**AN ONLINE HIV MEDICATION DELIVERY MANAGEMENT SYSTEM. CASE STUDY: NAGURU GENERAL HOSPITAL**

**BY**

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# **LIST OF ACRONYMS**

|  |  |
| --- | --- |
| **AIDS** | Acquired Immunodeficiency Virus |
| **BI** | Business Intelligence |
| **CRM** | Customer Relationship Management |
| **CUFH-N** | China-Uganda Friendship Hospital Naguru |
| **DSS** | Decision Support System |
| **EIS** | Enterprise Information Systems |
| **ERP** | Enterprise Resource Planning |
| **HIV** | Human Immunodeficiency Virus |
| **HRM** | Human Resource Management |
| **KCCA** | Kampala Capital City Authority |
| **OHMDMS** | Online HIV Medication Delivery Management System |

**Table of Contents**

[**LIST OF ACRONYMS** i](#_Toc162515812)

[**CHAPTER ONE** 1](#_Toc162515813)

[**INTRODUCTION** 1](#_Toc162515814)

[**1.0 Introduction** 1](#_Toc162515815)

[**1.1 Background of Study** 1](#_Toc162515816)

[**1.1.1 Historical Background of Naguru General Hospital** 1](#_Toc162515817)

[**1.1.3 Conceptual of the existing HIV Medication Delivery Management System** 2](#_Toc162515818)

[**1.2 Problem statement** 3](#_Toc162515819)

[**1.3 Research Questions** 4](#_Toc162515820)

[**1.3.1 General Research Question** 4](#_Toc162515821)

[**1.3.2 Specific Research Questions** 4](#_Toc162515822)

[**1.4 Objectives** 4](#_Toc162515823)

[**1.4.1 General Objective** 4](#_Toc162515824)

[**1.4.2 Specific Objectives of the Study** 4](#_Toc162515825)

[**1.5 Scope of the Study** 4](#_Toc162515826)

[**1.5.1 Subject Scope** 4](#_Toc162515827)

[**1.5.2 Geographical Scope** 5](#_Toc162515828)

[**1.5.3 Time Scope** 5](#_Toc162515829)

[**1.5.3.1 February 2024 to March 2024** 5](#_Toc162515830)

[**1.5.3.2 April 2024 to May 2024** 5](#_Toc162515831)

[**1.5.3.3 June 2024** 5](#_Toc162515832)

[**1.6 Target Group** 5](#_Toc162515833)

[**1.7 Significance of the Study** 6](#_Toc162515834)

[**1.7.1 To HIV patients** 6](#_Toc162515835)

[**1.7.2 To Healthcare Providers** 6](#_Toc162515836)

[**1.7.3 To Healthcare Systems** 6](#_Toc162515837)

[**1.7.4 To Researchears** 6](#_Toc162515838)

[**1.7.5 To Policy Developers** 7](#_Toc162515839)

[**1.9 Chapter Summary** 7](#_Toc162515840)

[**CHAPTER TWO** 8](#_Toc162515841)

[**LITERATURE REVIEW** 8](#_Toc162515842)

[**2.0 Introduction** 8](#_Toc162515843)

[**2.1 Theoretical Frame work of the Medication Delivery Management System** 8](#_Toc162515844)

[**2.2 Types of Information Systems** 9](#_Toc162515845)

[**2.2.1 Management information system** 10](#_Toc162515846)

[**2.2.2 Enterprise Information Systems (EIS)** 10](#_Toc162515847)

[**2.2.3 Decision Support System (DSS)** 10](#_Toc162515848)

[**2.3 Medication Access and Delivery Systems** 11](#_Toc162515849)

[**2.3.1 Patient Profiling and Prescription Management** 11](#_Toc162515850)

[**2.3.2 Authentication and Authorization** 11](#_Toc162515851)

[**2.3.3 Prescription Fulfillment and Delivery Coordination** 12](#_Toc162515852)

[**2.3.4 Patient Notification and Engagement** 12](#_Toc162515853)

[**2.3.5 The Impacts of the Medication Access and Delivery Systems** 12](#_Toc162515854)

[**2.4 The Current HIV Medication and Delivery Management System** 13](#_Toc162515855)

[**2.4.1 Merits of the Current Medication and Delivery Management System** 14](#_Toc162515856)

[**2.4.2 Demerits of the Current HIV Medication and Delivery System** 15](#_Toc162515857)

[**2.5 Technologies Used in Developing the Proposed Online HIV Medication and Delivery System** 16](#_Toc162515858)

[**2.5.1 Database Management System** 17](#_Toc162515859)

[**2.5.2 Relational database management system** 17](#_Toc162515860)

[**2.5.3 MySQL** 18](#_Toc162515861)

[**2.5.4 Hypertext Pre-Processor (PHP)** 18](#_Toc162515862)

[**2.5.5 Apache HTTP Server** 18](#_Toc162515863)

[**2.5.6 phpMyAdmin** 18](#_Toc162515864)

[**2.6 Chapter Summary** 19](#_Toc162515865)

[**CHAPTER THREE** 20](#_Toc162515866)

[**METHODOLOGY** 20](#_Toc162515867)

[**3.0 Introduction** 20](#_Toc162515868)

[**3.1 Research Design** 20](#_Toc162515869)

[**3.2 Sampling** 20](#_Toc162515870)

[**3.2.1 Selection** 20](#_Toc162515871)

[**3.2.2 Sample size** 20](#_Toc162515872)

[**3.3 Data Collection Methods** 21](#_Toc162515873)

[**3.3.1 Quantitative Data Collection** 21](#_Toc162515874)

[**3.4 Data Collection Tools** 21](#_Toc162515875)

[**3.4.1 Questionnaires** 21](#_Toc162515876)

[**3.5 Data Analysis Techniques** 21](#_Toc162515877)

[**3.5.1 Quantitative Analysis** 21](#_Toc162515878)

[**3.6 Waterfall model of the development life cycle** 22](#_Toc162515879)

[**3.6.1 Illustration of the waterfall model** 22](#_Toc162515880)

