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# MASTER'S DISSERTATION

**TOPIC**

**THE IMPACT OF ARTIFICIAL INTELLIGENCE TECHNOLOGY ON HEALTHCARE MANAGEMENT EFFICIENCY IN UGANDA**.

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This dissertation is submitted as a partial fulfilment of the requirements for the successful completion of the MBA program at the Business School of the University of Wales Trinity Saint David.

I hereby declare that this dissertation represents my own work and has not been submitted for any other degree or qualification. All sources of information and ideas have been acknowledged and properly cited. This work adheres to the academic standards and guidelines set by the Business School of the University of Wales Trinity Saint David.

## ABSTRACT

This study delves into the transformative power of Artificial Intelligence (AI) in healthcare within Uganda. The study aims to leverage successful AI applications in healthcare globally and tailor them to address Uganda's unique challenges and needs. Despite the potential benefits of AI, Uganda encounters similar obstacles to other countries but also confronts specific challenges.

This study pinpoints barriers to implementing AI in healthcare management and provides effective strategies to surmount them. It strongly recommends investing in research and development of AI applications tailored to Uganda's healthcare system. Moreover, the study highlights the criticality of a comprehensive, multi-stakeholder approach to optimize healthcare management efficiency in Uganda with AI's assistance.


**Key Words:** Uganda, Healthcare management**,** Artificial Intelligence (AI)**,** Mixed-method.

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# CHAPTER 1: INTRODUCTION

## 1.1. Background of the Study

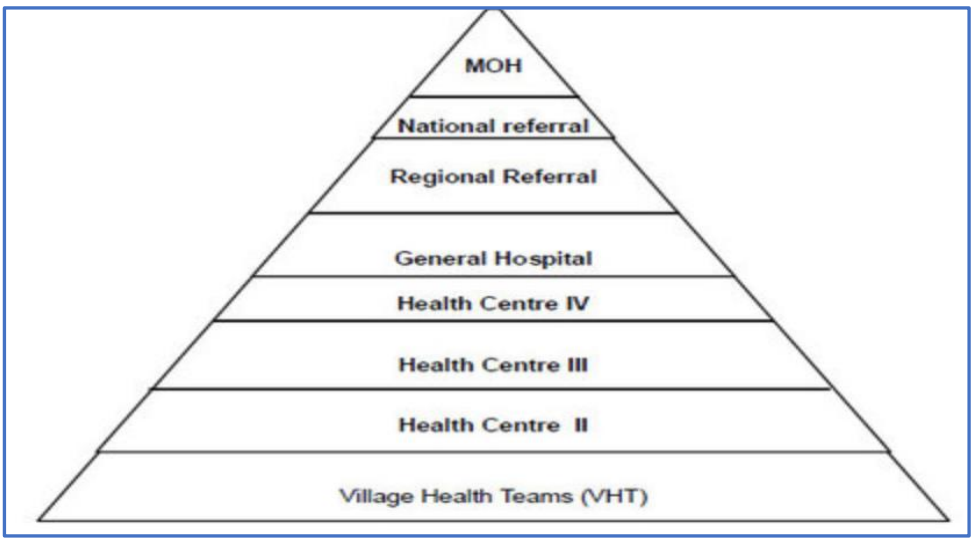
This research study aims to understand AI's role in mitigating Uganda's healthcare sector challenges and improving healthcare delivery.

### 1.1.1 Overview of Uganda's healthcare sector

Uganda's healthcare sector, as in many other developing nations, faces significant challenges such as a lack of resources, inadequate infrastructure, insufficient healthcare workforce, and high disease burden.

It is primarily managed by the Ministry of Health (MoH), (Ministry of Health-Uganda, 2023a) and is classified into four categories namely; national referral hospitals, regional referral hospitals, general hospitals and health centres 4,3,2 and 1 according to the size and nature of services provided (Ministry of Health-Uganda, 2022). However, the distribution of these facilities is uneven, with limited access in rural areas (Di Pietro *et al.*, 2020; Nannini, Biggeri and Putoto, 2021).

*Fig. 1. Classification of Healthcare facilities in Uganda*




*Source: Ministry of Health- Uganda*

The government is committed to providing accessible and affordable healthcare to its citizens, although challenges such as inadequate funding, limited resources, and a high disease

burden exist (Odokonyero *et al.*, 2017; Ministry of Health-Uganda, 2023c; World Bank, 2021; Ministry of Health-Uganda, 2021).

Healthcare system in Uganda is financed through a mix of public funding, donor support, and out-of-pocket payments from individuals. The government aims to increase public funding for healthcare to reduce reliance on out-of-pocket payments (Asasira and Ahimbisibwe, 2018a). Uganda faces a shortage of healthcare professionals, particularly in rural areas and efforts are being made to train and deploy more healthcare workers to address this issue, (Asasira and Ahimbisibwe, 2018a). The Ministry of Health focuses on providing essential healthcare services, including immunisation, maternal and child health, prevention and control of communicable diseases such as HIV/AIDS, malaria, and tuberculosis, and health promotion, (Ministry of Health-Uganda, 2023a).

Uganda has a health insurance scheme called the National Health Insurance Scheme (NHIS), (Parliament of Uganda, 2021). However, its coverage is still limited, and efforts are being made to expand its reach (Basaza, Namyalo and Mutatina, 2022). Despite these difficulties identified, an emergent factor that could potentially revolutionize the healthcare sector is the expansion of the application of artificial intelligence (AI) technology.

