905 responses.	The majority reported data display uses traditional tools: tables and graphs/charts to display the achievement of indicators versus the plan. The HITs print graphs from DHIS2 and post them on the board for visibility. Banners are also used to display achievements to the community. Some hospitals display data by connecting DHIS2 directly to a TV.	Unsatisfactory data display.
	A higher proportion, 34.5%, indicated internal data sharing through monthly reporting, while a low, 22.7% (n = 219), indicated internal data sharing through self-assessment out of 965 responses. Low, 10.5% (n = 288 + 300) indicated use of all forms of data sharing and feedback on data, respectively, out of 1298 responses to data management processes.	The majority of participants reported that data sharing through self-assessment of departments was irregular. Health staff do not regularly share data on their own; managers have to verify. They rated the feedback on the data as weak. The feedback from a higher level is fault-finding, and managers expose the HITs instead of defending.	Inadequate data sharing through self-assessment and feedback on data

Overarching theme	Quantitative findings	Qualitative findings	Meta-inferences
Technical factors Flexibility/Functionality and Complexities of HMIS tools	Nearly a third, 31% (n = 63), mentioned the computer (DHIS2) software in use is complex, mainly because it is slow to start out of 203 responses.	Most participants indicated that DHIS2 is less flexible: the data previously in e-HMIS archives cannot be accessed if required for a study purpose. It is difficult to edit some DHIS2 captured data, for instance, mortality data.	DHIS2 has limited archive functionality, flexibility and access to real-time data
		DHIS2 delays the output (results) of data analysis up to 24 hours between data entry and retrieval. DHIS2 does not automatically run data analysis disaggregated by period of enquiry	
	The complexity of the disease reporting form was mentioned by 39% (n = 85) of the participants among those who agreed that the HMIS reporting form is complex.	The managers complained about the ART (disease) report form. The complexity of DHI2 is related to the fact that the health professionals were not trained on DHIS2.	Complex diseases report forms.
		Most participants revealed that DHIS2 lacks regular maintenance. No one has the specialised skill to fix the reported problems. No regular review or comment box for regular improvement	Lack of competence in DHIS2 technical aspects
Internet connection and DHIS2 data	The majority, 48.6% (n = 104), showed that the DHIS2 software was too lengthy out of 214 responses.	Nearly all the participants indicated duplicative data elements of DHIS2. A weak internet connection causes loss of DHIS2 data, and the system is busy. Only one server for the entire country.	Unreliability of the DHIS2 software and Limited server capacity
Standardisation, Integra-	Slightly less than a third, 35% (n =	The participants discussed the lack of	Suboptimal en-

Overarching theme	Quantitative findings	Qualitative findings	Meta-inferences
tion, Simplification	144), of participants reported that all HMIS tools were standardised, integrated, and simplified in their health institutions.	lower-level participation in updating the standards of HMIS indicators and tools.	gagement, understanding and use of HMIS standards.
		The facility managers and HITs indicated that DHIS2 is not integrated with other data aggregation tools like SmartCare, nor does it include all NGO-required indicators.	Poor interoperability
Organisational factors.	On average, 81% (n = 340+357) indicated that the HMIS data is less used to conduct staff performance appraisal and planning of service quality improvement out of 423 and 442 responses, respectively.	Most of the participants mentioned that HMIS data is less used for QIP, mainly due to a lack of evidence-based feedback on how QI (change) achieved is attributable to data use; no such feedback means the gaps in data use persist.	No evidence of evidence-based decision-making.
Data Source for Management Functions	Only half: 51% (n = 210) of the participants showed the use of HMIS data for all the supportive supervision activities, including the design of the supervision checklist	The majority of participants indicated that the HMIS data use for supportive supervision is inadequate, as it is not based on a standard checklist, and feedback is not action-oriented.	Inadequate supportive supervision
Training, Responsibility and Accountability	Nearly a quarter, 23.8% of HMIS personnel in position were not trained on HMIS; more than a third, 35.5% of responses indicated the recent HMIS training has not improved skills in the data management process.	Most participants rated the HMIS training as low quality; only a kind of orientation is given on the changed indicators. A refresher/on-the-job training is superficial.	Suboptimal master HMIS training and challenges of cascading HMIS training.
		They stated that HMIS master training lacked printed reference material and the master trainers lacked knowledge, which has resulted in less ability of the	

Overarching theme	Quantitative findings	Qualitative findings	Meta-inferences
		trained staff to analyse, interpret and display data using different tools.	
		The majority of participants reported that facility-level training given on DHIS2/HMIS was not adequate; thus, there are persisting gaps in handling DHIS2. Additionally, health facility managers were not engaged in the HMIS TOT; therefore, it means it is difficult for them to mentor other staff on data management and the use of DHIS2.	
	The responsibility of ensuring continuous use of information is associated with HMIS/HIT staff 19.6% (n = 335) and the quality improvement team 18.7% (n = 320). Comparatively less, 13.3% (n = 228) attached to individual staff out of 1709 responses.	The majority of participants reported that the work of HMIS implementation relies mainly on the HITs/QI officers: recording/data entry, reporting and data quality check. They also interpret data and present to decision makers.	Lack of accountability for data management and information use at the staff level.
		The participants clarified that the health professionals trained do not mean they independently check data quality or report. Pressure is still on the service unit head. Accountability of HMIS work is not ensured at the individual health professional level.	
Behavioural factor. Data demand, Problem-	The least, 14.7% (n = 120), indicated that the high demand for the data was to engage the community into immunisation (health) service out of 814 re-	Most participants referred to the limited use of HMIS data to create community awareness and to reduce the dropout of	Persisting low demand for HMIS data to improve the quality of EPI

Overarching theme	Quantitative findings	Qualitative findings	Meta-inferences
atic processes and Motivation.	sponses.	vaccination.	(health) service
	The great proportion, 21% (n = 273) indicated that data collection is a problematic process to implement, out of 1298 responses	The majority of participants mentioned that data collection and collation processes are not yet digitised; they are performed using paper-based HMIS forms, which results in compromised data quality and information use.	The use of undigitized data collection tools poses difficulties in data collection
	Only less than a third, 30.6% (n = 126) of participants indicated that they were confident in carrying out all data management processes	Most of the participants described that health professionals have a knowledge gap in data management, they do not appreciate the value of data, are less willing to register and enter data and routinely use the HMIS.	Inadequate confidence in data management
	The data shows motivation through incentives (recognition) of champion data users and producers was reported by fewer, 12.4% (n = 148) responses.	The majority of participants agreed that motivation of the HITs (HMIS officers) is impacted by a lack of constructive feedback, career promotion, capacity building, low salary and incentives.	Low incentives/ motivation among data producers and users
Information Use	Low proportion, 18.2% (n = 252), indicates use of HMIS information for immunisation (health) service quality improvement out of 1386 responses.	The majority of the participants revealed that HMIS data is less used for designing immunisation QI projects, as indicators are overachieved/over-reported	Inadequate use of information for Quality improvement
Continuous use of information and Evidence	At least 15.6% (n = 216) responses showed information use for governance/ administrative functions (staff performance appraisal and resource	Most participants explained that there is a shortage of budget at the facility level to reproduce HMIS tools, and the HMIS data is inadequately used for budget alloca-	The HMIS data is least used for staff performance appraisal and Budget-

Overarching theme	Quantitative findings	Qualitative findings	Meta-inferences
	allocation)	tion and outbreak response.	ing.
	Relatively low, 17.9% (n = 168) of participants mentioned the Quality Improvement initiative as evidence for continuous use of information.	The majority of the participants indicated the interrupted use of the PDSA cycle in planning and implementation of QI. There is irregular monitoring and documentation of the QI projects.	The QI project is not regularly monitored using HMIS data.
	The least, 17.7% (n = 205), indicate using HMIS information to assess changes in quality of service out of 1158 responses.	The participants showed that the main barriers to the QI project are insufficient monitoring of plans related to change.	Suboptimal capacity of health staff to design and monitor the QI project
	Less than half, 43% (n = 177) of the participants indicated use of information for the entire QI process (phases).	Most participants reported limited skills among health professionals in designing, implementing and monitoring QI projects.	
	A third, 38.8% (n = 160) of the participants disagreed and strongly disagreed that HMIS produces high-quality data.	Most participants reported that health professionals submit inconsistent data, which undermines the reliability of HMIS-generated information.	Less confidence in the HMIS-produced data
	Less than half, 47.6% (n = 196) of the participants mentioned all defining components of standard HMIS design, indicator definition and tools.	The departments and facility managers described that the HITs have a low understanding of health indicators and data elements.	Low understanding of HMIS indicators contributed to low use of information.
	The least, 17.8% (n = 251), of responses indicate the use of HMIS information to conduct immunisation	Most participants expressed that inadequate supervision is one of the barriers to immunisation service quality improve-	Inadequate HMIS information use for EPI supportive su-

Overarching theme	Quantitative findings	Qualitative findings	Meta-inferences
	supportive supervision.	ment.	pervision
	Less than a fifth, 19.7% (n = 304) and 17.9% (n = 277) indicated interpretation and utilisation of HMIS data for immunisation activities, out of 1544 responses respectively.	Most participants mentioned that the care providers lack skill in the interpretation of data to identify gaps in performance. The EPI data is not adequately used to design QIP.	Suboptimal data interpretation and use
		The immunisation data is uniquely discrepant related to multiple antigens recording at a time, difficulty of locating the starting register after a long interval between Penta-3 and Measles, and absence of an electronic child health (EPI) card contribute to recording.	Lack of electronic tools for EPI data capturing

The final interpretation and discussion of the integrated findings are narrated in detail below.

6.5 INTERPRETATION AND DISCUSSION OF INTEGRATED FINDINGS

This study assessed data management processes in practice, determined the extent of information use and identified factors that influence data management and information use to improve the quality of immunisation service at frontline health facilities in Addis Ababa.

Using the mixed methods, participants' understanding of data, data quality and information, and application of data management and quality assurance tools were assessed. The assessment identified determinants of HMIS performance: technical such as views and application of HMIS tools and software; organisational, for instance, HMIS use for management functions, resources, training, supervision, and responsibility and accountability of HMIS implementation; and behavioural, for example, level of data demand, confidence and competence in data management process, perception to HMIS produced data and extent of information use for health (immunisation) service quality improvement. The mixed (hybrid) question of 'How can HMIS be used to strengthen the quality of data' is addressed through meta-inferences from integrated qualitative and quantitative data. The discussion and interpretation of meta inference are presented in the section below.

6.5.1 Data management (RHIS) process

6.5.1.1 Data collection (entry) and aggregation

The integrated results reveal that the data management (RHIS) process within health facilities is characterised by a high workload associated with multiple uncoordinated data collection tools and limited engagement in data interpretation and use. More than a quarter, 28.3% (n = 116), of respondents reported that HMIS data collection tools were too lengthy. This implies that more time was spent on collecting data through the use of time-consuming tools than on providing service and improving the quality of service.

This finding is corroborated by qualitative accounts describing a burdensome process in which data are collected manually and later entered into the DHIS2 system, often under conditions of unreliable internet connectivity. This is further expressed by the majority that the data is collected using hybrid tools (paper-based and printed out from programs' software) and entered into DHIS2; however, poor internet connection causes loss of DHIS2 data and re-entry of the data, which further increases workload and frustration.

The combined findings imply that limitations in the RHIS process that involved duplicative data entry and fragmented systems, together with capacity gaps in data interpretation, might have led to poor data quality and utility of information at the facility level. This interpretation is consistent with the argument of Kebede et al. (2020), who found that hybrid reporting systems and inadequate coordination mechanisms compromise data accuracy and undermine the potential of HMIS to support evidence-based decision-making. This highlights the need to use digitised and integrated immunisation data collection tools, enhance internet capacity, and build skills in the interpretation of data.

The integrated result also demonstrates that data aggregation continues to rely on parallel and non-interoperable tools. Although DHIS2 is the main tool for data entry, aggregation, storage, analysis, display and sharing, it is primarily used for line reporting. Complementary tools such as SmartCare for ART services operate independently, perpetuating vertical reporting systems. Quantitative data further support this observation, showing that only 40.1% (n = 343) of respondents reported using DHIS2 for data aggregation, while 25.3% (n = 216) relied on tally sheets and paper-based reporting forms. The synthesis of findings suggests that inadequate interoperability within DHIS2 and its limited capacity to meet program-specific data requirements have been major contributors to the persistence of parallel reporting practices.

The result of data demand shows that parallel donor reporting is one of the reasons for the high demand for HMIS data, indicated by 17.4% (n = 142) responses. The donors receive reports directly from departments; they bypass the DHIS2 reporting and facility

managers. The implication is that the parallel data demand from stakeholders, compounded with the burden of duplicative data aggregation, might have reduced data use capacity in the frontline of the health system. Similar findings were reported by others that the Ethiopian HMIS is characterised by fragmentation, the existence of multiple formats and definitions, parallel reporting, duplication of efforts in data collection and low information use.

The existence of duplicative data collection and aggregation and hybrid data sharing tools signifies the importance of streamlining data management processes to ensure useful data is generated through HMIS and the willingness of stakeholders to abide by standardisation and a single channel of reporting. Bifa (2024:224) argues that the practitioners need a complete, fully functioning electronic data-capturing system integrated into DHIS2. Another study emphasises the need to improve coordination between stakeholders in order to streamline the RHIS data process and transparency (MEASURE Evaluation 2018).

The integrated evidence thus underlines that hybrid and duplicative data management practices are a major barrier to effective HMIS performance. Quantitative findings showed that 82% of facilities conducted monthly data quality checks, while qualitative insights revealed that these checks were often superficial and lacked corrective follow-up, limiting their effectiveness. These findings illustrate how infrastructural and interoperability gaps interact with organisational weaknesses affecting data flow and quality. Continuous data quality assessments and training are requisite to address gaps and improve HMIS data quality (Nshimyiryo et al. 2020:2). From a systems perspective, fragmented data tools not only burden health workers but also discourage data interpretation, thereby limiting the behavioural reinforcement required for routine information use.

To strengthen data management processes, a comprehensive digital integration strategy is required—one that promotes the standardisation of tools, interoperability between DHIS2 and program-specific applications, and adherence to a single reporting channel. Complementary investment in internet infrastructure and analytical skill-building is equally

critical to ensure that the digital transition enhances the interpretive and decision-support functions of HMIS at the facility level.

6.5.1.2 Data quality assurance mechanism

The integrated findings reveal that health facilities have implemented several initiatives to enhance data quality, though these efforts remain partial and inconsistent. These points underscore the need to strengthen the capacity of health staff to routinely measure key dimensions of data quality using an integrated LQAS–RDQA approach, thereby enhancing the integrity and reliability of DHIS2 data. The RDQA (revised version of DQA) considers seven dimensions and assesses data integrity through double data entry, post data entry verification, backup for computerised data entry and correction of data discrepancies. Additionally, it allows data verification quantitatively and system (functional components of quality data generation) assessment qualitatively. Endriyas et al. (2019:5) recommend routine monitoring of data quality quantitatively and qualitatively against its dimensions to achieve acceptable quality and use. It was evident from the results that training was not adequate, which could have resulted in suboptimal data quality assurance.

Data quality assurance requires comprehensive skills in data quality check mechanisms. Most, 45.3% (n = 307), of participants indicated having skills only on the LQAS data quality check. Yet, the LQAS mechanism measures less than half of the common dimensions, missing important dimensions such as data integrity. Similarly, some studies cite common challenges, saying some of the data quality dimensions, for instance, data accuracy, is measured at higher rate in a Data Quality Assessment Frameworks (DQAFs), while the data integrity is assessed less frequently, which may raise many questions related to the validity of the DQAFs' decisions to eliminate or approve some of the dimensions (Al-Salim et al. 2022:11).

The finding indicates a need to capacitate frontline practitioners to generate high-quality immunisation data in consideration of relevant dimensions. Literature [also] indicates that

the traditional measures of data quality, such as accuracy, consistency, completeness, and timeliness, are no longer adequate in the era of Big Data (Ridzuan & Wan Zainon 2024:6). This indicates the need for meaningful, well-structured capacity building programs.

The majority of participants mentioned the challenges with LQAS sampling, which draws unrepresentative samples, the score below 90% is rejected and sampling repeats without a known cause and the number of times for re-sampling. The interpretation is that the LQAS data quality check is unreliable and might have contributed to less confidence in the quality of HMIS data, with consequent low use of information. To worsen the situation, there is a parallel application of LQAS and RDQA for health facility-generated data quality assurance. However, the two mechanisms measure slightly varying aspects of data quality. The RDQA deals with the data verification factor (VF), which is recounted over reported score 90-110%, measures data management process and use, while the LQAS measures consistency of figures across the HMIS tools at >90%, 'Yes, or No' consistent responses to 12 randomly selected indicators, computed and compared with the corresponding table value of LQAS. In other words, the RDQA looks for accuracy by comparing recounting data in the register versus reported data, while LQAS examines data consistency across the registry, tally and report form. Similarly, literature reveals a mismatch of LQAS and RDQA results, describing that the LQAS assessment shows a discrepancy in the reports for the accuracy of data (Solomon, Addise, Tassew, Balcha & Abebe 2021:2).

The implication is that the interpretational difference of the findings by the two methods would challenge the implementation of the data feedback process. On the other hand, RDQA-based data feedback is the second most received feedback by the facilities. Besides, application of different mechanisms to quality check the same data could contribute to mistrust in the LQAS and missed opportunity to gain experience from, thus necessitating the acquisition of skills in multiple data quality check mechanisms. Currently, health facilities bear the burden of data recount at a service unit and conduct LQAS at the de-

partment (sub) Performance Monitoring Team and the Facility level Performance Monitoring Team. A comparable study by Chanyalew et al. (2021:7) reports the absence of standardised guidelines for conducting Data Quality Assessments and highlights the impracticality of employing the LQAS approach. Consequently, only 22% of health facilities had undertaken an immunisation data quality review during the three months preceding the study.

An intervention to address this requires mapping complementarity and duplication of RDA and LQAS. This further depicts the importance of integrated data quality check mechanisms that assess inclusive data quality dimensions. Studies in support commend that an approach to data quality improvement should be comprehensive to understand the relative importance of individual barriers on data use outcome, stating that multifaceted interventions may have multiplicative effects on sustained data use as opposed to a single intervention focused on the specific barrier (MEASURE Evaluation 2018:22).

Additionally, finding solutions to the challenges of the LQAS sample size would ensure representativeness and increase acceptance of the mechanism and its data quality results. Bruce (2014:9) and Prasetya (2017:18) indicate that the RDQA can be used by an organisation/donor as an essential procedure to determine data quality at a time and provides an opportunity to prioritise, develop and implement strategies to address gaps.

Checking data quality is the second most accomplished data management process mentioned by more than 12.6% (n = 356) responses, and most participants argued that the LQAS is a less reliable data quality assurance mechanism. Consequently, there is a mixed application of formal and ad hoc data quality check mechanisms. The high rate of data quality accomplishment might be associated with redundant application of the LQAS mechanism at multiple levels, as mentioned above. Besides, the ad hoc assignment of department heads to enter data to minimise data entry error, the department's data committee and HMIS focal person to check data on a daily and weekly basis, creates more burden on already burdened healthcare providers.

Application of mixed formal and Ad hoc data quality check mechanisms is ascribed to the persistent wider problem of data quality. This finding is consistent with Bloland & MacNeil (2019:1), who argue that several approaches have been developed to evaluate the underlying quality of routinely collected immunisation data and resolve challenges that exist in simply defining “data quality”. Meaning that though data quality check is frequently carried out using a mix of mechanisms, none of the mechanisms has proved itself to produce trusted quality of data.

6.5.1.3 Data analysis and interpretation

The integrated findings revealed a lack of appropriate tools and capacity for data analysis and interpretation at health facilities. While DHIS2 is the main tool used for immunisation data analysis, the software fails to automatically analyse data by the required period, subsequently delaying reporting. Additionally, DHIS2 is considered complex due to its taking a longer time (slow) to start, as mentioned by a third, 31.0% (n = 63) of responses. The slowness of DHIS2 in data analysis and sharing could have resulted in a lack of timely data interpretation and information use for decision-making, and monitoring services quality improvement. These issues reflect multiple factors that impact information use in immunisation services.

Studies state that if software does not process data properly, the data analysis does not provide meaningful conclusions for decision-making in a timely manner (Aqil et al. 2009:6; FMOH-E Information Revolution Roadmap 2016:10). Therefore, DHIS2 needs to be regularly updated to fit customisation and provide timely output of data analysis.

The findings also indicated limited skills in data analysis and interpretation among the participants. Less than 12% (n = 292) of responses indicated performance of data analysis and interpretation. Additionally, the perceived self-confidence in data management is below average in data analysis and interpretation skills. The majority of the participants agreed that health professionals are less willing to analyse and interpret data. These con-

straints—the low confidence and willingness of healthcare providers to interpret and analyse data—might worsen low demand for and production of low-quality data.

The less data demand, analysis, interpretation and review would give more persistence in the low use of immunisation information for quality improvement of service. Besides, this could disadvantage HMIS officers in conducting multiple tasks. The necessity to enhance competence in data analysis and interpretation among care providers. According to Nwankwo & Sambo (2018:7), the use of data is likely to improve when staff possess the necessary skills in data analysis and interpretation, alongside a clear understanding of the importance and purpose of data utilisation in decision-making processes.

The result also shows that the process of data interpretation lacks identification of performance gaps and formulation of appropriate action plans. Currently, data interpretation typically entails comparing planned targets with actual achievements, analysing performance trends over time, and assessing the internal consistency of reported data. Less than a quarter, 23% (n = 284), of responses indicated data interpretation of performance gaps and developing related action plans. The weakness in the data interpretation process is associated with the low capacity of the performance monitoring team and inadequate training for most participants. This implies that the data interpretation process is more focused on computing coverage than on prioritising problems and developing performance improvement plans.

6.5.1.4 Data sharing, display and feedback

The study shows hybrid and parallel data sharing to various agencies, resulting in fragmentation. Equal, 28.4% (n = 293) and 26% (n = 265) responses indicated the use of electronic (direct access to DHIS2) and paper-based data sharing, respectively. The same sub-city office requires data shared through paper and electronic means from facilities. However, DHIS2 becomes busy and delays reporting when the internet connection is weak, most participants revealed. The participants also indicated that the main reason for

operating hybrid HMIS tools is the fear of a possible loss of important data when the system switches to an electronic (EMR) system. This points to the fact that the recent initiative of RHIS digitisation has not convincingly resolved the data burden. Literature concludes that digitisation worsened the duplication for fragmented RHIS and increased the data burden (Ruysen, Majid, Shamba, Minja, Rahman, Ngopi, Ramesh, Arifeen, Steege, Seeley, Lawen, Day et al. 2024:15).