[**3.6.2 Design phases of the waterfall model** 22](#_Toc162515881)

[**3.7 System Testing and System Validation** 23](#_Toc162515882)

[**3.7.1 System Testing** 23](#_Toc162515883)

[**3.7.1.1 Functional Testing** 23](#_Toc162515884)

[**3.7.1.2 Performance Testing** 23](#_Toc162515885)

[**3.7.1.3 Security Testing** 24](#_Toc162515886)

[**3.7.2 System Validation** 24](#_Toc162515887)

[**3.8.2.1 Security Validation** 24](#_Toc162515888)

[**3.8.2.2 Data Validation** 24](#_Toc162515889)

[**3.8 Ethical Considerations** 24](#_Toc162515890)

[**3.9 Chapter Summary** 24](#_Toc162515891)

[**REFERENCES** 26](#_Toc162515892)

# **CHAPTER ONE**

# **INTRODUCTION**

# **1.0 Introduction**

This chapter presents the background of the study, problem statement, research questions, objectives of the study, scope of the study, significance and chapter summary.

# **1.1 Background of Study**

## **1.1.1 Historical Background of Naguru General Hospital**

The China-Uganda Friendship Hospital Naguru (CUFH-N), generously donated by the Government of the People's Republic of China, stands as a testament to international cooperation and goodwill (Minister of health, 2024). Completed in January 2012, this state-of-the-art facility was constructed over three years with a total cost of US$8 million, showcasing the commitment of both nations to enhancing healthcare infrastructure in Uganda (Jayramdeepak, 2014). Situated on a 5-acre site donated by the Kampala Capital City Authority (KCCA) in Nakawa Division, the hospital serves as a crucial healthcare hub for residents of Kampala Metropolitan Area and beyond, aiming to alleviate the burden on Mulago National Referral Hospital (Minister of health, 2024).

With a bed capacity of 100 and a comprehensive range of medical services, including four operating rooms, a maternity ward, paediatric unit, and advanced diagnostic facilities such as a CT scanner, Naguru Hospital embodies excellence in healthcare provision. Since its official handover to the Government of Uganda in January 2012, it has been jointly managed by the Ministry of Health and KCCA (Jayramdeepak, 2014). Under the leadership of Executive Director Dr. Edward Naddumba, Naguru Hospital continues to play a pivotal role in safeguarding the health and well-being of the Ugandan populace (Jayramdeepak, 2014).

**1.1.2 Theories About the HIV Medication Delivery Management System**

The current state of HIV/AIDS is now a serious public health problem for Ugandans. Currently, Uganda, for the period 2010-2020, recorded a tremendous improvement in the fight against the HIV and AIDS epidemic. It is among the (08) countries in the world that had fully achieved the 90–90–90 targets by the end of 2020, the others (Uganda AIDs Commission, 2021). The number of People Living with HIV increased from 1.2M to 1.4M largely due to improved access and utilization of HIV services like testing, care and treatment. While addressing the media at the Uganda Media Center, Dr. Aceng Ruth Jane noted that the current prevalence of HIV among adults aged 15-49 years in Uganda is 5.5% (7.1% among women and 3.8% among Men) reflecting a slight decrease from 6.0% in UPHIA 2016-17 (Uganda AIDs Commission, 2021). In addition, the entire UPHIA 2020 survey sample of adults aged 15 years and older, HIV prevalence was 5.8% (7.2% among women and 4.3% among men) corresponding to approximately 1.3 million adults living with HIV in Uganda (Uganda AIDs Commission, 2021).

## **1.1.3 Conceptual of the existing HIV Medication Delivery Management System**

The existing system at Naguru general Hospital is plagued by prolonged waiting times and the stigma linked to in-person medication collection. These issues create a negative environment for HIV-positive individuals, hindering their ability to receive timely and discreet treatment (Uganda AIDs Commission, 2021). The absence of an efficient and patient-friendly solution exacerbates the problem, leading to potential health complications and increased mortality rates among the affected population (Uganda AIDs Commission, 2021). This study identifies the critical gap in the existing knowledge base, recognizing the urgent need to address the logistical and social barriers to medication access for HIV-positive patients. The absence of a streamlined system directly impacts the effectiveness of treatment administration, contributing to the persistence of HIV/AIDS-related challenges in Uganda (Theodoridis & Kraemer, 2011).

Furthermore, Patients using most online delivery management systems face late deliveries, exacerbating the problem and potentially leading to health complications and increased mortality rates among the affected population (Croker DM, 2022). Therefore, this research aims to develop and implement an online web-based system that offers dynamic scheduling, allowing customers to choose specific delivery windows based on their availability.

# **1.2 Problem Statement**

Uganda has achieved significant progress in HIV/AIDS control, meeting the 90-90-90 targets by 2020 and improving access to HIV services, resulting in reduced prevalence rates. However, challenges persist in healthcare delivery at Naguru General Hospital, where HIV-positive individuals encounter prolonged waiting times and stigma during medication collection, hindering timely treatment and potentially increasing mortality rates.

Additionally, existing online delivery systems exacerbate the problem by causing late deliveries, posing further risks to patient health and mortality rates. To tackle these issues, this research proposes an online web-based system with dynamic scheduling features, enabling patients to select delivery windows according to their availability. Therefore, by addressing this gap, overcomes barriers to medication access, improving treatment effectiveness and mitigating HIV/AIDS-related challenges at Naguru General Hospital, thus contributing to better health outcomes for affected individuals.

# **1.3 Research Questions**

## **1.3.1 General Research Question**

What online web-based system will streamline medication access and delivery for HIV-positive patients at Naguru General Hospital?

## **1.3.2 Specific Research Questions**

1. What are the requirements for a patient HIV medication access and delivery management system for Naguru General Hospital?
2. What design contribute to the development of an online HIV medication delivery management system for healthcare professionals and patients at Naguru General Hospital?
3. What are the processes for testing and validating Online HIV medication Delivery management system for Naguru General Hospital?