### 1.1.2. The current state of healthcare management in Uganda

The current state of healthcare management in Uganda is a complex issue and needs examining from several perspectives including infrastructure, workforce, accessibility, disease burden, and healthcare delivery systems.

**Infrastructure and Resources**: Uganda's healthcare system is challenged by inadequate infrastructure and resources (Dowhaniuk, 2021). Many health facilities, particularly in rural areas are under-equipped, underfunded and understaffed (Voice of Africa, 2023). The shortage of critical medical equipment and medicines is a common issue, hampering the delivery of quality healthcare services (Reuters, 2018).

The potential for AI to transform healthcare in Uganda is significant. AI can be used to tackle the challenges posed by the healthcare system's infrastructure and resource constraints in Uganda in the following ways;

1. Remote Diagnostics: AI can create remote diagnostic tools for healthcare in rural areas, analysing symptoms and medical images to offer likely diagnoses, and addressing the

scarcity of specialized doctors. Babylon Health and Aidoc already employ AI for this purpose.

2. Predictive Analytics: AI can provide insights into regions that are likely to suffer from specific diseases based on patterns in health data and enable better resource allocation and preparation.
3. Supply Chain Management: AI can optimize the supply chain for medicines and medical equipment by predicting demand for different supplies, minimizing waste and ensuring critical supplies reach where they are most needed.
4. Telemedicine: AI-powered telemedicine platforms can facilitate consultations with doctors remotely. Patients can connect with healthcare professionals without travelling long distances, thereby addressing the issue of understaffed local health facilities.

**Healthcare Workforce**: Uganda's healthcare faces a severe shortage of trained professionals, straining the workforce and harming patient care quality. The distribution of healthcare workers is skewed towards urban areas, neglecting rural regions, and there's a shortage of training opportunities (Okiror, 2017; Koutsoumpa et al., 2020).

AI can be utilised to address the shortage and uneven distribution of healthcare workers in Uganda in a number of ways;

1. Training: The application of AI in healthcare education can enhance the quality and quantity of training available to professionals by making it more efficient and scalable, simulating real-world scenarios and offering feedback on a continuous basis.
2. Decision Support Systems: AI has the ability to analyse vast amounts of patient data quickly and accurately, make efficient decisions and recommend treatment plans, enabling healthcare workers to handle more patients effectively and efficiently.
3. Task Shifting: AI can automate tasks like scheduling appointments, patient follow-ups, and basic diagnostic test reading, freeing healthcare workers for more critical responsibilities and reducing their workload.

**Accessibility:** Accessibility to healthcare in Uganda, especially in rural areas, is hindered by limited facilities. The Ministry of Health reports 6,937 facilities, with 45.16% government-owned, 14.44% private not-for-profit, and 40.29% private for-profit (Ministry of Health-Uganda, 2023b). Challenges include long distances, poor roads, and transportation issues (Nabukeera, 2016). High out-of-pocket expenses also affect affordability (Basaza, Namyalo, Mutatina, 2022; Kwesiga et al., 2020).

AI has the potential to significantly improve accessibility to healthcare services in Uganda through applications such as;

a) Health Bots: AI can create chatbots for basic healthcare advice, offering information on illnesses, home remedies, and when to seek medical help.
b) Mobile Health Apps: AI-driven mobile health apps offer users healthcare info, symptom checks, and personalized advice.
c) Cost Control: AI enhances healthcare efficiency, automating tasks, reducing errors, and optimizing resources to cut costs and lower out-of-pocket expenses.

**Disease Burden:** Uganda faces a heavy burden of communicable diseases like HIV/AIDS, tuberculosis, and malaria (WHO, 2017b; Mbonye and Sekamatte, 2018). Managing these is resource-intensive. Additionally, non-communicable diseases like cardiovascular diseases and diabetes are increasing, straining the healthcare system (Vollset et al., 2020).

AI has the potential to effectively manage both communicable and non-communicable diseases in Uganda through the following methods;

a) Predictive Analytics: AI analyses vast health data to predict disease outbreaks and high-risk groups, aiding proactive decision-making, resource allocation, and disease prevention.
b) Remote Patient Monitoring: AI enables remote health monitoring through wearables or apps, especially beneficial for managing non-communicable diseases with continuous monitoring and early intervention.
c) Health Education: AI chatbots offer personalized health education, boost disease awareness, and promote preventive actions for both communicable and non-communicable diseases.

**Healthcare Delivery Systems:** Uganda's healthcare system has inefficiencies, like long wait times, referral problems, and data management issues (Lugada et al., 2022; Ministry of Health-Uganda, 2017). AI provides innovative solutions to boost efficiency, streamline operations, and relieve administrative burdens (Nabukeera, 2016).

AI can be employed to tackle the inefficiencies in Uganda's healthcare system in the following ways;

a) Administrative Automation: AI automates scheduling, record-keeping, and billing, easing healthcare workers' administrative load for more patient-focused care.
b) AI Decision Support: AI quickly analyses patient data to offer treatment recommendations, speeding up decision-making and care processes.
c) Enhanced Patient Flow: AI predicts patient influx from historical data, helping facilities manage appointments and minimize wait times.
d) Efficient Referrals: AI streamlines referrals by matching specialists to patients and scheduling appointments, reducing delays and improving the patient experience.

