MAKERERE UNIVERSITY

SCHOOL OF PUBLIC HEALTH

A COMPARATIVE STUDY OF ELECTRONIC AND PAPER-BASED SYSTEMS ON THE TIMELINESS AND COMPLETENESS OF IMMUNIZATION DATA IN UGANDA: A CASE OF MOYO AND ADJUMANI DISTRICTS

By

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A RESEARCH THESIS SUBMITTED TO DIRECTORATE OF RESEARCH AND GRADUATE TRAINING OF MAKERERE UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE MASTER OF PUBLIC HEALTH MONITORING AND EVALUATION DEGREE OF MAKERERE UNIVERSITY.

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Declaration

I, **Sinah Kgomotso Phiri**, hereby declare that this dissertation is my original work and that to the best of my knowledge, this work has not been presented to any Institution (s) either partially or in total for any academic award (s), publication (s), or other use (s). Where the works of others is quoted, appropriate references have been given. I therefore present it to the Makerere University, Directorate of Graduate Studies

..... 22nd Jan 2026

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Acronyms and Abbreviations

ANC	Antenatal Care
CHW	Community Health Worker
DHIS2	District Health Information System, Version 2
eCHIS	Electronic Community Health Information System
FP	Family Planning
HMIS	Health Management Information System
iCCM	Integrated Community Case Management
LMICs	Low- and Middle-Income Countries
MoH	Ministry of Health
PNC	Postnatal Care
RMNCH	Reproductive, Maternal, Newborn, and Child Health
SSA	Sub-Saharan Africa
TT	Tetanus Toxoid
UNICEF	United Nations Children's Fund
VHT	Village Health Team
WHO	World Health Organization

Operational Definitions

Term	Definition
Completeness	The extent to which all required data fields in community health reports are filled without omissions.
Timeliness	The degree to which community health data are reported within the required time frame set by the Ministry of Health.
Data Quality	A composite measure of timeliness, and completeness of data captured through community health information systems.
Electronic Community Health Information System (eCHIS	A digital data management platform developed by Uganda's Ministry of Health to support CHWs in capturing, storing, and transmitting real-time health data at the community level.
Paper-Based Reporting System	A manual data recording and reporting method where CHWs use paper tools such as registers and tally sheets to capture and submit health data to the next reporting level.
Integrated Community Case Management (iCCM)	A community health strategy that enables trained CHWs to diagnose, treat, and refer children with common childhood illnesses.
Community Health Workers (CHWs)	Volunteers trained by the Ministry of Health to deliver basic health services, conduct health education, collect community-level health data, and link communities to formal health facilities.
Health Management Information System (HMIS)	An integrated national system that collects, processes, and disseminates health-related data from community, facility, and district levels to support evidence-based planning and decision-making in Uganda's health sector.

Abstract

Background: High-quality immunization data are fundamental for effective planning and monitoring of immunization programs. In Uganda, the coexistence of electronic and paper-based reporting systems presents a critical opportunity to evaluate their comparative impact on data quality, specifically timeliness and completeness.

Objective: This study aimed to compare the timeliness and completeness of immunization data between the electronic Community Health Information System (eCHIS) in Moyo District and the paper-based system in Adjumani District, and to explore health workers' perceptions and experiences with both systems.

Methods: A comparative cross-sectional mixed-methods study was conducted. Quantitative data were collected from 220 health workers (113 in Moyo, 107 in Adjumani) and analyzed using multivariate logistic regression. Qualitative data were gathered through key informant interviews and focus group discussions and analyzed thematically.

Results: The use of eCHIS was significantly associated with superior data timeliness and completeness. Health workers in Moyo were over seven times more likely to submit timely (Adj OR = 7.15, 95% CI: 2.72–18.82, p=0.001) and complete reports compared to those in Adjumani. Qualitative findings revealed that health workers perceived eCHIS as user-friendly and efficient, reducing workload and minimizing errors through automated reminders and validation checks. In contrast, the paper-based system was described as time-consuming, prone to errors, and hampered by logistical challenges like form stockouts. Key barriers to optimal eCHIS performance included unreliable electricity, poor internet connectivity, and gaps in digital literacy.

Conclusion: The eCHIS demonstrates a clear advantage over paper-based systems in enhancing the timeliness and completeness of immunization data in Uganda. For successful nationwide scale-up, sustained investment in digital infrastructure, continuous training, and robust technical support are essential to overcome existing barriers and fully realize the benefits of digital health information systems.

1 CHAPTER ONE: INTRODUCTION AND BACKGROUND

1.1 Introduction

Immunisation remains one of the most effective public health interventions for reducing morbidity and mortality from vaccine-preventable diseases, particularly among children under five years of age. Globally, immunisation programmes have contributed substantially to improvements in child survival and population health outcomes, with millions of deaths averted annually through routine vaccination (WHO, 2024). The effectiveness of these programmes, however, is highly dependent on the availability of high-quality data that are timely, complete, and reliable to support planning, implementation, monitoring, and evaluation.

Across low- and middle-income countries (LMICs), weaknesses in health information systems continue to undermine immunisation programme performance. Many countries rely heavily on paper-based reporting systems that are prone to delays, transcription errors, data loss, and incomplete records. These challenges compromise the ability of programme managers to accurately monitor coverage, forecast vaccine needs, identify underserved populations, and respond promptly to outbreaks. Consequently, poor data quality often results in inefficient resource allocation and missed opportunities to improve immunisation coverage (Harrison et al., 2020; Ngwa et al., 2022).

In sub-Saharan Africa (SSA), health information systems are frequently constrained by limited infrastructure, inadequate human resource capacity, and fragmented reporting platforms. These systemic challenges restrict the timely flow of immunisation data from community and facility levels to district and national decision-makers. To address these gaps, several countries in the region have begun adopting digital health innovations aimed at strengthening data collection, reporting, and use. Electronic community-level health information systems, in particular, have been promoted as tools for improving timeliness, completeness, and accessibility of routine health data (Bogale et al., 2023).

Digital health platforms offer the potential to transform immunisation data management through real-time data entry, automated validation checks, and rapid transmission to central databases. Evidence from various LMICs suggests that electronic systems can substantially improve reporting efficiency and data quality when adequately supported by infrastructure, training, and supervision. However, the extent to which these benefits are realised varies by context, underscoring the importance of country-specific and sub-national evaluations.

Within this broader global and regional context, Uganda has embarked on a gradual transition from paper-based reporting towards digital community health information systems. Understanding how these

electronic platforms perform relative to traditional systems is critical for informing policy decisions, guiding scale-up, and ensuring that digital investments translate into tangible improvements in immunisation programme performance. This study therefore situates itself within the global discourse on digital health and data quality, while focusing on empirical evidence from Uganda.

1.2 Background

In Uganda, immunisation is a core component of the national primary healthcare strategy and a key pillar of child survival efforts. The Ministry of Health (MoH) implements the Expanded Programme on Immunization (EPI) to ensure equitable access to vaccines against preventable diseases such as measles, polio, tetanus, and hepatitis B. Effective implementation of the immunisation programme relies on accurate, timely, and complete data to guide planning, monitor coverage trends, and support supervision and accountability across all levels of the health system.

Historically, Uganda's immunisation data management has depended largely on paper-based reporting tools, particularly at community and lower-level health facilities. Village Health Teams (VHTs) and health facility staff record service delivery data in registers and submit periodic reports that are later aggregated and entered into the District Health Information System II (DHIS2). While this approach has enabled nationwide reporting, it has been associated with persistent challenges including delayed submission, incomplete records, arithmetic errors, and loss or damage of paper forms (Bakkabulindi et al., 2023). These weaknesses have constrained the reliability of immunisation data and limited its use for timely decision-making.

To strengthen community-level data systems, the Ministry of Health, with support from implementing partners such as AMREF, UNICEF, WHO, and others, introduced the Electronic Community Health Information System (eCHIS) in 2020. The eCHIS builds on the Village Health Team strategy established in 2001 and is designed to digitise data captured by VHTs during service delivery. The platform supports the recording and reporting of services provided under the Integrated Community Case Management (iCCM) strategy, including management of malaria, pneumonia, and diarrhoea among children under five, as well as selected reproductive, maternal, newborn, child, and adolescent health indicators.

Although eCHIS is not a stand-alone system for the Expanded Programme on Immunization, it captures complementary immunisation-related indicators such as child immunisation status, human papillomavirus (HPV) vaccination among adolescents, and tetanus toxoid (TT) vaccination among women of reproductive age. By digitising community-level records and enabling real-time transmission of data, eCHIS aims to address long-standing challenges of data fragmentation, delayed reporting, and limited access to reliable

information for planning and supervision (MoH, 2023).

The implementation of eCHIS has been piloted in selected districts, including Moyo District in the West Nile sub-region, while other districts such as Adjumani continue to rely predominantly on paper-based reporting systems. This coexistence of electronic and paper-based systems within similar programmatic contexts presents a valuable opportunity to assess comparative performance. Preliminary assessments suggest that eCHIS has the potential to improve data timeliness and completeness through features such as automated reminders, mandatory data fields, and built-in validation checks. However, operational challenges including unreliable electricity, limited internet connectivity, and gaps in digital literacy among health workers may affect system performance (MoH, 2024).

Within Uganda's decentralised health system, evidence on the effectiveness of eCHIS in improving immunisation data quality remains limited, particularly at the community level where a substantial proportion of immunisation-related interactions occur. Most available studies focus on facility-based reporting or provide aggregate assessments of data quality without disaggregating by reporting system or specific dimensions such as timeliness and completeness. As a result, policymakers and implementers lack robust empirical evidence to guide decisions on scaling up electronic community health information systems.

This study therefore focuses on a comparative assessment of eCHIS and paper-based reporting systems in Moyo and Adjumani districts, respectively. By examining differences in the timeliness and completeness of immunisation data, as well as health workers' experiences with the two systems, the study seeks to generate context-specific evidence to inform Uganda's digital health agenda. The findings are expected to contribute to improved immunisation data management, support evidence-based decision-making, and strengthen overall immunisation programme performance in Uganda.

2 CHAPTER TWO : LITERATURE REVIEW

2.1 Introduction and Overview

High-quality immunization data are critical for effective functioning of the immunization program. Reliable data enable policymakers and program managers to plan, monitor, and evaluate immunization services effectively, ensuring equitable coverage and improved health outcomes. Inadequate data quality can result in poor program decisions, vaccine stockouts, or delayed responses to outbreaks. Within the broader dimensions of data quality accuracy, consistency, timeliness, and completeness, timeliness and completeness are particularly essential for ensuring that health interventions are implemented when and where they are most needed (WHO, 2024a).

Health information systems' performance largely depends on their ability to provide timely and complete data. In many low- and middle-income countries (LMICs), paper-based reporting systems dominate and are often characterized by delays and incomplete entries due to manual aggregation, transportation barriers, and limited supervision. In contrast, electronic systems have emerged as innovative tools for improving data flow and integrity. Their potential to automate data validation, facilitate real-time transmission, and minimize human error positions them as transformative solutions for enhancing immunization data management (Hailemariam et al., 2024).

2.2 Data Timeliness and Completeness

Timeliness refers to the extent to which data are made available within the timeframe required for decision-making or action (Kabir, 2016). For immunization programs, timely reporting ensures accurate tracking of vaccination coverage, timely replenishment of vaccine stock, and early detection of coverage gaps or disease outbreaks. The absence of timely data often leads to delayed interventions, which may result in vaccine-preventable disease outbreaks and inefficient use of health resources (Bloland and MacNeil, 2019).

In the context of electronic systems, timeliness is enhanced through real-time data entry and automatic synchronization with higher-level databases. Systems such as eCHIS allow community health workers (CHWs) to capture and transmit data immediately after service delivery, eliminating delays associated with manual report submission. This rapid data flow allows district health teams to make prompt decisions on vaccine distribution, outreach activities, and cold chain maintenance (Dadari et al., 2021). Conversely, in paper-based systems, data transmission depends on physical delivery and manual entry into digital platforms like DHIS2, introducing significant time lags.

Studies from various countries highlighted that improving timeliness requires not only technology but also strong institutional support. Regular supervision, reliable power supply, and internet connectivity are necessary for sustaining timely reporting. Therefore, while eCHIS offers technical advantages, its success depends on the local health system's readiness and capacity to integrate digital innovations into routine workflows (Hailemariam et al., 2024)

Completeness refers to the extent to which all required data fields are filled in and all health events are recorded without omissions (Wetherill et al., 2017). Complete immunization data ensure that every child vaccinated or due for vaccination is accurately documented, providing a reliable picture of program coverage. Missing or incomplete data may result in underestimation of immunization rates, misallocation of vaccines, and loss of follow-up for children who miss doses (Rahmadhan and Handayani, 2023).

Completeness is particularly critical for performance monitoring and evaluation. Without complete data, district and national health teams cannot accurately assess program effectiveness or identify populations at risk of under-immunization. Paper-based systems often suffer from incomplete tally sheets, missing registers, or inconsistent reporting, primarily due to staff workload, inadequate tools, and lack of standardization (Kwok et al., 2022). In contrast, electronic systems enforce mandatory data entry fields and perform real-time validation, ensuring that all required information is entered before submission (MoH, 2023c).