# **1.4 Objectives**

## **1.4.1 General Objective**

To develop an online web-based system for medication access to HIV-positive patients in Naguru General Hospital, thereby overcoming the barriers of time and stigma associated with in-person medication collection.

## **1.4.2 Specific Objectives of the Study**

1. To determine requirements for an online HIV medication delivery management system for Naguru General Hospital.
2. To design an online HIV medication delivery management system for Naguru General Hospital.
3. To test and validate an online HIV medication delivery management system for Naguru General Hospital.

# **1.5 Scope of the Study**

**1.5.1 Subject Scope**

This study will focus on the development and implementation of an online platform specifically designed for HIV-positive patients to order prescribed medication.

## **1.5.2 Geographical Scope**

This study was carried out at China-Uganda Friendship Hospital Naguru, Nakawa division Kampala district.

## **1.5.3 Time Scope**

The development of Online HIV Medication Delivery Management System will occur within a defined time frame, with the following temporal boundaries:

### **1.5.3.1 February 2024 to March 2024**

During the period from February 2024 to March 2024, the focus will be on conducting a comprehensive assessment and survey of relevant literature related to the Online HIV Medication Delivery Management System (OHMDMS). The objective is to understand the current landscape, functionalities, and requirements specific to HIV medication delivery management, setting the groundwork for subsequent development stages. This phase will involve stakeholder consultations and feedback from healthcare providers, HIV patients, and other relevant parties, which will be crucial in shaping the features and functionalities of OHMDMS.

### **1.5.3.2 April 2024 to May 2024**

The development phase will take place during these months, with a focus on creating the OHMDMS platform based on the gathered requirements from the Naguru General Hospital the using the data tools. This includes coding, testing, and refining the system to ensure its functionality aligns with the intended goals and report writing.

### **1.5.3.3 June 2024**

The final month of the development timeline will be dedicated to rigorous testing and evaluation of OHMDMS. This phase aims to identify and address any bugs, glitches, or performance issues, ensuring a stable and reliable platform. By the end of June 2024, the OHMDMS platform is expected to be developed, tested, and ready for deployment, marking the completion of the initial development phase and handing of report.

# **1.6 Target Group**

This study aims to engage individuals living with HIV/AIDS who are residents of Nakawa Division and adjacent areas. Specifically, the study targets adults aged 18 to 65, encompassing both males and females. The focus is on gathering insights and experiences related to HIV medication access and delivery management. By targeting this demographic group, the research seeks to capture a comprehensive understanding of the challenges and needs faced by HIV-positive individuals in accessing and managing their medication regimens.

# **1.7 Significance of the Study**

The significance of the study is as follows;

## **1.7.1 To HIV patients**

The development of the Online HIV Medication Delivery Management System (OHMDMS) aims to improve medication access and adherence. By providing a convenient platform for online medication delivery, it addresses the challenge of accessing medications, especially for individuals in remote or underserved areas. This initiative aims to enhance health outcomes and overall quality of life for HIV patients.

## **1.7.2 To Healthcare Providers**

The OHMDMS will offer streamlined medication management processes and improved communication channels with patients regarding their treatment plans. This advancement enables healthcare providers to deliver better patient care and optimize resource allocation within healthcare facilities.

## **1.7.3 To Healthcare Systems**

The implementation of the OHMDMS will lead to cost savings and resource optimization within healthcare systems. By reducing the need for frequent in-person visits to healthcare facilities, it lowers healthcare expenses and enhances overall efficiency in healthcare delivery.

## **1.7.4 To Researchers**

The OHMDMS has the potential to generate valuable data on medication adherence and treatment outcomes among HIV patients. This data can inform evidence-based decision-making, policy development, and research efforts aimed at improving HIV/AIDS management both locally and globally.

## **1.7.5 To Policy Developers**

The OHMDMS collects vast amounts of data on medication access, delivery efficiency, patient adherence, and other relevant metrics. Policy developers will be able to analyze this data to identify trends, gaps, and areas for improvement in HIV medication management

# **1.8 Definition of Key Terms**

1. **Dynamic Scheduling:** A feature of the OHMDMS that allows patients to choose specific delivery windows for their medication orders based on their availability and preferences
2. **Healthcare Accessibility:** The ease with which individuals can obtain healthcare services, including physical access to healthcare facilities, affordability of services, and cultural and linguistic barriers.
3. **Healthcare Delivery:** The ease with which individuals can obtain healthcare services, including physical access to healthcare facilities, affordability of services, and cultural and linguistic barriers.
4. **HIV/AIDS Control:** Efforts aimed at preventing the spread of HIV and reducing the impact of AIDS through strategies such as testing, treatment, education, and prevention programs.
5. **Medication Adherence:** The extent to which patients follow their prescribed medication regimen as instructed by healthcare providers, crucial for achieving optimal treatment outcomes in chronic conditions like HIV/AIDS.
6. **OnlineHIVMedicationDelivery Delivery Management System:** A digital platform designed to streamline the access, distribution, and management of HIV medications through online ordering, scheduling, and delivery services.
7. **Naguru General Hospital**: A healthcare facility located in Uganda's Nakawa Division, offering comprehensive medical services including HIV treatment and management.
8. **Stigma:** Negative attitudes, beliefs, and discrimination towards individuals living with HIV/AIDS, often leading to social isolation, reduced access to healthcare, and poor treatment outcomes.

# **1.9 Chapter Summary**

This chapter offers an extensive overview of the background, problem statement, research questions, objectives, scope, and significance of developing an Online HIV Medication Delivery Management System. It traces the evolution of HIV medication management from traditional manual methods to modern online systems, highlighting challenges such as manual record-keeping and limited accessibility. The statement of the problem underscores the urgency for a robust online system to address these shortcomings effectively. The scope of the research encompasses investigating the usability, effectiveness, and user satisfaction of the proposed system within a specific geographical and time context. The significance lies in the potential of the system to revolutionize HIV medication management practices, streamlining operations, enhancing patient adherence, and optimizing resource utilization, thus contributing to the advancement of healthcare services tailored to the needs of healthcare facilities and HIV-positive individuals.