**Health Financing:** Funding for healthcare is a critical issue, with low government spending and unreliable external financing (WHO, 2021; UNICEF, 2020). This affects healthcare delivery and service improvement capacity. Despite some progress in areas like child and maternal mortality reduction and expanded immunization (UNICEF, 2021), significant challenges persist, requiring urgent and innovative solutions. Despite these challenges, integrating Artificial Intelligence has the potential to address them effectively.

### 1.1.3. Overview of AI and its Application in the Uganda Healthcare System

Artificial Intelligence (AI) is a transformative technology, particularly in healthcare (Sunarti et al., 2021a). It's seen as the next frontier, with the potential to enhance healthcare outcomes, patient care, and operational efficiency (Stanfill and Marc, 2019; Manne and Kantheti, 2021).

Several healthcare apps are making a difference in Uganda, namely;

Insta Health: Created by Brenda Katwesigye, this app provides instant health information, connects users to health centres, and offers first-aid guidance and doctor consultations. It's accessible to over 40% of the population due to its simplicity (Lionesses of Africa, 2015).

Matibabu: This app helps combat malaria by allowing users to monitor and report their health status. Its non-intrusive Matiscope technology enables early malaria detection (Matibabu, 2020; Lardinois, 2017).

ClinicPesa: Onyancha Chrispinus established ClinicPesa to provide an affordable mobile healthcare platform offering micro-savings, loans, and online payment options for medical bills (Clinic Pesa, 2022).

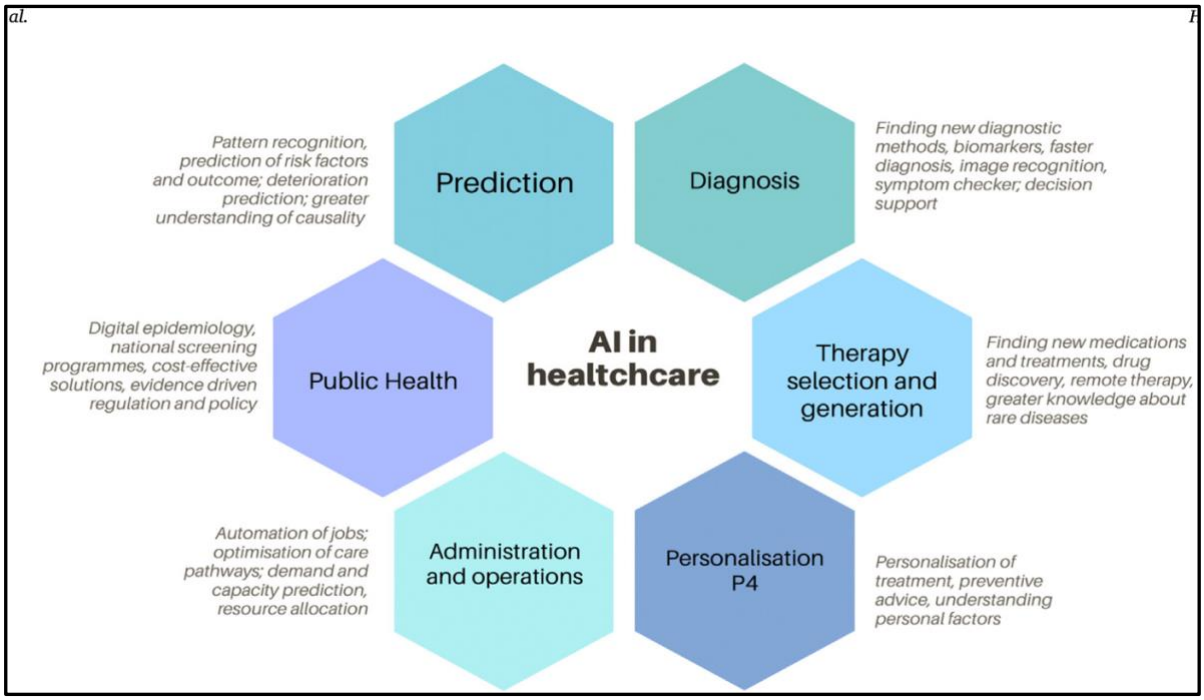
ClinicMaster: An innovative application managing patient information and billing, ClinicMaster automates patient care within healthcare facilities. It offers easy access to patient data and is highly customizable (ClinicMaster, 2021; Muhimba, 2023).

UgaMed: This online platform allows users to schedule appointments with healthcare professionals and facilities, with a convenient search function for finding providers based on location and speciality in Uganda (Tracxn.com, 2023; Reuters, 2008; New Vision, 2023).

MamaOpe: MamaOpe uses acoustic technology to detect respiratory diseases in low-resource environments, aiming to improve healthcare access (MamaOpe, 2023).

Despite these innovations, AI adoption in Uganda's healthcare sector remains limited, but it has significant potential to address pressing challenges. This study delves deeper into areas where AI is impacting the global healthcare industry.

*Fig. 2. Areas where AI is making a significant impact on healthcare*




*Source: Dawoodbhoy et al., 2021, p. 3*

**Predictive Analytics**: AI aids in anticipating disease outbreaks and patient deterioration by analysing complex healthcare data, offering early warnings and preventive care (Ooge, Stiglic, Verbert, 2022). For example, Google's DeepMind Health predicts acute kidney injuries 48 hours in advance, relying on extensive, accurate data; misinterpretations due to poor-quality or biased data must be avoided (Hassan et al., 2021).

**Diagnostics and Imaging**: AI enhances diagnostic accuracy, especially in imaging (Hosny et al., 2018). It detects anomalies in scans, reducing errors, like in cancer detection (Natarajan et al., 2019). The FDA-approved IDx-DR system diagnoses diabetic retinopathy, raising questions about AI's reliability and the risk of over-reliance (Rauschecker et al., 2020).