The implication could be the insistence on the use of hybrid HMIS tools owing to the inability of DHIS2 to timely data sharing, compounded by a lack of reliable system backup. A study by Bifa (2024:213), in support, cited [perceived] problems of switching between platforms, and positive aspects of the hybrid system, in that it provided paper-based support for the electronic system failure.

Duplicative data sharing is perceived as a burden to data producers and deters effective use of information for decision-making at the service delivery point. In addition, it should be noted that parallel reporting exacerbates the overwhelming of the workforce. There is a need to re-integrate tools, develop a single reporting channel and ensure DHIS2 data security. This finding is consistent with the literature that states the hybrid use of paper form and computer-based recording and reporting from health centres to the district health office in hard copies and using DHIS2 affect the utilisation of health information (Kefiyalew et al. 2021:6).

The findings show limited data sharing internally through self-assessment and externally through peer or performance review meetings. Data sharing through self-assessment was indicated by a low, 22.7% (n = 219) of responses, compared to 34.5% who indicated data sharing through monthly reporting. The majority of participants reported irregularity in data sharing through self-assessment of departments; health staff do not perform self-initiated data sharing, and in this case, managers had to verify. On the other hand, both high demand for HMIS data and data quality check are significantly associated with inter-

nal data sharing through self-assessment (X^2 = 20.12, df = 2, p =<0.001) and (X^2 = 4.60, df = 1, p = 0.03) respectively.

This can be interpreted as sharing data internally when preceded by self-assessment has high (strong) potential to increase data demand and improve the capacity of frontline health workers to check data quality. Studies show that users need to engage in priority information and dissemination, otherwise data demand and use cycle would break (Blessing et al. 2017:10; Sligo et al. 2017:8; MEASURE Evaluation 2018:14).

The findings indicate that data sharing tools remain multiple and fragmented across different platforms and stakeholders. While 34.1% (n = 348) of responses reported data sharing through DHIS2 monthly and quarterly reporting, only 23.7% (n = 242) mentioned performance review or peer review meetings as avenues for data sharing. In parallel, most participants indicated that data sharing with partners occurs primarily monthly using hard copy formats provided by the partners themselves. This pattern suggests that data is often passively shared, with limited interaction or shared interpretation. The minimal involvement of external stakeholders in routine data management and quality assurance processes may be contributing to weak trust in and limited use of HMIS data. These findings underscore the need for more structured and inclusive data-sharing mechanisms that actively engage stakeholders in both performance monitoring and data quality improvement efforts.

Literature indicates that data use culture promotes stakeholders' participation in the processes of data analysis, review, interpretation and use to generate quality information (Kebede et al. 2020:1-2; Gashu et al. 2019:2, 3).

Findings from this study indicate inadequate feedback on data management processes. There were relatively few responses indicating the implementation of data feedback and utilisation of HMIS data to provide feedback on service delivery. The use of data to provide feedback is significantly associated with the high demand for HMIS data (X^2 = 6.67,

df = 2, p = 0.04), meaning that the accomplishment of data feedback and the use of the data to provide feedback on service delivery could possibly increase the demand for data. This was confirmed by the majority of the participants, who stated that the lack of evidence-based feedback on how Quality improvement brought about change could invariably impact the use of HMIS data for planning and implementation of the Quality Improvement project. Weak feedback on data for service delivery weakens demand for data, hence quality of data from which inadequate quality information is generated, is unfit to improve quality service.

The majority of participants rated the feedback on data as weak, mentioning that feedback from a higher level is not constructive, rather fault-finding, and managers expose the HITs instead of backing up. A study result concurs with, states that in developing countries, health workers rarely receive feedback on HIS, and where feedback has been provided, it has tended to be negative, out of date and unproductive (Dehnavieh et al. 2019:2).

An absence of information usage for providing feedback and disseminating evidence on the outcomes of quality improvement initiatives diminishes the effectiveness of supervision in the data management process and weakens the role of information use in driving quality improvement efforts. A related study observed improvements in facilities benefiting from action-oriented feedback based on HMIS reports, where 12.1% and 7.5% more facilities received recommendations on resource allocation and examining planned target versus actual performance, respectively, in 2020 versus 2019 (Qian et al. 2023:4).

The result shows unsatisfactory data visualisation that is limited to key performance indicators and the 10 top diseases using traditional display tools: tables, charts and graphs. The use of graphs and charts for key indicators and EPI data display constitutes 48.6% (n = 440), whereas the DHIS2 data visualisation had 36.1% (n = 327). Most participants indicated that the practice of direct data visualisation is limited to a few hospitals. The data display task is mostly performed by Health Information Technicians. The reliance on pa-

per-based tools for data display presents a significant barrier to timely updates and external dissemination. Healthcare providers lack skill in data display, which means failure to monitor individual and department performance and take relevant corrective action.

This underscores the critical need to strengthen the capacity of data producers and users in leveraging DHIS2 data visualisation features to facilitate timely interpretation, continuous data updates, and broader information sharing to monitor performances. According to Salamkar (2024:204-206), the conventional visualisations, such as bar charts or line graphs, are often static and linear; they lack the ability to dynamically adapt to user interactions or changing data in real time. The health professionals, mainly at service delivery points, need to be more skilled in using pivot tables and other features of DHIS2, as they face challenges in data comparisons and visualisation (Bhatt et al. 2024:9).

6.5.2 PRISM-MFI determinants of the RHIS process and performance

6.5.2.1 Technical factors of HMIS data management and information use

6.5.2.1.1 Flexibility/Functionality and complexity of HMIS/DHIS2 tools

The study shows that DHIS2 is a primary tool for at least 50% data management processes; however, the system has limited archival functionality and flexibility. It falls short in flexibly meeting the requirements of different users in differing contexts; nearly half (48.6%, n = 104) of responses indicated that capturing data in DHIS2 is time-consuming. Complementarily, most participants stated that the software deletes or adds data by itself, ascribing this to a technical barrier (limited server capacity). The situation is worsened by the absence of root cause analysis to prompt technical intervention. This implies unreliability; mistrust of the platform contributed to the burden of paper-based parallel reporting. Similar study results show that technical issues, poor internet connectivity, power outages, and inexperienced health professionals were significant challenges to using DHIS2 (Bhatt et al. 2024:1).

An integrated result highlights the system design barrier of HMIS recording and reporting tools, aside from the siloed programmatic data system. The greater proportion (39%, n = 85) of responses indicates that HMIS forms such as ART and TB disease reporting are complex. The ART report form comprises numerous mandatory pages and contains duplicative data elements, contributing to reporting fatigue among the health workers. This indicates the RHIS design barrier constrains RHIS performance as indicated by Lemma et al. (2020:2), which emphasises that HIS design barriers can significantly reduce data quality and limit the ability in LMICs to use HIS data to inform healthcare decisions.

Additionally, while DHIS2 is a powerful but complex platform, health professionals have received insufficient training, rendering many of them unable to accurately enter data into the system. Lack of training for facility managers on the use of DHIS2 has limited their capacity to mentor other staff in its application, further constraining effective data use at the facility level. Although Health Information Technicians (HITs) received training on DHIS2, less than 20% of the allocated time was devoted to practical demonstrations, primarily due to internet interruptions. A major concern raised was the suboptimal competency of the HITs on the software. Furthermore, the lack of dedicated technical experts to address software-related issues has worsened the functional limitation of the system. Studies, in support, reveal inadequate attention to training needs as a major challenge in the use of DHIS2, citing significant demand for refresher training at the local level (Bhatt et al. 2024:14).

Technically, DHIS2 lacks interoperability, import export functions, and disallows editing data of some indicators that include mortality and family planning. An inadequate application, twined with the disallowance of the system to edit miss-entered data, reflects the limited flexibility of the platform to process data. This, combined with a lack of shared features with other sources, has resulted in limited acceptance of the system among stakeholders. A study that concurs with this finding shows that the users of DHIS2 face various challenges, including inexperienced health professionals, lack of technical support, infrastructure inadequacy, frequent changes to DHIS2 versions, maintaining both manual and

electronic systems side-by-side, and limited use of data for local-level decision-making, which prevent the successful implementation of DHIS2 (Bhatt et al. 2024:2).

DHIS2 needs to be integrated with other data sources, paralleled by upgrading the competence of data producers and users. These interventions would result in optimal use of the software in data processing, including quality assurance. Literature shows that to maintain the sustainability of DHIS2, it is crucial to enhance the capacity of local staff, conduct regular system updates and maintenance, and integrate the system with other platforms (Denboba et al. 2024:5).

6.5.2.1.2 Standardisation, integration and simplification

The result shows suboptimal engagement, understanding and use of HMIS standards, and poor interoperability of the tools. Less than half (47.6%, n = 196) and (48.5%, n = 205) of the participants demonstrated their understanding by specifying definitional components of HMIS standardisation and integration, respectively, while a slight majority (53.2%, n = 219) of the participants reported the use of standardised tools. Most participants stated that the periodic process of HMIS design update, where standard indicators and tools were revised, has failed to engage frontline implementors. However, the health facilities have a responsibility to procure renewed HMIS formats and devices.

The interpretation is that HMIS implementers lack early engagement in the HMIS design update; this has limited their knowledge of the RHIS's technical determinants, the updated tools, indicators and data elements. This, in turn, has resulted in the limited application of standard integrated tools. The finding is consistent with a study result in Ethiopia that reports 43% of health facilities had no standardized immunisation registration books and the other 50% did not use the standardized tally sheets (Kefiyalew et al. 2021:7). Additional study mentions consistent challenges saying though there is sufficient evidence of success when data collection design involves local stakeholders, there is insufficient decentralisation to facilitate local data driven decision-making (Scott & Gilson 2017:11).

Multiple unstandardized tools discourage efforts of quality data production and information use. The users' data interpretation performance is significantly associated with their views of HMIS tools (procedures) and indicators (X^2 (1, (N= 144) = 38.72, p = < 0.001). Health staff who have positive views of and apply standard tools were highly likely to have higher capacity of data interpretation; on the contrary, those who are less aware of standard indicators, appropriate HMIS tools and guidelines are unlikely to apply the tools, process and use data. The FMOH-E Information Revolution Roadmap (2016:10) concludes that a better understanding of indicators improves information use. It is imperative to ensure the participation of the HMIS implementers in the design and updating of HMIS standards. Literature emphasises that the design of the HIS needs to include users, as this has the potential to influence the generation and use of data for local governance (Bifa 2024:222).

Approximately half (49.8%, n = 205) of the participants reported application of integrated HMIS tools. In complement of this, most participants indicated non-integration of existing electronic tools with DHIS2, yet DHIS2 does not hold all programmatic (donor required) indicators or diseases (ICD) codes. Besides, the access to DHIS2 data relies on the presence of HITs. The low application of common recording and reporting tools and the inability of DHIS2 to capture programs' data would favour persistence of parallel tools, as well as users' lack of skill to access DHIS2 data without HITs, worsening dependence on paper forms. Studies in support show that siloed data systems caused by donors' mandates, and the lack of integration of data from the recent developments of digital health interventions, are some of the factors that affect the quality of data. Another study mentions that most health facilities had only one trained staff member responsible for DHIS2, which posed challenges during busy periods or when the trained staff were absent (Farnham et al. 2020:2; Bhatt et al. 2024:1, 9)

These findings suggest strengthening the utilisation of integrated data tools to resolve the burden of data collection and enhance information use. Kebede et al. (2020:2) state that

an integrated HMIS reduces duplication of efforts and improves the capacity and performance of primary healthcare units and coordination among all levels of healthcare.

The study highlights the combination of technical factors, such as inadequate application of integrated HMIS tools, interoperability of DHIS2 with existing programs' software, and the skill of the healthcare providers to process data using DHIS2, which results in a data burden posed by parallel (hybrid) reporting, consequently affecting the use of data for immunisation service improvement. This underscores the need to promote informed, effective use of simplified HMIS tools to enhance data quality and foster the use of information at the point of data generation. Literature in support cites that simplification leads to evidence-based information use at a lower level by relieving data burden on health workers at the service delivery point (Farnham et al. 2020:2).

6.5.2.2 Organisational factors of HMIS data management and information use

6.5.2.2.1 Functional components (HMIS resources) of data quality assurance.

The effective functioning of HMIS depends not only on adequate staffing levels but also on the presence of personnel with appropriate training and expertise in HMIS-related functions. Without a well-resourced and knowledgeable workforce, the system's capacity to generate, manage, and utilise quality health data is significantly compromised. Only a small proportion of responses (15.9%, n = 339) indicated that Monitoring and Evaluation (M&E) positions were staffed according to standard, while even fewer (13.3%, n = 238) reflected the promotion of a culture of information use in decision-making. Many participants reported the inadequate availability of Health Management Information System (HMIS) tools, primarily due to financial constraints at health facilities that limit their ability to print the necessary materials. Additionally, approximately one-fifth of HMIS/Health Information Technician (HIT) personnel posts remained vacant. These challenges— low staffing levels, limited availability of HMIS tools, and weak encouragement of information

use—are likely to contribute to increased burnout and attrition among HMIS staff, perpetuate low data quality, and hinder the institutionalisation of data-driven decision-making.

Literature reports understaffing in the health facilities as contributing to work overload for the available staff, resulting in data management errors, consequently undermining the potential of the DHIS2 in generating quality information (Shaikh et al. 2015:31). This underpins strengthening functional components of data quality to attain high-quality data through staffing HMIS posts and providing HMIS tools and guidelines. Similar study reports that the absence of information use culture, proper use of existing HITs/IT, fit human capacity, administrative commitment, as well as adaptive system design contributed to HIS persisting inaccuracies (Kimani & Namsunge 2015:4)**.**

6.5.2.2.2 Data source for management functions

The HMIS data source is primarily utilised for performance monitoring, with limited evidence supporting its use in evidence-based decision-making. The data are underutilised in the design and implementation of quality improvement projects (QIPs) and in guiding supportive supervision. Most participants mentioned that there is a lack of documented evidence that links QIP success to the use of information. Perception is widespread about the limited application of HMIS to initiate and implement QI projects, and a general lack of capacity among health professionals to effectively undertake QI-related tasks. However, existing literature indicates that improvement in healthcare delivery is achieved using QI methods; moreover, QI improves data quality and HIS at scale (Hagaman et al. 2020:1).

The result reveals that the HMIS data source is less used for outbreak response. Most participants reported that HMIS data are most employed for tracking performance indicators, while they are comparatively less used for responding to disease outbreaks. The underuse of the HMIS source for outbreak response would favour the development of parallel programmatic databases, which would further fragment the system. Studies in

support state that HMIS responds to both routine health service and emergency response information needs (Amouzou et al. 2021:1).

It is important to link the use of HMIS data sources to staff performance to entrust responsibility for information use at the individual level. Likewise, it is important to connect the use of the HMIS source to the epidemic preparedness response plan to enable the system to provide time-sensitive information, including information needed in response to vaccine-preventable disease outbreaks. More importantly, the data source actively used to service QI design and implementation would sustain the performance of RHIS. Studies often associate organisational success with the use of information to improve the quality of service, as QI satisfies clients, motivates managers, and makes organisations competitive and self-sustainable Lingamallu and Nayakvadi (2017:1).

The result shows limited use of HMIS data to develop a supervision checklist; the supportive supervision uses of HMIS data focus on verification of reported performance. Slightly more than half (51%, n = 210) of the participants showed the use of HMIS data for whole supportive supervision activities. Most of the Health Information Technician groups in the interview showed inadequate supportive supervision from a higher level that lacks checklists, regularity and constructive feedback. On the other hand, both data quality check and data interpretation performance were significantly associated with using HMIS data to conduct supportive supervision (X^2(1,(N= 210) = 22.63, p = < 0.001) and (X^2(1, N= 210) = 53.65, p = < 0.001), respectively. In concur with this, a study by Bifa (2024:221) argues that regular supervisory visits are linked to both good data quality and effective utilisation of routine health information. The interpretation of supportive supervision in practice is inadequate to maintain the motivation of the practitioners to generate quality immunisation data.

Supportive supervision is one of the organisational determinants of the RHIS process. The unsatisfactory supportive supervision might contribute to poor data quality and the non-use of information for decision-making. The supervision checklist, not guided by

HMIS data, fails to capture realities of service, resulting in low data quality, data interpretation and use of information to provide feedback. A study in support indicates that incorporating HMIS activities into routine supportive supervision checklists and processes provides a key entry point for HMIS strengthening, it highlights the importance of good quality data needed for program management improvement, and identifies points where additional capacity-building efforts are needed (Strachan et al. 2021:27).

6.5.2.2.3 Training, responsibilities and accountability

- **HMIS Training of Trainers (TOT) and cascade training**

The integrated result shows that the HMIS master training was suboptimal, and cascading it to the facility level had multiple challenges. Nearly a quarter (23.8%) of the HMIS/HIT personnel in post were not trained, while 19% of the trained personnel rated that the HMIS training was not recent, and more than a third (35.5%) of responses indicated the recent HMIS training had not improved skills in the data management process. The majority of participants disclosed that the refresher and on-the-job training courses were superficial, resulting in persistent gaps in the practice.

The health facility managers were not engaged in HMIS Training of Trainers (TOT), thus they face difficulty in mentoring other staff on data management as well as in the use of DHIS2. Both QI and HMIS trainings enrol only QI department staff without, the QI training also excludes the HITs.

It is interpreted that the less coverage and focus on ongoing skills would result in less use of the HMIS data. The lack of adequate hard-copied reference material, coupled with the limited capacity of master trainers, might have resulted in insufficient ability of the trained staff to apply data analysis and display techniques. Literature cites low levels of staff training on HMIS in Ethiopia, and the number of trainees seems to be declining (Alaro et al. 2019:1; Kebede et al. 2020:8).

- **Responsibility/accountability**

The findings indicate inadequate accountability of data management and information use among individual health workers. A greater proportion of participants attached the responsibility of ensuring continuous use of information to HITs/HMIS staff and QI officers, on average, one in five, 19% (n = 335+320) respectively, while the least, 13.3% (n = 228) recognised that ensuring ongoing use of information is the responsibility of individual staff. Most participants depicted that HMIS tasks, data recording, entry, quality check, interpretation and presentation to the decision makers rely on the HITs/QI officers. Health professionals disown performance of HMIS tasks, even after they have been trained on them. Literature cites that a poor culture of data use results from inadequate engagement of health professionals. Staff data use behaviour improvement requires the creation of staff accountability through training, supervision and feedback for organisational and stakeholders' priorities (Bruce 2014:8).

Persistent decline of accountability for information use among healthcare providers continues to keep the HMIS in a cycle of low-quality data and limited information use in routine decision-making. This highlights the critical need to cultivate a sustained sense of responsibility for effective use of information among individual health staff, as a pathway to improving the quality of data generated through HMIS. There is a need to emphasise ensuring staff accountability and strengthening data use through training, supervision and feedback (Bruce 2014:8).

6.5.3 The behavioural factors of HMIS data management and information use

6.5.3.1 Data demand, problematic processes and motivation

The study findings indicate that the data quality check skill of participants is limited to the three commonly checked dimensions, namely, completeness, timeliness and consistency. The LQAS is fit to measure only these dimensions by checking consistency across rec-

orded, tallied and reported data, so as to identify discrepancies and correct errors. However, a study by Hlaing and Myint (2022:9) argues that, although data quality encompasses multiple aspects, completeness, accuracy, and timeliness are the most frequently adopted attributes in low- and middle-income settings due to their measurability and simplicity. The data integrity, equally essential, dimension was not part of the routine data quality assessment.

Literature defines data integrity as one of the principles of data security [it is] examined through prevention of unauthorised access to data, unauthorised modification by authorised subject and maintaining internal and external consistency of the object (Yesin et al. 2021:3).

Limited awareness of integrity principles not only undermines data accuracy but also weakens user trust and information-use culture—key behavioural and organisational determinants in the PRISM-MFI framework. When staff perceive that the data system cannot safeguard information integrity, their motivation to rely on HMIS output declines, leading to underutilisation of data for decision-making. A study by Duggineni (2023:1) emphasises the importance for organisations to have robust measures in place to safeguard data integrity, so that data is not corrupted or modified in an unauthorised manner, either intentionally or unintentionally.

There is a lack of skill in solving problems of RHIS tasks; a greater proportion, 21%, revealed that the data collection is a problematic process. This might be associated with collecting data using parallel tools; in support, most participants also cited non-digitisation of EPI data collection tools, therefore, paper form capturing of quality-compromised data. The interpretation of disintegrated, undigitized tools made data collection a problematic process. This points to the need for integrated electronic tools to capture EPI data in tandem with training health staff, which would improve the quality of data, and the similar use of information to improve the quality of immunisation service. As indicated in Huser et al. (2021:11), integration of HMIS tools facilitates electronic (data management) software

development. Digitisation of data tools reduces cumbersome documentation and paperwork and increases the efficiency and quality of data collation and analysis (Gebremariam 2018:36, 124).

The result indicates a persistent low demand for RHIS data to improve the quality of immunisation (health) services. The data demand to create community awareness was less, approximately 15%, and most participants reported limited use of data to create community awareness. The finding could be interpreted as the lack of confidence in the quality of HMIS data contributing to the low demand for data to improve community participation and Quality Improvement of service. This implies the need to demand and use data to engage the community through the reminder technique to reduce dropout of vaccination, thus improving coverage and quality of immunisation service. Literature concludes that the community should be encouraged to take ownership of planning and service delivery (Mafigiri et al. 2021:2).

The integrated finding shows uncertainty about the quality of HMIS data. Greater than a third, 38.8% (n = 160) of the participants disagree with the statement that HMIS produces high-quality data. This is supported by most participants, who reported that health professionals submit inconsistent data, which undermines the reliability of HMIS-generated information. However, the chi-square test indicates that those participants who believe in the quality of HMIS-generated data are highly likely to use information for a quality improvement plan (X^2 = 30.39, df = 4, p = <0.001). Literature cites lack of trust in quality of data leads to limited data use; emphasizes on using available HIS information rather than waiting for it to become of ‘good’ quality, as data use and feedback process enhance this quality (Lemma et al. 2020:2). There is a need to build competence in DHIS2 data quality assurance, trust in quality of HMIS produced data and implement an integrated complementary data quality check mechanism.

In turn, the result indicates that the QI process improves both the performance of data quality checking and the perception of the quality of HMIS-generated data. Planning for

quality-of-service improvement is significantly associated with checking quality of data (X^2 = 25.52, df = 1, p = < 0.001); similarly, the use of information for designing and implementing service QI is significantly associated with perception of HMIS produces high-quality data (X^2 = 30.39, df = 4, p = <0.001). Literature in sport indicates QI is a driving force for information use and ensures successful HIS integration to quality of care. (Lingamallu & Nayakvadi 2017:1).