# **CHAPTER TWO**

# **LITERATURE REVIEW**

## **2.0 Introduction**

In this chapter, presents Theoretical framework, Types of information Systems, Medication Access and delivery system. This chapter aims to provide insights into existing information systems, specifically those related to healthcare and medication management, laying the groundwork.

# **2.1 Theoretical Frame work of the Medication Delivery Management System**

Online medication delivery systems have significantly transformed the landscape of pharmaceutical services by offering unprecedented convenience and accessibility to patients worldwide. Ranade and Hollinger (2003) conducted a study emphasizing the profound impact of these systems, illustrating how they empower patients to order medications from the comfort of their homes, effectively eliminating the need for physically visiting pharmacies. This shift represents a paradigmatic change in healthcare delivery, particularly beneficial for individuals with mobility issues, chronic conditions, or those residing in remote areas(Ranade & Hollinger, 2003). By providing a seamless avenue for medication procurement, online delivery ensures that patients can access essential medications without the constraints of geographical barriers, thereby enhancing overall healthcare access and patient satisfaction.

Furthermore, online delivery systems play a pivotal role in improving medication adherence, a critical aspect of healthcare management. Reichenpfader et al. (2020) highlighted the multifaceted strategies employed by these systems to enhance adherence rates, including the provision of timely reminders, personalized dosage schedules, and automatic refills. By streamlining the medication management process and reducing the burden of medication administration on patients, these systems significantly increase the likelihood of patients adhering to their prescribed regimens. This, in turn, leads to improved health outcomes, reduced hospitalizations, and ultimately lowers healthcare costs (Reichenpfader et al., 2020).

The integration of advanced technologies, such as artificial intelligence (AI) and data analytics, has further revolutionized online medication delivery systems .International Pharmaceutical Federation (2021) discussed how machine learning algorithms analyse patient data to predict medication adherence patterns, identify potential drug interactions, and personalize treatment plans. These technological advancements not only enhance the efficiency and effectiveness of medication delivery but also contribute to the overall quality of patient care. Additionally, the incorporation of telehealth services within these platforms facilitates seamless communication between patients and healthcare providers, enabling real-time monitoring, consultation, and intervention when necessary. This integration enhances medication management and monitoring efforts, ultimately improving patient outcomes and promoting healthcare accessibility and equity (International Pharmaceutical Federation, 2021).

However, the widespread adoption of online medication delivery systems also brings forth regulatory and ethical considerations. Brown and Lee (2019) emphasized the importance of stringent regulations to ensure the safety, authenticity, and quality of medications dispensed through online platforms. Moreover, ethical concerns surrounding patient privacy, data security, and informed consent necessitate robust governance frameworks to safeguard patient interests and maintain trust in these systems (Ranade & Hollinger, 2003). Addressing these challenges while harnessing the full potential of online medication delivery systems is essential for realizing their benefits and transforming the pharmaceutical landscape in a sustainable and equitable manner. In the context of online medication delivery management systems, various types of information systems play crucial roles in facilitating different aspects of the process. Here are some key types of information systems relevant to this domain.

# **2.2 Types of Information Systems**

Many people rely on various types of information systems to communicate with friends and family, shop online, or look up information via a search engine (GeeksforGeeks, 2023). Companies and organizations employ information systems to communicate and work with their customers and suppliers, manage the organization, perform essential business operations, and roll out and maintain marketing campaigns.

Understanding the broader landscape of information systems is crucial for the development of OHMDMS. This is divided into various types of information systems, such as Management Information Systems, Enterprise Information Systems, and Decision Support Systems, to identify key functionalities and features that can inform the design of OHMDMS.

## **2.2.1 Management information system**

Management Information Systems (MIS) form a critical component of the Online HIV Medication Delivery Management System (OHMDMS). These systems enable healthcare professionals to make informed decisions by leveraging data analytics, reporting tools, and centralized health information. MIS integrates decision support systems, workflow management, and user access controls to streamline processes related to medication access and delivery. By incorporating data warehousing and analytics, OHMDMS ensures efficient retrieval and analysis of HIV medication data, contributing to better decision-making. Furthermore, the inclusion of Electronic Health Records (EHR) and Health Information Exchange (HIE) ensures seamless access to patient information, fostering collaboration among healthcare providers. MIS plays a pivotal role in optimizing medication management, enhancing patient safety, and maintaining the overall effectiveness of OHMDMS (Motiwalla & Thompson, 2014).

## **2.2.2 Enterprise Information Systems (EIS)**

Enterprise Information Systems (EIS) are integral to the holistic functionality of OHMDMS. The incorporation of Enterprise Resource Planning (ERP) and Supply Chain Management (SCM) within EIS ensures a streamlined flow of medications from suppliers to patients, minimizing delays and optimizing healthcare operations. Customer Relationship Management (CRM) functionalities enhance patient interactions, communication, and feedback management. OHMDMS integrates Business Intelligence (BI) tools to analyse and interpret data, providing valuable insights into patient behaviours and system performance. EIS also incorporates Human Resource Management (HRM) components for efficient staff management and financial management systems to handle budgeting and financial transactions related to medication access and delivery. This comprehensive integration ensures OHMDMS operates within regulatory frameworks, complies with industry standards, and remains scalable and adaptable to evolving healthcare needs (Motiwalla & Thompson, 2014).

## **2.2.3 Decision Support System (DSS)**

Decision Support Systems (DSS) within OHMDMS play a pivotal role in enabling healthcare professionals to make well-informed decisions regarding medication access and delivery. Integrated analytics and reporting tools provide comprehensive insights into patient trends, medication usage, and system performance. These tools empower healthcare professionals to anticipate challenges, proactively manage medication resources, and optimize overall healthcare workflows (Adelberg et al., 1997). The incorporation of predictive analytics allows for trend forecasting, contributing to strategic decision-making and ensuring proactive responses to evolving medication management needs. User-friendly interfaces and real-time data access enhance the usability of DSS within OHMDMS, facilitating efficient decision-making processes for healthcare providers.