**Personalised Medicine**: AI tailors treatment plans based on patient characteristics, improving outcomes (Johnson et al., 2021; Cellina *et al.*, 2023). IBM's Watson Oncology personalizes cancer treatment using patient records but requires strict data security due to privacy and consent concerns (Fernandez-Luque et al., 2021; Ahmed et al., 2020).

**Administrative Efficiency**: AI automates healthcare administrative tasks like record-keeping, appointment scheduling, and billing, easing the burden on staff (Stanfill and Marc, 2019; Noorbakhsh-Sabet *et al.*, 2019). For instance, Zocdoc uses AI to verify insurance information, streamlining tasks. However, concerns about job displacement and job security can hinder staff acceptance (Arakpogun et al., 2021).

**Telemedicine and Virtual Health Assistants**: AI impacts telemedicine and virtual health assistants (Lee and Yoon, 2021), enhancing healthcare access, particularly in underserved areas, by offering symptom-based medical advice (Bajwa et al., 2021). "Babylon Health," an AI-driven virtual health assistant, assesses symptoms and advises patients, however, concerns about accuracy persist, with reports of incorrect recommendations (Manne and Kantheti, 2021).

**Drug Discovery:** AI speeds up drug discovery by analysing vast data to identify potential candidates more quickly (Whig et al., 2022). For instance, companies like Insilico Medicine use AI to predict compound behaviour, significantly accelerating drug development (Mak and Pichika, 2019). Yet, regulatory challenges arise for AI-developed drugs, as traditional approval processes may not apply (Iacobucci, 2020).

While AI brings numerous benefits to healthcare, it's crucial to examine its limitations and potential pitfalls such as; **Data Security and Privacy**: AI processing personal health data

raises data security and privacy concerns, requiring robust regulatory frameworks (Shaffer, 2020; Naidoo et al., 2022). **Implementation Costs**: Implementing AI systems involves substantial costs, including hardware, software, and professional training, limiting adoption in resource-limited settings (Assadullah, 2019). **Data Quality**: AI's effectiveness relies on data quality, with poor data or biases leading to inaccurate predictions and patient harm (Sukums et al., 2023). **Regulatory Challenges**: AI development has outpaced regulation, risking unvetted algorithms causing harm (Stanfill and Marc, 2019). **Ethical Considerations**: AI raises ethical concerns such as dehumanisation of care, accountability for AI decisions, and job displacement (Patil and Kulkarni, 2022).

## 1.2. Statement of the Problem

### 1.2.1. Description of the healthcare management challenges in Uganda

Uganda's healthcare system encounters structural, financial, and administrative obstacles that impede top-quality care and impact public health (Dehnavieh et al., 2019).

**Inadequate Infrastructure and Resources**: Rural areas lack essential healthcare facilities and face shortages of medical supplies, compromising care quality and leading to treatment delays or unavailability (Dowhaniuk, 2021).

**Healthcare Workforce**: Uganda grapples with a shortage of trained professionals due to low pay, tough work conditions, and limited growth opportunities, leading to high attrition rates (Koutsoumpa et al., 2020). Distribution of professionals is uneven, favouring urban areas (Dowhaniuk, 2021).

**Accessibility Challenges**: Many Ugandans, especially in rural areas, struggle to access healthcare due to long distances, poor roads, and transportation issues (Dowhaniuk, 2021). Despite policies for free care, out-of-pocket expenses make healthcare unaffordable for many (Nabukeera, 2016).

**High Disease Burden**: Uganda faces a dual disease burden—communicable diseases like HIV/AIDS, malaria, and tuberculosis, alongside the rising prevalence of non-communicable diseases like heart disease, diabetes, and cancer. This strains the healthcare system (Monitor, 2020; Mbonye and Sekamatte, 2018).

**Inefficient Healthcare Systems**: Uganda's healthcare system grapples with inefficiencies like long patient wait times, flawed referral systems, and healthcare data management issues, burdening healthcare professionals with administrative tasks (Nabukeera, 2016).

**Limited Financing**: Inadequate funding cripples Uganda's healthcare sector, as government spending falls short of population needs. Reliance on external donor funds adds instability to healthcare financing (Parliament of Uganda, 2021; Basaza, Namyalo and Mutatina, 2022).

**Lack of Health Information Systems**: Uganda's healthcare struggles with data management and health information systems. Robust data collection, management, and analysis systems are lacking, impacting health information availability and evidence-based decision-making (Lugada et al., 2022; Dehnavieh et al., 2019).

**Limited Research and Development Capacity**: Uganda lacks the capacity for health research due to funding, researcher shortages, and infrastructure limitations. This leads to reliance on foreign research that may not fit local contexts (Lugada et al., 2022; Dowhaniuk, 2021).

**Regulatory and Governance Challenges**: Uganda's healthcare faces governance issues, including corruption, weak regulation, and accountability problems, draining resources and eroding trust (Nabukeera, 2016).

**Cultural and Societal Factors**: Socio-cultural factors hinder healthcare, with misinformation, language barriers, beliefs, and stigma deterring timely treatment, especially in sexual and reproductive health, mental health, and HIV/AIDS care (Nabukeera, 2016).

**Climate Change and Health**: Climate change affects health, increasing diseases like malaria and cholera, while environmental degradation and pollution contribute to non-communicable diseases (Scheerens et al., 2021; Giesen et al., 2020).