While digital platforms improve completeness, challenges such as digital literacy gaps, inconsistent supervision, and limited internet connectivity can undermine progress. Therefore, ensuring data completeness demands a holistic approach that integrates system functionality with user capacity-building, supportive supervision, and accountability mechanisms (Bakkabulindi et al., 2023).

2.3 Advances in Digital Health Information Systems

Globally, the introduction of electronic health information systems (eHIS) has significantly transformed how immunization data are collected, reported, and utilized. Studies from Asia and Africa indicate that electronic systems enhance both the timeliness and completeness of data by enabling real-time reporting, automating feedback, and improving communication across health system levels (Adane et al., 2019). In Pakistan, for example, digitization of the national HMIS improved monthly reporting rates and reduced the proportion of late submissions from 42% to 15% within three years (Qazi and Ali, 2009).

In Ethiopia, the implementation of an electronic community health system increased data completeness through the use of in-built validation checks and compulsory data fields, ensuring that no records were left

blank before submission (Hailemariam et al., 2024). Similar improvements have been reported in Kenya, Bangladesh, and Tanzania, where digital systems reduced reporting delays and improved reliability of immunization coverage data (Worku et al., 2024). These global successes demonstrate the potential of electronic systems to bridge long- standing data quality gaps in immunization programs.

However, despite these advancements, disparities persist between high-resource and low-resource contexts. In regions with inadequate infrastructure, technical breakdowns, and limited training, the advantages of electronic systems may not be fully realized. This underscores the importance of contextual adaptation of digital tools like eCHIS, ensuring they are tailored to the realities of rural and resource-constrained settings such as Northern Uganda.

2.4 Challenges of Paper-Based Systems

Traditional paper-based systems remain the dominant mode of reporting in many LMICs, including Uganda. These systems are characterized by manual data entry, delayed transmission, and susceptibility to transcription errors (Umezuruike et al., 2017). Health facilities often experience shortages of registers, leading to incomplete recording of vaccination data and inconsistent reporting across months. Additionally, physical forms are prone to loss or damage, resulting in data gaps and reduced reliability (Grace et al., 2023).

Several studies have highlighted the inefficiencies inherent in paper-based data management. For instance, in Nigeria and Malawi, paper systems accounted for over 40% of late or missing monthly immunization reports (Yao et al., 2022). These delays compromise the timely availability of data for planning and evaluation. The manual collation of reports from lower health units to district levels also increases the risk of duplication and arithmetic errors. Such challenges highlight the limitations of traditional systems in meeting the growing data demands of modern immunization programs.

Consequently, many countries have turned to hybrid models where paper systems are gradually replaced by electronic platforms. This transition phase requires careful management to ensure data consistency and capacity-building for frontline health workers. Uganda's adoption of eCHIS represents a similar effort to modernize health information management while addressing persistent weaknesses in data timeliness and completeness.

2.5 Determinants of Timely Reporting

Timely reporting in immunization programs depends on several factors, including system efficiency, staff capacity, and institutional coordination. Electronic systems promote timeliness by enabling real-time data capture, reducing physical movement of reports, and automating notifications for late submissions (Hailemariam et al., 2024). In paper-based systems, however, data submission often relies on the physical

transfer of registers, which can take days or even weeks, especially in rural areas.

Studies in Kenya, Tanzania, and Ethiopia have demonstrated that health facilities using electronic reporting tools achieved higher rates of timely submission than those relying on manual reporting. For instance, studies found that facilities using eHIS in Kenya achieved an 85% timely reporting rate compared to 52% among paper-based facilities(Kansiime et al., 2024). In Uganda, the pilot introduction of eCHIS in Moyo District has shown promise in reducing reporting delays through mobile-based uploads directly to the DHIS2 platform (MoH, 2023b).

Nonetheless, sustaining timeliness requires consistent technical support, supervision, and motivation of health workers. Without these, system efficiency alone cannot guarantee continuous timely reporting. The availability of reliable power sources and internet connectivity further influences system functionality and the frequency of real-time uploads (Bakkabulindi et al., 2023).

2.6 Determinants of Data Completeness

Completeness is primarily determined by the quality of data entry, adequacy of tools, and capacity of health workers to adhere to documentation standards. Electronic systems have demonstrated superiority by enforcing mandatory data fields and providing error alerts that prevent submission of incomplete forms (Jones et al., 2014). However, human factors—such as lack of training, workload, and motivation still influence the degree of completeness even within digital systems (Hailemariam et al., 2024).

Paper-based systems face multiple constraints that contribute to data incompleteness. Missing registers, poor handwriting, and loss of forms during submission are common issues. Additionally, manual aggregation introduces errors that distort final summaries (Kwok et al., 2022). Evidence from Nigeria and Ethiopia indicates that incomplete immunization reports can range from 30% to 60% depending on supervision quality and staff workload (Odekunle et al., 2017).

In Uganda, early assessments of eCHIS have revealed marked improvements in completeness due to automated validation checks and centralized data storage (MoH, 2023c). However, differences in digital literacy and uneven system adoption across districts remain significant challenges that require continuous technical support and training interventions.

2.7 Perceptions and Experiences of Health Workers Using eCHIS

Studies from low- and middle-income countries (LMICs) indicate that electronic systems like eCHIS significantly enhance the timeliness, completeness, and accuracy of data through automation and real-time reporting (Adane et al., 2019, Hailemariam et al., 2024). Health workers have reported positive experiences with eCHIS, citing user-friendly interfaces, reduced manual workload, and improved supervision and

feedback mechanisms (Worku et al., 2024). In Moyo District, where eCHIS has been implemented, health workers perceive the system as efficient in minimizing errors, reducing duplication, and facilitating immediate data transmission to the national DHIS2 platform. The availability of automated reminders for incomplete submissions and in-built validation checks has also enhanced confidence in data reliability. Furthermore, eCHIS has improved collaboration and accountability among staff, fostering a culture of data-driven decision-making within immunization programs(Stephens et al., 2021).

In contrast, health workers operating under paper-based systems, such as those in Adjumani District, encounter significant challenges that influence their perceptions and experiences. Manual data entry, physical report submission, and limited storage capacity contribute to delays, inaccuracies, and data loss (Rahmadhan and Handayani, 2023). Health workers frequently describe the paper-based process as time-consuming, cumbersome, and prone to human error, which affects motivation and efficiency. Issues such as illegible handwriting, missing registers, and inadequate supervision further compromise data quality. Although some health workers appreciate the tangible nature of paper records for reference purposes, the overall experience is marked by frustration due to workload and reporting inefficiencies. These constraints highlight the limitations of paper-based systems in meeting the growing demands of modern health data management, particularly within the immunization program.

Despite the reported advantages of eCHIS, health workers in Moyo and other districts continue to face barriers that hinder optimal utilization. Studies attribute these challenges to unreliable internet connectivity, power interruptions, inadequate digital devices, and gaps in technical skills (Bakkabulindi et al., 2023, Bogale et al., 2023). Infrastructural and institutional weaknesses reduce system efficiency, leading to delays and occasional data loss during synchronization. Additionally, limited refresher training and inconsistent technical support have been cited as key factors affecting user confidence and system adoption. Sustained investment in capacity building, reliable infrastructure, and supportive supervision is therefore essential to maintain user engagement and ensure system sustainability. Overall, health workers' positive perceptions of eCHIS are closely tied to its ability to simplify workflows and improve data quality, while their negative experiences often stem from contextual and operational barriers that need systemic attention.

2.8 Synthesis of Literature Gaps

Despite global progress in health information system digitalization, there is still limited empirical evidence comparing electronic and paper-based systems within the same national context, especially concerning immunization data. Existing studies in Uganda focus mainly on national averages of data quality without disaggregating findings by system type or by the specific dimensions of timeliness and completeness.

Moreover, most research has concentrated on facility-based reporting, neglecting community-level data where the bulk of immunization outreach activities occur. The role of community health workers (CHWs) in ensuring data timeliness and completeness through eCHIS remains underexplored. Evaluating their contribution is essential, given their frontline position in Uganda's primary healthcare system.

This study therefore addresses these gaps by providing a comparative analysis of eCHIS in Moyo District and the paper-based system in Adjumani District. By focusing on timeliness and completeness, the research will generate evidence to guide the scale-up of digital health solutions in Uganda's immunization program and contribute to the broader discourse on health system strengthening in LMICs.

3.0 CHAPTER THREE : PROBLEM STATEMENT, JUSTIFICATION, AND CONCEPTUAL FRAMEWORK

3.1 Statement of the Problem

Timely and complete immunization data are fundamental to the effective planning, monitoring, and evaluation of immunization programmes. High-quality data enable health managers to accurately monitor vaccination coverage, forecast vaccine needs, identify populations at risk of under-immunization, and respond promptly to outbreaks of vaccine-preventable diseases (WHO, 2024). Conversely, poor data quality undermines evidence-based decision-making and result in inefficient resource allocation and missed opportunities to improve health outcomes.

In many low- and middle-income countries, including Uganda, immunization data quality remains a persistent challenge, particularly at community and lower-level health facilities. Paper-based reporting systems, which have historically dominated immunization data collection, are frequently associated with delayed reporting, incomplete records, transcription errors, and loss or damage of reporting tools (Harrison et al., 2020; Bakkabulindi et al., 2023). These challenges are especially pronounced at the community level, where VHTs and frontline health workers generate a substantial proportion of immunization-related data but often operate under constrained infrastructure and supervision (Ssegujja et al., 2024).

To address these operational weaknesses, the MOH in Uganda introduced the eCHIS as a digital innovation designed to improve data capture, validation, and transmission through real-time reporting and automated checks (MoH, 2023). Evidence suggests that electronic health information systems can improve data timeliness and completeness when adequately supported by infrastructure, training, and supervision (Hailemariam et al., 2024). However, in Uganda, the implementation of eCHIS has been limited to selected districts, while many others continue to rely on paper-based reporting, resulting in the coexistence of electronic and paper-based systems within similar programmatic contexts.

There is limited evidence comparing the performance of eCHIS and paper-based reporting systems with respect to the timeliness and completeness of immunization data at the district and community levels in Uganda. Most existing studies focus on national or facility-level data quality assessments and do not explicitly isolate reporting system type or disaggregate data quality into specific dimensions such as timeliness and completeness (Bogale et al., 2023; MoH, 2024). It remains unclear whether observed differences in immunization data quality across districts are attributable to the reporting system itself or to contextual and institutional factors. Addressing this gap is essential to inform decisions on the scale-up and optimization of eCHIS and to ensure that investments in digital health systems lead to measurable improvements in immunization programme performance.

3.2 Justification

This study is justified by the need to generate empirical evidence on whether electronic community-level reporting systems offer a demonstrable advantage over paper-based systems in improving the timeliness and completeness of immunization data in Uganda. While eCHIS has been implemented in selected districts, there is limited comparative evidence showing what changes, if any, occur after its introduction relative to districts that have not yet adopted the system. Without such evidence, decisions regarding national scale-up risk being driven by assumptions rather than demonstrated performance gains.

By comparing Moyo District, where eCHIS has been implemented, with Adjumani District, which continues to use paper-based reporting, this study directly addresses the critical knowledge gap identified by reviewers: what is not known after implementation in some districts and not others. The comparative design allows for an assessment of whether differences in data timeliness and completeness are associated with the reporting system itself, rather than with broader contextual factors, given the districts' comparable health system structures and service delivery environments.

The findings from this study will provide actionable evidence to inform Ministry of Health decisions on the expansion, modification, or optimization of eCHIS within the Expanded Programme on Immunization. In addition, the study will help identify system-related and contextual factors that mediate the effectiveness of electronic reporting, thereby guiding investments in infrastructure, training, and supportive supervision. Ultimately, improving the timeliness and completeness of immunization data will strengthen evidence-based planning, promote equitable service delivery, and contribute to better child health outcomes and progress toward national and global immunization targets..

3.3 Conceptual framework and narrative

This study's conceptual framework is based on two data quality dimensions, timeliness, completeness and the study intends to evaluate the outcome of the eCHIS' immunization data timeliness and completeness within Uganda's iCCM. By comparing eCHIS in Moyo District to traditional paper-based reporting in Adjumani District, the framework examines how this digital intervention enhances health information management, enabling real-time data access, reducing errors, and centralizing reporting. Dependent variables, capture the essential components of data quality influenced by eCHIS utilization (Schmidt et al., 2021).