# **2.3 Medication Access and Delivery Systems**

Medication access and delivery systems play a crucial role within healthcare frameworks, facilitating the effective management, distribution, and accessibility of medications, particularly in the context of HIV medication (Theodoridis & Kraemer, 2011). Programs such as Medicare Part D and the Affordable Care Act (ACA) have been implemented with the aim of improving the accessibility and affordability of healthcare and medications. However, despite these efforts, the population of Uganda continues to face significant barriers to medication access. A recent publication by the Pharmacy Quality Alliance and National Pharmaceutical Council presented a medication access framework, which identified the most common and relevant barriers based on published studies (Sobeski et al., 2021).

## **2.3.1 Patient Profiling and Prescription Management**

A robust Medication Access System begins with a patient profiling mechanism, capturing essential patient information and medical histories. Medication Access System incorporates features for managing prescriptions, ensuring accurate and up-to-date information on prescribed HIV medications. This is done during his initial visit to the system, the patient should be asked to fill out an appropriately designed questionnaires so as to acquiring patient information (O’Hara, 1976).

## **2.3.2 Authentication and Authorization**

To enhance security and regulatory compliance, Medication Access Systems includes authentication and authorization protocols. These mechanisms ensure that only authorized healthcare professionals can access and modify prescription details (Vaishnav et al., 2022). Each healthcare professional accessing the system is required to have a unique identifier, such as a username or ID, along with a corresponding password or other authentication factors and the system will maintain detailed audit trails to track user activities and access attempts, including successful and unsuccessful login attempts, changes to prescription records, and other relevant actions (Vaishnav et al.,2022). This helps in monitoring and investigating unauthorized access or misuse of the system.

## **2.3.3 Prescription Fulfillment and Delivery Coordination**

Prescription Fulfillment and Delivery Coordination is a pivotal function of Medication Access Systems. The systems will meticulously orchestrate the preparation of medications for delivery, optimizing logistics to guarantee prompt and precise delivery to patients. Through seamless integration of inventory management where the prescribed medication is checked if its available or not and dynamic scheduling feature will allow patients to schedule their preferred delivery times based on their availability and convince, it ensures that patients receive their prescribed medications efficiently and without delay. This coordination not only enhances patient satisfaction but also contributes to improved health outcomes by facilitating timely access to essential medications.

## **2.3.4 Patient Notification and Engagement**

Patient engagement is particularly important during transitions in care, where patients are transferred to the care of other HCPs or moved between clinical settings, as the quality and safety of patient care is at risk of being seriously compromised during transitions (Chaboyer et al., 2016). These notifications are delivered through various channels like SMS, emails, and phone calls, will provide real-time updates on medication orders, appointment reminders, and educational content. Customizable preferences allowing patients to tailor their notification settings, while automated medication reminders support adherence to prescribed regimens (Pradhan et al., 2017). Two-way communication features enable patients to interact directly with the system, facilitating seamless communication and assistance when needed. Moreover, notifications play a crucial role in emergency alerts, ensuring patients are promptly informed about potential risks and appropriate actions.

## **2.3.5 The Impacts of the Medication Access and Delivery Systems**

Improving access to essential medicines is pivotal for addressing various global health challenges and promoting well-being worldwide

According to Sobeski et.al ( 2021) found that equitable access to medications plays a critical role in reducing health inequalities across different socioeconomic strata. By ensuring that everyone, regardless of their financial status or geographic location, can obtain necessary treatments, we foster a fairer and more inclusive society (Bigdeli et al., 2012). This not only enhances individual health outcomes but also contributes to the overall stability and cohesion of communities.

Robust medication access systems are essential for enhancing disease control and prevention efforts, particularly concerning infectious diseases (Bigdeli et al., 2012). By providing timely and effective treatments, we can cure the spread of illnesses like HIV/AIDS, tuberculosis, and malaria, thereby safeguarding public health on a broader scale. Furthermore, promoting access to medications supports broader initiatives aimed at reducing morbidity and mortality rates associated with preventable diseases, ultimately fostering healthier populations and more resilient healthcare systems.

According to Bigdeli et al.(2012) pointed that improving medication access has far-reaching socio-economic benefits, including promoting economic productivity and bolstering maternal and child health. Healthy individuals who can access essential medications are better equipped to participate actively in the workforce, driving economic growth and prosperity. Additionally, ensuring access to medications during pregnancy and childbirth not only reduces maternal mortality but also contributes to the healthy development of infants, laying a foundation for future generations' well-being (Neiman et al., 2019). By prioritizing collaboration among stakeholders and addressing barriers to access, we can forge a path towards a more equitable, prosperous, and healthier world for all.

# **2.4 The Current HIV Medication and Delivery Management System**

The current HIV medication and delivery management system at Naguru General Hospital and similar healthcare facilities in Uganda encompasses several key components aimed at ensuring access to and adherence to prescribed medications for HIV-positive individuals as argued by healthcare providers (Minister of health, 2024) .

patients visit healthcare facilities like Naguru General Hospital to collect their medications, where they interact with healthcare providers who dispense medications and offer counselling on adherence and potential side effects. This face-to-face interaction is crucial for patient education and support in managing their HIV treatment effectively.

Secondly, patient information, medication dispensing records, and treatment histories are typically documented manually using paper-based systems. Healthcare providers maintain patient files containing relevant medical information, including medication regimens and appointment schedules. While this method allows for the documentation of crucial patient data, it can be cumbersome, prone to errors, and lacks the efficiency and accessibility of digital record-keeping systems. In some instances, healthcare facilities may offer appointment-based medication delivery services for stable patients or those unable to visit the facility in person. Patients schedule appointments for medication delivery, and healthcare providers arrange for the medications to be delivered to their homes or designated locations. This service helps to improve access to medications for patients who may face transportation barriers or other challenges in accessing healthcare facilities regularly.

Additionally, community health workers or peer educators play a vital role in providing support to HIV-positive individuals with medication adherence and treatment management. They offer education, counselling, and social support to help patients adhere to their medication regimens and navigate the healthcare system effectively. However, the scope of their involvement may be limited by resources and reach.