**Health System Resilience**: The COVID-19 pandemic exposed Uganda's healthcare system's lack of resilience, which should adapt, maintain core functions, and reorganize during crises (Adabavazeh, Nikbakht and Tirkolaee, 2023). The system struggled to handle both regular services and COVID-19 patients (Kabwama et al., 2022).

**Mental Health**: Uganda's mental health services are under-resourced due to stigma, limited awareness, and scarce mental health professionals (Miller et al., 2021). Conflicts, poverty,

and diseases like HIV/AIDS and COVID-19 worsen this issue (Cappo, Mutamba and Verity, 2021).

**Continuity of Care**: Uganda's healthcare lacks continuity of care for chronic conditions and palliative care (Mwanga-Amumpaire et al., 2021; Lubega, 2020). Challenges include poor record keeping, patient tracking, and referral systems (Uganda Debt Network, 2020; Nakayuki, Basaza and Namatovu, 2021).

**Health Education and Awareness**: Limited public health education leads to misconceptions, ignorance of preventive measures, and undervaluing early medical intervention (Nwosu, 2018).

**Integration of Traditional Medicine**: Traditional medicine is widely used, but integration into formal healthcare faces regulation, standardisation, and quality control challenges (Abbo, Odokonyero and Ovuga, 2019; Mwaka et al., 2019).

Addressing these issues requires cooperation among the government, healthcare providers, NGOs, international aid organisations, and the public. Incorporating AI can help manage health data, predict disease outbreaks, improve diagnostics, and automate administrative tasks. However, Uganda's unique challenges like resource limitations and digital literacy need careful consideration for effective AI implementation in healthcare.

### 1.2.2. Relevance of AI in addressing the healthcare management issues

AI's potential to aid healthcare management in Uganda is significant. However, it's crucial to assess its suitability and limitations in the local context, while also recognizing its potential benefits.

**Predictive Analytics**: AI can enhance disease surveillance and prediction, vital in Uganda with its diverse health challenges. It can analyse health data to forecast outbreaks, allocate resources, and boost preventive care. For instance, Google's DeepMind Health predicted kidney injury (Financial Times, 2019; CNN, 2019). However, its success in Uganda depends on quality health data, which is currently lacking, and biased or low-quality data can lead to incorrect predictions, as seen during COVID-19.

**Diagnostics and Imaging**: AI improves diagnostic speed and accuracy, especially in underserved remote areas. It can detect diseases like cancer early, as with the FDA-approved

IDx-DR system for diabetic retinopathy (Natarajan et al., 2019). This is valuable in remote parts of Uganda, but it requires robust medical infrastructure and reliable internet, which are often unavailable (NITA-Uganda, 2022).

**Healthcare Administration**: AI streamlines administrative tasks like patient records, appointments, and inventory, allowing healthcare professionals to focus on patient care. Zocdoc in the United States verifies patient insurance, reducing administrative burdens (Khandelwal and Salazar, 2020). However, implementing such applications in Uganda faces challenges such as digital literacy among staff and initial costs.

**Telemedicine**: AI-driven virtual health assistants enhance healthcare access, especially in remote areas, by offering basic health advice and relieving healthcare professionals. For instance, the UK's NHS 111 online provides medical guidance (NHS, 2023), and Babylon Health offers primary care consultations through an AI chatbot (Babylon Health UK, 2023). While promising for remote areas in Uganda, challenges like language barriers, digital literacy, and internet access can limit effectiveness.

**Training and Capacity Building**: AI, like Osso VR using virtual reality to train surgeons (Cevallos et al., 2022), can assist in healthcare professional training. However, Uganda faces hurdles due to limited technology and infrastructure.

**Health Information Systems**: AI supports robust health information systems for data collection, analysis, and management. But data privacy and security concerns require strong regulatory frameworks, as seen with DeepMind's NHS data controversy (BBC, 2021; CNBC, 2021).

**Research and Drug Development**: AI speeds up research and drug development, exemplified by Insilico Medicine (Insilico, 2023). However, this demands substantial funding and research infrastructure.

To effectively harness AI in Uganda's healthcare, contextual factors like quality health data, technology, internet access, digital literacy, and local regulation must be considered for tailored solutions.

## 1.3. Objectives of the Study

### 1.3.1. General objective

To examine the impact of AI technology on healthcare management efficiency in Uganda.

### 1.3.2. Specific objectives

1. To identify the current challenges faced in healthcare management in Uganda.
2. To analyse the AI-enabled systems in healthcare management.
3. To evaluate how AI can address the challenges and improve healthcare delivery in Uganda.

## 1.4. Research Questions

### 1.4.1. Main research question

What are Uganda's current healthcare management challenges, and how can Artificial Intelligence (AI) solutions be leveraged to address these challenges and improve healthcare delivery?

### 1.4.2. Sub-questions

1. What are the current healthcare management challenges faced by healthcare institutions in Uganda?
2. How has artificial intelligence technology been applied in healthcare management globally?
3. What are the potential benefits and limitations of using AI technology in healthcare management?
4. How can AI solutions be effectively integrated into the healthcare system in Uganda to improve management efficiency and healthcare delivery?
5. What are the key considerations and potential barriers to implementing AI technology in healthcare management in Uganda?

## 1.5. Significance of the Study

This research is vital to grasp AI's potential benefits and challenges in Uganda's healthcare sector. It aim to learn from global AI healthcare applications, focusing on practical, context-specific solutions.