High competence and confidence in RHIS-related tasks contribute to the high performance of RHIS. In this study, less than a third, 30.6% (n = 126), of participants indicated that they were confident in carrying out all data management processes. There was a notable knowledge gap in data management; thus, the value of data is compromised. Consequently, healthcare providers demonstrate limited willingness to register, enter, and routinely utilise data. This suggests that a lack of confidence in data management processes significantly contributes to the persistently low quality of HMIS data. This necessitates behavioural intervention, such as motivation, to enhance staff confidence in the data management process. Literature in support states that perceived behavioural control highlights the importance of healthcare providers' confidence in their ability to use HMIS effectively (Wekesa & Kamwele 2025:2).

There were variations in the results. Whilst the majority cited challenges with data collection due to the hybrid system, there was also a high percentage of participants who reported competence in good principles of data collection and verification of data quality, while a few indicated competence in data interpretation. A study's findings show the healthcare workers' possession of necessary HMIS skills, pointing to some areas, such as computer literacy and data interpretation, where further training could enhance competency and system utilisation (Wekesa & Kamwele 2025:6).

The overall confidence in data management processes was average on a 5-point Likert scale, with the least confidence in the data interpretation process. The majority of participants showed that healthcare providers lack the initiative to use and share HMIS data for

decision-making, implying that HMIS is the mandate of others. The observed disparity, where competence and confidence are higher in data collection and verification than in data analysis and interpretation, suggests that greater emphasis has been placed on data collection and quality assurance processes, with comparatively limited attention to the actual utilisation of information for decision-making. The high self-reported competence in data collection would be the result of redundant data collection in hybrid forms and repeated entry of data on DHIS2 due to an erroneous internet connection. Likewise, the reported high competence in data quality assurance would be due to repeated application of the LQAS data quality assurance mechanism.

The accumulation of high-quality data means much effort is spent on collecting and improving data without a culture of using that data for health systems improvement. The health professionals perceive that the health workers are care providers and are not responsible for recording the care they provide to patients and registering their role (Wagenaar et al. 2017:1; Muhindo et al. 2016:4; Ledikwe et al. 2014:7). There is a need to strengthen self-assessment and internal data sharing to improve the quality and demand of HMIS data. This, at the same time, would build competence in data interpretation and responsibility for information use among care providers.

It is evident from the data that participants expected some incentives for attending training sessions. MEASURE Evaluation (2018:16; Muhindo et al. 2016:7) argues that, in general, there are inadequate organisational incentives for the analysis and use of data and few penalties for not doing so. The data shows that motivation through incentives of champion producers and users and managers' use of information has a significant association with performance of data interpretation and data analysis (X^2 = 18.34, df = 1, p =< 0.001); (X^2= 13.55, df = 1, p = <0.001). There is a critical need to strengthen the data use capacity of health managers, accompanied by comprehensive and sustained motivation strategies targeting both data producers and users to foster a culture of information-driven decision-making. Literature shows staff motivation, performance monitoring and

decisions based on superior directives were found to be determinants of HMIS data utilisation (Yarinbab & Assefa 2018:1, 5).

6.5.4 PRISM-MFI performance (RHIS) of information use

6.5.4.1 Continuous use of information and evidence

Continuous utilisation of RHIS information cannot be established without purposeful usage of information. The MFI component of the PRISM-MFI framework establishes the nexus of aimful information usage to improve immunisation service quality. A study states that quality improvement of healthcare contributes to continuous learning and hence to a culture of information use and organisational success (Nshimyiryo et al. 2020:10; Aqil et al. 2020:4).

The findings show the influence of the RHIS process determinants, limited capacity for data interpretation and its use in decision-making. Less than a fifth, 19.7% (n = 304) and 17.9% (n = 277) responses indicated interpretation and utilisation of HMIS data for immunisation activities, respectively. Most participants mentioned the low competence of care providers in interpreting data to identify performance gaps. These findings have several critical implications for immunisation services, especially in low and middle-income countries where resurgence of epidemics from vaccine-preventable diseases is common. Practitioners are less able to identify root causes of coverage gaps, high-risk populations and underperforming regions. This can result in missed opportunities and undermine efforts to achieve universal immunisation (health) coverage.

Ethiopia is among the countries recurrently confronted with outbreaks and epidemics of vaccine-preventable diseases (Manyazewal et al. 2018:2). Another study by Salangwa, Munthali, Mfune and Nyirenda (2025:6) shows the least use of HMIS data for epidemic response compared to utilisation of data for planning, indicating data use for planning was 42%, whilst it was just 1% for being ready for disease epidemics.

The integrated result depicts a low understanding of technical determinants. Less than half (47.6%) of participants correctly listed components of standardisation involving standard indicators. The departments and facility managers reported that Health Information Technicians (HITs) experience difficulties in understanding health indicators and data elements. This limited comprehension of standardised definitions and health-related terminologies may contribute to poor data quality and hinder the effective use of information for planning and decision-making. Dufera et al. (2018:1) report that if health workers understand HMIS tasks, they would perform the tasks perfectly. The result shows less use of HMIS information for organisational determinants such as governance and administrative (management) functions. Use of HMIS information for staff performance appraisal and resource allocation was mentioned by a low, 15.6% (n = 216) of responses. Most participants explained that HMIS data is inadequately used for budget allocation and outbreak response. Inadequate data use hampers evidence-based planning and budgeting.

This can result in the inefficient allocation of vaccines, staff, and cold chain resources, potentially leading to vaccine stockouts in some areas and wastage in others—both of which compromise immunisation program performance. The finding on the use of HMIS information for budget and resource allocation is even less than what is reported by Salangwa et al. (2025:6), a study in Zanzibar, which reported 23% HMIS data use for managing supplies and medications, and 18% for budgeting.

Utilisation of HMIS-generated data needs to be improved to enhance organisational effectiveness, such as need-based resource allocation and optimal utilisation. A study by Qian et al. (2023:10) recommends the use of HMIS data at the facility-level for ongoing monitoring of health programs, resource allocation, and quality improvement as an essential tool to improving health service effectiveness in Ethiopia and similar settings.

Perception of HMIS data is one of the behavioural determinants of RHIS. Concern was raised regarding HMIS that the data is reported to be inconsistent and lacks reliability. This could result in low use of HMIS data for immunisation (health) quality service im-

provement, and could have serious implications for monitoring equity in immunisation service. When health professionals are not equipped to interpret data and the organisation fails to promote the information use culture, that diminishes the perceived value of data collection and perpetuates a cycle of underuse and poor-quality data. The health workers' RHIS data use behaviour is often associated with their perception of data quality, as indicated in (MEASURE Evaluation 2018:11).

Most of the participants reported that Expanded Programme on Immunisation (EPI) indicators are frequently overachieved or overreported, with identified gaps typically addressed through the development of action plans rather than through the design and implementation of quality improvement (QI) projects. As a result, the EPI unit has limited experience in executing QI initiatives. This reflects a systemic emphasis on monitoring service coverage over efforts to enhance the quality of immunisation services. Literature acknowledges that data problems limited QI leaders' ability to make use of assessment and feedback, as well as impeded efforts to evaluate QI programs' success (Grabert, Heisler-MacKinnon, Liu, Margolis, Cox & Gilkey 2021:6).

The exclusive focus on underperforming indicators suggests the absence of a standardised baseline framework in the design of Quality Improvement (QI) projects. This limits the ability to systematically identify performance gaps, set measurable targets, and evaluate the effectiveness of QI interventions. WHO (2016:2) concludes that high service coverage alone is not enough to reduce mortality; therefore, quality of healthcare has become a critical aspect of the unfinished maternal and newborn agenda, at the local level.

The PRISM-MFI framework of the study explains that continuous use of RHIS information is driven by the established aim of QI testing changes and solving problems using data. In turn, the use of information for QI consistency improves the quality of data.

However, the findings show less use of documented QI initiatives to evidence regular use of information. While 23.2% (n = 218) of responses indicated the monthly report as evi-

dence for continuous use of information, a relatively low 17.9% (n = 168) of responses revealed documented QI initiative as evidence for continuous use of information. The majority of the participants showed the interrupted use of the PDSA cycle in planning and implementation of Quality Improvement. This implies the use of data mainly for sending reports and inadequate use of HMIS information for improving the quality of service. This aligns with a study result that indicates information from health data is used only for report purposes and not to drive decisions and program improvements (Dagnew et al. 2018:2). A culture of evidence-based decision-making or documentation of information use in organisational settings.

The result depicts inadequate (43%; n = 177) use of HMIS information for the entire cycle of improving the quality of immunisation (health) service. Even this low use of information focuses on the planning (aim setting) phase of a QI project, deprioritising the use for assessment of changes in quality. The greater proportion, 29.1% (n = 337), of responses indicate information use for a QI design phase, while the least, 17.7% (n = 205), reported its use for assessment of changes in quality of service. Besides, the participants revealed that insufficient monitoring of change ideas of a QI project is a main barrier, besides the lack of ownership to sustain the changes. Irregular use of QI monitoring tools and use of data for the partial process of QI are also among the challenges. Performance of information use.

On the whole, this study revealed a low culture of information use. The QI of healthcare contributes to continuous learning and hence to a culture of information use and organisational success (Nshimyiryo et al. 2020:10; Aqil et al. 2020:4).

The study result shows less use of HMIS data for monitoring vaccine stock and the cold chain. The main use of immunisation data is to reduce the Dropout Rate (DOR) of vaccination. The greater, 21.8% (n = 340), responses revealed the use of data to reduce the DOR compared to 17.1% (n = 267) responses depicted its use to monitor the stockpile of vaccines. Most participants mentioned irregular use of vaccination data to monitor the

availability of vaccines and cold chain functioning. An insufficient monitoring of the availability of vaccines results in a stock-out of vaccines, which might contribute to the interruption of immunisation services that could worsen the DOR. Similarly, interrupted monitoring of the cold chain (potency of vaccines) would result in delivery of impotent vaccines, which would contribute to outbreaks of vaccine-preventable diseases.

The result shows uneven use of information for immunisation service activities related to challenges in producing quality data. Nearly half, 53.2% (n = 217), of participants had experience of using HMIS information for immunisation service-related activities. Most participants mentioned that immunisation data is uniquely discrepant. They listed various factors affecting consistency of the EPI data: recording multiple antigens at a time, difficulty in locating immunisation start registering to record full immunisation status, for instance, measles dose after six months of Penta 3, and absence of an electronic child health (EPI) card. This implies that the manual entry of multiple antigens simultaneously and the challenges of tracing a record contribute to the low quality of data and the use of immunisation information for decision-making**.**

Additionally, the finding indicates minimal use of HMIS data to supervise immunisation activities. Fewer than a fifth, 17.8% (n = 251), of responses reveal use of data to conduct immunisation supportive supervision. Most participants expressed that inadequate use of HMIS data to supervise EPI service is among the barriers to immunisation service quality improvement. This implies that the low attention to the contribution of evidence-based supervision would undermine the quality of immunisation data and service delivery. Regular HIS supervision might help health workers to improve their capacity for health data analysis, interpretation, and use it to make an evidence-based decision at lower levels of the healthcare system (Chanyalew et al. 2021:9).

The study depicts weak utilisation of HMIS data for planning health (immunisation) services. While a slight majority, 51.3%, of participants mentioned the use of information for general health service planning, less than a quarter, 23.2% (n = 327), mentioned the use

of HMIS data for planning and management of immunisation resources. Most interview participants indicated that the REC micro plan is a top-down approach with less participation at the implementer's level. This implies low use of health facility-generated data to develop and implement the REC micro plan. A study cites significant knowledge gaps among health workers at all levels regarding the Reach Every Child with immunisation microplanning process (Mafigiri et al. 2021:1; The Maternal and Child Survival Program (MCSP) Uganda 2016:1).

As mentioned above (Section 6.4), the integration process identified convergence, complementarity, and divergence findings between the two datasets and produced meta-inferences that guided the conclusion of the study. The majority of findings from the two strands were convergent and complementary, whereas some findings were divergent. This labelling is expressed in paragraphs below under the overarching theme of data management processes.

- **Areas of convergence:**

The quantitative finding demonstrates that most responses revealed the use of multiple data aggregation tools; use of DHIS2 over 40%, and tally sheets and reporting forms 25%. The qualitative findings revealed that the majority of participants reported use of multiple parallel tools for data aggregation, including DHIS2, tally sheet, register and other programmatic software. Interpretation of combined findings provided metainference of parallel hybrid data aggregation tools.

- **Areas of complementarity:**

The minority, 39.8% (n = 164) of participants, reported having skills in multiple data quality check mechanisms, while qualitative insights revealed that the majority of participants mentioned the application of only the LQAS mechanism for data quality check, indicating that the LQAS is unreliable to ensure data quality. The metainerence in this regard is low competence in data quality checks.

- **Areas of divergence:**

While 34.1% (n = 348) of responses reported data sharing through DHIS2 monthly and quarterly reporting. Qualitative source data, in parallel, revealed reports of most participants that data sharing with partners occurs primarily monthly using hard copy formats provided by the partners themselves. The metainference concludes institutional versus parallel systems that use hybrid forms and parallel reporting from health facilities to different agencies

6.6 SUMMARY

The integrated result indicates inefficient HMIS data management processes. The processes from data collection to quality assurance had a shared contribution to the uncertain quality of HMIS-generated data. Additionally, the data analysis using DHIS2 delays output, data interpretation fails to explain performance gaps and formulation of appropriate action plans. These challenges, in turn, constrain data analysis, interpretation, and dissemination, which may subsequently result in low demand for data, inadequate capacity for data quality checks, and diminished stakeholder confidence in the data.

Moreover, overreliance on manual tools for data display presents a significant barrier to timely updates and external dissemination. Inadequate constructive feedback diminishes the contribution of supervision to data quality and information use. Owing to this, data quality, interpretation and the use potential of frontline facilities are negatively impacted. The intervention should focus on streamlining data management processes to ensure useful data is generated through HMIS. And use of integrated data quality check mechanisms that assess inclusive data quality dimensions.

HMIS diseases and the BSC data tools are rated as complex, containing duplicative and difficult-to-understand data elements. The DHIS2 was also found to be complex, lacking interoperability, data import-export and edit features. Suboptimal knowledge and applica-

tion of standard integrated tools, and the HITs' inability to understand health indicators and data elements, compromise the quality of data generated from HMIS processes.

The results indicated a low organisational culture of information use. Disengagement of frontline staff in HMIS design affects ownership of HMIS implementation. The less usage of the HMIS data source for governance and management functions, including supportive supervision. Inadequate coverage and focus of master HMIS training, and insufficient resources and motivation for cascaded training. Health professionals externalise accountability of data management and information use to HMIS and QI officers.

The HMIS data collection process was found to be problematic due to being redundantly executed. The staff are average with confidence in overall data management processes, with high competence in data collection and data quality checks. This might imply repeated execution of the two processes because of the unreliability of DHIS2 and LQAS. Health managers need to have information use capacity to be accompanied by comprehensive and sustained motivation strategies targeting both data producers and users to foster a culture of information-driven decision-making.

Suboptimal technical, organisational, and behavioural determinants contributed to the inadequate execution of data management processes, which in turn resulted in compromised HMIS data quality and the underutilization of information for planning, implementation, and service quality improvement.

Utilisation of HMIS information is unacceptably low; slightly greater than half of the participants reported information use for immunisation (health) service planning and implementation. The utilisation of information for the whole cycle of immunisation (health) service quality improvement was reported by less than half, 43%, of the participants. The necessity of prioritising a holistic service quality improvement initiative to ensure the continuing use of information.

CHAPTER 7: GUIDELINE DEVELOPMENT AND PRESENTATION OF INTERLINKED GUIDELINES

7.1 Introduction

Chapter 6 presented the integration of the quantitative and qualitative findings of this study. Based on the integration phase findings, this chapter describes the development of interlinked three key guidelines to strengthen the use of the HMIS for immunisation service quality improvement in Ethiopia. The three guidelines are the Data Quality Improvement Guideline, the Information Use Guideline, and the Immunisation Service Quality Improvement Guideline.

The mixed methods result revealed gaps in data management processes, including data quality; extent of evidence-based decision-making, and consistency of immunisation service quality. In response to these findings, a three-in-one guideline package was developed to address these identified shortcomings in a systematic manner. The guidelines represent an integrated framework that brings together multiple approaches and innovations relevant to the Ethiopian health system.

The data quality improvement guideline focuses on ensuring accuracy, reliability, timeliness, integrity and precision of HIMS data. It proposes integration and standardisation of data collection, aggregation and reporting tools. The proposal also includes building data management capacity among health staff to carry out data quality assurance, data analysis, interpretation in problem identification and mitigation planning to the extent it targets enhancing infrastructure and the application of an integrated complementary data quality check mechanism; LQAS, RDQA and DQRC, while it provides a comprehensive understanding of DQA.

The information use guideline outlines the approaches to continuous use of information and evidence of information use at the health facility level. It emphasises the purpose of

information use and building the capacity, strengthening supportive supervision and feedback, and ensuring accountability of healthcare workers and managers to analyse and interpret data, and use information effectively and continuously. The guideline aims at fostering a culture of information use to bridge the gap in the use of information for planning, performance monitoring, budgeting, performance appraisal and implementation of health interventions such as quality improvement.

The immunisation service quality improvement guideline offers a systematic approach to the use of information to improve (health) immunisation service and address barriers of supply, cold chain and use of HMIS information for EPI supportive supervision. It proposes tools to assess client satisfaction with changes in quality of service, and deals with setting baseline indicators of quality improvement, monitoring quality improvement projects, and engaging the community in immunisation services. It focuses on the identification and prioritisation of problems in immunisation service quality and the monitoring of changes in quality using the plan-do-study-act (PDSA cycle) approach of the Model for Improvement (MFI). With effective implementation, the guideline would contribute substantially to improving the quality of data generation, promoting the use of information, and enhancing information utilisation for improving immunisation service delivery and quality.

This chapter first outlines the guideline development process, then presents the scope, purpose and objectives of the guidelines, followed by a summary of the integrated findings and interpretation that informed them. It then details the content and key strategies (actions) of the three guidelines, the responsible unit/person and expected outcomes.

7.2 Process of guideline development

The three guidelines were developed through a systematic and participatory process to ensure methodological rigour, contextual relevance and stakeholder ownership. The process was guided primarily by the integrated findings of the study (quantitative and qualita-

tive), supported by relevant literature and refined through expert consultation and a validation workshop.:

7.2.1 Step 1: Draft guidelines development based on integrated findings

The starting point for guideline development was the integrated analysis of the quantitative and qualitative results presented in Chapter 6. These findings provided pivotal information on:

- Weaknesses in RHIS data management processes.
- Technical, organisational and behavioural determinants of RHIS performance.
- Gaps in information use.
- Limitations in immunisation quality improvement practice.

On the basis of these integrated findings, draft guideline components were developed to be:

- Evidence-based - directly linked to empirical findings.
- Contextually relevant - tailored to the Addis Ababa and Ethiopian PHC context.
- Actionable - specifying concrete activities and mechanisms.
- Aligned with national immunisation and HMIS objectives.

7.2.1.1 Framework selection

The PRISM-MFI framework not only guided the study but also served as the foundation for developing the immunisation service quality improvement guidelines. It ensured alignment with global standards and best practices, alongside the integration of key study findings. This process was situated within broader health system strengthening frameworks, with a particular focus on two critical health system building blocks: health information systems and service delivery.

The PRISM (Performance of Routine Information System Management) framework informed the focus on RHIS processes and Technical-Organisational-Behavioural (TOB) determinants of data quality and information use.

The Model for Improvement (MFI)—particularly the Plan-Do-Study-Act (PDSA) cycle—guided the design of iterative, data-driven improvement processes in immunisation service delivery.

Locating the guideline development within this integrated framework ensured:

- Alignment with health system strengthening perspectives.
- Explicit attention to two WHO health system building blocks (health information systems and service delivery).
- A clear link between improved RHIS performance and continuous quality improvement in immunisation services.
- The PRISM-MFI integration provided the conceptual foundation for structuring the guidelines, their components and their implementation pathways.

7.2.2 Step 2: Healthcare expert consultations before validation

A diverse group of 13 health experts, including policymakers (two), health managers (three), service providers (five), and development partners (three), was engaged from the outset. Their participation in the guideline ensured that the guideline addressed practical realities and aligned with local, national and regional priorities.

7.2.3 Step 3: Evidence synthesis and drafting based on the consultations

In this step, evidence from three main sources was integrated. The evidence from integrated quantitative and qualitative results, literature review on RHIS performance, information use and immunisation QI and the expert consultations with immunisation and pub-

lic health experts was systematically synthesised to inform the initial drafting and iterative refinement of the deleted guidelines.

7.2.4 Step 4: Validation and finalisation

A validation workshop was convened to review the guidelines. The workshop was conducted in a conference hall of the Yeka sub-city health centre. A two-day workshop was held on 12-13 October 2025, with 15 participants attending the workshop. The participants in this workshop constituted seven experts who reviewed the draft guidelines at the expert consultation step, and eight purposively selected individuals from facility managers, immunisation service providers and health information officers. Scope, clarity and structure of the guidelines were a high emphasis of the workshop, confirming alignment with identified needs and priorities and verifying the technical accuracy and contextual appropriateness of proposed strategies.

Feedback from the workshop, both written and verbal, was used to refine the guidelines, leading to their finalisation as a three-part interlinked package for facility-level use.

7.3 SCOPE AND PURPOSE OF THE GUIDELINE

7.3.1 Scope

The three-in-one guideline package provides a comprehensive framework for strengthening HMIS use and immunisation service quality at the health facility level. It focuses primarily on:

- Improving RHIS data management and integration
- Strengthening data quality assurance mechanisms
- Promoting purposeful and continuous information use
- Guiding the design, implementation and monitoring of immunisation quality improvement projects

The guidelines are intended for use by facility managers and department heads, immunisation service providers, health information technicians/officers and quality improvement focal persons.

7.3.2 Purpose

The primary purpose of the data quality improvement guideline, information use guideline, and immunisation service quality improvement guideline is to:

- Strengthen health systems by addressing critical challenges in data quality, information utilisation, and quality of service delivery.
- Enhance evidence-based decision-making at facility and sub-city levels.
- Foster a culture of routine information use; and
- Build the capacity of service providers, managers and policymakers to use quality-assured HMIS data for continuous quality improvement.

The guidelines outline the use of tools, processes and resources to support:

- Improved data analysis, interpretation and application.
- Strengthened feedback loops and accountability mechanisms.
- Better alignment between HMIS outputs and quality improvement efforts.

7.3.3 Objective

The specific objectives of the guidelines are:

- To ensure reliable, accurate and fit-for-use immunisation data by standardising and integrating data collection, aggregation, quality assurance and sharing tools.
- To promote evidence-based, purposeful information use for decision-making by strengthening data analysis, interpretation and feedback of immunisation data.
- To enhance the quality of an immunisation (health) service through data-driven implementation and monitoring of the QI project.

7.4 SUMMARY OF THE FINDINGS FROM THE MIXED METHODS OF THE STUDY

The study identified critical gaps in data quality, information use, and immunisation service quality. A detailed result from the integration phase is presented in Chapter 6, while the key summaries for each guideline are outlined below.