3.3.1 Conceptual Framework

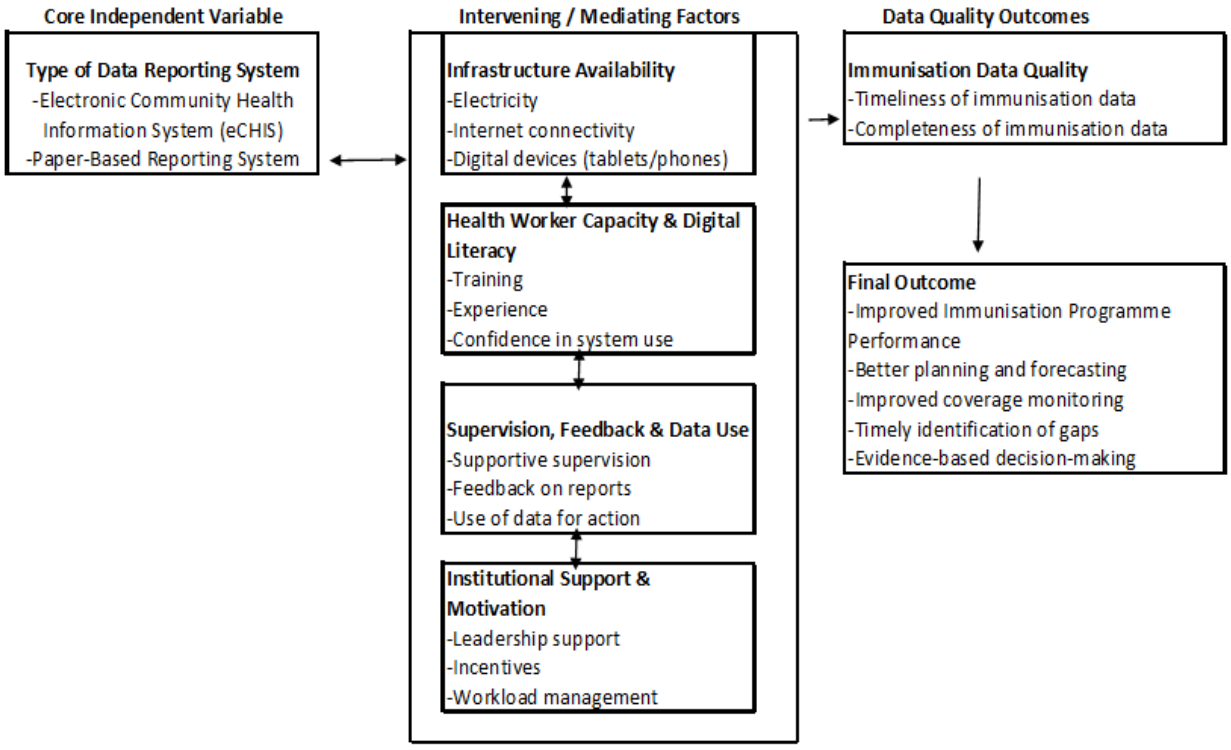

Figure 1: Conceptual framework illustrating the non-linear and interlinked relationships between data reporting systems, contextual and institutional factors, and immunisation data quality outcomes in Uganda.

3.3.3 Narrative

The conceptual framework for this study, adapted from the WHO Performance of Routine Information System Management (PRISM) framework, recognises that relationships between data reporting systems and immunisation data quality are dynamic and non-linear. At the centre of the framework is the type of reporting system Electronic Community Health Information System (eCHIS) or paper-based which directly influences the timeliness and completeness of immunisation data through differences in data capture, validation, and transmission processes. However, this influence does not occur in isolation but is shaped by multiple interacting contextual and institutional factors.

These mediating factors include infrastructure availability, health worker capacity and digital literacy, supervision and feedback mechanisms, and institutional support and motivation. The framework illustrates that these factors are interlinked and mutually reinforcing. For instance, adequate infrastructure enables effective system use, training strengthens health worker competence, and supportive supervision enhances motivation and adherence to reporting standards. Weakness in any of these areas can limit the effectiveness of both electronic and paper-based systems, demonstrating that data quality outcomes result from combined system and human interactions rather than a single linear pathway.

The framework further incorporates feedback loops, acknowledging that data quality outcomes also influence health system processes. Timely and complete immunisation data improve planning, supervision, and decision-B, which in turn strengthen institutional support and health worker motivation, reinforcing positive reporting behaviours. Ultimately, improved data quality contributes to better immunisation programme performance, including accurate coverage monitoring and timely identification of service gaps. This non-linear framework therefore provides a realistic representation of immunisation data systems in Uganda and justifies the comparative analysis of eCHIS and paper-based reporting systems in the study districts.

4.0 CHAPTER FOUR : RESEARCH QUESTIONS AND OBJECTIVES

4.1 Study Questions

1 How does the timeliness of immunization data reporting compare between electronic Community Health Information Systems (eCHIS) in Moyo District and paper-based systems in Adjumani District?

2 What are the differences in the completeness of immunization data collected and reported through eCHIS in Moyo District and paper-based systems in Adjumani District?

3 What are the perceptions and experiences of health workers regarding the use of eCHIS in Moyo District and paper-based systems in Adjumani District.

4.2 Study Objectives

3 General Objective

To assess and compare the quality of data in immunisation between eCHIS in Moyo District and paper-based systems in Adjumani District, focusing on timeliness, completeness, and health workers' perceptions, to identify best practices and recommend strategies for improving data quality in immunization programs.

4.2.2 Specific objectives

1. To evaluate and compare the timeliness of immunization data reporting between eCHIS in Moyo District and paper-based systems in Adjumani District.
2. To assess and compare the completeness of immunization data collected and reported through eCHIS in Moyo District and paper-based systems in Adjumani District.
3. To explore health workers' perceptions and experiences regarding the use of eCHIS in Moyo District and paper-based systems in Adjumani District.

5. Chapter Five: Methodology

5.1 Study Area

This study was conducted in Moyo and Adjumani Districts, located in the West Nile sub-region of Northern Uganda. The two districts were purposively selected because they operate under different immunization data management systems, providing an appropriate setting for a comparative analysis. Moyo District has implemented the Electronic Community Health Information System (eCHIS), while Adjumani District continues to rely on the traditional paper- based Health Management Information System (HMIS). This distinction allows for a meaningful comparison of how electronic and paper-based systems influence the timeliness and completeness of immunization data under real-world operational conditions.

Moyo District lies along Uganda's northwestern border with South Sudan, approximately 470 kilometers from Kampala. It has a mix of rural and peri-urban settings, with health service delivery organized through public, private-not-for-profit, and community-based facilities. The district was among the early adopters of eCHIS under the Ministry of Health's digital health initiative, supported by AMREF, UNICEF, and other partners. Through eCHIS, Village Health Teams (VHTs) and health workers use tablets and mobile applications to record immunization data in real time, allowing for direct transmission into the national District Health Information System (DHIS2). The district's experience with eCHIS therefore provides an opportunity to examine the effects of digitalization on reporting timeliness and data completeness at both community and facility levels.

In contrast, Adjumani District situated southeast of Moyo has similar demographic and geographic characteristics but still uses paper-based registers and monthly reporting forms to capture and transmit immunization data. The district borders Moyo to the north, Amuru to the south, and the River Nile to the east, and is also home to large refugee populations from South Sudan, which place significant demands on health services. Health facilities in Adjumani depend on manual compilation and physical submission of reports to the district health office, followed by data entry into the DHIS2 platform. This conventional reporting process often involves delays and data omissions typical of paper-based systems, making it a suitable comparison point for evaluating the efficiency of electronic systems.

The choice of Moyo and Adjumani was therefore not based on an intervention or experimental design, but rather on their naturally existing differences in data reporting systems. This study does not introduce or implement any intervention; instead, it objectively compares data quality outcomes across two operational settings one using an electronic reporting platform and the other maintaining a paper-based system. The comparison enables an empirical assessment of how system type influences the timeliness and

completeness of immunization data within Uganda's decentralized health system.

Both districts share comparable health system structures, socio-economic profiles, and immunization service delivery models, ensuring that observed differences can reasonably be attributed to the type of data management system rather than contextual disparities. Their selection thus provides a robust basis for concluding relevant to Uganda's ongoing transition from paper- based to electronic health information systems, contributing to national efforts toward improving immunization data quality and evidence-based decision-making.

5.2 Study Design

This study employed a comparative cross-sectional mixed-methods design to examine the effects of electronic and paper-based systems on the timeliness and completeness of immunization data in Uganda. The design was chosen to enable both quantitative measurement and qualitative exploration of factors influencing data reporting performance. The study compared health facilities using the Electronic Community Health Information System (eCHIS) in Moyo District with those relying on paper-based reporting systems in Adjumani District. These districts were purposively selected because they operate under different data management systems, providing a natural setting for comparison without introducing any external intervention.

Using a mixed-methods approach allowed for triangulation of findings enhancing the credibility, depth, and contextual understanding of the results. Quantitative data provided statistical comparisons between the two systems, while qualitative insights enriched the interpretation of these findings. This design was particularly appropriate for a non-interventional study seeking to compare existing data systems under real-world operational conditions, rather than testing a new intervention.

Overall, the comparative cross-sectional mixed-methods design enabled the study to holistically assess both measurable and experiential aspects of immunization data management in Moyo andAdjumani Districts, generating practical evidence to guide the national transition from paper-based to electronic reporting systems.

5.3 Study Population

The study population comprised health facility staff and district-level personnel directly involved in immunization data generation, management, and reporting in Adjumani and Moyo districts. This included community health workers, records/data clerks, health facility in-charges, and program managers responsible for immunization services. These categories were selected because they are key actors in the collection, entry, verification, and use of immunization data, whether through the eCHIS

in Moyo or the paper-based reporting system in Adjumani. Their perspectives and experiences provided insights into the perceived influence of eCHIS on data quality, as well as the factors associated with timeliness, completeness, and accuracy of immunization data across the two systems.

5.3.1 Inclusion Criteria:

Participants eligible for this study included healthcare workers and data personnel who were directly involved in the iCCM

- These individuals had played an active role in data management, reporting, or immunization service delivery within their respective facilities.
- Participants must have worked in their current roles for a minimum duration of six months to ensure they have sufficient experience and familiarity with either the paper-based or electronic data management systems under evaluation.

5.3.2 Exclusion Criteria:

- Individuals unwilling to provide informed consent were also excluded from participation.
- Health facilities undergoing transition between paper-based reporting and eCHIS during the study period.
- Health workers who were on prolonged leave or unavailable during the data collection period.

5.4 Sample Size

For the quantitative component, the sample size was determined using Fischer's formula:

$$n = Z^2 * \frac{p(1-p)}{d^2}$$

where Z is the standard normal deviation set at 1.96 for a 95% confidence level, p is the estimated proportion (0.5 in the absence of prior data), and d is the margin of error (0.05). Substituting into the formula;

$n = 1.96^2 * \frac{0.5(1-0.5)}{0.05^2}$ = 384. Since the target population of healthcare workers in the two districts is below 10,000, the finite population correction formula will be applied: nfinal = n/(1 + n/N), where N represents the total population of healthcare workers in the study area (Moyo and Adjuman Districts). Moyo and Adjuman districts has a total of 487 healthcare workers in; the adjusted sample size is calculated as nfinal = 384/(1 + 384/487) = 213.96. The number of participants was 214. This sample size ensured adequate representation and statistical power for reliable analysis.

Qualitative component, sample size estimation followed saturation principles, where data collection continues until no new information based on the methodological path to reach the degree of saturation in qualitative research (Moura et al., 2021); 8 KIIs and 1 IDIs were conducted. Given that both KIIs and IDI

respondents were key personnel in entering and managing immunization data, this approach ensured a diverse range of perspectives were captured, providing rich, in-depth qualitative insights. Combining both quantitative and qualitative sampling strategies allowed for a balanced approach, where numerical trends are supported by contextual narratives. This integrated methodology ensured comprehensive data collection and enhanced the robustness of the study findings.

S/No	District	KII	IDI
1	Moyo	4	1
2	Adjuman	4	0
Total		8	1

5.5 Sampling Procedure

A multi-stage sampling procedure was employed to select study participants in Moyo and Adjumani districts. The sampling process was conducted at three sequential levels: district selection, health facility selection, and individual health worker selection within facilities.

Stage 1: Selection of Study Districts

Moyo and Adjumani districts were purposively selected based on the type of immunization data reporting system in use. Moyo District had implemented the Electronic Community Health Information System (eCHIS), while Adjumani District continued to rely on the traditional paper-based reporting system. The selection of these districts was not intended to introduce an intervention but to allow comparison between two naturally existing reporting systems operating under similar regional and programmatic contexts.

Stage 2: Selection of Health Facilities

Within each district, a list of all health facilities providing immunization services was obtained from the respective District Health Offices. Health facilities were then stratified by level of care (Health Centre II, Health Centre III, Health Centre IV, and Hospital) to ensure representation across the health system hierarchy. From each stratum, health facilities were selected using simple random sampling proportional to the number of facilities at each level. This approach ensured that both lower-level and higher-level facilities were adequately represented in the study and minimized selection bias across facility types.

Stage 3: Selection of Health Workers within Facilities

Sampling of participants was conducted within the selected health facilities. At each facility, a list of all health workers directly involved in immunization service delivery and/or immunization data management was compiled in collaboration with the facility in-charge. Eligible participants included community health

workers (VHTs/CHWs), nurses, midwives, records assistants, and facility in-charges who had worked at the facility for at least six months. Where the number of eligible health workers in a facility exceeded the allocated sample size, simple random sampling was used to select participants. In facilities with a small number of eligible staff, all eligible health workers were invited to participate (total enumeration). This ensured adequate representation while maintaining feasibility.

Qualitative Sampling Procedures

For the qualitative component, purposive sampling was used to select key informants with in-depth knowledge of immunization data reporting systems. These included district biostatisticians, HMIS focal persons, immunization programme managers, and selected facility in-charges. Participants were chosen based on their roles and experience rather than on numerical representation. Sampling continued until information saturation was achieved, defined as the point at which no new themes emerged from additional interviews.