This study delves into the potential of artificial intelligence (AI) to enhance the healthcare landscape in Uganda. Its primary objective is to comprehensively examine the healthcare challenges within the country, with the ultimate aim of enhancing the delivery and management of healthcare services. To gain a deeper understanding of AI's impact on healthcare, a comparative analysis of AI-driven systems will be conducted, allowing for the identification of global best practices and potential hurdles.

It is imperative to acknowledge both the advantages and constraints that AI presents within the healthcare domain. While AI promises heightened efficiency and enhanced quality of care, it simultaneously introduces concerns related to data security, financial implications, and the imperative need for specialised training and skill development.

The effective integration of AI technology within Uganda necessitates a multifaceted approach encompassing the establishment of robust information technology infrastructure, the provision of comprehensive AI education for healthcare professionals, the meticulous safeguarding of healthcare data, and the cultivation of partnerships with AI technology providers.

The introduction of AI within Uganda's healthcare sector demands a strategic approach encompassing several critical factors: a thorough evaluation of the healthcare system's readiness for AI integration, the procurement of necessary financial resources, the proactive resolution of potential resistance from healthcare professionals, and the adept management of regulatory and ethical complexities.

This research endeavours to furnish Uganda with a structured AI integration framework that prioritizes ethical considerations, effectiveness, and long-term sustainability, ultimately resulting in enhancement of healthcare services. Furthermore, the insights gathered from this study hold the potential to offer guidance to other developing nations confronted with similar healthcare challenges and opportunities.

## 1.6. Scope and Limitations

To provide clarity and focus for this study to be relevant, manageable, and deeply focused, as well as facilitate efficient resource management, save time and effort from being spent on irrelevant aspects, enhance credibility and identify future research directions to address the gaps and contribute to the continuous development of knowledge in this field, the following scope and limitations criteria shall be applied.

### 1.6.1. Geographical, temporal, and subject matter scope.

A study's parameters, including its geographical, temporal, and subject matter scope, significantly influence its research boundaries, depth, breadth, and findings' generalizability. This research specifically investigates the impact of Artificial Intelligence (AI) technology on enhancing healthcare management efficiency in Uganda.

**Geographical Scope**: The study centers on Uganda, a landlocked East African country, with a particular focus on Lira Regional Referral Hospital in the north and Mulago National Referral Hospital in Central region. These healthcare facilities offer valuable insights into Uganda's distinctive healthcare challenges and the potential AI holds for enhancing healthcare management within this context. However, it's essential to note that findings may not necessarily apply to other nations or settings due to geographical limitations. Additionally, variations in digital infrastructure and healthcare accessibility across Uganda's regions may affect the study's representativeness.

**Temporal Scope**: Given its reliance on literature review and online survey, the study's temporal scope aligns with the timeframe of available resources. The dynamic nature of AI necessitates the use of recent and pertinent literature to maintain currency. Nonetheless, study findings may require periodic updates to reflect evolving AI technology and changes in Uganda's healthcare sector.

**Subject Matter Scope**: This study concentrates on healthcare management and the application of AI technology in Uganda. Emphasizing management allows for a comprehensive exploration of resource allocation, patient data management, administrative efficiency, and decision-making within healthcare. The AI focus facilitates discussions on technological advancements, integration into healthcare, and potential enhancements in health outcomes. However, the study's specific focus may limit exploration of other vital

healthcare aspects in Uganda, such as frontline patient care, public health initiatives, and the role of traditional medicine.

### 1.6.2. Limitations and delimitations of the study.

To establish the scope and boundaries of this study, the following limitations and delimitations shall be considered.

#### 1.6.2.1. Limitations

**Data Availability**: The quality of this research depends on the amount of literature available on AI's use in healthcare. Limited or lower-quality resources may hinder the study's scope and thoroughness.

**Survey Limitation**: The mode and medium of survey for this study is an online questionnaire using Google Forms. Using an online survey for data collection may result in bias as it could mainly attract respondents who are tech-savvy or have access to dependable internet services. Moreover, the use of self-reporting may lead to responses that are biased or not accurate.

**Dynamic Field**: The field of AI in healthcare is rapidly evolving, and the study might quickly become outdated if new technologies or strategies are introduced shortly after the study is conducted.

**Lack of Qualitative Insights**: The study heavily depends on secondary data and online surveys, which means it may not have access to valuable qualitative insights that could have been gathered from first-hand observations or interviews.

#### 1.6.2.2. Delimitations

**Geographical Concentration**: The study's focus is confined to Lira Regional Referral Hospital and Mulago National Referral Hospital in north and central Uganda respectively. While this allows an in-depth exploration of the country's unique context, it reduces the broader applicability of the findings to other regions or countries with different socio-economic or healthcare contexts.

**Narrow Subject Matter**: The research delimits its focus to healthcare management efficiency and the role of AI in it. This delimitation excludes crucial areas such as patient care, policy-making, or public health initiatives, which could be intertwined with healthcare management.

**Technological Focus**: By focusing specifically on AI technology, the study might overlook or undervalue the impact of other technological advancements in healthcare.

# CHAPTER 2: LITERATURE REVIEW

## 2.1. Literature search and selection

### 2.1.1. Criteria for selecting studies

To ensure a comprehensive, relevant, and reliable literature review and survey for this research, the following inclusion and exclusion criteria shall be applied.