7.4.1 RHIS data management processes and quality assurance

Overall, RHIS processes were sub-optimally implemented, resulting in redundant data capture, fragmented aggregation, limited quality assurance, delayed data display and sharing, ineffective feedback, and weak analysis, interpretation, and decision-making. This is supported by a similar study by Mekebo, Gobena, Hawulte, Tamiru, Debella, Yadeta and Eyeberu (2022:10), who mention that technical barriers, including DHIS2 system failures, complex reporting formats, and unreliable internet connectivity, further hinder timely data reporting and utilisation.

7.4.2 PRISM-MFI factors on RHIS process and performance

Technical determinants: The result indicated that the design of DHIS2/HMIS is complex, as the software had limited archival functionality, flexibility, interoperability and access to real-time data. These made the system unable to flexibly accommodate emerging programmatic data needs, to correct incorrect data entry, and to ensure data security. Data aggregation and entry apply multiple integrated tools and software. Health staff lack skills in DHIS2 technical aspects. The DHIS2 gaps are more intricated by limitations in internet connection and server capacity. The complex design of disease reporting forms and lengthy data collection tools negatively impacts data generation and information use. Due to a lack of digitised EPI data collection tools, care providers report inconsistent EPI data. Moreover, sub-optimal engagement from frontline actors in the design and revision of standard indicators, procedures and data elements results in less ownership and unresolved challenges of implementation.

Organisational determinants: Lack of documented success story ascribed to, evidence-based decision-making demotivates continuous use of data, which means the quality of data and its use remains insufficient. Inadequate supportive supervision worsens loose accountability to HMIS-related tasks. Sub-optimal master and cascaded HMIS training undermines efforts to create fit human capacity for data management and information use. Weaker data use for staff performance appraisal and budgeting weakens both accountability and motivation to use information for organisational and stakeholder priorities.

Behavioural determinants: Limited data quality check skills impede the application of multifaceted mechanisms to examine comprehensive dimensions. Persistently low data demand constrains the production of fit-for-use data, thereby hindering the improvement of the quality of immunisation (health) services. Studies show low engagement of users in priority information, and dissemination would break the cycle of data demand and use (Blessing et al. 2017:10; Sligo et al. 2017:8; MEASURE Evaluation 2018:14).

Undigitized data collection tools worsen the burden of workload on health staff while affecting the quality of data. Similarly, the observed low competence and confidence in data management affect the RHIS's contribution to health system performance. Absence of incentives/motivation among data producers and users weakens interest in data processing and use. Low perception of data quality would retain the system in a cycle of poor data quality and utilisation of information.

7.4.3 RHIS performance of Information use

The HMIS data is primarily used for coverage monitoring purposes, rather than for the QI initiative of immunisation service, due in part to unreliable EPI data to set a baseline for quality projects. Although there is significant training staffing for quality improvement at the health facility level, persistent use of information to monitor QIP and inform quality improvement has not yet been established. Current use of information for quality focuses on planning phases of quality projects, neglecting the use of information for testing changes

in quality and solving quality problems. The QI initiative is not yet instituted as evidence for continuous use of information. Quality Improvement Project lacks effective monitoring tools: the use of the PDSA cycle for regular monitoring of the designed project is interrupted.

7.4.3.1 Immunisation service quality improvement

The immunisation service lacks the use of HMIS data to monitor vaccine stock and cold-chain functionality. Additionally, there are limited mechanisms to track and reduce drop-out rates, and inadequate follow-up on missed opportunities for vaccination (MOV), both of which reduce effective coverage of vaccination. Health professionals lack confidence in designing and implementing immunisation service quality improvement due to a lack of guidance on how to enrol QIP indicators. HMIS immunisation data is less used in the execution of the RED/C strategy, which includes EPI supportive supervision and feedback; engagement of the community into service; reaching all eligible population through a reminder system to enhance coverage and quality of immunisation service.

Ethiopia's immunisation service quality improvement is limited by the underutilisation of HMIS data, which focuses on performance monitoring rather than proactive problem-solving, leading to missed opportunities for service enhancement JSI (2021:1). Strengthening M&E through structured quality improvement cycles and robust data feedback loops is essential for enhancing immunisation service delivery and ensuring continuous improvement (Zemariam, Kibret, Kassa, Alamaw, Molla, Abate, Tilahun, Wondie, Shimelash & Fentanew 2024:13).

These findings underscored the need for structured, data-driven QI guidance anchored in HMIS information.

7.5 GUIDELINES TO IMPROVE DATA QUALITY, INFORMATION USE AND IMMUNIZATION QUALITY IMPROVEMENT

The following sections present the three interlinked guidelines. The guidelines are detailed in a structure of the study findings, interpretation, actionable guidelines, responsible entity, and expected outcome.

7.5.1 Data Quality Improvement Guideline

7.5.1.1 Introduction

The data improvement guidelines have two parts:

- An overview of key data quality assessment mechanisms, and
- Proposed strategies to improve data quality across the RHIS cycle.

The guideline aims to provide facility teams with a clear understanding of available data quality tools (LQAS, DQA, RDQA, DQRC, validation, verification factor) and to guide the practical application of integrated, routine data quality assurance for better data accuracy, completeness, timeliness, precision, integrity and usability.

7.5.1.2 Data quality assessment mechanisms

Data quality assessment methods are essential for ensuring that health data is accurate, complete, reliable, and timely, thereby enabling effective decision-making and resource allocation (Getachew, Erkalo & Garedew 2022:5). In Ethiopia, where data management systems such as DHIS2 and other electronic platforms such as SmartCare are widely used alongside paper-based tools, assessment methods must respond to both systemic and contextual challenges (Mekebo et al. 2022:4). This study shows that data quality assessment, mainly, applies LQAS at facility level and RDQA at districts and higher levels.

The guidelines, therefore, summarise the main mechanisms and propose their integrated application.

7.5.1.2.1 Lot Quality Assurance Sampling (LQAS)

LQAS is used to determine whether health data from a specific area meets quality standards or if corrective actions are needed (Azizi 2021:2). LQAS is particularly useful in settings where there is a need to assess data quality quickly and efficiently without needing to check every data point. The mechanism selects a random sample of 12 data elements from a dataset and verifies only the consistency dimension of data quality in reports. If the selected sample fails to meet the quality threshold of 90%, the sampling is repeated; however, there is no guidance on the number of times or the rationale for repeating sampling to attain the threshold.

Previous studies and reviews in Ethiopia indicate inclusive use of LQAS at district and regional levels to assess data of large-scale programs like immunisation and maternal health services (Federal Democratic Republic of Ethiopia Ministry of Health 2018:30). This study, however, identifies that the LQAS data quality check mechanism is applied only to health facility level users, whereas the RDQA application is at district and higher levels.

Reliability of LQAS is questioned by the end-users, because it draws a smaller sample size. Besides, it fails to measure important dimensions other than consistency (reliability) and does not involve a review of missing and zero values. The mechanism, inherently, lacks a parameter to assess the system that generates the data. A study indicates that Quality data is a function of the program's M&E system and data verification processes (Ochieng, Chemutai, Odida, Otieno, Ochola, Charles et al. 2022:8).

7.5.1.2.2 Data quality audits (DQAs)

The DQA is an indicator-specific external audit designed to evaluate a program's capability to report quality data from a sample of health facilities. It identifies gaps in data quality, factors that support or hinder data quality and use with recommendations for improvement (Gimbel et al. 2017:2, 6). A study results on DQA recommend strengthening staff skills as a place to begin data quality improvement, coupled with standardisation of reporting procedure (Yourkavitch et al. 2019:1, 2, 6). The DQA audit applies data verification, and its assessment and intervention involve beyond single health facilities, not applicable for self-assessment; however, this guideline underscores the need to have a comprehensive understanding of the DQA application among facility staff to own and implement feedback based on DQA assessment findings.

7.5.1.2.3 Routine Data Quality Assessment (RDQA)

The RDQA, a revised version of the DQA, serves for self-assessment and enables organisations to proactively identify and address data quality issues. The RDQA tool is employed to validate the quality of data, evaluate the system that generates that data, and formulate action plans to enhance both (MEASURE Evaluation 2017:7-9). The proposed application of RDQA at the health facility level would enable the system to promptly assess the availability and functionality of data quality assurance components, besides the data verification factor. A study indicates that the RDQA is designed for regular use by programs and projects to assess and strengthen their data management and reporting systems (MEASURE Evaluation 2017:1).

7.5.1.2.4 Data Quality Report Card (DQRC)

The DQRC is a tool developed by the World Health Organization (WHO) to systematically assess the quality of data generated by health facility-based information systems (World Health Organization 2017:8). The DQRC can assess the quality of RHIS data: inconsist-

encies and inaccuracies in terms of completeness of reporting; the internal consistency of reported data; the external consistency of population data; and external consistency of coverage rates.

The DQRC involves assessment of completeness and timeliness of the report, missed or zero values for each reported indicator, internal accuracy and outlier values. Additionally, it assesses consistency over time and between indicators of simultaneous or follow-up services. Its external consistency denotes consistency of population projection by national versus international (UN) levels; consistency of operational denominator by the district official versus recent survey on the targets, and external coverage rate of HMIS versus the recent survey (Ouedraogo et al. 2019:3-4).

The DQRC is a more comprehensive data quality assurance tool as it measures accuracy, completeness and timeliness dimensions; and internal and external consistency (reliability). Use of DQRC would, by far, resolve issues of data quality at the health facility level; however, its application requires access to robust and up-to-date survey results for substantiation of the findings. The use of DQRC is indicated in the PRISM framework to regularly assess and evaluate different dimensions of data quality, such as completeness, accuracy, and timeliness. In Ethiopia, the PRISM tool can be used at health facilities, districts, and regions to identify gaps in data management practices (Ethiopia Ministry of Health 2019:3).

In summary, the LQAS concludes on an inadequate sample size, DQA is meant for data audit of more than one site by an external body; RDQA is not applied to the consistency of population data; and DQRC needs survey data to compare with routine data for consistency of coverage rates. Therefore, the use of integrated LQAS, RDQA and DQRC mechanisms is proposed for reliable and level-appropriate data quality assurance.

7.5.1.2.5 Data validation and verification (verification Factor (VF)

Data validation involves checking the accuracy and consistency of data based on predefined rules or criteria, for instance, a predetermined acceptance level. Data verification, on the other hand, refers to checking that the data entered into systems, like DHIS2, corresponds with source documents or primary data records (Federal Democratic Republic of Ethiopia Ministry of Health 2018:41, 52). Verification can be done through manual comparison or by using automated tools available in the system. Data validation and verification are crucial at all levels of the health system in Ethiopia (Arsenault et al. 2021:5). They are especially important at the facility level to ensure data entering national systems, DHIS2, is accurate.

Individually, each mechanism has limitations. The guideline therefore recommends an integrated data quality assurance approach combining:

- Enhanced LQAS,
- Routine RDQA,
- Periodic DQRC, and
- Systematic use of data validation and verification procedures. All anchored in the PRISM framework.

❖ Study findings on data management processes and quality assurance revealed:

- The data collection process uses multiple, fragmented and undigitized hybrid tools.
- Data entry into DHIS2 by the HITs, often with a limited understanding of indicators and data elements. Unreliable internet connectivity and system failures led to data loss and repeated data entry.
- The data aggregation relied on disintegrated hybrid systems (tally sheets, DHIS2, and program-specific software). Lack of interoperability between DHIS2 and platforms such as SmartCare, EMR, and pharmaceutical systems

- Donor-specific tools and the absence of a clear government roadmap for RHIS integration.
- Data quality assurance at the facility level relied heavily on LQAS, which assessed mainly consistency and neglected attributes such as integrity.
- Other data quality mechanisms (RDQA, DQRC, DHIS2 inbuilt checks) were infrequently and inconsistently used, partly due to limited skills and inadequate staffing of HMIS/M&E posts.
- Limited data analysis, interpretation and feedback contributed to low data quality and underutilisation of information.
- Data visualisation (e.g., paper charts, underutilised DHIS2 dashboards) was inadequate.
- Data-sharing practices prioritised upward reporting over internal use for planning and quality improvement.

This study's findings highlight systemic vulnerabilities within the RHIS. Suboptimal data management processes—exacerbated by unstandardized and largely paper-based reporting systems, poor internet connectivity, and limited staff competency—contribute to significant data entry errors. In addition, the unreliability, lack of interoperability and slow performance of DHIS2 hinder timely data processing and reporting. Furthermore, an overreliance on standalone LQAS quality checks, coupled with a lack of system ownership, has resulted in parallel tracking mechanisms that compromise data quality and weaken the effective use of health information for decision-making.

7.5.1.2.6 Proposed data quality improvement strategies

The guideline proposes four main strategies:

1. Standardisation and simplification of tools.

2. Infrastructure enhancements.

3. Capacity-building (HMIS training); and

4. Implementation of integrated data quality assurance mechanisms.

7.5.1.2.7 Standardisation and simplification of tools

Effective data management is critical for improving data quality, and standardising and simplifying tools play a vital role in addressing inefficiencies and fragmentation in health information systems (Heywood & Boone 2015:11). The proposed interventions focus on integrating data tools and providing clear and user-friendly guidelines to reduce complexity in consistent data collection and reporting.

- **Key interventions**

❖ **Assessment and stakeholder engagement**

- Assess and identify gaps such as disintegration and redundancies (inefficiencies) in current EPI data collection and reporting tools.
- Omit non-relevant data elements to measure EPI program indicators.
- Ensure alignment of standardisation with national and local health priorities.

❖ **Tools standardisation process**

- Define immunisation data elements fit for indicators: for instance, vaccine stock out rate, functional cold chain, coverage rates and adverse events monitoring.
- Develop data collection and reporting forms with uniform fields.
- Provide standard, unambiguous instructions to users.
- Digitise the templates compatible with DHIS2 reporting platforms; the one with offline data entry in case of internet interruption, and for later synchronisation.
- Conduct workshops and on-the-job training to familiarise the users with new tools, proper data entry, validation and error correction.
- Provide user manuals, video tutorials, and visual guides, practicum and demonstration to support learning.

❖ **Tool integration**

- Create uniform non-duplicate immunisation data elements,
- Develop an immunisation module and integrate it with the DHIS2.
- Introducing a single channel of reporting through an integrated module with DHIS2,
- Implement the integrated system in selected health facilities, gather user feedback, make adjustments and standardise before roll-out implementation.

❖ **Implementation and support**

- Roll out the standardised tools and integrated system in priority phases.
- Establish help desks and mentorship programs for users in the transition.
- Regularly assess the understanding and effective use of standardised tools through mentoring, supervision, surveys, and stakeholders' feedback.
- Address challenges promptly and refine tools addressing the findings.

❖ **Feedback and continuous improvement**

- Create channels for health workers to provide feedback on the usability of the tool and system integration challenges.
- Gather, synthesise and identify user needs and feedback.
- Provide checklist-based actions on the feedback, with scheduled follow-up visits.
- Periodically review and update forms, guidelines, and system configurations to accommodate changes in health programs reporting.

❖ Responsible entity

- Ministry of Health (MOH), the Regional Health Bureau and other stakeholders
- Health (immunisation) care providers and facility managers participated in the update.
- Newly established (existing) task force or Technical Working Group (TWG)
- Intern (apprenticeship) health science students.

Expected results:

- Standardised and integrated tool, indicators and data elements owned by implementers
- A unified DHIS2 reporting module for immunisation.
- Reduced duplication and parallel reporting.
- Improved competence and motivation in data capture and reporting.
- More consistent, accurate and timely data for decision-making.

7.5.1.2.8 Infrastructure enhancements

Enhancing infrastructure is critical for improving data quality and efficiency in Ethiopia's health system. This strategy focuses on upgrading systems and server capacity, expanding internet connectivity, and integrating platforms to address current challenges of software failures, poor internet access, and fragmented systems, thereby resolving over-reliance on paper-based forms. The following steps outline how this strategy can be effectively implemented:

➢ **Key steps**

❖ **Assess current DHIS2 infrastructure.**

- Assess DHIS2 functions: data edition, integrity, offline entry and reliable archival.
- Assess internet connectivity with a focus on health facility-level function.
- Examine the technical capability of DHIS2 users and care providers.
- Identify causes of unreliability and failure to real-time data access.
- Ensure regular scheduled updates of the software in response to user feedback.
- Map facilities with frequent software and internet failures and rely on paper-based tools.

❖ **Upgrade the DHIS2 software, server capacity and internet access.**

- Implement regular updates on DHIS2 to enhance system performance.

- Integrate the immunisation data module with DHIS2 for efficient data management.
- Upgrade server infrastructure for added data volumes and reliable operation.
- Pilot the upgraded system in selected sub-cities in Addis Ababa
- Scale in Ethiopia based on gathered pilot feedback and necessary adjustments.
- Implement alternative internet access: satellite, mobile network for remote sites.
- Enhance offline data entry to DHIS2 and storage in intermittent connectivity.
- Train health workers on synchronising offline data to the server once the connection resumes.

- **Integration with other platforms**
- Create interoperability among DHIS2, SmartCare and EMR for data sharing.
- Automate data exchange across systems to minimise manual data entry errors.
- Establish secure and efficient data sharing among platforms.
- Maintain confidentiality and integrity in data sharing.

❖ **Monitor and evaluate the progress.**

- Track the performance of upgraded infrastructure and software.
- Ensure internet availability and system integration success.
- Regularly assess the impact of infrastructure enhancements on data quality, timely access and data utilisation.

❖ **Responsible entity**

- MOH and other stakeholders (Tele, Non-governmental organisations, NGOs)
- Regional health bureau, HMIS/M&E units, ICT (DHIS2) experts and health partners to align infrastructure plans and updates with national health priorities.
- Frontline health managers, data producers and users

Expected results.

- More stable and responsive DHIS2 environments.
- Improved real-time and offline data reporting and access.
- Reduced dual data entry and errors.
- Better support for the routine use of HMIS data.

7.5.1.2.9 Capacity building (HMIS training)

Capacity building is essential for empowering health professionals and HITs to manage and utilise health data effectively (Molla, Hayelom, Adamu, Mihiretu & Adem 2024:8). It addresses gaps in skills, knowledge, and motivation to improve data quality and foster a culture of data-driven decision-making.

➢ **Key interventions**

❖ **Needs assessment and planning**

- Assess knowledge and skills of health workers on HMIS tools, indicators and International Classification of Diseases (ICD) codes.
- Examine understanding and application of data collection, quality assurance, data analysis, visualisation, interpretation and utilisation.
- Identify specific improvement needs: understanding all-inclusive dimensions of data quality; and competence in data analysis, interpretation and utilisation.
- Assess understanding and application of the DHIS2.
- Develop a training plan detailing topics, timeline and targeted personnel.
- Align the HMIS training with national HIS goals and local needs.

❖ **Design and deliver training programs.**

- Assign subject matter experts to conduct HMIS Training of Trainers (TOT).

- Develop HMIS training schedules adequate for TOT and cascading.
- Enrol facility managers, department heads and HITs in the TOT.
- Organise in-person workshops and online training sessions for the participants.
- Focus on data elements, indicators, analysis, interpretation and visualisation.
- Demonstrate integrated EPI data modules for HITs on interoperability, data security, and troubleshooting problems of the DHIS2.
- Organise training venue out of the workplace, not interrupted by work routines.
- Use real-world case studies and scenarios to enhance practical learning.
- Provide adequate financial incentives to trainees.
- Assess the impact of training using the standard pre-post-test evaluation tool.
- Keep staff updated with refresher training courses.

❖ **Strengthen mentorship and support systems.**

- Support healthcare providers, data and facility managers with trained mentors guiding them in applying new skills.
- Regularly mentor to provide on-the-job training and feedback.
- Encourage peer review and learning among health facilities.

❖ **Develop user-friendly resources.**

- Provide user manuals, quick references, and job aids on key processes: data entry, validation, quality checks, analysis and interpretation.
- Incorporate visual aids, checklists and flowcharts to simplify data interpretation and visualisation.
- Develop free smartphone and PC based training platforms on RHIS processes.
- Use interactive platforms to encourage active participation and self-paced learning.

❖ **Build data-driven leadership.**

- Equip leaders with skills to promote performance and data quality assurance.
- Focus on data interpretation, accountability and information use culture.
- Create leadership competence in motivating teams to prioritise high-quality data; foster continuous information use; and own quality improvement implementation.

❖ **Monitor and evaluate capacity-building efforts.**

- Engage in simulation on data entry, display, interpretation and use of DHIS2.
- Analyse changes in data accuracy, timeliness, data interpretation and use before and after capacity-building initiatives.
- Gather feedback from participants and facilitators to refine training materials and approaches.

❖ **Responsible entity**

- MOH and regional health bureau, DHIS2 and ICT experts
- Master (TOT) trainers with HMIS/DHIS2 training material developers
- Subcity and health facility managers, care providers and HITs

Expected results

- Clearly identified gaps in competence guided need-based training
- Improved knowledge and skill of health workers in ensuring high-quality data collection, analysis, visualisation, interpretation, utilisation and reporting.
- Enhanced data-driven decision-making among the health workers in planning and quality improvement.
- Strengthened mentorship, peer-learning and continuous capacity development.
- Created accountability for a data-driven culture among managers and leaders at the front-line health system.

7.5.1.2.10 Implementation of an integrated data quality assurance mechanism

Quality assurance mechanisms are critical for ensuring high-quality data that is accurate, complete, timely, and reliable (Central Statistical Agency 2011:15). According to the Central Statistical Agency (2011:30), improved quality assurance mechanisms are essential to ensure high-quality data in Ethiopia's health system. This strategy uses standardised tools, frameworks, and methodologies to systematically identify and address data quality issues. Below is a detailed implementation plan integrating tools such as LQAS, RDQA, DQRC and PRISM.

- **Key Interventions**

❖ **Establish a strong quality assurance system.**

- Create an understanding of integrated data quality assurance mechanisms.
- Develop clear guidelines on data quality standards, processes, and responsibilities of health workers at the front line.
- Define key indicators (dimensions) for assessing data quality (accuracy, completeness, timeliness, precision, integrity).
- Strengthen performance monitoring team at facility with roles to own and reinforce routine data quality reviews, corrective actions and capacity building.
- Train health workers on the use of RDQA and DQRC tools to identify discrepancies and system functionality.

❖ **Implement an integrated data quality assessment (RDQA/DQRC).**

- Perform RDQA quarterly to include functional components of data generation.
- Implement DQRC quarterly to include internal and external consistency for triangulation.
- Demonstrate data entry (DHSI2) and actions to resolve data quality issues.
- Access data from recent surveys and other sources for the triangulation.

- **Strengthen feedback provision mechanisms.**
- Use RDQA/DQRC findings at facilities and implement targeted improvements.
- Establish regular feedback to discuss performance, share best practices, and address challenges.
- Encourage facilities to act on feedback through continuous follow-up support.
- Use visual dashboards to display DQRC results, making it easier for managers to identify trends and prioritise improvements.