In summary, this study employed a structured and transparent sampling process: districts were purposively selected based on reporting system type; health facilities were randomly selected within strata; and health workers were sampled within facilities using either simple random sampling or total enumeration. This approach ensured representativeness, reduced selection bias, and directly linked participant selection to the operational context of immunization data reporting in each district.

5.6 Study Variables

Study variables were derived from the conceptual framework and measured using structured questionnaires for the quantitative component and semi-structured interview guides for the qualitative component.

3.1.1 Independent Variables

Type of Data Reporting System: The primary independent variable was the **type of reporting system** used for immunization data reporting, measured as a categorical variable:

- Electronic Community Health Information System (eCHIS)
- Paper-based reporting system

This was measured through questionnaire items asking respondents to indicate the system routinely used at their facility.

Contextual and System-Related Factors: These variables were measured using closed-ended and Likert-scale questionnaire items:

- Availability of infrastructure: assessed through self-reported availability and reliability of electricity, internet connectivity, and digital devices.
- Health worker capacity and digital literacy: measured by training received, self-reported competence, and ease of using reporting tools.
- Supervision and feedback mechanisms: measured by receipt and frequency of supervision and feedback on data quality.
- Institutional support and motivation: assessed through perceived management support, availability of technical assistance, and motivation to report data.

3.1.2 Dependent Variables

Immunisation Data Quality: Data quality was operationalised using two dimensions:

- Timeliness of immunisation data reporting: measured by questionnaire items on whether reports were submitted within Ministry of Health timelines and categorised as *timely* or *not timely*.
- Completeness of immunisation data reporting: measured by self-reported frequency of missing fields and ability to complete all required reporting sections, categorised as *complete* or *incomplete*.

3.1.3 Qualitative Themes of Inquiry

Qualitative data were collected through KIIs and IDIs. The main themes of inquiry were: Perceived influence of reporting systems on data timeliness and completeness

- Advantages of eCHIS
- Challenges of paper-based reporting
- Barriers to effective use of eCHIS
- Role of supervision and institutional support
- Health worker motivation and attitudes
- Suggested strategies for improving immunisation data quality

5.7 Data Collection Tools

Quantitative data were collected using pretested structured questionnaires developed in line with the study objectives to capture indicators on timeliness, completeness, and health workers' perceptions of immunization data under both the electronic (eCHIS) and paper-based systems. The questionnaires were programmed into Kobo Collect, a mobile data collection platform, to facilitate real-time entry, minimize transcription errors, and ensure data quality and paper questionnaires were also used by the data collector who did not have a gadget. For the qualitative component, KIIs and IDIs were conducted using semi-structured discussion guides. KIIs, Records Officers, and data clerks directly engaged in immunization data management, while IDIs focused on health facility biostatisticians The guides ensured consistency in topics covered and enabled probing for detailed insights.

To ensure smooth fieldwork, the research team systematically moved from one health facility to another following a pre-approved schedule developed in consultation with the District Biostatistians of Moyo and Adjumani. In each district, data collection began at higher-level facilities, which served as coordination points, and then proceeded to lower-level facilities.

5.8 Quality Assurance and Quality Control

Quality assurance and control were critical components of this study to ensure the reliability and validity of the collected data. The data collection tools were pretested at Bwerogerere Health Centre III in Wakiso District. The pretest assessed clarity, flow, and appropriateness of questions, allowing for refinement of wording and structure before actual fieldwork. All research assistants received intensive training on study objectives, ethical principles, use of Kobo Collect, and standard operating procedures for moving between facilities to ensure uniform understanding and minimize interviewer bias.

During data collection, field supervisors accompanied teams as they moved systematically from one facility to another, ensuring adherence to the study protocol, verifying completeness of responses, and providing on-site technical support. At the end of each day, supervisors reviewed data entries for completeness, accuracy, and internal consistency before synchronization to the central database. The principal investigator and district focal persons randomly cross-checked submissions against source documents to confirm reliability. For qualitative data, audio recordings and field notes were reviewed daily for completeness and coherence. This structured supervision,continuous feedback, and daily validation ensured that all data collected from both Moyo and Adjumani districts were accurate, comparable, and of high quality.

5.9 Data Management and Analysis

5.9.1 Data management

Data management for this study involved a systematic approach to both quantitative and qualitative data to ensure accuracy, consistency, and security. Quantitative data was downloaded into Excel, cleaned and then exported to Stata version 14, a robust statistical software commonly used for data analysis. Regular audits were conducted to identify and address any inconsistencies, missing values, or outliers, ensuring that the data is of high quality before analysis.

In addition to quantitative data management, qualitative data were handled with a focus on preserving the integrity of the information while facilitating the analysis process. During interviews, note-taking was done alongside audio recordings to capture all relevant details. These notes served as a supplement to the recordings, ensuring that no crucial information was missed. The audio recordings were transcribed into text while the memory of the interview or discussion was still fresh, ensuring that the transcriptions accurately reflect the responses provided. This process helped to create a reliable and detailed record of the qualitative data, which was analysed systematically.

To maintain the security and confidentiality of the data, both the transcripts and audio recordings were stored on a password-protected computer. Access to these files was strictly controlled, with only authorized personnel; the Principal Investigator (PI) was allowed to handle the data. This protected sensitive information from unauthorized access or loss. The data remained in this secure storage until it was ready for analysis, at which point the necessary data analysis procedures were followed to ensure that both quantitative and qualitative data were analysed rigorously and accurately. These data management practices were essential for maintaining the integrity of the study and ensuring that the final analysis was based on reliable and complete data.

5.9.2 Data Analysis

Quantitative data analysis was conducted using both descriptive and inferential statistical techniques to draw meaningful comparisons and insights from the data collected. Descriptive statistics, including frequencies, percentages, and means, were used to summarize the data and provide a clear picture of the distribution of key indicators across the two study districts (Adjumani and nd Moyo). These measures offered an overview of the data quality indicators, such as the prevalence of missing values, outliers, or discrepancies in reporting, and helped identify general trends within each district.

This study employed a cross-sectional comparative design to assess and compare the quality of immunization data specifically timeliness, completeness, and health workers' perceptions between electronic Community Health Information Systems (eCHIS) in Moyo District and paper-based systems in Adjumani District. The key independent variable was the type of reporting system used**,** coded as 1 for electronic (Moyo) and 0 (Adjumani) for paper-based. Statistical analyses were conducted using STATA version 14 at a 5% level of significance and 95% confidence intervals.

Descriptive analysis was first performed to characterize the study population. Frequencies and proportions were used to summarize categorical variables which were presented in tables to compare distribution across the two districts. This step was followed by bivariate logistic regression modeling to identify associations between each independent variable and the outcome (district/system type). In the bivariate stage**,** unadjusted odds ratios (ORs) and 95% confidence intervals (CIs) were computed. Variables with a p-value less than 0.2 in bivariate analysis or those with theoretical relevance to the study objectives were considered candidates for the multivariate model to avoid omitting potential confounders.

To build the multivariate logistic regression model**,** all variables selected in the bivariate stage were included and adjusted for potential confounding. Age and sex were treated as a priori confounders due to their established influence on health worker experience and digital literacy, which in turn may affect data completeness and timeliness. The final multivariate model produced adjusted odds ratios (AORs) and 95% confidence intervals to identify independent predictors of being in a district using eCHIS (Moyo). By comparing these AORs with crude ORs from the bivariate analysis, the model helped assess the effect of confounders and refine the associations between variables and system type.

5.10 Ethical Considerations

Ethical considerations were a cornerstone of this study to ensure the rights and welfare of all participants are protected. Before the commencement of data collection, ethical clearance was obtained from the Makerere University School of Public Health Research and Ethics Committee (MakSPH-REC). This approval ensured that the study met the ethical standards required for research involving human subjects. The ethical review process assessed the study's design, methodology, and risk factors to ensure that the research is conducted in a responsible and ethically sound manner, prioritizing the participants' well-being.

Informed consent was a fundamental part of the data collection process. All participants were thoroughly briefed on the study's objectives, the procedures involved, and the potential risks and benefits of their participation. This explanation ensured that participants fully understand what was expected of them before agreeing to participate. Participants were explicitly informed that their involvement was voluntary and that they had the right to withdraw from the study at any time without any negative consequences. Informed Consent forms were provided, and participants were allowed to ask questions to clarify any doubts. Only those who provide written informed consent were included in the study.

Confidentiality and anonymity were strictly maintained throughout the research process. Personal identifiers were anonymized to protect the identity of the participants. All collected data was securely stored in password-protected files and were accessible only to authorized personnel involved in the research. The data was stored safely, and access to it was highly controlled to prevent unauthorized use or disclosure. This ensured that the privacy of participants was respected and that the data remained secure at all stages of the research. Adhering to these ethical guidelines, the study ensured that participants' rights were upheld, and the research was conducted with integrity and respect for all individuals involved.

5 Chapter Six: Results

6.1 Descriptive Statistics of Respondents

A total of 220 respondents participated in the study, with 113 (51.4%) from Moyo District (intervention, using eCHIS) and 107 (48.6%) from Adjumani District (control, using paper-based reporting). The majority of respondents were aged 21–39 years (86.4%), with a slightly higher proportion of males (56.4%). Community Health Workers (CHWs) made up 52.3% of the study population, while nurses and midwives constituted 46.4%. Almost all respondents (99.5%) reported having received at least some form of immunization-related training, and the majority had more than one year of work experience in immunization service delivery.

A significant difference was observed in the types of health facilities and staff roles between the districts. Moyo respondents were predominantly from higher-level facilities (Health Center IVs, 97.7%) and were mostly Community Health Workers (CHWs, 64.3%). In contrast, Adjumani respondents were primarily from community-based sites (76.9%) and were largely Nurses/Midwives (63.7%). Most respondents (99.5%) had received immunization training, and experience levels were varied across both districts.

Table 1: Social demographic Characteristics

Variable	Category	Moyo n=113	Adjumani n=109	Total
Age (years)	21-29	53 (55.8%)	42 (44.2%)	95
	30-39	54 (54.5%)	45 (45.5%)	99
	40-49	6 (25.0%)	18 (75.0%)	24
	50+	0 (0.0%)	2 (100.0%)	2
Sex	Male	66 (53.2%)	58 (46.8%)	124
	Female	47 (49.0%)	49 (51.0%)	96
Service Delivery	Community Based	18 (23.1%)	60 (76.9%)	78
	Health Center III	50 (58.8%)	35 (41.2%)	85
	Health Center IV	43 (97.7%)	1 (2.3%)	44
	Hospital	2 (15.4%)	11 (84.6%)	13
Occupation	Community Health Worker (CHW)	74 (64.3%)	41 (35.7%)	115
	Health Assistant	2 (66.7%)	1 (33.3%)	3
	Nurse/Midwife	37 (36.3%)	65 (63.7%)	102
Experience in Role	6-12 months	21 (65.6%)	11 (34.4%)	32
	1-3 years	51 (43.2%)	67 (56.8%)	118
	>3 years	41 (58.6%)	29 (41.4%)	70
Received Training	Yes	113 (51.6%)	106 (48.4%)	219
	No	0 (0.0%)	1 (100.0%)	1

A stark contrast existed in the HMIS systems used. Adjumani relied almost exclusively on paper- based systems (98.2%), while Moyo predominantly used a combination of paper and the electronic eCHIS mobile system (100% for both "eCHIS only" and "Both Systems" categories). Despite this technological difference, a large majority in both districts felt "Very Comfortable" with their current system (55.8% in Moyo, 44.2% in Adjumani).

However, perceptions of the system's support for timely reporting were polarized. In Moyo, 98.9% felt the system did *not* support timeliness, whereas in Adjumani, 83.0% felt that it did. Correspondingly, 100% of those who reported an *improvement* in timeliness were from Moyo, suggesting that the introduction of the eCHIS system, while not yet perceived as fully supportive, is associated with a positive change.

Table 2: Health Management Information System (HMIS) Use and Reporting Practices

Variable	Category	Moyo	Adjumani	Total
Current HMIS System	Paper-Based Forms/Registers	2 (1.8%)	107 (98.2%)	109
	eCHIS on Mobile	22 (100.0%)	0 (0.0%)	22
	Both Systems	89 (100.0%)	0 (0.0%)	89
Attitude to the system	Not Comfortable	3 (12.5%)	21 (87.5%)	24
	Comfortable	4 (66.7%)	2 (33.3%)	6
	Very Comfortable	106 (55.8%)	84 (44.2%)	190
Frequency of Data Submission	Daily	8 (18.2%)	36 (81.8%)	44
	Weekly	44 (100.0%)	0 (0.0%)	44
	Monthly	61 (46.2%)	71 (53.8%)	132
	Quarterly	0 (0.0%)	0 (0.0%)	0
Timeliness Practice	No	7 (14.9%)	40 (85.1%)	47
	Yes	106 (61.3%)	67 (38.7%)	173
Major Reason for Untimeliness	Data-related challenge	41 (100.0%)	0 (0.0%)	41
	Form misplaced	0 (0.0%)	23 (100.0%)	23
	System/device challenge	8 (88.9%)	1 (11.1%)	9
	Workload	54 (54.0%)	46 (46.0%)	100
	Transport Challenge	3 (100.0%)	0 (0.0%)	3
Perceived System Support for Timeliness	No	87 (98.9%)	1 (1.1%)	88
	Somehow	11 (25.0%)	33 (75.0%)	44
	Yes	15 (17.0%)	73 (83.0%)	88
Perceived Change in Timeliness	Improved	37 (100.0%)	0 (0.0%)	37
	Stayed the same	1 (1.4%)	70 (98.6%)	71
	Not applicable	6 (5.4%)	106 (94.6%)	112

Data quality challenges differed by district. In Moyo, the primary difficulties in completing forms were complex systems (97.7%) and device issues (100%), directly linked to the use of technology. In Adjumani, the main challenges were missing information (83.3%) and a lack of understanding (81.8%), issues more associated with a paper-based system.