#### 2.1.1.1. Inclusion Criteria

**Relevance to AI and Healthcare**: Primary and secondary sources that specifically discuss the application and impact of AI technologies in healthcare, especially in the context of healthcare management, will be included in this study.

**Ugandan Context**: Studies, reports, or articles that provide insights into Uganda's healthcare management system, its challenges, and potential improvements will be included.

**Timely and Current**: Due to the rapid advancement in AI technology, only recently published materials (within the last five years) shall be included to maintain the study's relevancy.

**Credible and Reliable Sources**: The selected materials shall be from reputable, credible, and peer-reviewed sources such as academic journals, reputable international organisations, government reports, and respected research institutions.

#### 2.1.1.2. Exclusion Criteria

**Non-Healthcare Focus**: Resources discussing AI applications in fields other than healthcare will be excluded, as they do not directly relate to the research question.

**Lack of Focus on Management Efficiency**: Materials that discuss AI's impact on healthcare but do not specifically address its effect on healthcare management efficiency shall be excluded.

**Non-Applicable Contexts**: Studies based in geographical contexts that are significantly dissimilar from Uganda, especially those from high-income countries with very different healthcare infrastructure, might be excluded due to their limited applicability if deemed necessary.

**Outdated Materials**: Older studies or resources that do not accurately reflect the current state and capabilities of AI technology would be excluded.

**Non-Credible or Unverifiable Sources**: Any resources from non-verified, non-peer-reviewed, or potentially biased sources should be excluded to maintain the credibility and integrity of this study.

The use of these criteria will improve the review and survey quality, enhancing the study's overall reliability and relevance.

### 2.1.2. Databases and other sources used to identify studies

For this study on AI's impact on healthcare management efficiency in Uganda, the following resources will be used: PubMed, IEEE Xplore, African Journals Online (AJOL), Google Scholar, Science Direct, Web of Science, World Health Organization (WHO) Database, Uganda Bureau of Statistics and Ministry of Health Reports, Social Science Research Network (SSRN), and newspaper articles.

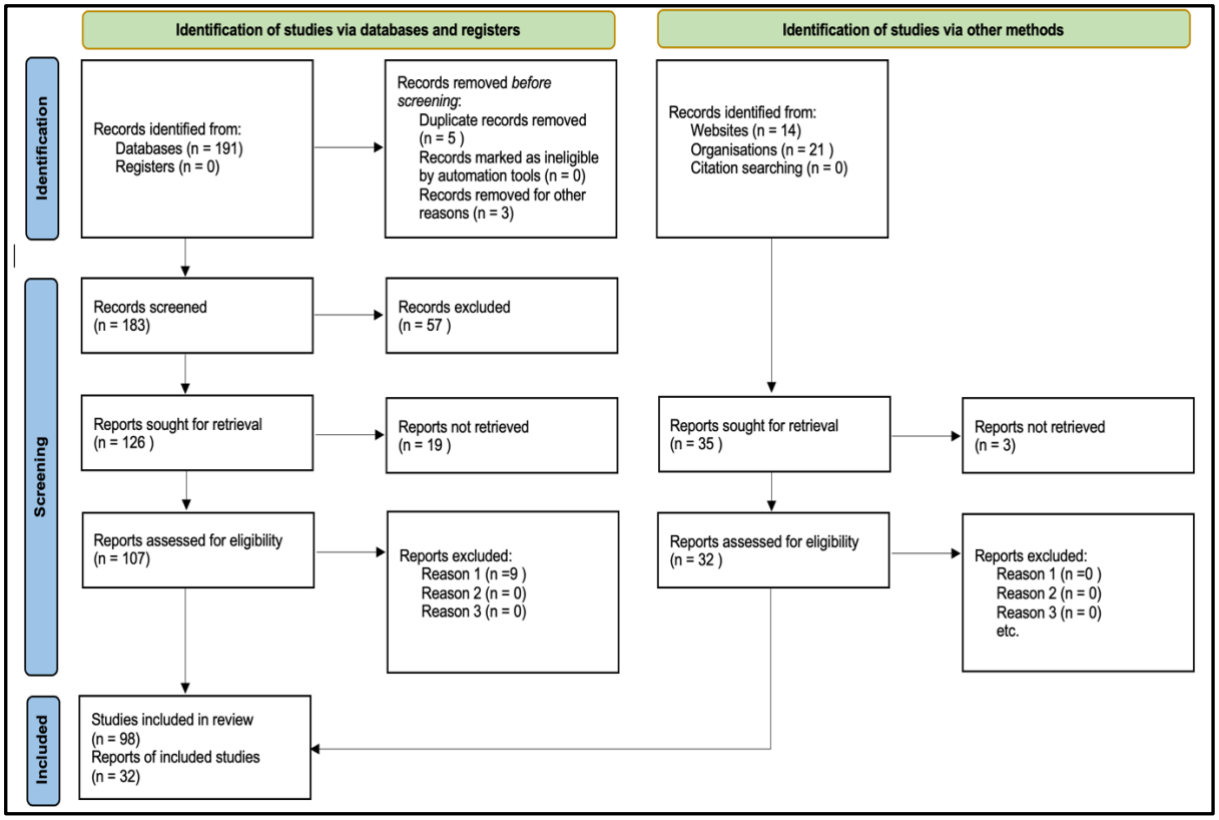
### 2.1.3. Search strategy

To ensure that all possible relevant literature is included, systematic, comprehensive, and repeatable search strategies were applied using; Identifying key concepts, Determining keywords and phrases, Boolean operators, Truncation and Wildcards, Phrase searching, filtering and refining results, Documenting the search and Evaluating results. These strategies were used in research literature search tools such as Uwtsd online library, Elicit, Research Rabbit and Zotero among others.