❖ **Apply enhanced Lots Quality Assurance Sampling (LQAS)**

- Increase LQAS sample size, preferably 19 data elements.
- Reinforce trust in the LQAS mechanism, ensuring non-biased sampling.
- Repeat sampling, when necessary, not beyond three times in a reporting month, and recount from the register is the last reconciliation.
- Validate the consistency of selected data elements of health facilities.
- Include LQAS along with RDQA in checking data quality during supervision.
- Link the interpretation of the LQAS consistency value with the RDQA Verification Factor.

❖ **Implement the Performance of Routine Information System Management (PRISM) framework (Technically, Organisationally and Behaviourally).**

- Assess the application of standard tools and the performance of RHIS indicators.
- Ensure the conduct of training, supervision and feedback on data and data sharing.
- Assess data demand, motivation, and perception of data quality.
- Ascertain the leadership's own data management and use for decision-making.
- Establish accountability of data management and use at the individual and institutional levels.

❖ **Conduct data validation and verification.**

- Verify data between source documents and integrated data aggregation tools.
- Address discrepancies immediately and provide feedback to health workers.
- Automate DHIS2 to flag incomplete, inconsistent, or outlier data entry.
- Develop automated validation rules to simplify the data review process.
- Use mobile applications for real-time data quality checks in remote facilities.
- **Monitor and evaluate the data quality assurance activities.**
- Assess implementation of the integrated data quality assurance mechanisms.
- Link quality assurance to performance appraisals and incentives.
- Monitor implementation of data quality assurance feedback.

❖ **Responsible entity**

- MOH, Regional health bureau and subcity health office
- HITs, QI officers and DHIS2 (ICT) experts
- Stakeholders (donors, partners)
- Health facility managers and the performance monitoring team.

Expected results

- Applied integrated data quality assurance mechanisms: Updated LQAS monthly, and LQAS, RDQA, and DQRC quarterly, aligned with PRISM.
- Improved data consistency, functional components and M&E system.
- Regularly conducted assessment of data quality at the facility level.
- Improved capacity among health workers in adherence to data quality standards.
- Adequate on-time available HMIS resources are efficiently used, and automated data tools reduce redundancies.
- Improved perception of fit for use of HMIS-generated data.

7.5.2 Information Use Guideline

7.5.2.1 Introduction

The effective use of health information is a cornerstone of improving decision-making, resource allocation, and service delivery in Ethiopia's health system (Tadele, Yilma, Mekonnen & Tilahun 2023:10). However, studies on HMIS in the country reveal persistent gaps in the use of collected data for informed decision-making. Ensuring the utilisation of information at the point of data generation has been an unresolved critical challenge.

This study's result revealed:

- Limited understanding of indicators
- Inadequate data analysis and interpretation
- Loose accountability of information use
- Low confidence in HMIS-generated data quality
- Low use of data for supportive supervision, performance appraisal, test changes in quality, and solving problems of service quality.

The study result indicates limitations in the use of information for evidence-based decision making that stem from a lack of staff confidence in data quality, limited indicator comprehension, and the failure to use HMIS information for budgeting or performance appraisals. This environment fosters the persistence of an underdeveloped culture of information use. Absence information used as an organisational resource affects the motivation of frontline managers and users. In the same way, the absence of data usage for supervision and performance appraisal weakens the accountability of HMIS tasks.

Only a small fraction of health professionals had experience in developing action plans based on the findings from data analysis. A study by Ngusie, Ahmed, Kasaye, and Kanfe (2022:5) in Ethiopia indicates that while data collection has improved, its utilisation for ev-

idence-based decision-making remains limited, with health professionals often lacking confidence in applying data for performance improvement.

Hence, the information use guideline intends to build a culture where data is not just collected and reported but also actively used to improve health outcomes. The strategies in the guideline focus on capacity enhancement; strengthening supportive supervision and feedback mechanisms; creating accountability and integration of health information into management functions, specifically to quality improvement.

The capacity enhancement strategy builds data analysis, interpretation and visualisation competence among health workers using standard tools. Second, strengthening supportive superposition feedback systems intends to provide constructive lessons in the identification of gaps in RHIS processes and information use through enhanced collaboration between the supervisor and the recipient. Introduction of accountability aims at promoting and motivating care providers to use information in routine decision-making. The final strategy: integrating information use, especially with the QI initiative, foresees establishing continuous use of information through the application of the Model for Improvement under the PRISM-MFI framework.

Implementation of these strategies would prove effective use of information not only in planning, resource allocation and performance monitoring, but also in designing, implementing and assessing changes in service quality using quality improvement tools. Refer to the section below for information on immunisation quality improvement.

Studies show that application of the human development model that includes competence-based training, mentorship, supportive supervision, experience sharing and QI initiative, and implementation of the initiative has improved data quality and information use both at health facilities and administrative levels (Ayele et al. 2021:2).

7.5.2.2 Proposed strategies for information use guidelines

The proposed strategy in the information use guidelines has two parts. Definition of required information and purpose of information use. This strategy defines indicators, purpose and evidence of information use. It measures the extent of information use and devises strategies to mitigate the contentious use of health information for decision-making.

The second part of the guideline lists steps of information use in planning, self-assessment, supportive supervision, monitoring and evaluation. Here, the intervention focuses on enhancing the skills of health workers in data analysis and interpretation, strengthening supervision and feedback systems, and promoting accountability through incentives/recognition to data use champions. Bruce (2014:8) emphasises ensuring staff accountability and strengthening staff data use behaviour through training, supervision and feedback for organisational and stakeholders' priorities.

7.5.2.2.1 Definition (purpose) of information needed at an institutional level

Health facilities require HMIS information for the development (adaptation) of annual planning, resource mobilisation, performance monitoring, performance appraisal, budgeting and service quality improvement. At the institutional level, the definition of the needed information is critical for effective management, decision-making and program improvement (Ethiopia Ministry of Health 2019:15). Information needs specified serve as the purpose and indicator of information use. According to the Ethiopian Ministry of Health (2019:15), health institutions, such as hospitals, clinics, and district health offices, require specific data to manage daily operations, track progress, and improve service delivery through performance monitoring teams. This enables the system to efficiently allocate, monitor and adjust resources, health outcomes and interventions as necessary.

Some key areas of information needed at an institutional level are presented below:

- **Key interventions**

❖ **Diseases prevention and service delivery data**

- Diseases prevention and control (ICD) data: to define indicators of the ten top diseases; to increase coverage of prevention and control interventions; and to implement interventions of diseases targeted for elimination or eradication, and to develop a timely preparedness and response plan for outbreaks.
- Service delivery data: maternal and child health services (coverage, utilisation).
- Clinical protocols and procedures related to adherence to clinical guidelines and treatment protocols; the service delivery fits clinical standard practices data.

❖ **Resource management data**

- Administrative and governance data: budget allocation and utilisation.
- Inventory data: availability and functionality of cold chain equipment, stock-out.
- Human resources data: staffing levels, qualifications and competence-based training, performance appraisal.

❖ **Programmatic data**

- Health programs' performance data: immunisation target and coverage.
- Community health data: diseases and service trends in the catchment population and community engagement.

❖ **Operational management and quality improvement data**

- Service efficiency data: patient waiting times, treatment outcomes.
- Operational challenges data: infrastructure, facilities and challenges.
- Data quality review/assurance data: LQAS result, Integrated RDQA/DQRC
- Quality improvement data: indicators of quality-of-care, satisfaction survey, and adherence protocols and changes (improvement) in quality-of-service data.

❖ **Responsible entity**

- MOH, regional and subcity health offices, and donors and partners
- Service delivery and quality improvement officers and experts

- Administrative and human resource development units
- HMIS and M&E units at health facilities, subcities and offices

Expected results

- Created clarity with the required information.
- Improved ability of facility and program managers to use information.
- Quality assured immunisation data used for decision-making.
- Established institutional support of information use for decision-making.

7.5.2.2.2 Steps in use of information for planning, self-assessment, monitoring and evaluation.

➢ **Capacity enhancement programs**

Capacity enhancement is critical for ensuring that health workers, especially those involved in immunisation activities, are equipped with the knowledge and skills to effectively use health information for planning, monitoring, and decision-making (John Snow, Inc. [JSI] 2020:13).

The capacity enhancement strategy first focuses on the identification of competence gaps in data analysis and interpretation. Second, the strategy guides the development of comprehensive training modules to build a data-driven culture in the immunisation service. The overall aims of this strategy are to build data literacy and trust, improve data analysis and interpretation, and integrate health information into everyday immunisation service activities. Below are the steps to implementing the strategy.

➢ **Key intervention (steps)**

❖ **Assess current competence and identify gaps.**

- Assess current skills in the analysis and interpretation of immunisation data.
- Examine the use of information for defined immunisation indicators and targets.

- Assess skills in the development of an EPI micro plan using the RED strategy.
- Review the execution of in-built performance monitoring at the department and facility level.
- Understand the practice of gap identification, action plan development and follow-up.
- Identify key areas (need) of capacity-building: use of HMIS tools, immunisation data collection, quality assurance, analysis and interpretation indicators definition, development of EPI micro plan, problem identification and mitigation plan.

❖ **Develop comprehensive training modules.**

- Develop training materials focused on immunisation-related data and indicators: vaccine coverage and immunisation dropout rates, and monitoring adverse event (AEFI), cold chain function, and vaccine stock.
- Describe techniques of data analysis, visualisation and interpretation of trends to draw actionable insights from immunisation data.
- Describe the use of numeric and text data, and build and update basic graphs and charts.
- Include practical sessions and real-world case studies related to immunisation data management in the training.
- Create interactive methods: group discussions, role-playing, and hands-on exercises to help participants engage with the tools and techniques.

❖ **Deliver targeted training programs.**

- Design training in the effective use of data for micro-planning, session planning, immunisation resource allocation, and monitoring services delivery.
- Conduct in-person training regularly, at least biannually, to reinforce concepts and adapt to emerging challenges.
- Provide mentoring and on-the-job training on the use of information for decisions.

- Create online training courses to reach a larger and remote audience when possible.
- Monitor use of self-paced modules (self-learning) fit for busy schedules.

❖ **Monitor and evaluate the effectiveness of training.**

- Measure the effectiveness of training by pre- and post-training evaluations.
- Assess participants' new skills in data analysis and interpretation for decisions.
- Monitor the changes in immunisation data quality and service coverage after implementation of capacity-building efforts.

❖ **Develop mentorship and support systems.**

- Assign less experienced immunisation staff to peer mentors proficient in health information use and decision-making to guide effective data utilisation.
- Create channels for ongoing support, such as a helpline, online forums, or regular check-ins, where health workers can ask questions and receive guidance on data analysis, interpretation and display related challenges.

❖ **Focus on data analysis and interpretation.**

- Provide training on software like DHIS2, SmartCare, Excel, and other data analysis and visualisation tools used for monitoring immunisation performance.
- Enable health workers to interpret trends, identify gaps and develop a feasible and appropriate action plan.
- Conduct practice-based workshops, where staff can practice data analysis using actual immunisation data from their regions or health facilities.
- Use examples from previous immunisation service experience to illustrate how data can be used to adjust strategies in real time.

❖ **Build a data-driven culture in immunisation.**

- Regularly review immunisation data quality in monthly meetings
- Routinise data analysis and interpretation in EPI planning and monitoring.
- Use immunisation data in programmatic decisions: vaccine stock needs, targeting low coverage villages, and prioritising outreach sessions.
- Ensure front-line staff use immunisation data to inform their routine activities.]

❖ Responsible entity:

- MOH, Regional and Subcity Health offices with relevant stakeholders
- Immunisation service and HMIS subject matter experts
- Health facility managers and the performance monitoring team
- Service providers and the HITs.

Expected results

- Improved competence in data analysis, interpretation and feedback.
- Enhanced data-driven decision-making by front-line health workers routinely in immunisation resource allocation and targeting the population with services.
- Improved efficiency in immunisation programs, interventions and coverage.
- Sustained capacity of health workers in dealing with evolving data challenges and staying up to date with new technologies and practices.

➢ **Strengthening the supervision and feedback mechanism on the use of information**

❖ **Preparing for regular supportive supervision**

- Conduct self-assessment and interact with health workers by reviewing and discussing immunisation data.
- Assess immunisation coverage and quality, including missed opportunities for vaccination (MOV), dropout rate (DOR), and availability of supplies and cold chain performance.
- Develop a data-driven supervision checklist to address identified gaps

- Train managers and Quality Improvement (QI) teams to conduct facility-level self-supervision

❖ **Conducting constructive supervision in line with the agreed-upon schedule**

- Conduct supervision by trained supervisors
- Review previous supervision findings and actions implemented
- Organise regular data review and information use workshop where staff can discuss experience of data management and quality assurance, information use and success story, and troubleshooting on persistent challenges.

❖ **Providing regular constructive evidence-based feedback**

- Provide constructive verbal and written feedback on immunisation data management, use and reporting with proposed action plans for improvements.
- Facilitate data review meetings where health professionals, HITs, and managers can collaboratively analyse immunisation data, discuss discrepancies, and make decisions on corrective actions.

❖ Responsible entity

- Line managers at MOH, Regional and subcity health offices, and health facilities
- Supervisors at MOH, Regional and subcity health offices, and health facilities

Expected results

- Checklist-based, regularly conducted supportive supervision
- Inclusion of information use in supervision and feedback.
- Conducted data quality and information use review meetings.
- Routinised information use and data quality review meetings at health facilities.

➢ **Strengthening the accountability and recognition system**

An accountability and recognition system fosters a culture of responsibility and motivation among health professionals by ensuring they are recognized for their contributions and

held accountable for the use of health information (Veenstra, Dabekaussen, Molleman, Heineman & Welker 2022:159; Bianchi 2024:16). Approaches to accountable use of information in planning, performance monitoring and immunisation service quality improvement include establishment of accountability system, implementation of recognition mechanism, strengthening supervision and support system and enhanced accountability to community.

- **Key elements**

❖**Creation of accountability frameworks**

- Define responsibilities of health professionals, HITs and facility managers in the collection, analysis, interpretation and utilisation of immunisation data.
- Specify data management and information use duties and obligations in the job descriptions of immunisation health workers.
- Define dimensions of data quality and indicators of information use for immunisation.
- Link information use performance to the performance appraisal of health professionals.
- Ensure the right use of immunisation data among health workers for decision-making.
- Introduce a checklist to monitor activities of accountability in data management and use it for individual healthcare staff and department decision-making.

❖**Implement recognition for data champions and professional development.**

- Recognise exemplary data management and utilisation: timely reporting, identifying immunisation gaps and implementing innovative data-driven solutions.
- Introduce incentives like recognition certificates, monetary rewards, and public acknowledgement to motivate health professionals for effective data use and improved immunisation performance.
- Create opportunities for peer-to-peer recognition, where health workers can nominate colleagues who excel in data-driven immunisation activities.

- Provide training on accountability in health data management, focusing on ethics, data-driven decision-making, and improving immunisation outcomes.
- Link execution of data use accountability into career promotions: educational and special training programs.

❖**Enhance supervision and support systems to strengthen accountability.**

- Conduct supervision visits that focus on mentoring and coaching health workers on effective data use rather than punitive assessments.
- Guide health workers on analysing immunisation data, identifying gaps, and implementing corrective actions.
- Use scorecards with indicators like data timeliness, data-driven decisions, and immunisation quality improvements to evaluate health facilities or teams.
- Provide regular, constructive feedback to health workers on their performance in using immunisation data as detailed in the feedback section above.

❖ **Establish community-level accountability mechanisms.**

- Strengthening the link between the community and health workers for tracking immunisation performance.
- Establish community scorecards or dashboards that display immunisation performance, such as coverage and dropout rates, to increase transparency.
- Create a community channel to provide feedback on immunisation services, such as suggestion boxes, community meetings, or digital platforms.

❖ Responsible entity

- Line managers at MOH, Regional and subcity health offices, and health facilities
- Supervisors at MOH, Regional and subcity health offices and health facilities
- Immunisation service providers and the HITs

Expected results

- Created unambiguous accountability of RHIS tasks with clarity in dimensions of data quality and indicators of information use.

- Implemented incentive packages reinforcing champion data quality assurance and information use.
- Conducted evidence-based supportive supervision and feedback with emphasis on core competencies in data management and information use.
- Established community-oriented, equitable, and measurable immunisation service.

7.5.3 Immunisation service quality improvement guideline

7.5.3.1 Introduction

Ensuring high-quality immunisation services is essential for achieving universal health coverage and protecting communities from vaccine-preventable diseases (World Health Organization 2022:20). However, this study identifies key gaps in delivery of quality immunisation service that includes sub-optimal capacity of care providers to design, implement and monitor QI projects; low use of information to immunisation service quality improvement due to unreliable data to set baseline indicator for a QI project; and lack of regular monitoring of the designed project, while using the PDSA cycle for is interrupted.

This study's result revealed

- The QI project is not regularly monitored using HMIS data.
- Persistently low use of HMIS information
- Lack of electronic tools for EPI data capturing, resulting in unreliable data
- Sub-optimal capacity of health staff to design and monitor the QI project.
- **I**nadequate HMIS information use for EPI supportive supervision.

The finding reveals that regular use of HMIS information to guide immunisation service improvement has not yet been demonstrated through the implementation of QI initiatives. Use of an effective QI monitoring approach, such as the PDSA cycle, was not sustained. HMIS data are not adequately utilised to monitor key immunisation service indicators,

such as cold-chain functionality. In addition, there are limited mechanisms for tracking and reducing immunisation dropout rates and insufficient follow-up of missed opportunities for MOV, which negatively affects immunisation coverage and service quality. Health professionals often lack the confidence and skills required to design and implement immunisation QIP due to the unreliability of data, coupled with inadequate guidance on selecting, monitoring, and reporting QI indicators. Furthermore, HMIS immunisation data are underutilised in the implementation of the RED/C strategy, including supportive supervision and feedback, community engagement, and reminder systems aimed at reaching eligible populations and improving immunisation coverage and quality.

This guideline, thus, proposes strategies focused on building the capacity of health staff in the QI cycle; ensuring continuous use of HMIS information for QI through the application of the PDSA cycle; Enhancing regular monitoring of QI projects using HMIS data to improve immunisation service quality, hence, raising coverage of vaccination.

The immunisation quality improvement guideline is divided into two main parts. The first part provides guidance on the identification and prioritisation of problems of quality in immunisation services. The guideline proposes to apply the Model for Improvement (MFI) in the PRISM-MFI framework to identify the problems, and apply ‘5 whys’ to identify the root cause of the identified problem and generate a change idea (intervention).

The second part of the guideline applies the PDSA cycle, enabling health workers to track changes and test interventions systematically until they achieve measurable (sustainable) changes ascribable to an intervention. Implementation of the interventions would result in continuous use of HMIS information, persistent quality data production, and thereby changes in the quality of immunisation service. Similarly, it results in the capacity of health staff in designing, implementing and monitoring quality improvement projects. The enhanced data quality, immunisation service quality, and implementers’ capacity eventually ensure equitable access and better health outcomes for the population in Ethiopia and other similar setups.

7.5.3.2 Proposed strategy for immunisation service quality improvement

7.5.3.2.1 Problem identification and prioritisation in immunisation service quality

The proposed application of MFI in the guideline would improve immunisation service quality and enhance the capacity of health workers in designing, monitoring and implementing quality improvement projects. This involves processes of identifying recurring problems in the quality of immunisation service and root cause analysis, generating changes (intervention) to address identified problems stepwise and implementing intervention through the application of the continuous PDSA cycle.

The MFI defines problems of quality and applies appropriate quality improvement techniques: for instance, brainstorming to generate change ideas; fishbone to know cause and effect relationship and 5 Whys to identify the root cause of the problem. The model consists of two parts: setting the aim and testing the changes. Setting the aim part of MFI responds to basic Quality Improvement questions: What are we trying to accomplish (a goal)? How do we know that change is an improvement (measures), and what change can we make that will result in an improvement (changed idea)?

The testing part of MFI incorporates application of PDSA, which is an iterative learning, improvement and problem-solving cycle (Cancer Screening Collaborative, The Model For Improvement, Australia 2017:3-9). The intervention must be planned, tested, analysed (studied) and acted upon, whether to adopt (scale), adapt (modify) or abandon (leave) and try another intervention based on the result.

The PDSA cycle starts with ‘P’: develop a data-driven action plan to small-scale test (implement) an intervention with the resources needed and predictions of outcome. It is followed by ‘D’: implement the action plan and monitor progress towards the action plan by collecting data from observation and feedback. The third comes ‘S’: analyze and interpret the data to see if predictions are met, or not and the ‘why not,’ hence, summarize lessons

learned with whether the change idea contributes to achievement of the goal or not; and finally 'A': decide whether to scale implement the intervention or modify at 'D' stage and test again, or test another intervention based on the result.

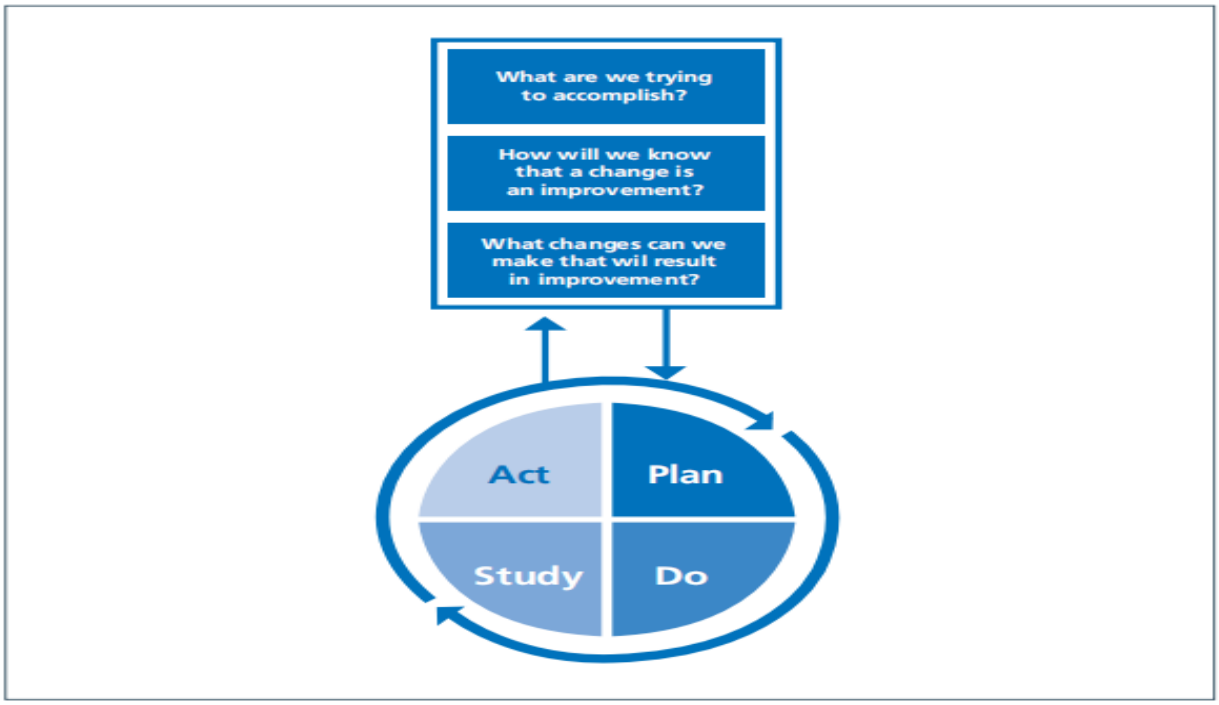

Figure 7.1: Inquiry of MFI and application of PDSA in response

Source NHS England (2017:3)

- **Identification (definition) of the problem and root cause**

  - **What are we trying to accomplish (what problems are there to solve)?**

    - Recruit a multidisciplinary QI circle (team) of health workers and community leaders.
    - Identify a problem and a goal.
    - Review performance data by the team, for instance, interpreted recurring problem is a high Dropout rate (DOR) of vaccination 12%, exceeding the 10% maximum limit.
    - Set (agree) a goal of reducing the DOR to 9% in 6 months' time.