The electronic system in Moyo provided a key advantage: 100% of respondents received reminders for incomplete submissions and for missing fields. This feature was entirely absent in Adjumani's paper-based system. The main advantages cited in Moyo were easy data retrieval (65.3%), while in Adjumani, it was the system's perceived ease of use (83.0%). Common challenges in Moyo included poor internet (100%) and difficulty accessing previous data (95.6%). Supervision feedback was universally received in both districts, primarily on a quarterly basis

Table 3: Data Quality, System Features, and Supervision Feedback

Variable	Category	Moyo n=113	Adjumani	Total
Completion of Required Fields	Rarely	6 (14.0%)	37 (86.0%)	43
	Sometimes	34 (44.2%)	43 (55.8%)	77
	Often	64 (64.0%)	36 (36.0%)	100
Difficulty Completing Fields	Complex forms/systems	43 (97.7%)	1 (2.3%)	44
	Device freezing	13 (100.0%)	0 (0.0%)	13
	Lack of Understanding	8 (18.2%)	36 (81.8%)	44
	Limited time to complete	35 (100.0%)	0 (0.0%)	35
	Missing information	14 (16.7%)	70 (83.3%)	84
Missing Field Reminders	No	44 (29.1%)	107 (70.9%)	151
	Yes	69 (100.0%)	0 (0.0%)	69
Perceived Advantages	Easy to retrieve data	64 (65.3%)	34 (34.7%)	98
	Easy to use	14 (15.9%)	73 (83.0%)	87
	None	35 (79.5%)	9 (20.5%)	44
Perceived Challenges	Difficult to access	8 (100.0%)	0 (0.0%)	8
	Takes long to complete	7 (15.9%)	37 (84.1%)	44
	Requires extra training	33 (56.9%)	25 (43.1%)	58
	Difficult to access previous data	65 (95.6%)	3 (4.4%)	68
	Poor Internet	41 (100.0%)	0 (0.0%)	41
	Paper forms get lost	3 (8.8%)	31 (91.2%)	34
Receive Supervision Feedback	Yes	113 (100.0%)	107 (100.0%)	220
	No	0 (0.0%)	0 (0.0%)	0
Frequency of Supervision Feedback	Monthly	44 (48.4%)	47 (51.6%)	91
	Quarterly	69 (53.5%)	60 (46.5%)	129
Reminders for Incomplete Submissions	No	0 (0.0%)	107 (100.0%)	107
	Yes	113 (100.0%)	0 (0.0%)	113

6.2 Timeliness of Immunization Data Reporting

The bivariate analysis of factors associated with the timeliness of immunization data reporting in Table 2 show that the reporting system had the strongest influence on timeliness. In Moyo District, where eCHIS was used, 84.1% of respondents reported timely submission, compared to only 42.1% in Adjumani, which relied on paper-based reporting. The odds of timely reporting in Moyo were significantly higher (OR = 7.15, 95% CI: 2.72–18.82, p = 0.001), underscoring the positive impact of the electronic system.

Table 4: Bivariate Analysis of comparison between Moyo and Adjumani Timeliness of Immunization Data Reporting

Variable	Timely Reporting n (%)	Delayed Reporting n (%)	OR (95% CI)	p-value
District/System				
Adjumani (Paper)	45 (42.1)	62 (57.9)	1.00	–
Moyo (eCHIS)	95 (84.1)	18 (15.9)	7.15 (2.72–18.82)	0.001
Sex				
Female	60 (61.9)	37 (38.1)	1.00	–
Male	80 (64.0)	45 (36.0)	1.14 (0.66–1.98)	0.62
Age Group				
≥30 years	62 (60.2)	41 (39.8)	1.00	–
<30 years	78 (67.2)	38 (32.8)	1.21 (0.70–2.11)	0.50
Cadre				
Nurse/Midwife	64 (62.1)	39 (37.9)	1.00	–
CHW	76 (66.1)	39 (33.9)	1.17 (0.68–2.01)	0.57

The multivariate logistic regression results for factors associated with timeliness of immunization data reporting in Table 3 confirms that the reporting system was the only significant predictor of timely reporting. Health workers in Moyo District (using eCHIS) were more than seven times more likely to submit reports on time compared to those in Adjumani (AOR = 7.15, 95% CI: 2.72–18.82, p = 0.001). After adjusting for sex, age, and cadre, none of the socio-demographic factors showed a significant association with timeliness. This analysis strengthens the conclusion that eCHIS features such as automated reminders and real-time submission were central to improved timeliness, overshadowing individual worker characteristics.

Table 5: Multivariate Logistic Regression of Factors Associated with Timeliness of Immunization Data Reporting

Variable	Timely Reporting n (%)	Delayed Reporting n (%)	cOR (95% CI)	aOR (95% CI)	p-value
District/System					
Adjumani (Paper)	45 (42.1)	62 (57.9)	1.00	1.00	–
Moyo (eCHIS)	95 (84.1)	18 (15.9)	7.15 (2.72–18.82)	7.15 (2.72–18.82)	0.001
Sex					
Female	60 (61.9)	37 (38.1	1.00	1.00	–
Male	80 (64.0)	45 (36.0)	1.14 (0.66–1.98)	1.18 (0.64–2.04)	0.51
Age Group					
≥30 years	62 (60.2)	41 (39.8)	1.00	1.00	–
<30 years	78 (67.2)	38 (32.8)	1.21 (0.70–2.11)	1.20 (0.69–2.10)	0.52
Cadre					
Nurse/Midwife	64 (62.1)	39 (37.9)	1.00	1.00	–
CHW	76 (66.1)	39 (33.9)	1.17 (0.68–2.01)	1.12 (0.61–1.89)	0.60

6.3 Completeness of Immunization Data

Factors associated with the completeness of immunization data in Table 4 shows that respondents from Moyo District, using eCHIS, demonstrated a much higher level of completeness (79.6%) compared to those in Adjumani (36.4%). The odds of reporting complete data in Moyo were nearly seven times greater than in Adjumani (OR = 6.83, 95% CI: 2.44–15.77, p = 0.001). In contrast, socio-demographic characteristics such as sex, age, and cadre were not significantly associated with completeness. Both males (59.2%) and females (56.1%) had comparable completeness rates, while younger respondents (<30 years) reported slightly higher completeness (61.2%) than older ones (56.3%), but these differences lacked statistical significance. Similarly, CHWs (60.9%) and nurses/midwives (57.3%) reported almost equal levels of completeness. These findings confirm that the use of eCHIS, with its built-in validation checks, was the decisive factor in improving completeness, rather than health worker characteristics.

Table 4 : Bivariate Analysis of Factors Associated with Completeness of Immunization Data

Variable	Complete Records n (%)	Incomplete Records n (%)	OR (95% CI)	p-value
District/System				
Moyo (eCHIS)	90 (79.6)	23 (20.4)	6.83 (2.44–15.77)	<0.01
Adjumani (Paper)	39 (36.4)	68 (63.6)	1.00	–
Sex				
Male	74 (59.2)	51 (40.8)	0.93 (0.54–1.62)	0.80
Female	55 (56.1)	43 (43.9)	1.00	–
Age Group				
<30 years	71 (61.2)	45 (38.8)	1.10 (0.64–1.87)	0.72
≥30 years	58 (56.3)	45 (43.7)	1.00	–
Cadre				
CHW	70 (60.9)	45 (39.1)	1.10 (0.65–1.87)	0.71
Nurse/Midwife	59 (57.3)	44 (42.7)	1.00	–

Multivariate logistic regression analysis for completeness of immunization data in Table 5 show that the reporting system again emerged as the strongest independent predictor. Respondents in Moyo District, who used eCHIS, had significantly higher odds of submitting complete records (AOR = 6.42, 95% CI: 2.31–14.80, $p < 0.01$) compared to their counterparts in Adjumani. In contrast, socio-demographic factors such as sex, age, and cadre had no significant associations with completeness. For example, males had an adjusted odds ratio of 0.95 (95% CI: 0.55–1.65, $p = 0.82$), while younger respondents had an AOR of 1.08 (95% CI: 0.62–1.86, $p = 0.77$). Similarly, CHWs and nurses/midwives reported nearly identical outcomes. These results suggest that completeness was primarily driven by the system's design particularly the mandatory fields and validation checks built into eCHIS, rather than by health worker characteristics.

Table 5: Multivariate Logistic Regression of Factors Associated with Completeness of Immunization Data

Variable	Complete Records n (%)	Incomplete Records n (%)	cOR (95% CI)	aOR (95% CI)	p-value
District/System					
Moyo (eCHIS)	90 (79.6)	23 (20.4)	6.83 (2.44–15.77)	6.42 (2.31–14.80)	<0.01
Adjumani (Paper)	39 (36.4)	68 (63.6)	1.00	1.00	–
Sex					
Male	74 (59.2)	51 (40.8)	0.93 (0.54–1.62)	0.95 (0.55–1.65)	0.82
Female	55 (56.1)	43 (43.9)	1.00	1.00	–
Age Group					
<30 years	71 (61.2)	45 (38.8)	1.10 (0.64–1.87)	1.08 (0.62–1.86)	0.77
≥30 years	58 (56.3)	45 (43.7)	1.00	1.00	–
Cadre					
CHW	70 (60.9)	45 (39.1)	1.10 (0.65–1.87)	1.05 (0.58–1.74)	0.70
Nurse/Midwife	59 (57.3)	44 (42.7)	1.00	1.00	–

6.4 Health Worker Perceptions and Experiences: A Comparative Analysis of Data Systems

To explore the perceptions and experiences of health workers, this chapter presents findings from qualitative interviews conducted in Moyo (eCHIS) and Adjumani (paper-based). The analysis reveals a complex landscape of system efficacy, structured around four central themes: 1) Perceived Advantages of Electronic Systems, 2) Persistent Challenges of the Paper-Based System, 3) Critical Barriers to eCHIS Effectiveness, and 4) Institutional and Attitudinal Factors. These themes, which directly address impacts on data quality and program efficiency, are substantiated by integrating direct quotes from participants to ground the comparative analysis in their lived experiences.

6.4.1 Perceived Advantages of Electronic Systems for Data Quality

There was a strong, cross-district consensus that the electronic Community Health Information System (eCHIS) possesses inherent features that directly enhance the timeliness, completeness, and accuracy of immunization data compared to the paper-based system.

Participants reported that eCHIS significantly accelerates the reporting process. The automation of data compilation and submission eliminates the time-consuming manual tallying and physical transportation of reports, leading to more timely data. A respondent from Moyo explained:

"The moment you have clicked, it will just go. Other than the deadline day, which is beyond 7th... now because of this system, every report is submitted there and then." (KII002_LF_MOYO)
Another from Moyo highlighted the efficiency gains:
"Previously, when we were using paper-based, every quarter, you need to call community health workers... it was tedious... But now with this system, what you have done today is already in the system." (KII001_DSP_MOYO)

A frequently cited advantage was the system's ability to enforce completeness through built-in validation rules. The system prevents users from proceeding with incomplete entries, thereby ensuring that all required data fields are populated. A Moyo-based participant stated:

"Completeness is also better because for electronic, there are some data validation tools. But once you don't fill another field, it will not allow you to go to the next level... So, it will cause you to fail immediately." (IDI001-OJ_MOYO)

Another elaborated:
"Should you skip any step, should you miss any data about this child, you cannot proceed and complete the report. Actually, it is now the system helping us." (KII001_DSP_MOYO)

Participants reported that eCHIS reduces errors associated with handwriting and manual calculation. Furthermore, features like GPS tracking and real-time entry make it significantly more difficult to fabricate data, thereby enhancing its reliability. A respondent noted the difficulty of forging data once sent to the server:

"We have come to realize that it is not easy for VHTs to forge data using the electronic system once submitted." (KII002_LF_MOYO)

Another highlighted the clarity of electronic data:
"I prefer electronic because... some of the handwritings you may find if you don't find the person who recorded the thing, it will be difficult... But if it is electronic if it is one it is one if it is two it is two. It will not confuse." (KII002_AA_ADJUMANI)

6.4.2 Persistent Challenges of the Paper-Based System

Despite being the primary system in Adjumani and a fallback in Moyo, the paper-based system was universally described as fraught with challenges that directly compromise data quality. The reliance on manual entry was frequently cited as a major source of error, including illegible handwriting and transcription mistakes. A participant from Adjumani described this issue:

"With the paperwork now, the issues of rubbing to correct, it's difficult... You make the paper dirty." (KII001_AG_ADJUMANI)

The physical nature of paper-based systems was described as creating a significant workload, leading to delays and fatigue that can result in reporting omissions. A respondent from Moyo contrasted it sharply with the electronic system:

"Paper-based is slow and time-wasting... When you are using electronic, things end up direct; you will not have too much workload." (KII004_DV_MOYO)