Despite these efforts, the current system faces challenges, including limited integration of technology, transportation barriers, medication stockouts, and stigma. These factors can impact patient adherence to treatment regimens and contribute to suboptimal health outcomes. There is a growing recognition of the need for innovative solutions, such as online medication management systems, to address these challenges and enhance the efficiency and effectiveness of HIV medication management in Uganda.

## **2.4.1 Merits of the Current Medication and Delivery Management System**

While there are certainly challenges within the current HIV medication and delivery management system, there are also merits to acknowledge;

1. **Accessibility**

The current HIV medication and delivery management system provide relatively accessible access points for HIV-positive individuals to obtain their medications. Healthcare facilities, such as Naguru General Hospital, serve as central locations where patients can reliably access their prescribed medications from trained healthcare professionals. This accessibility is crucial in ensuring that patients can easily obtain the medications they need to manage their HIV condition. By having centralized locations for medication distribution, the system helps to reduce barriers to access and promotes equity in healthcare delivery.

1. **Personalized Care**

Patients often have the opportunity for face-to-face interactions with healthcare providers during medication collection within the current system. This allows for personalized care, including counselling on adherence, potential side effects, and other aspects of HIV treatment. These interactions build rapport and trust between patients and healthcare providers, fostering a supportive environment for managing their HIV condition. Additionally, personalized care enhances patient engagement and empowerment, leading to improved treatment adherence and better health outcomes in the long term.

1. **Documentation**

Despite its limitations, the use of paper-based record-keeping systems ensures that patient information, medication dispensing records, and treatment histories are documented within the current HIV medication and delivery management system. This documentation plays a crucial role in tracking patient progress, monitoring medication adherence, and facilitating continuity of care between different healthcare providers. While electronic health records (EHRs) offer advantages in terms of accessibility and data management, paper-based systems provide a tangible record that can be easily accessed and reviewed by healthcare providers, promoting effective communication and collaboration in patient care.

1. **Appointment-Based Delivery**

Some healthcare facilities offer appointment-based medication delivery services within the current system, particularly for stable patients or those unable to visit the facility in person. This service enhances accessibility for patients who face transportation barriers or other challenges in accessing healthcare facilities regularly. By scheduling medication deliveries at convenient times, the system promotes treatment adherence and continuity of care, ensuring that patients receive their medications in a timely manner.

## **2.4.2 Challenges of the Current HIV Medication and Delivery System**

1. **Limited Reach**

One of the challenge of the current system is its limited reach, especially in rural or remote areas where healthcare facilities are scarce. This lack of accessibility poses significant challenges for individuals living in these regions, often resulting in delayed or inadequate access to essential HIV medications. The geographical disparities in healthcare infrastructure exacerbate disparities in treatment access and outcomes, particularly for marginalized populations who may already face numerous barriers to care.

1. **Resource Constraints**

Healthcare facilities, particularly those in low-resource settings, encounter various challenges such as staffing shortages, inadequate infrastructure, and limited financial resources. These resource constraints can severely hinder the effective delivery of HIV medications and support services, compromising the quality of care provided to patients. Without sufficient resources, healthcare providers may struggle to meet the growing demand for HIV treatment and support, leading to gaps in service delivery and suboptimal treatment outcomes.

1. **Medication Stockouts**

Stockouts of essential HIV medications are a common occurrence within the current system, further exacerbating the challenges faced by patients. These stockouts may stem from procurement challenges, supply chain disruptions, or insufficient funding allocated to medication procurement and distribution. As a result, patients may experience interruptions in their treatment regimens, which can have serious consequences such as increased viral load, development of drug resistance, and compromised health outcomes.

1. **Stigma and Discrimination**

Stigma and discrimination surrounding HIV/AIDS persist within healthcare settings and communities, posing significant barriers to medication access and adherence. HIV-positive individuals often face judgment, rejection, or mistreatment from healthcare providers or community members, leading to reluctance to seek care and adhere to treatment. The fear of stigma and discrimination can deter individuals from accessing healthcare services, thereby impeding efforts to control the spread of HIV and improve health outcomes.

# **2.5 Technologies Used in Developing the Proposed Online HIV Medication and Delivery System**

The proposed Online HIV Medication Delivery Management System will utilize several technologies such as MySQL, PHP, Apache HTTP Server, and phpMyAdmin, which are all technologies that can be used in developing the proposed system. These technologies are commonly used in web-based applications and can be used to build a powerful and robust OHMDMS. These technologies will help to improve the organization's management practices and achieve its strategic goals.

## **2.5.1 Database Management System**

Database Management Systems (DBMS) are software systems used to store, retrieve, and run queries on data. A DBMS serves as an interface between an end-user and a database, allowing users to create, read, update, and delete data in the database argued by Rouse ( 2022). DBMS manage the data, the database engine, and the database schema, allowing for data to be manipulated or extracted by users and other programs. This helps provide data security, data integrity, concurrency, and uniform data administration procedures. DBMS optimizes the organization of data by following a database schema design technique called normalization, which splits a large table into smaller tables when any of its attributes have redundancy in values. DBMS offers many benefits over traditional file systems, including flexibility and a more complex backup system. Database management systems can be classified based on a variety of criteria such as the data model, the database distribution, or user numbers (Wiederhold & Qian, 2002).

## **2.5.2 Relational database management system**

According by Wiederhold & Qian (2002), Relational database management system (RDBMS) is the foundation of every contemporary database management system, including MySQL,and Microsoft Access. It is called a Relational Database Management System (RDBMS) because it is based on the relational model. In a relational database, data is stored in one or more tables or relations of columns and rows, making it simple to see and comprehend how various data structures relate to one another. Data is organized in relational databases according to predetermined relationships (Wiederhold & Qian, 2002). Relationships are logical connections that have been made between various tables as a result of their interaction.

## **2.5.3 MySQL**

MySQL is a popular open-source relational database management system that can be used to store and manage the data for the proposed online HIV medication and Delivery System. It provides robust data management capabilities and can handle large amounts of data with high efficiency ( Rouse, 2022). PHP can be used as a programming language to interact with the MySQL database and retrieve, insert, update, and delete data.