- Apply fishbone to identify possible causes of the problem ‘DOR’.
  - ✧ Possible causes of DOR may include low perception of caregivers, population movement, and interruption of immunisation service.

Fishbone diagrams are used to identify and organise the possible causes of a specific effect and then separate the root causes (Holifahtus, Eltivia & Afandi 2022:7).

✧ Apply “five whys” in interpreting data to uncover the root causes of the DOR:

- Why: low perception of caregivers about the importance of vaccinations.
- Why: not clearly informed about completing the vaccination by health workers.
- Why: not given a reminder on the schedule for completing the vaccination.
- Why: lack of a reminder system for completion of the immunisation service.
- Why: absence of follow-up (reminder) protocol.

✧ Change idea (intervention): apply the reminder technique (protocol) to caregivers (parents) on completion of the immunisation schedule. Implement the intervention on a small scale using PDSA as it appears below.

The five whys tool repeatedly asks the question ‘Why?’ to lead you to the root cause of the problem, or it can help a team define the drivers relating to the improvement aim and then the change idea. Root cause analysis is best carried out using the 5 Whys along with fishbone analysis (Olaitan, Tien, Russ, Tapper, Herrington, Green & Chaudhri 2023:6; Gupta 2021:1).

❖ **How do we know that a change is an improvement?**

- Build consensus on measurement, in the case of DOR, outcome measurement of reduced DOR due to the impact of the implemented intervention.
- Set baseline (current performance) of the indicators, DOR = 12%.
- Review HMIS data monthly and measure the DOR of vaccination.

- See the rate of reduction compared with the predicted reduction of DOR by 25% or more value during and after 6 months of implementing the change idea.

➢ **Problem prioritisation and intervention**

❖ **What changes can we make that result in improvement (solutions to implement)?**

- Agree on the intervention (solution) and period of implementation.
- The immunisation reminder technique is the selected intervention to address the root cause of vaccination DOR.
- Enrol the chosen intervention into the PDSA cycle of the QI project.

7.5.2.3 Application of the PDSA cycle in quality improvement processes.

Plan-Do-Study-Act (PDSA) cycles provide a structured method for testing changes, assessing their impact, and ensuring that new ideas improve quality before broader implementation (Fereday & Malbon 2020:19). By systematically testing changes, evaluating results, and making necessary adjustments, the PDSA cycle helps to ensure that the interventions are effective and lead to sustainable improvements. Besides, the PDSA process encourages data-driven decision-making, fosters a culture of accountability, and supports the achievement of measurable health outcomes. Below is a step-by-step guide to implementing this strategy effectively in the Ethiopian healthcare facility context.

❖ **Plan**

- Use quality-assured data through an integrated quality assurance mechanism.
- Plan to implement (test) immunisation reminder technique.
- Assign the quality improvement cycle with roles and responsibilities.
- Target (prediction): minimum 30% of underserved communities with eligible children will reduce the current DOR by 25%.

❖ **Do**

- Sending (implement) text reminders to a small-scale, underserved (under-engaged) community should be at least 30% of the catchment population of a health centre.
- Ensure the caregivers have received the immunisation service reminder.
- Collect data on the change in DOR of immunisation due to the intervention.
- Document problems, observation and interview, related to the implementation of the reminder technique, including unexpected events:
    - Recall of the schedule and understanding of the immunisation service.
    - Perception of intervention and feedback of the caregivers.
    - Information sharing among caregivers.
    - Punctuality, availability and compassion of the service providers.
    - Apply a “run chart” to monitor data on a monthly basis.

Run charts display observed data over time and are the most frequently used graphics in QI. It makes trends or patterns over a specified period easy to identify (Chen, Vander-Laan and Heher 2021:4).

❖ **Study**

- Analyse the collected data, see trends, and determine if the plan implementation results in the predicted reduction of DOR.
- Evaluate the effectiveness of changes in terms of achieving reduced DOR.
- Summarise the lessons learned from the test of reminder techniques.
- The decision of the outcome of the reminder technique implementation contributes to the achievement of the set goal (predicted reduction in the DOR).

❖ **Act**

- Adopt or scale implement if the implementation of the reminder technique has achieved the predicted reduction of DOR, and incorporate the technique into regular practice.
- Adapt, modify the intervention at the ‘do’ stage and run the next cycle of PDSA based on data from the implementation monitoring.
- Abandon (leave) if the intervention is not successful.
- Continuing application of the PDSA cycle on other identified problems and corresponding change ideas until sustainable improvement in the quality of immunisation service has been achieved.

In the PDSA cycle, “Act” represents a final reflection on whether the change idea should be adopted, adapted, or abandoned (Barron, Hulleman & Hartka 2024:12).

Other identified causes of the DOR problem may be either interruption of the immunisation service or population movement eligible to run the PDSA cycle.

7.5.2.4 During implementation of the reminder techniques intervention using PDSA

❖ **Engage the community and local leaders in immunisation services**

- Strengthen collaborations with the community, traditional healers, and organisations.
- Share immunisation data, identifying gaps and jointly planning for improvement.
- Engage leaders in outreach activities to advocate for immunisation in any event.
- Empower health extension workers or volunteers as immunisation ambassadors.
- Recognise champion families completing the immunisation schedule.
- Describe the under-vaccinated group by geography, culture and awareness to access.

❖ **Enhance health education and communication**

- Use child health cards and educational materials to address community awareness.
- Develop targeted, culturally relevant messages addressing myths and concerns of the under-vaccinated group, and emphasising timely vaccination benefits.
- Conduct surveys or focus group discussions to evaluate how well families understand text messages (reminder technique) on completion of the immunisation service.
- Share immunisation progress reports with community leaders and members to build trust and maintain accountability.
- Publicly acknowledge immunisation achievement to motivate continued community involvement, and input to adapt or test another change idea.

❖ Responsbile entitry

- Health facility managers and department heads
- Quality improvement circle (team) and HMIS (HITs) officers
- Intern health science students
- Immunization service providers

Expected results.

- Improved HMIS data use for planning, monitoring and implementing quality improvement projects.
- Enhanced competence in designing, monitoring and implementing immunisation quality improvement projects.
- Increased accountability: regular engagement in QI fostered accountability of stakeholders, monitoring of vaccines and cold chain functioning.
- Improved vaccination outcomes: DOR and MOV.
- Successfully implemented scalable change ideas in the QIP of the immunisation service.

- Enhanced engagement of the community in the immunisation service.
- Sustained quality improvements.
    - The iterative PDSA (Plan-Do-Study-Act) approach ensures continuous enhancement of vaccination programs over time. Ensured ownership and leadership of immunisation (health) service improvement.

7.6 SUMMARY

This chapter presented the development of a three-part, interlinked guideline package to improve data quality, information use and immunisation service quality in Ethiopia. Grounded in the integrated findings of this mixed-methods study and framed by the PRISM-MFI framework, the guidelines offer:

- A structured approach to strengthening RHIS processes and data quality assurance.
- Practical strategies to embed information use in routine management and decision-making, and
- A clear methodology for designing, implementing and monitoring data-driven immunisation quality improvement projects using PDSA cycles.

The guidelines are intended to support health facilities, managers, HITs and frontline providers in moving from a predominantly reporting-oriented HMIS culture to one in which high-quality data are routinely used to improve immunisation services and health outcomes. The use of unified HMIS tools, including DHIS2, a capacitated workforce, adequate infrastructure, and integrated data quality assurance mechanisms would contribute to the generation of high-quality data. Enhanced supervision and feedback, together with strengthened accountability systems, improved staff competence, and better integration of information into management functions, would enable overcoming persistent challenges in information use. Practical guidance on identifying and prioritising service quality

problems, analysing root cause, and applying the PDSA cycle in the implementation of QI projects would enhance the competence and confidence of healthcare providers to effectively design, implement, and monitor immunisation service quality improvement initiatives.

CHAPTER 8: CONTRIBUTIONS TO KNOWLEDGE, RECOMMENDATIONS, STUDY LIMITATIONS AND CONCLUSIONS

8.1 INTRODUCTION

This final chapter presents a synthesis of the study's key contributions, practical recommendations, acknowledged limitations, and concluding reflections. While detailed operational recommendations are embedded within the validated guidelines presented in Chapter 7, this chapter highlights strategic-level insights drawn directly from the research findings. These recommendations aim to enhance the utilisation of Health Management Information System (HMIS) data for quality improvement in immunisation services.

The overarching purpose of this study was to develop evidence-informed guidelines to strengthen the quality of immunisation service delivery through effective use of HMIS in Addis Ababa, Ethiopia. Grounded in the PRISM-MFI theoretical framework and guided by a mixed-methods approach, the study identified critical technical, organisational, and behavioural determinants influencing data management and information use. The findings offer valuable contributions to both academic knowledge and health system strengthening practices, particularly in resource-constrained urban settings.

8.2 CONTRIBUTIONS OF THE STUDY

8.2.1 Theoretical contributions

This study makes a significant theoretical contribution by extending and integrating the PRISM and MFI frameworks to explore and explain the interplay between Health Management Information System utilisation and quality improvement in immunisation services. The framework revealed how Technical, Organisational, and Behavioural (TOB) determinants influence routine health information system (RHIS) processes, thereby in-

fluencing the production of quality data and its use in decision-making. In the framework, more emphasis was given to how the purposeful use of information can initiate a positive cycle, in which effective use leads to sustained improvements in data quality and service delivery. In doing so, the study supports the notion that "use brings usability" (Gashu et al. 2019) and adds conceptual clarity to the field of health information systems in low-resource settings.

Furthermore, the study contributed to a better theoretical understanding of the hierarchical structure of health information systems, clarifying the distinctions and relationships among RHIS, HMIS and HIS, which are often used interchangeably in the literature. This clarification has implications for designing future health information interventions with a clear system focus and scope.

8.2.2 Methodological contributions

The study contributes methodologically through its use of a mixed-methods design that successfully integrated qualitative and quantitative data to enhance the depth and credibility of the findings. By adopting nested sampling techniques, the study ensured the inclusion of diverse yet relevant participants, particularly in Phase II, resulting in rich, context-specific data. The study also benefited from a pilot test, which helped refine the tools and procedures before full-scale implementation.

Moreover, the research instruments were tested for reliability and consistency, increasing confidence in their future use by other researchers or program evaluators. The application of standardised statistical software for quantitative analysis and qualitative analysis tools for thematic coding ensured a rigorous and transparent analytical process. These methods enabled meaningful meta-inferences that integrated multiple strands of evidence, strengthening the study's internal validity.

8.2.3 Empirical contributions

Empirically, the study generated new knowledge on how TOB factors impact HMIS implementation and information use at the facility level in Addis Ababa. It identified concrete challenges affecting all three TOB domains—technical issues such as undigitized data tools, organisational constraints such as weak accountability and supervision, and behavioural factors including low confidence and motivation among healthcare workers.

The research highlighted the critical link between perception of data quality and actual information use. It also provided detailed insights into gaps in the HMIS data management process, including inconsistencies in data collection, duplication in quality checks, inadequate use of feedback mechanisms, and challenges related to cold chain management, community engagement, and performance monitoring within immunisation programs.

These empirical findings offer contextual evidence for how HMIS can be better leveraged to drive QI in health services, particularly in low-resource urban settings.

8.2.4 Practical contributions

From a practical standpoint, the most important output of this study is the development and validation of evidence-based guidelines to improve immunisation service quality through better HMIS utilisation. These guidelines are rooted in empirical findings and validated through workshops and expert reviews, ensuring their feasibility, relevance, and adaptability.

The study also proposes actionable strategies tailored to different stakeholders, including healthcare providers, facility managers, training institutions, NGOs, and health bureaus, to address the identified barriers to data quality, information use, and QI implementation. These practical recommendations aim to strengthen routine data practices and institutionalise a culture of information use across all levels of the health system.

By aligning training, supervision, digitisation, and feedback mechanisms with QI goals, the study provides a concrete pathway for improving not only immunisation programs but also potentially other health services that depend on reliable data.

8.3 RECOMMENDATIONS

The researcher makes the following recommendations based on the findings of the study to effectively use HMIS for improving the quality of immunisation (health) service, for the stakeholders to partake in the implementation of HMIS and health QI Projects.

8.3.1 Healthcare providers

The results of this study suggest that healthcare providers' accountability, interest, willingness, perception, competence, and confidence in data management are crucial in generating quality data and utilising information generated from the HMIS. The healthcare providers are the forefront generators of data at encounters with service seekers and users to improve the quality of service that satisfies the service seekers. They need to be capacitated with need-based training, mentoring and resources to improve their interest, commitment, competencies and confidence in data management, information use and using the information for improving the quality of health immunisation service.

8.3.2 Facility managers

The facility lacks ownership and is less involved in HMIS master training and quality improvement; yet, their positive view of HMIS, support, and directives to staff on data use have a high impact on staff motivation to own and operate data management and information use. Managers should receive the HMIS Training of Trainers, mentor the staff to improve the performance of RHIS and implement quality improvement. The managers should ensure accountability of data use among staff for decision-making and take needed action based on the performance of individual staff regarding the HMIS task.

8.3.3 Quality improvement/Health Management Information System (HMIS) unit

The Quality Improvement (HMIS) unit and officers, and Health Information Technicians (HITs) are custodians of the HMIS and QI. Therefore, they need to be capacitated to facilitate HMIS data use for quality improvement, provide guidance to healthcare providers on the use of information to design, implement and monitor the QIP. They, too, need to ensure effective data management and apply an integrated quality assurance mechanism. The QI officers should mentor in setting baseline indicators in the design of QIP.

8.3.4 Training managers

The study revealed the need for comprehensive yet detailed HMIS training, both at TOT and cascaded to health facilities. The TOT should be led by subject-matter experts in HMIS/DHIS2, Quality Improvement, immunisation (health) programs, and service delivery. The training needs assessment should be conducted regularly using standard tools, and the findings should identify critical areas and the personnel to be enrolled. More specifically, the TOT should enrol facility managers, department heads, care providers and officers of service delivery, HMIS and QI. Planning for training should prioritise production of training and reference materials in hard and soft copies, allocate adequate time for specific training and focus areas, and provide training evaluation tools.

The development of a training plan should be undertaken jointly with non-governmental organisations and other stakeholders to identify and mobilise the required resources. Adequate attention should be given to practicums in the training to enhance the competencies required for effective data management, information use, and for the design, implementation, and monitoring of immunisation (health) quality improvement. Accordingly, focus areas of the training should be on data quality assurance, data analysis, interpretation and utilisation for quality improvement, thereby instituting a culture of information use.

8.3.5 Immunisation program managers/providers

The immunisation program providers/officers should use the integrated and digitised data collection tools, data, and checklists in the conduct of supportive supervision and in providing feedback. The EPI unit, in connection with the QI department, should design and implement immunisation service quality improvement projects. Service providers at the facility level use reminder technology to raise awareness of immunisation and engage the community in immunisation services. The implementors need to use information for cold chain functioning and vaccine stock balance.

8.3.6 Non-governmental organisations

Supporting non-governmental organisations should abide by standardisation, integration and simplification of HMIS tools, discouraging the use of parallel systems. They should consent to the centralised ownership of HMIS-related software by the government. Actively participate in the design and update of HMS, as well as in the provision of HMIS and QI trainings. Partake in immunisation data quality assessment and improvement, data interpretation and utilisation, quality improvement project design, implementation and monitoring. Additionally, they should build the capacity of health workers at the frontline to effectively apply DHIS2, display data and use information for improving service quality and patient care.

8.3.7 Higher education and training institutions

The higher institutes need to certify that the students of health and medicine are competent in the RHIS process and performance before graduation from their studies. Train the candidate health workers on HIS and its subcomponents as one of the six building blocks of the health system, and sensitise them on challenges in implementing the HMIS. The research degrees of higher education should authorise the design and implementation of problem-solving research that focuses on the utilisation of HMIS information to improve

quality service. Internship programs include posting the candidate health workers to design, implement and monitor quality improvement projects using HMIS information. The education system should consider HIS in the curricula and components of competency assessment as partial fulfilment of completion from studies. The Ethiopian Information Revolution plans an ongoing HMIS training, incorporating HMIS and M&E into school curriculum and strengthening generic training of ICTs (FMOH-E Information Revolution Roadmap 2016:6, 9).

8.3.8 Sub-city Health Office (Regional Health Bureau)

The regional health bureau, along with sub-city health offices, should reinforce standardisation and integration of HMIS data tools and software; ensure availability and functionality of input, processes and performance of HMIS, and quality improvement. The bureau should expedite digitisation and integration of EPI data tools with DHIS2; improve performance and scale up of the EMR; engage frontline systems in the design and update of HMIS/DHIS2, and development of the EPI micro plan. The bureau and offices must demonstrate ownership of training and mentoring of HMIS with the supply of adequate course materials. Additionally, the bureau should create accountability and responsibility for data management and information use among HCPs, promote a culture of information use and implement quality improvement. More importantly, the bureau and offices should revitalise supportive supervision and feedback mechanisms.

The bureau and offices facilitate this study guideline, which should first be implemented in Addis Ababa, then cascaded to other regions as per convenience. Similarly, there should be assistance with program evaluation that will be conducted with invited heads of departments and health facilities.

8.3.9 Further research

More research needs to be carried out to clearly understand the direct and indirect effects of TOB factors on data management and information use. Similarly, gaining more knowledge on the role of QIP in using information needs further study. The focus of the current study was on the utilisation of HMIS to improve the quality of immunisation service; similar studies need to be conducted on the utilisation of HMIS to improve the quality of other health programs (services) and set measurable indicators of information use. Correlational studies are needed to establish the effects of individual determinants on data quality and information use. As this study was conducted in urban areas, matching studies need to be carried out in rural settings for generalisation and nationwide application of the guideline.

8.4 LIMITATIONS OF THE STUDY

While this study offers important insights into the use of HMIS for improving immunisation service quality, certain limitations must be acknowledged, as they may influence the interpretation and generalisation of the findings.

Firstly, the study focused specifically on data management processes and information use within the immunisation program, excluding other health service areas. As such, while the findings offer strong relevance to immunisation service delivery, they may not fully represent HMIS use across other programmatic domains such as maternal health or disease surveillance.

Secondly, the study did not measure the magnitude or strength of association between individual technical, organisational, and behavioural (TOB) factors and system performance. This limits the ability to quantify the exact impact of each determinant on HMIS effectiveness, though the qualitative findings provide meaningful interpretive insights.

Thirdly, the research was conducted in five sub-cities within Addis Ababa, which—while capturing a range of urban health facility settings—limits the geographical scope of the study. Findings may not be fully generalizable to rural areas or other regional states with different contextual realities, health system structures, or resource availability.

Despite these limitations, the study applied rigorous mixed methods approaches, involved diverse stakeholder perspectives, and utilised validated tools. These methodological strengths, along with the inclusion of expert input and validation workshops, enhance the credibility and contextual transferability of the findings and recommendations within similar urban settings in Ethiopia and beyond.

8.5 CONCLUSION

This study set out to explore the use of Health Management Information System (HMIS) data for improving the quality of immunisation services in Addis Ababa and to develop evidence-informed guidelines to strengthen these practices. Through the application of a mixed-methods design and the integrated PRISM-MFI theoretical framework, the study successfully examined data management processes, the extent of information utilisation, and the influence of technical, organisational, and behavioural (TOB) factors on HMIS performance.

Findings revealed a range of persistent challenges that undermine data quality and limit the effective use of information for service improvement. These included undigitized and fragmented data-collection tools, limited integration with systems such as DHIS2, insufficient feedback mechanisms, and weak supervision and accountability structures. Moreover, low competence and confidence among healthcare professionals in applying quality improvement methods—particularly the Plan-Do-Study-Act (PDSA) cycles—contributed to missed opportunities to transform data into actionable insights.

At the core, the study identified a cyclical relationship: poor data quality leads to underutilisation of information, while low levels of use further erode the motivation to improve data systems. The PRISM-MFI framework clarified how TOB determinants shape this cycle, showing that information use is not simply a technical process but is deeply embedded in organisational culture, leadership, resource allocation, and the attitudes and beliefs of health workers.

Importantly, the research also identified areas of strength, such as awareness of quality improvement concepts and existing efforts to use HMIS for performance monitoring. However, these strengths remain underleveraged due to gaps in capacity, system design, and participatory implementation.

The guidelines developed and validated in this study directly address these gaps. They offer practical interventions to improve data quality, foster a culture of information use, and strengthen quality improvement practices. They also emphasise inclusive design, digitisation, integration, and the empowerment of frontline health workers as key enablers of sustainable change.

In conclusion, the study demonstrates that improving immunisation service quality through HMIS is both necessary and feasible—but requires a shift from compliance-based data practices to a system of meaningful data use. Institutionalising these practices demands strong leadership, capacity building, and a clear sense of accountability at all levels of the health system. The adoption and scaling of the proposed guidelines have the potential to transform routine data into a driver of continuous improvement—not only for immunisation services but for broader health system performance.

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ANNEXURE A: REQUEST FOR SITE PERMISSION

Labu Street

Addis Ababa

16 April 2023

To City Government of Addis Ababa Health Bureau

Addis Ababa

I, Feleke Fanta TAssew request to conduct a study with Title: **Health Management Information System (HMIS) utilization for Quality (QI) of Immunization service at public health institutions, Addis Ababa Ethiopia. This study will be conducted as requisite to complete my PhD in public health from University Of South Africa (UNISA)** under the supervision of Professor MM Ramukumba.

THE PURPOSE OF THE STUDY

The purpose of this study is to develop guidelines to strengthen quality of immunization service using the Health Management Information System (HMIS). .