A participant from Adjumani highlighted the administrative burden:

"The paperwork is too much. Here, the month has ended, here you have clients to attend to, here you have reports to compile. So, at the end of the day, you get tired." (KII002_AA_ADJUMANI)

A critical operational challenge was the frequent stock-out of essential data collection tools, such as registers and reporting forms, which forces facilities to improvise with non-standardized notebooks, leading to data gaps. A respondent from Adjumani reported:

"We experience stockouts of some of those reporting tools. As I talk now, there is no OPD register in the facility... we are now improvising with counter books... When it comes to RTF indicators, children under 5 have to be assessed and if you find that the real register is not there... that data will not be captured." (KII004_CJ_ADJUMANI)

6.4.3 Critical Barriers to eCHIS Effectiveness (The "Why It Fails" Factors)

Despite its perceived advantages, the implementation and sustainability of eCHIS are hindered by several critical barriers that prevent the realization of its full potential. Unreliable electricity and poor internet connectivity were identified as the most significant technical barriers, rendering the electronic system inoperable for extended periods. A participant from Moyo General Hospital stated:

"The electronic data system was introduced, but due to the power fluctuation and the constant breakdown... this time the system is down." (KII004_DV_MOYO)

Regarding network, a respondent explained:
"The challenge was network challenge. You know we are... some of our areas, around the border, they are not having network completely... around 20 villages in the whole district have completely no network." (KII001_DSP_MOYO)

A significant barrier is the varying levels of digital literacy among health workers and Village Health Teams (VHTs), leading to resistance, fear, and incorrect use of the system. A district-level official in Moyo noted:

"When we introduced the electronic one, a good number of them had challenges... During their training, we had to eliminate some of them... So, we had to get someone to leave voluntarily." (KII002_LF_MOYO)

A respondent from Adjumani echoed this, stating:
"The electronic needs people to first... There are people who are even fearing how to... fearing to touch computer." (KII003_ACA_ADJUMANI)

The heavy reliance on donor funding for incentives, data bundles, and hardware maintenance creates a fragile system that collapses when project funding ends. A Moyo participant lamented:

"The biggest challenge with this system is financial support... when the partner withdrew and we completely not giving any incentive to the VHTs, it has also affected their reporting." (KII001_DSP_MOYO)

An HMIS focal person from Adjumani highlighted the long-term risk:

"When donor funding becomes a problem... The moment the organization is out, the apps have died. And no one talks about it, and that's how it is." (KII001_AG_ADJUMANI)

6.4.4 Institutional and Attitudinal Factors

Beyond the technical systems, broader institutional and human factors play a crucial role in determining the quality of data, regardless of the system in use. Chronic understaffing was frequently reported as a primary reason for delays in both data recording and reporting, as a single individual is often overwhelmed with multiple responsibilities. A data manager explained:

"The delay is sometimes the workload, finding the facility, there's only one staff. Basically, again, compiling the report becomes a lot of other things that cause delays." (IDI001-OJ_MOYO)

A pervasive challenge is the attitude among some health workers that data management is not their core

responsibility but solely that of the records officer, leading to poor documentation and delayed reporting. A health information assistant expressed his frustration:

"The attitude of staff towards data recording and reporting is that they don't own their reports... They say... Ah, this is Christopher's work... they say that it is the records person supposed to attend to it; that because it's none of their business." (KII003_AC_MOYO)

Another confirmed this, noting:
"There are some health workers who you know us being health information assistants, you can't just be all the time at the facility; and once you are not around, they may not document patients who have come." (KII004_CJ_ADJUMANI)

Furthermore, key factors influencing immunisation data quality as perceived by frontline health workers and managers. The following chapter will discuss the implications of these findings, relating them to the broader literature and the study's objectives.

Chapter Seven: Discussion

The study compared the effects of electronic and paper-based reporting systems on the timeliness and completeness of immunization data in immunization, using Moyo District (eCHIS) and Adjumani District (paper-based) as case studies. The key findings revealed that the electronic Community Health Information System (eCHIS) significantly improved both timeliness and completeness of immunization data compared to paper-based systems. The eCHIS facilitated real- time data entry, automated reminders, and validation checks that minimized reporting delays and missing fields. Health workers in Moyo reported improved efficiency, reduced workload, enhanced accuracy, and faster data retrieval, while those in Adjumani cited persistent challenges with manual errors, late reporting, and loss of records. However, eCHIS implementation also faced challenges such as unstable internet connectivity, limited digital literacy, and inadequate infrastructure. These findings align with global evidence showing that digital health systems can substantially enhance data quality when supported by adequate resources, user capacity, and institutional commitment (Hailemariam et al., 2024, Worku et al., 2024, Farahani et al., 2024).

7.1 Timeliness of Immunization Data Reporting

The study demonstrated that the eCHIS substantially improved the timeliness of immunization data reporting in Moyo District compared to paper-based systems in Adjumani. The odds of timely reporting were seven times higher among health workers using eCHIS, emphasizing the system's effectiveness in reducing reporting delays. This improvement can be attributed to features such as real-time data entry, automated submission, and in-built notifications for late or incomplete reports. These functions enabled health workers to transmit data directly to the District Health Information System (DHIS2), eliminating the need for manual aggregation and physical report delivery. Similar outcomes have been observed in Ethiopia and Kenya, where digital systems significantly reduced reporting lag and improved data flow across health system levels (Hailemariam et al., 2024, Kansiime et al., 2024).

The eCHIS improved operational efficiency by automating reminders and reducing the time spent on manual compilation. Health workers appreciated its real-time submission feature, which eliminated physical transport of reports and minimized human error. This contributed to timely decision-making at district and national levels, particularly for vaccine forecasting and performance monitoring. Furthermore, the system enhanced accountability through electronic time-stamping and traceability, ensuring that late submissions could easily be identified and addressed (Odekunle et al., 2017, Dadari et al., 2021).

Despite these strengths, the system's effectiveness was hindered by inconsistent internet connectivity and unreliable power supply, especially in remote areas. Some health workers reported challenges logging in or submitting data when the network was weak, causing occasional delays (Bakkabulindi et al., 2023). Additionally, limited digital literacy among older staff slowed data entry and created dependency on a few trained personnel, risking burnout. These challenges reflect findings from other LMICs, where digital health initiatives often struggle with infrastructural and human resource limitations (Bogale et al., 2023).

Overall, while eCHIS offers clear advantages for improving data timeliness, its sustainability depends on addressing connectivity gaps, ensuring continuous technical support, and integrating user-friendly features to accommodate all cadres of health workers.

7.2 Completeness of Immunization Data

Findings revealed that completeness of immunization data was significantly higher in Moyo (79.6%) compared to Adjumani (36.4%), with respondents using eCHIS being almost seven times more likely to produce complete reports. The superior completeness in eCHIS is largely attributed to the system's design, which enforces mandatory data fields and provides real-time validation checks that prevent submission of incomplete records. This ensures that all critical information, such as child identifiers, vaccination dates, and doses, is recorded before a report is finalized. These findings are consistent with earlier studies in Ethiopia and Bangladesh, which reported similar gains in completeness following adoption of electronic health systems (Hailemariam et al., 2024, Worku et al., 2024).

Completeness in paper-based systems was often compromised by missing tally sheets, incomplete registers, and manual aggregation errors. Health workers in Adjumani cited factors such as workload, stockouts of reporting tools, and limited supervision as contributors to incomplete records. The absence of validation mechanisms meant that errors and omissions were only detected during supervision, delaying corrections and reducing data reliability.

The eCHIS, by contrast, reduced duplication and standardized data entry formats, improving record consistency and reliability. However, challenges such as system downtime and inadequate training occasionally disrupted data entry, underscoring the need for continuous mentorship and eriodic system updates. Similar observations have been reported and it was emphasized that system reliability and user competence are critical determinants of data completeness (MoH, 2023b, Rahmadhan and Handayani, 2023). Therefore, eCHIS enhanced completeness by combining digital validation, real-time submission, and structured formats, but sustained improvement requires strong supervision, user support, and regular data quality audits.

7.3 Health Workers' Perceptions and Experiences

Health workers' perceptions of eCHIS in Moyo were overwhelmingly positive, reflecting its perceived ability to improve efficiency, reduce workload, enhance accuracy, and facilitate faster data retrieval compared to paper-based systems. These perceptions align with evidence from other studies showing that digital reporting systems promote user satisfaction and data ownership when adequately supported (Adane et al., 2019, Odekunle et al., 2017)

The eCHIS streamlined data entry and transmission, allowing health workers to spend less time compiling monthly reports. Automated features reduced repetitive manual tasks and eliminated the need to physically transport reports to district offices. This increased productivity and allowed more time for patient care and outreach activities. Health workers in Moyo also noted that real- time synchronization with DHIS2 enabled immediate access to up-to-date data, improving planning and supervision (Worku et al., 2024).

Unlike the labor-intensive paper-based reporting process in Adjumani, eCHIS consolidated multiple registers into a single digital interface. This minimized paperwork and the burden of manual tabulation, reducing fatigue and improving morale. The ability to submit data electronically also decreased the need for after-hours documentation, which was a common complaint under paper-based systems (Kansiime et al., 2024).

Electronic validation checks ensured that only complete and logical data could be submitted, drastically reducing transcription and calculation errors. Health workers expressed confidence in the system's reliability and appreciated the immediate feedback on data entry errors, which promoted learning and continuous quality improvement. These findings echo similar results in Kenya and Ethiopia, where digital tools improved the accuracy and traceability of immunization records (Hailemariam et al., 2024, Farahani et al., 2024).

The eCHIS made it easier for health workers to retrieve historical records, monitor immunization defaulters, and generate summary reports for review meetings. In contrast, staff in Adjumani faced difficulties locating paper registers and compiling retrospective data, especially during audits or supervision visits. The electronic system's search functionality allowed quick access to client records, thereby improving responsiveness and decision-making (Dadari et al., 2021, MoH, 2023a).

Nevertheless, challenges persisted. Health workers cited limited access to functioning tablets, poor network coverage, and inadequate technical support as constraints to optimal system use. Some also

highlighted the need for continuous refresher training to maintain proficiency and confidence in using the digital system. These findings underscore that while digital tools enhance performance, their long-term success depends on sustained capacity-building, infrastructure development, and institutional support.

Chapter 8: Conclusion and Recommendations

8.1 Conclusion

This study set out to compare the timeliness and completeness of immunisation data between districts using the Electronic Community Health Information System (eCHIS) and those relying on paper-based reporting, while also exploring health workers' experiences with both systems. By triangulating quantitative and qualitative findings, the study provides robust evidence on how reporting system type influences immunisation data quality in Uganda.

Quantitative findings demonstrated that the use of eCHIS was significantly associated with improved data quality. Health workers in Moyo District were more than seven times more likely to submit immunisation reports on time and more than six times more likely to submit complete reports compared to their counterparts in Adjumani District. These differences persisted even after adjusting for health worker characteristics, indicating that improvements in timeliness and completeness were primarily driven by system-level factors rather than individual attributes.

Qualitative findings strongly reinforced these results. Health workers and managers described eCHIS as facilitating real-time data entry, reducing paperwork, and minimizing errors through automated validation checks and mandatory fields. Participants consistently reported that system features such as reminders for incomplete submissions and immediate transmission of data supported timely reporting and improved completeness. In contrast, paper-based systems were perceived as time-consuming, prone to data loss, transcription errors, and delayed submission, which directly undermined data quality.

Triangulation of findings also highlighted that the effectiveness of eCHIS is influenced by contextual and institutional factors. While the electronic system improved data quality, qualitative evidence revealed persistent challenges including unreliable electricity, poor internet connectivity, device-related problems, and gaps in digital literacy. These constraints occasionally limited real-time data submission and created frustration among users, suggesting that technology alone is insufficient without supportive infrastructure and systems.

Overall, the convergence of quantitative and qualitative evidence confirms that eCHIS offers a clear advantage over paper-based reporting in enhancing the timeliness and completeness of immunisation data. However, the sustainability and scalability of these gains depend on addressing contextual barriers and strengthening institutional support. The study therefore provides compelling evidence to inform Uganda's digital health strategy and immunisation data management reforms.

8.2 Recommendation

In view of the study findings, the following recommendations are proposed to improve the timeliness and completeness of immunization data in Uganda.

- Given the observed improvement in data timeliness and completeness in districts implementing eCHIS, the MoH should expand eCHIS to capture the entire EPI dataset, rather than limiting the system to a few immunization variables. Full integration of routine vaccination records, defaulter tracking, outreach activities, and vaccine stock data into eCHIS would eliminate parallel paper-based reporting and enhance the overall efficiency and reliability of immunization data management.

- Since districts relying on paper-based systems demonstrated poorer data performance, the Ministry of Health, in collaboration with implementing partners, should prioritize the phased roll-out of eCHIS to non-implementing districts, with emphasis on high-burden and hard-to-reach areas. Clear transition timelines should be established to progressively reduce dependence on paper-based reporting systems.

- Considering that infrastructural limitations affected optimal use of eCHIS, the Ministry of Health and District Local Governments should strengthen digital infrastructure, including reliable power supply and internet connectivity at community and facility levels. Where network coverage is limited, offline data entry and scheduled synchronization should be strengthened to support uninterrupted reporting.