## **2.5.4 Hypertext Pre-Processor (PHP)**

PHP is a server-side scripting language that can be used to build the OHMDMS’s web-based interface. PHP can be used to create a user-friendly and intuitive interface that allows staff members to access and update asset information. PHP can also be used to build features such as data validation, error checking, and security features.

## **2.5.5 Apache HTTP Server**

Apache HTTP Server is an open-source web server that can be used to host the proposed OHMDMS. Apache is a widely used and open-source technology that can handle high traffic and support large numbers of users (Wiederhold & Qian, 2002). It provides a platform for the OHMDMS to run on and can handle multiple requests simultaneously, making it a suitable choice for a web-based Online HIV medication and Delivery system.

## **2.5.6 phpMyAdmin**

phpMyAdmin is a web-based tool that can be used to manage the MySQL database. It provides a user-friendly interface for staff members to access and manage the data stored in the database. Staff members can use phpMyAdmin to view and edit the data, create and manage tables, and perform other database management tasks (Wiederhold & Qian, 2002). In summary, MySQL, PHP, Apache HTTP Server, and phpMyAdmin can be used together to develop the proposed Online HIV medication and Delivery system for the organization. MySQL will be used as the database management system, PHP as the programming language to interact with the database, Apache HTTP Server as the web server.

# **2.6 Chapter Summary**

In this literature review provides an in-depth exploration of fundamental concepts in information systems, medication access system, and database management, setting the stage for the development of the Online HIV Medication Delivery Management System (OHMDMS). While specifically tailored to the healthcare domain, the insights drawn from this literature review extend beyond the realm of HIV medication, uncovering innovations and challenges that resonate across diverse healthcare sectors. This analysis not only serves as a guide for aligning OHMDMS with best practices in healthcare but also presents potential applications and implications for advancing healthcare management practices on a broader scale.

# **CHAPTER THREE**

# **METHODOLOGY**

# **3.0 Introduction**

This Chapter presents Research Design, Sampling, Data collection methods, Data collection tools, Data Analysis Techniques, system design and Development, Conceptual framework of online HIV medication delivery system, system Testing, Ethical considerations and chapter summary.

# **3.1 Research Design**

The research design adopted for this study is a quantitative approach, seamlessly integrating quantitative a research technique (Thakur, 2021). This hybrid design not only allows for a comprehensive exploration of the multifaceted factors influencing medication access and delivery but also ensures a nuanced understanding of the challenges faced by HIV-positive individuals and healthcare providers. The combination of surveys and questionnaires facilitates a holistic investigation, leveraging both statistical data and in-depth qualitative insights.

# **3.2 Sampling and Selection**

## **3.2.1 Selection**

The selection criteria for the sample include individuals diagnosed with HIV, professional medical workers aged between 18 and 65, and residents of Nakawa Division and its neighboring areas using random selection method. This comprehensive approach ensures that the research encompasses individuals directly affected by the condition, as well as insights from healthcare providers. By focusing on a specific geographic area, namely Nakawa Division and its surroundings, the sample is tailored to represent a distinct community, facilitating targeted research outcomes and enhancing the relevance of the findings.

## **3.2.2 Sample size**

The sample size will be determined based on individuals meeting the selection criteria. We'll identify HIV patients and professional medical workers aged 18-65 in Nakawa Division and neighbouring areas. The sample size will be calculated considering factors like precision and variability.

# **3.3 Data Collection Methods**

## **3.3.1 Qualitative Data Collection**

Qualitative data collection methods offer a nuanced approach to understanding the intricacies of human experiences, perceptions, and perspectives. such as literature review, involving the systematic gathering and analysis of existing research literature related to the research topic. This review encompasses academic journals, books, conference proceedings, and other relevant sources, providing valuable insights into existing knowledge, research gaps, and theoretical frameworks pertinent to the study. Additionally, online surveys are also utilized as a quantitative data collection method, facilitated through web-based platforms. Structured questionnaires are designed and distributed to a targeted sample of participants via email, social media, or survey websites.

## **3.3.2 Quantitative Data Collection**

Quantitative data collection methods, such as questionnaires, involves the administration of standardized surveys to gather numerical data from participants. Researchers design structured questionnaires with closed-ended questions and predefined response options, which can be distributed through various formats including paper-based forms, online surveys, or face-to-face interviews. Questionnaires efficiently collect data on attitudes, behaviours, and preferences. In contrast, qualitative data collection methods like interviews entail one-on-one interactions between researchers and participants.

Therefore, this research will involve the use Quantitative data collection because Quantitative data allows easy comparison between different groups or conditions, facilitating the evaluation of interventions, policies, or treatments after distributing some questionnaires to respondents.

# **3.4 Data Collection Tools**

## **3.4.1 Literature Reviews**

Literature reviews involves exploring various sources, ranging from scholarly articles to case studies this will unveil the requirements within the field. As the literature unfolds, it not only informs the project team about proven functionalities and successful approaches but also serves as a compass for navigating challenges faced by contemporary systems. In the process, industry trends and cutting-edge innovations are identified, ensuring that OHMDMS is not only a response to current needs but a forward-looking solution.

## **3.4.2 Surveys**

Online surveys are deployed to gather quantitative data on user satisfaction, system usability, and overall performance. Structured survey questions provide the insights into specific aspects of the system and open-ended questions allowing users to share detailed feedback.

## **3.4.3 Observation**

This is a research method that involves observing subjects and phenomena in their most natural environments. Instead of using organized environments like research labs or focus groups, this enables researchers to see how their participants respond to and make decisions in their everyday environments.

Observational data is collected during a visit to the organization's premises, where the researchers observe the processes and practices. This provides an opportunity to gain a deeper understanding of the organizational context and requirements for the system.

## **3.4.4 Questionnaires**

Questionnaires are a popular quantitative data collection method that involves presenting participants with a series of structured questions to gather data on their attitudes, opinions, behaviors, or demographics. Therefore, in this research questionnaires will be involved where by questionnaires will be constructed, designed to extract valuable insights from healthcare professionals and potential users.