1. Examine data management processes in healthcare facilities and sub-city offices.
2. Identify the effect of TOB factors on data management.
3. Determine the extent of information use in managing immunization services.
4. Identify the effect of TOB factors on information use
5. Explore experiences of health professionals of data generation, information use and quality improvement of immunization service

To achieve these objectives the mixed methods approach with explanatory sequential design was applied. The collection, analysis and interpenetration of quantitative data will be followed by collection, analysis and interpretation of qualitative data.

Target population for this study are health professionals and health information workers currently serving at public health facilities in the area of immunization quality improvement (QI)t and health management information system (HMIS). All information thereby collected will be treated under strictest confidentiality

You are, therefore, kindly requested to grant permission for this important study to be conducted at health facilities of your jurisdiction

If you require any further information or want to, please contact Feleke Fanta Tassew on 0911605899 or email 66421055@mylife.unisa.ac.za.

The query regarding ethical aspect of the study can be forwarded to my stuy advisor Professor MM Ramukumba (Supervisor) on 072 630 2504, or email ramukmm@unisa.ac.za during office hours

Thank you for taking time to read this information and allow me to conduct this study in health facilities under your catchment area.

Thank you.

Signature:

Feleke Fanta Tassew (Researcher)

ANNEXURE B: ETHICAL CLEARANCE FROM UNISA

UNISA university of south africa

RESEARCH ETHICS COMMITTEE: DEPARTMENT OF HEALTH STUDIES
REC-012714-039 (NHERC)

04 March 2020

Dear Tassew Feleke Fanta

HSHDC/963/2020

Student: Tassew Feleke Fanta

Student No: 66421055

Supervisor: Prof M Ramukumba

Qualification: PhD
Joint Supervisor:

Decision: Approval

Name: Tassew Feleke Fanta

Proposal: Utilization of Health Management Information System (HMIS) for quality immunization service in Ethiopia

Qualification: PhD

Risk Level: Medium

Thank you for the application for research ethics approval from the Research Ethics Committee: Department of Health Studies, for the above mentioned research. Final approval is granted from 04 March 2020 to completion.

The application was reviewed in compliance with the Unisa Policy on Research Ethics by the Research Ethics Committee: Department of Health Studies on 03/03/2020.

The proposed research may now commence with the proviso that:

1) The researcher/s will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.

2) Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study, as well as changes in the methodology,

UNISA university of south africa

RESEARCH ETHICS COMMITTEE: DEPARTMENT OF HEALTH STUDIES
REC-012714-039 (NHERC)

04 March 2020

Dear Tassew Feleke Fanta

HSHDC/963/2020

Student: Tassew Feleke Fanta

Student No: 66421055

Supervisor: Prof M Ramukumba

Qualification: PhD
Joint Supervisor:

Decision: Approval

Name: Tassew Feleke Fanta

Proposal: Utilization of Health Management Information System (HMIS) for quality immunization service in Ethiopia

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Risk Level: Medium

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The proposed research may now commence with the proviso that:

1) The researcher/s will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.

2) Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study, as well as changes in the methodology,

should be communicated in writing to the Research Ethics Review Committee, Department of Health Studies. An amended application could be requested if there are substantial changes from the existing proposal, especially if those changes affect any of the study-related risks for the research participants.

3) The researcher will ensure that the research project adheres to any applicable national legislation, professional codes of conduct, institutional guidelines and scientific standards relevant to the specific field of study.

4) You are required to submit an annual report by 30 January of each year that indicates that the study is active. Reports should be submitted to the administrator HSREC@unisa.ac.za. Should the reports not be forthcoming the ethical permission might be revoked until such time as the reports are presented.

Note:

The reference numbers [top middle and right corner of this communiqué] should be clearly indicated on al/ forms of communication [e.g. Webmail, E-mail messages, letters] with the intended research participants, as well as with the Research Ethics Committee:

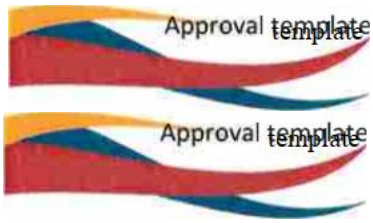
Department of Health Studies.

Kind regards,

Prof JM Mathibe-Neke
CHAIRPERSON
mathijm@unisa.ac.za

Prof KM Masemola
DEAN OF COLLEGE OF HUMAN SCIENCES

University of South Africa
Preller Street, Muckleneuk Ridge, City of Tshwane
PO Box 392 UNISA 0003 South Africa
Telephone: +27 12 429 3111 Facsimile: +27 12 429 4150
University of South Africa
Preller Street, Muckleneuk Ridge, City of Tshwane
PO Box 392 UNISA 0003 South Africa
Telephone: +27 12 429 3111 Facsimile: +27 12 429 4150



ANNEXURE C: ETHICAL CLEARANCE LETTER FROM ETHIOPIAN REGIONAL LEARNING CENTER

UNISA university of south africa

17 April, 2023
UNISA-ET/KA/ST/29/17-04-2023

ADDIS ABABA CITY ADMINISTRATION HEALTH BUREAU
ADDIS ABABA

Dear Madam/Sir,

The University of South Africa (UNISA) extends warm greetings. By this letter, we want to confirm that Tassew Feleke Fanta (student number 66421055) is a PhD student in the Department of Health Studies at UNISA. Currently, he is at the stage of data collection on his doctoral research entitled "**Utilization of Health Management Information Systems (HMIS) for quality immunization services in Ethiopia**".

This is therefore to kindly request your cooperation in assisting the student to be able to collect data from the selected Health Centers under your administration. We would like to thank you in advance for all the assistance that you would provide to the student.

Sincerely,

Dr. Tsige GebreMeskel Aberra

Director

UNISA-ETHIOPIA CENTER
P.O.BOX:13836
ADDIS ABABA
TEL+251912191483

University of South Africa
Regional Learning Center
P.O. Box: 13836, Addis Ababa, Ethiopia
Telephone: +251 11 435 2244 / +251 11 435 0078
Facsimile: +251 11 435 1242/ 43/ 44
Mobile: +251 912 19 1483
www.unisa.ac.za

UNISA university of south africa

17 April, 2023
UNISA-ET/KA/ST/29/17-04-2023

ADDIS ABABA CITY ADMINISTRATION HEALTH BUREAU
ADDIS ABABA

Dear Madam/Sir,

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Sincerely,

Dr. Tsige GebreMeskel Aberra

Director

UNISA-ETHIOPIA CENTER
P.O.BOX:13836
ADDIS ABABA
TEL+251912191483

University of South Africa
Regional Learning Center
P.O. Box: 13836, Addis Ababa, Ethiopia
Telephone: +251 11 435 2244 / +251 11 435 0078
Facsimile: +251 11 435 1242/ 43/ 44
Mobile: +251 912 19 1483
www.unisa.ac.za

ANNEXURE D: ETHICAL CLEARANCE FROM ADDIS ABABA REGIONAL HEALTH BUREAU

አዲስ አበባ ከተማ አስተዳደር ጤና ቢሮ
City Government of Addis Ababa Health Bureau

REF.NO 1/0/1217/2007

DATE 12/8/15

TO:

- ARADA SUB-CITY HEALTH OFFICE
- YEKA SUB-CITY HEALTH OFFICE
- LIDETA SUB-CITY HEALTH OFFICE
- NIFAS SILK LAFTO SUB-CITY HEALTH OFFICE
- LEMIKURA SUB-CITY HEALTH OFFICE
- AKAKI KALITY SUB-CITY HEALTH OFFICE
- TERUNESH BEIJING GENERAL HOSPITAL
- ZEWDITU MEMORIAL HOSPITAL
- RAS DESTA DAMTEW MEMORIAL HOSPITAL
- ADDIS ABABA HEALTH BUREAU

Subject: Request to access Facilities to conduct approved research

This letter is to support **Feleke Fanta** conduct research which is entitled as **"Utilization of Health Management Information System (HMIS) for quality immunization service in Ethiopia."** The study proposal was duly reviewed and approved by Addis Ababa Health Bureau procedures and submit an activity progress report to the Ethical Committee as required. Therefore we request the facility and staffs to provide support to the principal investigator.

The Addis Ababa City Administration Health Bureau

With Regards

Ethical Clearance Committee

ዶ/ር ዮሐንስ ወ/ሚካኤን
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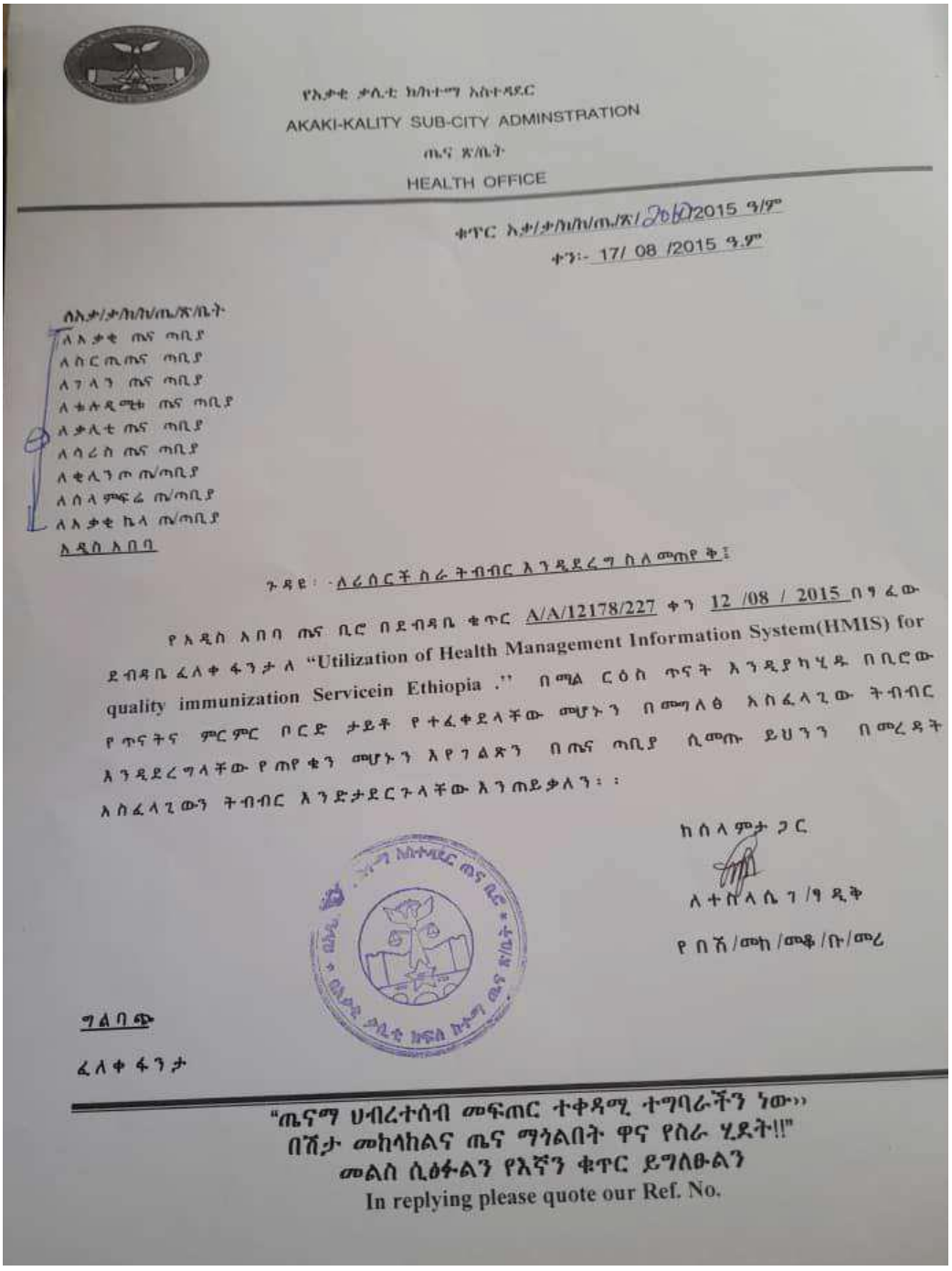
Cc

- **FELEKE FANTA**
- **ETHICAL CLEARANCE COMMITTEE**

ANNEXURE E: ETHICAL CLEARANCE FROM PARTICIPATING HEALTH FACILITIES



የአቃቂ ቃሊቲ ክ/ከተማ አስተዳደር
AKAKI-KALITY SUB-CITY ADMINSTRATION
ጤና ጽ/ቤት
HEALTH OFFICE

ቁጥር አቃ/ቃስክ/ጤ/ጽ/706/2015 ዓ/ም
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ለአቃ/ቃስክ/ጤ/ጽ/ቤት
ለአቃቂ ጤና ጣቢያ
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ለሳሪስ ጤና ጣቢያ
ለቂሊንጦ ጤ/ጣቢያ
ለሰላምፍሬ ጤ/ጣቢያ
ለአቃቂ ኬላ ጤ/ጣቢያ
አዲስ አበባ

ጉዳዩ: -ለሪሰርች ስራ ትብብር እንዲደረግ ስለመጠየቅ፤

የአዲስ አበባ ጤና ቢሮ በደብዳቤ ቁጥር A/A/12178/227 ቀን 12 /08 / 2015 በዓ ፈው ደብዳቤ ፈለቀ ፋንታ ለ "Utilization of Health Management Information System(HMIS) for quality immunization Servicein Ethiopia ." በሚል ርዕስ ጥናት እንዲያካሂዱ በቢሮው የጥናትና ምርምር ቦርድ ታይቶ የተፈቀደላቸው መሆኑን በመግለፅ አስፈላጊው ትብብር እንዲደረግላቸው የጠየቁን መሆኑን እየገልጽን በጤና ጣቢያ ሲመጡ ይህንን በመረዳት አስፈላጊውን ትብብር እንድታደርጉላቸው እንጠይቃለን::

ከሰላምታ ጋር

ለተስላሴ ገ/ዓዲቅ
የበሽ/መከ/መቄ/ቡ/መሪ

ግልባጭ
ፈለቀ ፋንታ

"ጤናማ ህብረተሰብ መፍጠር ተቀዳሚ ተግባራችን ነው"
በሽታ መከላከልና ጤና ማጎልበት ዋና የስራ ሂደት!!"
መልስ ሲፅፉልን የእኛን ቁጥር ይግለፁልን
In replying please quote our Ref. No.

ANNEXURE F: INFORMATION LEAFLET

UNISA university of south africa

PARTICIPANT INFORMATION SHEET

For Questionnaire method participants

Ethics clearance reference number: HSHDC/963/2020

Research permission reference number: UNISA-ET/KA/ST/29-05-102020

Date: 24/04/2023

Title: **Health Management Information System (HMIS) utilization for Quality (QI) of Immunization service at public health institutions, Addis Ababa Ethiopia. View and experience of health service providers, managers and HMIS/HIT workers on Data process, data quality, information use and quality of immunization service.**

Dear Prospective Participant

My name is Feleke Fanta Tassew and I am studying towards a Doctor of philosophy Degree (PhD) in Public Health at the University of South Africa (UNISA), Department of Health studies under the supervision of Professor MM Ramukumba. We are inviting you to participate in this research study titled: Utilization of HMIS for immunization quality improvement at public health facilities & sub-cities health offices Addis Ababa, Ethiopia

THE PURPOSE OF THE STUDY

The purpose of this study is to develop guidelines to strengthen quality of immunization service using the Health Management Information System (HMIS). .

This study is expected to collect important information that could identify views and experiences of health professionals and health information workers on HMIS data process, data quality assurance and health information use. In addition to make recommendations based on the participants' responses and develop the guideline.

The study might add to knowledge and skills of health staff in data process, data quality assurance and persistent health information use for quality of immunization service at public health facilities and sub-city (district) health offices

Thank you.

Signature:... ……

Feleke Fatna Tassew (Researcher)

University of South Africa
Preller Street, Muckleneuk Ridge, City of Tshwane
PO Box 392 UNISA 0003 South Africa
Telephone: +27 12 429 3111 Facsimile: +27 12 429 4150
www.unisa.ac.za

PARTICIPANT INFORMATION SHEET

For Questionnaire method participants

Ethics clearance reference number: HSHDC/963/2020

Research permission reference number: UNISA-ET/KA/ST/29-05-102020

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The study might add to knowledge and skills of health staff in data process, data quality assurance and persistent health information use for quality of immunization service at public health facilities and sub-city (district) health offices

Thank you.

Signature:... .....

Feleke Fatna Tassew (Researcher)

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PO Box 392 UNISA 0003 South Africa
Telephone: +27 12 429 3111 Facsimile: +27 12 429 4150
www.unisa.ac.za

ANNEXURE G: CONSENT FORM FOR STUDY PARTICIPANTS

UNISA university of south africa

CONSENT TO PARTICIPATE IN THIS STUDY

I, _____ (participant name), confirm that the person asking my consent to take part in this research has told me about the nature, procedure, potential benefits and anticipated inconvenience of participation.

I have read (or had explained to me) and understood the study as explained in the information sheet.

I have had sufficient opportunity to ask questions and am prepared to participate in the study.
I understand that my participation is voluntary and that I am free to withdraw at any time without penalty (if applicable).

I am aware that the findings of this study will be processed into a research report, journal publications and/or conference proceedings, but that my participation will be kept confidential unless otherwise specified.

I agree to the recording of the interview with the researcher.

I have received a signed copy of the informed consent agreement.

Participant Name & Surname…… (Please Print)

Participant Signature……Date……

Researcher's Name & Surname…… (Please Print)

Researcher's signature……Date……

University of South Africa
Preller Street, Muckleneuk Ridge, City of Tshwane
PO Box 392 UNISA 0003 South Africa
Telephone: +27 12 429 3111 Facsimile: +27 12 429 4150
www.unisa.ac.za

ANNEXURE H: DATA COLLECTION TOOL QUES-TIONNAIRE

Novembre, 2019, final Revised in April 2023

Part I Identification of the Participant

Quantitative Questionnaire

***Instruction**: For all the questions, circle or mark with tick (√) (the number(s) of the answer(s) you choose (agree). Write in the space provided under "specify other" for those answer(s) which you provide, but not listed in the choice. Be sure you always use a pencil to complete questionnaire*

1.1.Consent obtained:	1	Yes		1.3.Date of the Interview l____l____l l____l____l l____l____l____l____l
	2	No		1.4. Name of interviewer (coordinator): _____

1.2.Interview ID No: l____l____l____l	1.5. Phone number + 2 5 1 | | | | | | | | | | | | 1.6. Email address:_____

1.7.What is the type of health institution (facility)?	1.7.1. City Admin office		1.8.Name of hospital	1.8.1. Ras Desta Damte	
	1.7.2. Subcity Admin office			1.8.2. Turunesh Bejging	
	1.7.3. Hospital			1.8.3. Zewditu Memorial	

1.9.Name of Sub-city	1.9.1. Akaki Kality Sub-city		1.9.4.N. Slik Lafto Sub-city	
	1.9.2. Arada sub-city		1.9.5. Yeka Sub-city	
	19.3. Lideta Sub-city			

1.9.1-5. Name of the health office or health facility _____

Part II Demographic Background of the participant

SN	Questions	Responses					Instruction: (skip...)
2.1	Gender of the participant	1	Male	2	Female		
2.2	Age of the participant						
2.3	Educational status of the participant	1 Dplomal holder					
		2.BSc/BA degree					
		3 Master's degree					
		99. Other [specify] _____					
2.4.	Professional category of the participant	1 Nurse					
		2 Health officer					
		3 Information Technician (HIT)					
		4 Statistician					
		5 Environmental health professional					
		99. Other [specify] _____					

2.5	Responsibility or role at the health institution	1. Immunization provider/EPI officer	
		2. Diseases prevention control (CDC) officer	
		3. Maternal and Child health (MCH) officer	
		4. HMIS (HIT) officer	
		5. Quality Improvement (QI) officer	
		6. Planning officer (coordinator or head)	
		7. Facility director or head of the office	
		99. Other [specify] _____	
2.6.	☐☐ Years of service in current position		☐☐ 2.7. Total Years of service

3.1	What do you understand by the term "Data" ***Multiple responses are possible***	1. Information		
		2. Raw fact		
		3. Item		
		4. Number		
3.2	What is (are) characteristic(s) of good quality data? ***Multiple responses are possible***	1. Accuracy/ precision		
		2. Completeness		
		3. Reliability (consistency)		
		4. Timeliness		
		5. Confidentiality		
		6. Integrity		
3.3	What mechanism do you use to check data quality at your health institution?	1. No data quality check		
		2. RDQA		
		3. DQA		
		4. LQAS		
		5. DQRC (Data Quality Report card)		
		99. Other [specify]		

	Multiple responses are possible	_____

Part III Data management processes implemented in healthcare facility/subcity health office. Encircle or tick your choice(s) in relation to data and routine management activities being carried out at your healthcare institution

3.4	**Availability of Functional Components needed to ensure data quality: (Yes, No, I do not know (IDK)**		Yes	No	IDK	
	3.4.1.M&E structure is adequately staffed as per standard (HIT/HMIS staff)					
	3.4.2. Indicator definition manual is available					
	3.4.3. Regular supply of data collection and reporting forms					
	3.4.4. Reporting guidelines are available					
	3.4.5. Have linkage with the national system (reporting requirements and minimum indicators are linked)					
	3.4.6 Culture of data use for decision making is encouraged					
3.5	Which function(s) is (are) accomplished in data management processes at your health institution? ***Multiple responses are possible***	1. Data collection				
		2. Data aggregation/compilation				
		3. Data quality check				
		4. Data analysis				
		5. Data storage/archiving/repository				
		6. Data display				
		7. Data interpretation				
		8. Data transmission (sharing)				
		9. Feedback				
3.6	If this health institution collects routine data, which tool(s) is/are used for the routine data collection? ***Multiple responses are possible***	1. DHIS2 (data base)				
		2. Child health (patient) card				
		3. Registers				
		4. Tally sheet				
		5. Reporting forms				
		99. Other [specify] _____				
	Which computer (software) is (are)	1. DHIS2 (data base)				

3.7	used to capture/store data at this health institution? ***Multiple responses are ossible***	2. EHMIS		
		3. EMR		
		4. HFIS (Health Financing Information System)		
		99. Other [specify] _____		
3.8	Which tool(s) is/are used to aggregate (compile) routine data? ***Multiple responses are possible***	1. DHIS2 (data base)		
		2. EHMIS software		
		3. Tally sheet		
		4. Reporting forms		
		99. Other [specify]_____		
3.9	If this health institution uses data software for analysis, what type(s) of tool(s) is are used? ***Multiple responses are possible***	1. DHIS2 (data base)		
		2. EHMIS		
		3. EMR		
		99. Other [specify]_____		
3.10	What is (are) tools used for routine data display at this health institution? ***Multiple responses are possible***	1. DHIS2 (data base) visualization		
		2. EPI monitoring chart		
		3. Epidemic (diseases) monitoring chart		
		4. Performance monitoring indicators table/graph		
		99. Other [specify]_____		
3.11	Which step(s) is (are) followed in monthly/quarterly routine data (results) interpretation at this health institution? ***Multiple responses are possible***	1. Compare the result with previous achievements		
		2. Compare the result with annual target (indicator)		
		3. Describe significant findings (gaps)		
		4. Develop action plan		
		99. Other [specify]_____		
	What is (are) tool(s) mechanism(s) used for sharing of routine data at	1. Direct access to DHIS2 plat-form internally		