- In response to identified health worker capacity gaps, the MoH and District Health Teams should institutionalize regular refresher training and supportive supervision on eCHIS, with specific emphasis on immunization data entry, data quality standards, and system troubleshooting. Routine supervision should include review of eCHIS dashboards and feedback on data quality performance.

- To promote sustainability and evidence-informed decision-making, the MoH and academic institutions should support periodic evaluations of eCHIS, including assessments of long-term performance, cost-effectiveness, and impact on immunization programme outcomes. Such evidence will guide optimization and national scale-up of the system.

Reference

ABERA, A., TOLERA, A., TUSA, B. S., WELDESENBET, A. B., TOLA, A., SHIFERAW, T., GIRMA, A., MOHAMMED, R. & DESSIE, Y. 2023. Experiences, barriers, and facilitators of health data use among performance monitoring teams (PMT) of health facilities in Eastern Ethiopia: A qualitative study. *Plos one,* 18**,** e0285662.

ADANE, K., GIZACHEW, M. & KENDIE, S. 2019. The role of medical data in efficient patient care delivery: a review. *Risk Manag Healthc Policy,* 12**,** 67-73.

AQIL, A., LIPPEVELD, T. & HOZUMI, D. 2009. PRISM framework: a paradigm shift for designing, strengthening and evaluating routine health information systems. *Health Policy Plan,* 24**,** 217-28.

BAGHERIAN, H. & SATTARI, M. 2022. Health Information System in Developing Countries: A Review on the Challenges and Causes of Success and Failure. *Med J Islam Repub Iran,* 36**,** 111.

BAKKABULINDI, P., AMPEIRE, I., AYEBALE, L., MUBIRI, P., FELETTO, M. & MUHUMUZA, S. 2023. Engagement of community health workers to improve immunization coverage through addressing inequities and enhancing data quality and use is a feasible and effective approach: An implementation study in Uganda. *PLoS One,* 18**,** e0292053.

BANGURA, J. B., XIAO, S., QIU, D., OUYANG, F. & CHEN, L. 2020. Barriers to childhood immunization in sub-Saharan Africa: A systematic review. *BMC Public Health,* 20**,** 1108.

BLOLAND, P. & MACNEIL, A. 2019. Defining & assessing the quality, usability, and utilization of immunization data. *BMC Public Health,* 19**,** 380.

BOGALE, T. N., WILLEMS, H., BONGASSIE, L. A., EYOB, Y., MENGESHA, C. K., YIHUN, B. Y., MOHAMMED, M., WENDRAD, N., MELKAMU, G., DAKA, D. W., MERESSA, S. & BEKELE, T. A. 2023. Acceptability and use of the electronic community health information system and its determinants among health extension workers in Ethiopia: a retrospective cross-sectional observational study. *BMC Medical Informatics and Decision Making,* 23**,** 290.

BULTHUIS, S., KOK, M., ONVLEE, O., O'BYRNE, T., AMON, S., NAMAKULA, J., CHIKAPHUPHA, K., GEROLD, J., MANSOUR, W., RAVEN, J., BROERSE, J. E. W. & DIELEMAN, M. 2023. How to scale-up: a comparative case study of scaling up a district health management strengthening intervention in Ghana, Malawi and Uganda. *BMC Health Serv Res,* 23**,** 35.

DADARI, I., HIGGINS-STEELE, A., SHARKEY, A., CHARLET, D., SHAHABUDDIN, A., NANDY, R. & JACKSON, D. 2021. Pro-equity immunization and health systems strengthening strategies in select Gavi-supported countries. *Vaccine,* 39**,** 2434-2444.

FARAHANI, M., TINDYEBWA, T., SUGANDHI, N., WARD, K., PARK, Y., BAKKABULINDI, P., KULKARNI, S., WALLACE, A., BIRARO, S., WIBABARA, Y., CHUNG, H., REID, G. A., ALFRED, D., ATUGONZA, R., ABRAMS, E. J. & IGBOH, L. S. 2024. Evaluation of Integrated Child Health Days as a Catch-Up Strategy for Immunization in Three Districts in Uganda. *Vaccines (Basel),* 12.

GRACE, A. M., SILVIA, M. & SANNER, T. A. Check for updates Taking a Leaf from Health: Implementation of a Decentralized Education Management Information System in Uganda. 2023 2023. Springer Nature, 156.

HAILEMARIAM, T., ATNAFU, A., GEZIE, L., KAASBØLL, J., KLEIN, J. & TILAHUN, B. 2024. Intention to Use an Electronic Community Health Information System Among Health Extension Workers in Rural Northwest Ethiopia: Cross-Sectional Study Using the Unified Theory of Acceptance and Use of Technology 2 Model. *JMIR human factors,* 11**,** e47081.

HAILEMARIAM, T., ATNAFU, A., GEZIE, L. D., KAASBØLL, J. J., KLEIN, J. & TILAHUN, B. 2023. Individual and contextual level enablers and barriers determining electronic community health information system implementation in northwest Ethiopia. *BMC Health Services Research,* 23**,** 644.

HARRISON, K., RAHIMI, N. & DANOVARO-HOLLIDAY, M. C. 2020. Factors limiting data quality in the expanded programme on immunization in low and middle-income countries: A scoping review. *Vaccine,* 38**,** 4652-4663.

JONES, S., RUDIN, R., PERRY, T. & SHEKELLE, P. 2014. Health Information Technology: An Updated Systematic Review With a Focus on Meaningful Use. *Annals of internal medicine,* 160.

KABIR, S. M. 2016. METHODS OF DATA COLLECTION.

KANSIIME, W. K., ATUSINGWIZE, E., NDEJJO, R., BALINDA, E., NTANDA, M., MUGAMBE, R. K. & MUSOKE, D. 2024. Barriers and benefits of mHealth for community health workers in integrated community case management of childhood diseases in Banda Parish, Kampala, Uganda: a cross-sectional study. *BMC Prim Care,* 25**,** 173.

KUVUNA, B., NYANCHOKA, M., GULEID, F., OGUTU, M., TSOFA, B. & NZINGA, J. 2024. Community-Based Health Information Systems in Africa: A Scoping Review of Data Generation, Utilization, and Community Empowerment. *Wellcome Open Res,* 9**,** 485.

KWOK, C. S., MUNTEAN, E. A., MALLEN, C. D. & BOROVAC, J. A. 2022. Data Collection Theory in Healthcare Research: The Minimum Dataset in Quantitative Studies. *Clin Pract,* 12**,** 832-844.

LAWRENCE, M., FULLER, B., ISABIRYE, H., KYOZIRA, C., MAKUMBI, I., BAKAINAGA, A., MOORE, C. & SSEKITOLEKO, R. 2024. *Health Data Reporting Challenges in the Age of DHIS2: a Mixed-Methods Review in the Teso Sub-Region of Uganda*.

LINDSTRAND, A., CHERIAN, T., CHANG-BLANC, D., FEIKIN, D. & O'BRIEN, K. L. 2021. The World of Immunization: Achievements, Challenges, and Strategic Vision for the Next Decade. *J Infect Dis,* 224**,** S452-s467.

LUBANGA, A. F., BWANALI, A. N., KANGOMA, M., MATOLA, Y., MOYO, C., KAONGA, B., SSEBIBUBBU, S., MAKOLE, T. J., KAMBILI, F., CHUMBI, G. D., MUNTHALI, L., MWALE, A., KAPHESI, F., SIMFUKWE, R., MPHEPO, M., KAPATSA, T., HARAWA, G. & MPINGANJIRA, S. L. 2024. Addressing the re-emergence and resurgence of vaccine-preventable diseases in Africa: A health equity perspective. *Hum Vaccin Immunother,* 20**,** 2375081.

MEDICS. 2024. *Transforming community health in Uganda: The journey of the electronic Community Health Information System* [Online]. Available: https://medic.org/stories/transforming-community-health-in-uganda-the-journey-of-the-electronic-community-health-information-system/ [Accessed].

MILLER, N. P., AMOUZOU, A., TAFESSE, M., HAZEL, E., LEGESSE, H., DEGEFIE, T., VICTORA, C. G., BLACK, R. E. & BRYCE, J. 2014. Integrated community case management of childhood illness in Ethiopia: implementation strength and quality of care. *Am J Trop Med Hyg,* 91**,** 424-434.

MOH 2020. Uganda Ministry of Health, ELECTRONIC COMMUNITY HEALTH INFORMATION. Kampala Uganda: Ministry of Health, Uganda.

MOH. 2023a. *DIGITIZATION AND HEALTH INFORMATION MONTHLY REPORT* [Online]. Available: https://library.health.go.ug/sites/default/files/resources/Health%20Sector%20Digitization%20Bulletin%20December2.pdf [Accessed].

MOH. 2023b. *Electronic Community Health Information (eCHIS) Bulletin* [Online]. Kampala: Ministry of Health - Uganda. Available: https://library.health.go.ug/sites/default/files/resources/electronic%20Community%20Heatlh%20Information_eCHIS_Bulletin.pdf [Accessed].

MOH. 2023c. *Electronic Community Health Information (eCHIS) Bulletin,* [Online]. Uganda Ministry of Health. Available: https://library.health.go.ug/health-information-systems/digital-health/electronic-community-health-information-echis-bulletin [Accessed].

MOH 2024. MINISTRYOF HEALTH, UGANDA, UGANDA NATIONAL EXPANDED PROGRAM FOR IMMUNIZATION (UNEPI).

MOURA, C. O., SILVA Í, R., SILVA, T. P. D., SANTOS, K. A., CRESPO, M. & SILVA, M. M. D. 2021. Methodological path to reach the degree of saturation in qualitative research: grounded theory. *Rev Bras Enferm,* 75**,** e20201379.

NANSIKOMBI, H. T., KWESIGA, B., ACENG, F. L., ARIO, A. R., BULAGE, L. & ARINAITWE, E. S. 2023. Timeliness and completeness of weekly surveillance data reporting on epidemic prone diseases in Uganda, 2020–2021. *BMC Public Health,* 23**,** 647.

NGWA, C. H., DOUNGTSOP, B. K., BIHNWI, R., NGO, N. V. & YANG, N. M. 2022. Burden of vaccine-preventable diseases, trends in vaccine coverage and current challenges in the implementation of the expanded program on immunization: A situation analysis of Cameroon. *Hum Vaccin Immunother,* 18**,** 1939620.

ODEKUNLE, F. F., ODEKUNLE, R. O. & SHANKAR, S. 2017. Why sub-Saharan Africa lags in electronic health record adoption and possible strategies to increase its adoption in this region. *Int J Health Sci (Qassim),* 11**,** 59-64.

OKESANYA, O. J., OLATUNJI, G., OLALEKE, N. O., MERCY, M. O., ILESANMI, A. O., KAYODE, H. H., MANIRAMBONA, E., AHMED, M. M., UKOAKA, B. M. & LUCERO-PRISNO III, D. E. 2024. Advancing Immunization in Africa: Overcoming Challenges to Achieve the 2030 Global Immunization Targets. *Adolesc Health Med Ther,* 15**,** 83-91.

POTET, J., BERAN, D., RAY, N., ALCOBA, G., HABIB, A. G., ILIYASU, G., WALDMANN, B., RALPH, R., FAIZ, M. A., MONTEIRO, W. M., DE ALMEIDA GONÇALVES SACHETT, J., DI FABIO, J. L., CORTÉS, M., BROWN, N. I. & WILLIAMS, D. J. 2021. Access to antivenoms in the developing world: A multidisciplinary analysis. *Toxicon X,* 12**,** 100086.

QAZI, M. & ALI, M. 2009. Pakistan's health management information system: Health managers' perspectives. *JPMA. The Journal of the Pakistan Medical Association,* 59**,** 10-4.

RAHMADHAN, M. & HANDAYANI, P. W. 2023. Challenges of vaccination information system implementation: A systematic literature review. *Hum Vaccin Immunother,* 19**,** 2257054.

SCHMIDT, C. O., STRUCKMANN, S., ENZENBACH, C., REINEKE, A., STAUSBERG, J., DAMEROW, S., HUEBNER, M., SCHMIDT, B., SAUERBREI, W. & RICHTER, A. 2021. Facilitating harmonized data quality assessments. A data quality framework for observational health research data collections with software implementations in R. *BMC Medical Research Methodology,* 21**,** 63.

SSEGUJJA, E., AKULUME, M., EKIRAPA-KIRACHO, E., KIGGUNDU, P., ZALWANGO, S. K. & RUTEBEMBERWA, E. 2024. Coping mechanisms and strategies adopted to improve the quality and timeliness of immunization data among lower-level private-for-profit service providers in Kampala Capital City, Uganda. *PLoS One,* 19**,** e0303998.

STEPHENS, A. B., WYNN, C. S., HOFSTETTER, A. M., KOLFF, C., PENA, O., KAHN, E., DASGUPTA, B., NATARAJAN, K., VAWDREY, D. K., LANE, M. M., ROBBINS-MILNE, L., RAMAKRISHNAN, R., HOLLERAN, S. & STOCKWELL, M. S. 2021. Effect of Electronic Health Record Reminders for Routine Immunizations and Immunizations Needed for Chronic Medical Conditions. *Appl Clin Inform,* 12**,** 1101-1109.