These questionnaires will serve as a pivotal tool to probe into the nuanced requirements and expectations regarding the functionalities and specifications of OHMDMS (Johnson & Christensen, 2017). Questions will be strategically formulated to elicit detailed responses, ensuring a comprehensive understanding of the diverse perspectives within the user base. The questionnaires will act as a direct channel for stakeholders to articulate their specific needs, preferences, and challenges, empowering the development team to align OHMDMS with the practical and strategic requirements identified during this data collection phase. This answers the first research question and second research question.

# **3.5 Data Analysis Techniques**

## **3.5.1 Qualitative Analysis**

This involves analysising open ended survey questions and other data collection tools qualitative data using thematic analysis techniques. This process involves coding the data to identify recurring themes, patterns, and insights related to user experiences with the

## **3.5.2 Quantitative Analysis**

Survey data collected through questionnaires will be analyzed using statistical techniques such as descriptive statistics, frequency distributions, and correlation analysis. These methods will provide insights into various aspects, including user satisfaction levels, medication usage patterns, and correlations between demographic variables and perceptions of the OHMDMS. The analysis will be conducted using statistical software such as SPSS or Excel.

# **3.6 Waterfall model of the development life cycle**

The Waterfall Model is a linear and sequential approach to software development that follows a structured and predefined set of phases. It is one of the oldest and most straightforward methodology (Mudassar & Khan, 2023).

## **3.6.1 Illustration of the waterfall model**

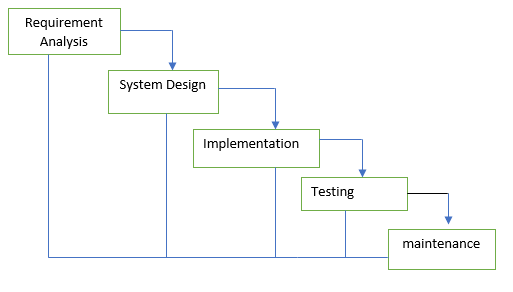


Figure 1: The waterfall modal development lifecycle (Mudassar & Khan, 2023)

## **3.6.2 Design phases of the waterfall model**

1. **Requirements Gathering and Analysis**

This phase involves gathering and documenting detailed requirements from stakeholders, including clients and end-users. The goal is to understand the project scope, objectives, and functionalities (Mudassar & Khan, 2023). These requirements will be got through using data collection tools mainly questionnaires and reviewing literature review.

1. **System Design**

Based on the gathered requirements, the system design phase involves creating a blueprint for the entire system. High-level design outlines system architecture, and low-level design provides detailed specifications for each component.

1. **Implementation**

After defining the clear and rich requirements this step is building and developing the software product according to the defined standards (Mudassar & Khan, 2023). I will start coding and designing products this step involves the implementation of all the pre-and post-condition of a project like the development of complete functionalities of the software product according to the requirement verified by all the stakeholders of the project.

1. **Testing**

The testing phase involves systematically checking the software for defects, errors, and compliance with specified requirements. Testers verify that the software functions as intended and identify and report any issues (Mudassar & Khan, 2023).In addition ,this will involve testing every module behaving and functioning if they are according to the standards.

1. **Maintenance**

This activity involves modification of software to meet the customer and market new trends. Modification means that improve the system to such standards that can support today's technologies and meets the customer requirement efficiently (Mudassar & Khan, 2023).

# **3.7 System Testing and System Validation**

## **3.7.1 System Testing**

The Online HIV Medication delivery Management System will be tested in real world environments alongside regular maintenances and updates. This System Testing will involve evaluating the complete online HIV medication delivery management system to ensure it meets specified requirements and functions as intended. This involves the following;

### **3.7.1.1 Functional Testing**

This will involve evaluating the online HIV medication delivery management system to ensure it performs required functions correctly and as specified. This includes testing functionalities such as user registration, medication ordering and prescription validation.

### **3.7.1.2 Performance Testing**

Performance Testing will focus on evaluating the efficiency and performance of the online HIV medication delivery management system. This includes load testing to assess system response under various levels of user activity, stress testing to determine system stability under extreme conditions, and scalability testing to ensure the system can handle growing user demands.

## **3.7.1.3 Security Testing**

Security Testing will involve evaluating the security of the online HIV medication delivery management system to protect sensitive patient information and ensure secure transactions. This includes penetration testing to identify vulnerabilities in the system's defenses and vulnerability scanning to detect potential security threats.

Therefore, the system testing will mainly do with the functional testing to ensure it performs required functions correctly and as specified. This includes testing functionalities such as user registration and medication ordering.

## **3.7.2 System Validation**

System validation is the process of evaluating the system to ensure that it meets the specified requirements and works as intended in the real-world environment. The following will be some of the used system validation methods:

### **3.8.2.1 Security Validation**

This will involve evaluating the system to ensure that it was secure and that penetration testing and vulnerability scanning.

### **3.8.2.2 Data Validation**

This will involve evaluating the system to ensure that the data entered into it was accurate, consistent, and complete. This type of testing included data integrity testing and data quality testing.

Therefore, the system validation will mainly focus on the data and security so data validation and security validation will be conducted.

# **3.8 Ethical Considerations**

Prior to data collection, ethical approval will be obtained from relevant institutional review boards. Informed consent will be sought from all participants, ensuring their voluntary participation, confidentiality, and privacy. Ethical considerations will be central to the entire research process, respecting the dignity, rights, and well-being of all participants.

# **3.9 Chapter Summary**

This chapter provides a detailed and transparent overview of the research methodology adopted for the development and evaluation of OHMDMS. The mixed-methods approach, coupled with a focus on interviews and surveys, promises a holistic investigation into the challenges and dynamics of HIV medication access and delivery. The subsequent chapters will present and discuss the findings derived from the implemented research methodology, contributing to the refinement and enhancement of OHMDMS with a comprehensive understanding of both qualitative and quantitative dimensions.

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