3.12	this health institution? ***Multiple responses are possible***	2. Electronic form sharing, externally		
		3. Hard copy report sharing, externally		
		4. Sharing in data review meeting, internally		
		99. Other [specify]_____		
3.13	What feedback mechanism(s) is (are) given/received on routine data at this health institution? ***Multiple responses are possible***	1. Self-assessment of own data/records feedback		
		2. Higher level RDQA (supervision) feedback		
		3. Data review day workshop feedback		
		4. Stakeholder's/partners data review feedback		
		5. Peer data/performance review meeting feedback		
		99. Other [specify]_____		

Part IV. Technical aspects of data management process - reporting forms, procedures, IT use, computer software and HMIS design

4.1	The HMIS reporting forms are complex (not simplified).	1. Strongly disagree		If your choice is 1 or 2, go to Q4.4
		2. Disagree		
		3. Neither disagree or agree		
		4. Agree		
		5. Strongly agree		
4.2	If you agree or strongly agree to Q 4.1 above, which reporting from is (are) complex? ***Multiple responses are possible***	1. Immunization reporting form		
		2. The diseases reporting form		
		3. The MCH reporting form		
		4. IDSR reporting form		
		99. Other [specify]_____		
4.3	Why you think the reporting form(s) is/are complex?	1. No guideline on use of the reporting form(s)		

	Multiple responses are possible	2. Data elements are duplicative (redundant)	
		3. Difficult to understand the contents	
		99. Other [specify]_____	
4.4	The HMIS data collection tool(s) are too lengthy.	1. Strongly disagree	If your choice is 1 or 2, go to 4.7
		2. Disagree	
		3. Neither disagree or agree	
		4. Agree	
		5. Strongly agree	
4.5	If you agree or strongly agree to Q 4.4 above, which of the HIS/ IT tool(s) take(s) long to complete? ***Multiple responses are possible***	1. DHIS2 (data base)	
		2. EHMIS data base	
		3. Child health (patient) card	
		4. The Immunization Registers	
		5. The Immunization Tally sheet	
4.6	Why you think the HMIS data collection tool(s) is/are taking a long time to complete?	1. No guideline on use of data collection tools	
		2. Difficult to understand the contents	
		3. The data elements in the tool are duplicative	
		99. Other [specify] _____	
4.7	The computer software this health institution uses for data capturing is complex.	1. Strongly disagree	If your choice is 1 or 2, go to Q 4.9
		2. Disagree	
		3. Neither disagree or agree	
		4. Agree	
		5. Strongly agree	
4.8	Why do you think the computer software you mentioned in 4.7 is complex? ***Multiple responses are possible***	1. No guidelines on how to use the software	
		2. Difficult to understand its operation	
		3. It is very slow and time taking	
		4. Data elements in the software are duplicative	
		99. Other [specify] _____	

4.9	What do you understand by the term standardized HMIS design? ***Multiple responses are possible***		1. HMIS data have standard agreed definition	
			2. Similar HMIS tools at similar level of the system	
			3. HMIS Indicators are clearly defined understandable	
			4. Guidelines are available on how to use HMIS tools	
			99. Other [specify]_____	
4.10	What do you understand by the term integrated HMIS design? ***Multiple responses are possible***		1. Uniform (no duplicative) data registers/records	
			2. Single channel (no parallel) reporting	
			3. All health programs have a common data tool	
			4. Data capture made easier	
			5. Data analysis made easier	
			6. Data use made easier	
			99. Other [specify] _____	
4.11	What do you understand the term simplified HMIS design (tools)? ***Multiple responses are possible***		1. Procedure/content HMIS tools are understandable	
			2. Data capturing in HMIS tools are not time taking	
			3. HMIS collected data are relevant to performance indicators at health facility level	
			4. Filling the HMIS reporting form are not time taking	
			5. Data sharing using HMIS tools made easier	
			99. Other [specify] _____	
4.12	Which of the HMIS tool(s) is (are) standardized? ***Multiple responses are possible***		1. Child health card (individual medical record)	
			2. Immunization service register	
			3. Immunization service tally sheet	
			4. Immunization service reporting form	
			5. None of the above tools is standardized	
			99. Other [specify] _____	

4.13	Which of the HMIS tool(s) is (are) integrated? ***Multiple responses are possible***		1. Child health card/individual medical record 2. Immunization service register 3. Immunization service tally sheet 4. Immunization service reporting form 5. None of the above tools is integrated **99. Other [specify]** _____
4.14	Which of the HMIS tools is (are) simplified? ***Multiple responses are possible***		1. Child health card (individual medical record) 2. Immunization service register 3. Immunization service tally sheet 4. Immunization service reporting form 5. None of the above tools is simplified **99. Other [specify]** _____

Part V. Organizational factors and data management process

5.1	Which of the management tasks/functions are carried out at this health institutions? **Tick (√) on Yes, No or I do not know (IDK)**		Yes	No	IDK
		1. Developing strategic plan			
		2. Developing annual work plan			
		3. Performance monitoring			
		4. Staff performance appraisal			
		5. Quality of service improvement plan			
		6. Supply request, use and distribution			
		7. Resource mobilization and allocation			
		8. Immunization service sessions plans			
		9. Emergency (outbreak) response plan			
		99. Other [specify] _____			

		Tick (√) Data sources used for the ctivities/functions in your facility			
	Activities/functions	1. Routine HMIS	2. Census	3. Survey	**99.Other [specify]**
	1. Developing strategic plan				_____
	2. Developing annual work plan				_____

5.2	3. Performance monitoring				_____
	4. Staff performance appraisal				_____
	5. Quality of service improvement plan				_____
	6. Supply request, use and distribution				_____
	7. Resource mobilization and allocation				_____
	8. Immunization service sesions plan				_____
	9. Emergency (outbreak) response plan				_____
	10. Other [specify]_____				_____

5.3	Which immunization activities are carried out at your health institution using routine health information? ***Multiple responses are possible***	1. Immunization (RED/C) plan development		
		2. Immunization coverage monitoring		
		3. Defaulter tracing		
		4. Vaccines and other supply management		
		5. Linking the service to community		
		6. Advocacy work		
		99. Other [specify]_____		

5.4	Is the post for HMIS processes filled at this institution?	1. Yes, HMIS/HIT post is filled		If your choice is 2, 3 or 4, go to Q5.8
		2. No HMIS post is not filled		
		3. I do not know if HMIS post is filled		
		4. No HMIS staff post at this institution		

5.5	If your choice to the Q5.4. above is "1," are HMIS personnel assigned for data management process been trained recently?	1. Yes, recently trained		
		2. Yes, trained, but not recently		
		3. No, not trained		

5.6	If your choice to the 5.5 above is "1," answer this **Question:**	1. Yes, the training was need based		If your choice is 2 or 3, go
		2. No, the training was not need based		
		3. I do not know if training was need		

	Was the recent training need based?	based		to Q5.8
5.7	After training, was there improvement on data process skill?	1. Yes, the training has improved skills		
		2. No, the training has not improved skills		
		3. I do not know if training has improved skills		
5.8	How does this institution use HMIS to conduct supervision? ***Multiple responses are possible***	1. To design supervision checklist		
		2. To verify reported performance		
		3. To provide feedback		
		4. Not using HMIS for supportive supervision		
		5. I do not know if HMIS is used for supervision		
5.9	How does this health institution share data internally? ***Multiple responses are possible***	1. Data is not shared due to external pressure		
		2. Data is not shared internally		
		3. Shared during monthly reporting		
		4. Shared in the performance review meeting		
		5. Shared through self-assessment of units		
5.10	How does this health institution report data to external stakeholders? ***Multiple responses are possible***	1. Monthly/quarterly reporting		
		2. Monthly/quarterly feedback		
		3. Performance (peer) review meetings		
		4. Up on request by the stakeholders		
		99.Other _____		**[specify]**
5.11	Who is responsible for continuous use of HMIS data at this health institution?	1. HMIS/HIT staff		
		2. Individual health service providers		
		3. Management team		
		4. Performance monitoring team		
		5. Quality improvement team		
		6. Head of the health institution/facility		

	Multiple responses are possible	**99.Other** _____		**[specify]**
5.12	Who is accountable to ensure continuous use of quality checked HMIS data/information at this health institution? ***Multiple responses are possible***	1. HMIS/HIT staff		
		2. Quality improvement team		
		3. Management team		
		4. Head of the health institution/facility		
		5. Higher level managers		
		99. Other _____		**[specify]**

Part VI. Behavioral factors and data management process

6.1	How is the demand of routine data among health staff in this health institution?	1. High Demand of HMIS data		
		2. Average Demand of HMIS data		
		3. Low Demand of HMIS data		
6.2	If HMIS data demand is high, what is/are reasons? ***Multiple responses are possible***	1. To program planning		
		2. To send routine report timeously		
		3. To send parallel donor (partner) report		
		4. To program review		
		5. To community mobilization		
		99. Other _____		**[specify]**
6.3	If the demand is high, which unit has the highest demand for HMIS data?	ɪation (EPI) unit		
		l and Child Health (MCH) unit		
		prevention and control (CDC) unit		
		IT unit		
		99. Other _____		**[specify]**
	What purpose/aim is HMIS immunization data used for?	1. Defaulter tracing		
		2. Reducing dropout rate		
		3. QI planning		
		4. Quality improvement (doing)		

6.4	***Multiple responses are possible***	5. Quality control (monitoring)		
		6. Reducing Missed Opportunities		
		99. Other _____		**[specify]**
6.5	In which data quality assessment areas are you skilled? ***Multiple responses are possible***	1. No skill(s) of data quality check		
		2. RDQA (Routine Data Quality Assurance)		
		3. DQA		
		4. LQAS		
		5. DQRC (Data Quality Report Card)		
		99. Other _____		**[specify]**
6.6	How often is the routine data quality check conducted at this health institution?	1. Data quality check not done regularly		
		2. Data quality check done Monthly		
		3. Data quality check done quarterly		
		4. Data quality check done annually		
		99. Other _____		**[specify]**
6.7	HMIS produces high quality data in your institution	1. Strongly disagree		
		2. Disagree		
		3. Neither disagree or agree		
		4. Agree		
		5. Strongly agree		
6.8	Indicate problematic areas of data management processes at this health institution? ***Multiple responses are possible***	1. Data collection		
		2. Data quality checking		
		3. Data analysis		
		4. Data interpretation		
		5. Data display		
		6. Data sharing		
		7. Feedback		
		99. Other _____		**[specify]**
6.9	Indicate your level of confidence in solving problems related to			**1 to 5**
		1. Data collection		

	these data management processes **1, Most confident, 2 Confident, 3 Somehow confident 4, Less confident 5, Least confident**	2. Data quality checking	
		3. Data analysis	
		4. Data interpretation	
		5. Data display	
		6. Data sharing	
		7. Feedback	

	Indicate using a (tick) your level of competence on HIS related tasks	**Yes**	**No**	**Not Sure**
6.10	1. **Data collection**: can you demonstrate that you understand the principles of good data collection?			
	2. **Data quality checking**: can you evidence understanding of data quality verification?			
	3. **Data analysis**: are you normally analyzing data on your own without supervision?			
	4. **Data interpretation**: can you describe how you follow organisational processes in data interpretation?			
	5. **Information use**: can you evidence how you use data in compliance with regulations and standards?			
	6. **Data sharing**: can you demonstrate proficiency in the use of HMIS electronic data transmission?			
	7. **Data display**: can you demonstrate data on graphs, pie charts, and update accordingly/periodically?			
	8. **Data feedback**: can you advise/train others on data quality check/data use			

6.11	How does this health institution motivate data producers/ data users? ***Multiple responses are possible***	1. Managers provide directives on data use		
		2. Managers use HMIS information		
		3. Sufficient supervision and feedback provided		
		4. Incentives (recognition) for data use champions		
		5. Training and capacity building on data use		
		99. Other [specify] _____		

Part VII Information use

7.1	Indicate your experience of HMIS information use Currently, I use HMIS information for: ***Multiple responses are possible***	1. Planning of health service delivery		
		2. Monitoring performance coverage indicators		
		3. Reporting health/immunization service progress		
		4. Performing administrative functions		
		5. Improving health/immunization service quality		
		99. Other [specify] _____		
7.2	How often does this health institution use HMIS(DHIS2) information for decision making?	1. It uses information continuously		If your choice is 2 or 3 go to Q7.4
		2. It uses information, but inconsistently		
		3. No, it does not use HMIS information		
7.3	If this institution uses information continuously, which evidence is available to indicate continued use of HMIS information? ***Multiple responses are possible***	1. Archived monthly immunization service report		
		2. Updated display of EPI monitoring chart		
		3. Current operational plan reflecting targets		
		4. Documented performance monitoring minutes		
		5. Ongoing quality improvement (QI) initiative		
		99. Other [specify] _____		
7.4	In your opinion, what should be done to continuously use HMIS information at this health institution? ***Multiple responses are pos-***	1. Connect information use to quality improvement process		
		2. Connect information use to health service planning		
		3. Agree on needs of information use		
		4. Ensure quality of data before using it		
		99. Other [specify] _____		

	sible			
7.5	To which of process/activity of quality improvement is HMIS information used? ***Multiple responses are possible***	1. Plan (aim) for quality improvement		
		2. Measure quality improvement indicators		
		3. Monitor quality improvement implementation		
		4. Assess changes in quality of service		
		99. Other _____		**[specify]**
7.6	For which immunization service related activity is HMIS information used at this health institution? ***Multiple responses are possible***	1. Planning and management of resources		
		2. Reaching all eligible population		
		3. Monitoring and data use for action		
		4. Conducting supportive supervision		
		5. Improving quality of immunization service		
		99. Other _____		**[specify]**
7.7	What are steps included in monitoring use of immunization data for action? ***Multiple responses are possible***	1. Define monitoring process schedule		
		2. Select core indicators and targets		
		3. Collect data and submit reports		
		4. Analyze and interpret data		
		5. Take corrective action		
7.8	What is/are the aims of using HMIS immunization data for quality improvement? ***Multiple responses are pos-***	1. Minimize Missed Opportunity for Vaccination (MOV)		
		2. Reduce vaccines dropout rate (DOR)		
		3. Raise coverage of fully immunized children		
		4. Monitor stockout rate of vaccines/supplies		
		5. Monitor cold chain functioning		
		99. Other _____		**[specify]**

	sible	

Dear participants, thank you have come to the end of the questionnaire!!

We would like to thank you for taking time to complete this questionnaire, your contribution is irreplaceable to the success of this study. We appreciate your call for clarification if needed.

Please call us on +251911605899/+251946399016 (Feleke Fanta, on top of this study) or Tarekegn Negese assisting with the study +251946750279

ANNEXURE I: INTERVIEW GUIDE

A PhD thesis study on Utilization of Health Information Use (HMIS) for Quality of Immunization (QI) service, Addis Ababa Ethiopia By Feleke Fanta Tassew

November, 2019

Annexure III: Semi-structured interview guide for Focus group (FG) at health facility level

I. **Tell me how you implement HMIS in your facilities/offices.**

Probing areas:

- Please elaborate on your role
- orientation to the system/training and support
- system flexibility and functionality
- data management
  - Data interpretation and methods used.
  - Data aggregation(compilation) tools/software used.
  - Use of DHIS2 and hard copy data collection (hybrid)

II. **How have you experienced using HMIS tools?**

Probing areas:

- What works/ why?
- Data quality check methods, perception of data quality
- DHIS2 software
- Design of HMIS tools (forms, software)
  - Why?

III **Please share with me how the immunization service is structured and organized.**

Probing areas:

- Scope of service provision

- Resources (infrastructure. human power, financial etc.)
- Accountability

IV. How do you use information from HMIS to manage the immunization service?

Probing areas:

- Culture of information use (how?)

a. Micro-planning, vaccines, and supplies

b. implementation (coverage) monitoring for action, supervision

c. Immunization service quality improvement (how is design of Immunization QI)

V. What are enablers and barriers to QI implementation at this facility/office?

VI. What can be done to strengthen the quality of immunization services?

ANNEXURE J: CONFIDENTIALITY BINDING FORM FOR RESEARCH ASSISTANTS

Confidentiality clause between

Feleke Fanta Tassew, herein after Principal investigator of thesis research

and

Ms/Mr/Dr_____

Hereinafter the thesis research assistant (data collector)

Research title

Utilization of Health Management Information System (HMIS) for quality immunization service in Ethiopia

Research code of ethics mandates parties involved in the research process upkeep confidentiality throughout data collection, analysis and dissemination of study result

I, here the undersigned as research assistant of the above study willingly commit myself to maintain confidentiality of the information accrued due to my participation in the study at capacity of data collector for quantitative phase data collection

Name of research assistant: _____

Signature of research assistant:_____

Date signed:_____

ANNEXURE K: CONFIDENTIALITY BINDING FORM FOR QUALITATIVE DATA INDEPENDENT CODER

Confidentiality clause between

Feleke Fanta Tassew, herein after Principal investigator of PhD thesis research

and

Ms/Mr/Dr_____

Hereinafter PhD thesis study qualitative data independent coder

Research title

Utilization of Health Management Information System (HMIS) for quality immunization service in Ethiopia

Research code of ethics mandates parties involved in the research process upkeep confidentiality throughout data collection, analysis and dissemination of study result

I, here the undersigned as research assistant of the above study willingly commit myself to maintain confidentiality of the information accrued due to my participation in the study at capacity of data collector for quantitative phase data collection

Name of research assistant: _____

Signature of research assistant:_____

Date signed:_____

ANNEXURE L: CONSENT FORM FOR EXPERTS FOR DRAFT GUIDELINE REVIEW

search mentioned above. The background, purpose, risks and benefits of the study have been explained to me. I also understand that I may withdraw from the study at any time without consequences. I know that my participation in the study will be acknowledged, although my identity will be withheld.

....

Participants' signature Date

Declaration by investigator

I, Feleke Fanta Tassew declared that

I fully explained the information in the study and purpose of guideline

I prompted him/her to ask questions, thus took adequate time to explain them

I proved that the participant experts had adequate understanding of the aspects of study, and intention of the guideline

Signature:

Date:

ANNEXURE M: PANEL OF EXPERTS GUIDELINE VALIDATION CHECKLIST

Study Title: Utilization of Health Management Information System for data driven decisions in maternal healthcare in Addis Ababa

Please rate your level of support for the updated strategies

S.N	**Guidelines and Major strategies and key interventions to improve data quality, Information use and immunization Quality Improvement (Guidelines 1, 2 and 3)**	**Level of endorsement**		
		Strongly endorsed (Code-1)	Some-how endorsed (Code-2)	Less endorsed (Code-2)
1	**Data quality improvement Guideline**			
1.1	**Standardization and simplification of data tools/software;** Assess stakeholders' engagement, standardize and integrate tools, support and feedback	9	4	2
1.2	**Infrastructure enhancement:** Upgrade DHIS2, server, internet, interoperability, monitor and evaluate the progress	8	6	1
1.3	**Capacity building (improved HMIS training),**	9	5	1
1.4	**Implementation of integrated data quality assurance mechanisms;** integrated data quality assessment (LQAS, RDQA, DQRC) supported by PRISM framework, strengthen feedback provision, conduct data validation and verification, Monitor and evaluate data quality assurance activities	9	4	1
2	**Information use guideline**			
2.1	**Definition (purpose) of information needed at an institutional level;** emphasizes on purpose of information use and building the capacity of healthcare workers and managers to analyze and interpret data, and use of\ information effectively and continuously	10	4	1
2.2	**Strengthening supportive supervision and feedback;** formulate continuous use of information and evidence of information use at health facility level	12	2	1
2.3	**Strengthening accountability system; f**ostering culture of information usage bridges the gap in use of information for planning, per-	10	4	0

	formance monitoring, budgeting, performance appraisal and implementation of health interventions such as quality improvement.			
3	**Immunization service quality improvement guideline**			
3.1	**Identification and prioritization of immunization quality problems**: Provision of a systematic approach to use of information to improve immunization service and address barriers of supply shortages, cold chain and conduct EPI supportive supervision.	11	3	1
3.2	**Application of PDSA cycle for continuous information use**: Use tools to assess client satisfaction with changes in quality of service, and deals with setting baseline indicator of quality improvement, monitoring quality improvement projects, and engaging community into immunization service	8	6	1
3.3	Engagement of stakeholders during PDSA implementation: Strengthen collaborations with organizations; Share immunization data, identifying gaps; Engage leaders in outreach activities; Empower health extension workers or volunteers; Recognize champion families	9	5	1
Total (cumulative) level of agreement		63.3%	28.7%	8.0%
Summary of comment				
Comment 1				
Comment 2				

ANNEXURE N: EDITING CERTIFICATE

CERTIFICATE OF LANGUAGE AND TECHNICAL EDITING

I, the undersigned, declare that I have edited the **DPhil thesis of FELEKE FANTA TASSEW**, titled:

UTILIZATION OF HEALTH MANAGEMENT INFORMATION SYSTEM (HMIS) FOR QUALITY IMMUNIZATION SERVICE IN ETHIOPIA

I have read the thesis and made suggestions regarding the layout and use of UK English. I have also verified that all sources listed in the list of references were cited correctly in the thesis and that all in-text references are accounted for in the list of references. While I tried to work as carefully as possible, some errors may have been overlooked, and I may also have made mistakes during the editing process.

Where figures in the thesis were inserted as images, I was unable to make any corrections to them. I also refrained from correcting the English translations of interviewees' citations, since these quotations had to reflect the language of the interviewee or the precise translation from Amharic to English.

I consulted the guide for doctoral students from the Department of Health Studies at UNISA and attempted to comply with the required regulations. Please note that the correct abbreviation for et al. is with a period, not et al as the guide states.

I changed the American spellings of words to the British equivalents, except for the thesis title (which had to stay the same) and references to titles in USA English.

I cannot be held responsible for changes made to the thesis after editing was completed and before it was submitted in its final form for examination, or for submission into the UNISA repository.

Signed: 

Prof (emeritus) P.J. Botha
(Member of the South African Translators' Institute, no. 1000048.)
Date: 16th January 2026

ANNEXURE O: TURNITIN REPORT

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FINAL THESIS UTILIZATION OF HMIS FO R IMMUNIZATION QI.docx

AUTHOR

FELEKE FANTA TASSEW

WORD COUNT

121071 Words

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717263 Characters

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490 Pages

FILE SIZE

6.8MB

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