UMEZURUIKE, C., NWANKWO, W., MCPN & KAREYO, M. 2017. Implementation Challenges Of Health Management Information Systems In Uganda: A Review. *Journal of Multidisciplinary Engineering Science and Technology (JMEST),* 4**,** 2458-9403.

WETHERILL, O., LEE, C.-W. & DIETZ, V. 2017. Root Causes of Poor Immunisation Data Quality and Proven Interventions: A Systematic Literature Review. *Annals of infectious disease and epidemiology,* 2**,** 1-7.

WHO. 2024a. *Uganda Commits to Investing in Community Health Workers to Advance Primary Health Care and Promote Community Well-being* [Online]. Kampala: World Health Organisation. Available: https://www.afro.who.int/countries/uganda/news/uganda-commits-investing-community-health-workers-advance-primary-health-care-and-promote-community [Accessed].

WHO. 2024b. *World Health Organisation, 50th anniversary of the Expanded Programme on Immunization (EPI)* [Online]. Available: https://www.who.int/news-room/events/detail/2024/01/01/default-calendar/50th-anniversary-of-the-expanded-programme-on-immunization-(epi) [Accessed 20122024 2024].

WHO. 2024c. *World Health Organisation, Essential Programme on Immunization* [Online]. Geneva: World Health Organisation. Available: https://www.who.int/teams/immunization-vaccines-and-biologicals/essential-programme-on-immunization#:~:text=Building%20on%20the%20momentum%20of,%2D19%20(for%20adults). [Accessed 20122024 2024].

WHO/UNICEF. 2012. *WHO/UNICEF JOINT STATEMENT on Integrated Community Case Management (iCCM)* [Online]. WHO/UNICEF. Available: https://www.childhealthtaskforce.org/hubs/iccm#:~:text=Integrated%20Community%20Case%20Management%20(iCCM)%20is%20a%20strategy%20to%20train,of%20the%20iCCM%20target%20areas. [Accessed].

WORKU, A., KINFE, A., OMER, A., DENBOBA, W., BELAY, H., KEBEDE, E., BIRHAN, D., HAILU, T., ALEMU, E., KELBESA, A., KABA, O., KUMELA, C., BIRU, A., MELAKU, G. & WENDRAD, N. 2024. Revisiting Strategies: A Hybrid Study on the Effective Implementation of the Electronic Community Health Information System for Enhanced Data Quality and Service Provision. 38.

YAO, R., ZHANG, W., EVANS, R., CAO, G., RUI, T. & SHEN, L. 2022. Inequities in Health Care Services Caused by the Adoption of Digital Health Technologies: Scoping Review. *J Med Internet Res,* 24**,** e34144.

Appendices

Appendix 1 : Informed Consent Form

Title of Study: A comparative study of electronic and paper-based systems on the timeliness and completeness of immunization data in Uganda: a case of Moyo and Adjumani districts

Principal Investigator: Sinah Kgomotso Phiri

Institution: Makerere University School of Public Health **Study Districts:** Moyo and Adjumani

Introduction: You are being invited to participate in a research study conducted by Sinah Kgomotso Phiri from Makerere University School of Public Health. The purpose of this study is to assess the effectiveness of the Electronic Community Health Information System (eCHIS) in improving immunization data quality in Uganda. Before you decide to participate, please read this form carefully. It explains why this research is being conducted, what your participation will involve, the possible risks and benefits, and your rights as a participant. If you have any questions, feel free to ask the research team before signing this form.

Purpose of the Study: The study aims to evaluate how the use of eCHIS compares to the paper- based system in improving the accuracy, completeness, timeliness, and consistency of immunization data.

What Your Participation Involves: If you agree to participate, you will be asked to:

1. Complete a structured questionnaire that will take approximately 20-30 minutes.
2. If selected, participate in a Key Informant Interview (KII) which will take approximately 45-60 minutes.
3. Provide information on immunization data management practices, challenges, and perceptions about eCHIS.

Your participation is entirely voluntary, and you may refuse to answer any questions or withdraw at any time without any consequences.

Potential Risks and Discomforts: There are no direct physical risks involved in participating in this study. However, you may feel uncomfortable answering some questions. If you experience any distress, you may skip those questions or withdraw from the study at any time.

Potential Benefits: Your participation will help improve health information management systems in Uganda. The findings from this study will contribute to better immunization program planning and data accuracy, ultimately benefiting healthcare workers, policymakers, and the general population.

Confidentiality and Privacy: All responses will be kept confidential and used only for research purposes.

- Your name **will not** be recorded or mentioned in any report.

- Data collected will be securely stored in a password-protected system, and only authorized researchers will have access.
- Any published results will present data in an anonymous format to protect your identity.

Voluntary Participation and Right to Withdraw: Participation is completely voluntary. You have the right to refuse to participate or withdraw at any time without any penalty. If you choose to withdraw, any information you have provided will be destroyed and not used in the study.

Compensation: Each participant will be given compensation of UGX20,000/= as transport refund and time reimbursement

Contact Information: If you have any questions about this study, please contact: Principal Investigator: Sinah Kgomotso Phiri, phirisinah@gmail.com, +267 777825114] and or Research Ethics Committee: Makerere University School of Public Health Research and Ethics Committee (MakSPH-REC) Phone:256-312-291-397, email: sphrecadmin@musph.ac.ug. If you have any concerns about your rights as a research participant, you may contact the above Ethics Committee.

Participant Consent Statement

By signing this form, I confirm that: I have read and understood the study details explained in this consent form. I have had the opportunity to ask questions, and they have been answered satisfactorily. I understand that my participation is voluntary and that I can withdraw at any time. I give my consent to participate in this study.

Participant's Name: _____ Signature: _____Date: _____

Researcher's Name: _____Signature: _____ Date: _____

Appendix 2 : QUESTIONNAIRE

SECTION A: DEMOGRAPHIC INFORMATION

1. Age (in years): _____
2. Gender: Male ☐ Female ☐
3. Highest Level of Education Completed: Certificate ☐ Diploma ☐ Bachelor's Degree ☐ Master's Degree ☐ Other (Specify) _____
4. Current Job Title/Designation: Health worker ☐ Data Clerk ☐ Program Manager ☐ District Health Officer ☐ Other (Specify) _____
5. Years of Experience in Current Role: Less than 1 year ☐ 1-3 years ☐ 4-6 years ☐ More than 6 years ☐
6. Facility Type: Health Centre II ☐ Health Centre III ☐ Health Centre IV ☐ Hospital ☐ Other (Specify) _____
7. District: Moyo (using eCHIS) ☐ Adjumani (paper-based system) ☐

SECTION B: HEALTH INFORMATION SYSTEM UTILIZATION

8. What type of data management system do you primarily use for immunization records? Paper-based ☐ Electronic (eCHIS) ☐ Both ☐
9. How frequently do you update patient immunization records? Immediately after vaccination ☐ Daily ☐ Weekly ☐ Monthly ☐ Other (Specify) _____
10. How easy is it to access patient immunization data in your system? Very Easy ☐ Easy ☐ Difficult ☐ Very Difficult ☐
11. How would you rate your level of training in using the health information system you work with? Well-trained and confident ☐ Somewhat trained but need more support ☐ Poorly trained ☐ Not trained at all ☐
12. How would you rate the availability of technical support when you face challenges with the system? Always available ☐ Sometimes available ☐ Rarely available ☐ Never available ☐
13. Do you have regular feedback sessions on immunization data quality and reporting? Yes ☐ No ☐

SECTION C: DATA QUALITY INDICATOR

1. Data Completeness

16. How complete are the immunization records in your system? 100% complete ☐
Mostly complete ☐ Somewhat incomplete ☐ Very incomplete ☐

17. What are the main challenges affecting data completeness? (Select all that apply)
☐ Shortage of staff
☐ High workload
☐ Lack of training
☐ Poor internet connectivity
☐ System failures
☐ Other (Specify) _____

2. Data Timeliness

18. How timely is immunization data entered into the system? Always on time ☐ Often on time ☐ sometimes late ☐ frequently delayed ☐

19. If delays occur, what are the main causes? (Select all that apply)
☐ High patient volume
☐ System downtime
☐ Limited access to computers
☐ Lack of trained staff
☐ Other (Specify) _____

SECTION D: PERCEPTIONS AND CHALLENGES IN DATA MANAGEMENT

20. How would you compare eCHIS with the paper-based system in terms of data quality?
eCHIS is much better ☐ eCHIS is slightly better ☐ Both are the same ☐
Paper-based is better ☐

21. What are the biggest challenges you face when using your data management system? (Select all that apply)
☐ Poor system reliability
☐ Lack of training
☐ Poor internet connectivity
☐ High workload
☐ Data entry errors
☐ Other (Specify) _____

22. What improvements would you suggest for better immunization data management?
☐ More training on system use

☐ Upgrading computer systems
☐ Improving internet access
☐ Increasing staff numbers
☐ Other (Specify) _____

SECTION E: FINAL REMARKS

23. Do you have any additional comments or suggestions on how to improve immunization data management in Uganda?

……

……

……

Thank You for Your Participation!

Appendix 3 : Key Informant Interview (KII) Guide

Introduction:

Thank you for agreeing to participate in this interview. We are conducting a study to assess how electronic and paper-based data systems affect immunization data quality under the Immunization data. Your insights will help us understand the operational experiences, challenges, and opportunities related to both systems.

This interview is confidential and voluntary. You may decline to answer any question or stop the interview at any point.

Section A: Background Information

1. Name of facility: _____
2. Type of system used (tick):
    - eCHIS
    - Paper-based
3. Position of respondent: _____
4. Number of years in current position: _____
5. Training received on data management (if any): _____

Section B: General System Experience

1. Can you describe how immunization data is currently collected and reported in your facility?
2. How do you perceive the overall usability of the data system you are using (eCHIS or paper-based)?
3. What type of support (technical, supervisory, mentorship) have you received in using your current system?

Section C: Data Quality Dimensions

Timeliness

4. How timely is the data reporting in your current system?
5. What challenges, if any, affect timely reporting in your facility?
6. In your opinion, does the current system (eCHIS or paper) enable faster reporting compared to the other?

Completeness

7. How do you ensure that all required immunization data is captured and reported?
8. Are there any gaps you commonly observe in data collection or reporting?
9. In your experience, which system (eCHIS or paper-based) better supports complete dataentry and reporting?

Section D: Comparisons and Perceptions

10. If you are familiar with both systems (eCHIS and paper-based), how would you compare them in terms of:

- Data entry ease
- Error detection and correction
- Data access and retrieval
- User satisfaction

11. What factors make one system more efficient or preferable than the other?

Section E: Institutional and Individual Factors

12. How would you describe the institutional support for data management in your facility (availability of resources, leadership engagement, mentorship)?
13. Do you feel adequately trained and equipped to use the current system? Why or why not?
14. What attitudes do health workers in your facility generally have toward data recording and reporting?
15. What barriers exist in adopting or using either eCHIS or paper-based systems in your setting?

Section F: Recommendations

16. What improvements would you suggest for the current data system in your facility?
17. In your opinion, what would be needed to ensure better data quality (timeliness and completeness) regardless of system type?

Thank You

Appendix 4 : Appendix 4: In-Depth Interview (IDI) Guide

Introduction:

Thank you for agreeing to participate in this interview. We are conducting a study to assess how electronic and paper-based data systems affect immunization data quality under the on Immunization data. Your insights will help us understand the operational experiences, challenges, and opportunities related to both systems.

This interview is confidential and voluntary. You may decline to answer any question or stop the interview at any point.

Section A: Respondent and Facility Profile

1. What is your current role in the health facility?
2. How long have you worked in this role?
3. What type of data system does your facility use for immunization data?
    - Paper-based
    - eCHIS
4. Have you ever worked with the other system (eCHIS if you are in a paper-based facility, or vice versa)?
    - If yes: For how long and in what capacity?

Section B: Data Timeliness

1. Can you describe the process you follow to record and report immunization data?
2. How often do you submit immunization reports?
3. What helps you meet the reporting deadlines in your current system?
4. What delays, if any, have you encountered in reporting?
5. In your opinion, does the system you use support timely reporting better than the alternative? Why?

Section C: Data Completeness

6. How do you ensure all required immunization data is recorded in your system?
7. Are there specific types of data that are often missed or inconsistently recorded? Why?
8. Does your current system have features or processes that help ensure completeness of data?
    - (For eCHIS users: Probe on built-in checks, prompts)
    - (For paper-based users: Probe on manual reviews, tally sheets)

Section D: Challenges and Enablers

9. What are the main challenges you face with your current data system in terms of timeliness and completeness?
10. What tools, resources, or support would help improve your ability to produce timely and complete immunization data?
11. Have you received any training on immunization data management?
    - If yes, what did it focus on?
    - Was it useful?

Section E: Comparative Reflections (if applicable)

12. (For respondents with experience in both systems):

- How would you compare paper-based and eCHIS systems in terms of:
    - Timeliness of reporting
    - Completeness of data
    - Ease of use
    - Support available

Which system do you think leads to better immunization data quality overall? Why?

Section F: Recommendations

14. Based on your experience, what changes would you recommend to improve the quality (timeliness and completeness) of immunization data in your facility?
15. What specific support (training, tools, supervision) would you find most helpful in your day-to-day work?

Your insights are valuable and will contribute to better data practices and health outcomes. We appreciate your time and willingness to share your experience.

Thank You