### 2.1.4. Number of studies identified and screened

To ensure a methodologically rigorous and transparent approach to this study, the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines have been utilized.

*Table 1. Number of studies identified and screened using PRISMA*




### 2.1.5. Reasons for excluding studies

To ensure the study's relevancy, accuracy, and focus, the reasons outlined in subsection 2.1.1.2 have been applied.

## 2.2. Healthcare Management in Uganda

Uganda's healthcare management is influenced by its history, current challenges, and government strategies (Mulumba et al., 2021; WHO, 2017a).

**Historical Background**: Uganda's healthcare system, shaped by colonialism and political instability, was mainly government-run until the 1980s civil war. Afterward, it faced reconstruction due to significant damage (Nabukeera, 2016). Decentralization in the 1990s shifted responsibilities to districts, aiming for better local services (Lugada et al., 2022), though challenges persisted (Nabukeera, 2016).

**Current Status and Challenges**: Uganda faces a low doctor-to-patient ratio (1:25,000) compared to WHO standards (Ajari and Ojilong, 2020). Healthcare access varies, with rural underservice, infectious diseases, and emerging non-communicable diseases (Ssensamba et al., 2019). Funding gaps lead to drug shortages, equipment issues, and reported corruption (Nabukeera, 2016).

**Government Policies and Initiatives**: Government introduced the Health Sector Development Plan (2015-2020) to improve healthcare quality and access, establishing Health centre 3s and 4s at sub-county and county levels (Ministry of Health-Uganda, 2023c). Digital health strategies, such as the eHealth policy, aim to enhance service delivery (Ministry of Health-Uganda, 2021). Public-private partnerships, led by the Uganda Healthcare Federation, have increased private health facilities (Asasira and Ahimbisibwe, 2018b). Plans to recruit more healthcare workers and raise their pay are in place (New Vision, 2018), but effectiveness is hindered by funding and infrastructure challenges (Nabukeera, 2016).

**Technological Advancements and International Aid:** Healthcare sector in Uganda is influenced by technology and international aid (Mirugwe, 2023; Asasira and Ahimbisibwe, 2018b). Private hospitals use mobile tech for health education, appointment reminders, and data collection, improving healthcare access (Kamulegeya et al., 2019; Egami and Matsumoto, 2020). International aid from organisations such as Global Fund, WHO, Bill and Belinda Gates Foundation, and USAID, addresses health issues like HIV/AIDS, tuberculosis, and malaria, often focusing on specific programs (World Bank, 2021).

**Research and Development**: Uganda relies on international collaborations and donor funding for research, involving local institutions like Makerere University and Uganda Virus Research Institute (Ministry of Health-Uganda, 2016; WHO, 2021). However, translating research into policy is challenging (Koutsoumpa et al., 2020; Nabukeera, 2016).

Uganda's healthcare system needs to tackle issues like funding, corruption, accessibility, and a shortage of professionals. Digital health strategies and public-private partnerships can help.

AI and advanced tech have potential, e.g., in disease surveillance and diagnostics, but face challenges like infrastructure, literacy, privacy, and ethics.

*Table 2. Key Findings of the research work identified*

| Reference | Key Findings |
|---|---|
| Mulumba *et al.*, (2021) | The historical legacy of colonialism in Uganda has had a profound impact on community participation in health governance, resulting in a notable erosion of local involvement and engagement. |
| Nabukeera, (2016) | The healthcare sector in Uganda faces major challenges due to weak public health systems, insufficient resources, poor organisation of healthcare services, and a lack of information about local diseases. |
| Lugada *et al.*, (2022) | The results indicate that the supply chain system's capacity and performance are improving in various technical and functional domains, as evidenced by the wider availability of Essential Medicines and Health Supplies(EMHS) at all levels of care. |
| Ajari and Ojilong, (2020) | The study revealed the need to improve various healthcare system development metrics to prepare for disease outbreaks. |
| Ssensamba *et al.*, (2019) | The study's findings reveal that the public primary health care system of Uganda is inadequately equipped to provide comprehensive and age-friendly geriatric care services. |
| Asasira and Ahimbisibwe, (2018) | The study found that partnering with private health providers helped reduce overcrowding in public facilities and improved health coverage. |
| Kamulegeya *et al.*, (2019) | The study concluded that mobile phone-based health innovations provide a cost-effective and flexible solution to ongoing healthcare delivery challenges in Uganda, including a low doctor-to-patient ratio, extended waiting times at health centers, and inadequate patient follow-up systems. |
| Koutsoumpa *et al.*, (2020) | The study found that Uganda still faces a healthcare worker shortage. This shortage is not aligning with population growth, disease shifts, or demographic changes, despite government and partner efforts. |

### 2.2.1. Review of AI in Healthcare Management globally

AI has brought hope to global healthcare management (Efthymiou - Egleton et al., 2020), improving clinical decisions, enhancing efficiency, and optimizing patient care (Lee and Yoon, 2021). It is being widely adopted across healthcare sectors, from start-ups to large organizations and public health institutions, due to its immense potential (Jiang et al., 2017).

#### 2.2.1.1. Applications

AI advancements in global healthcare encompass:

**Predictive Analytics**: AI is being used to predict health trends and outcomes (Londhe and Bhasin, 2019). For instance, Jvion aids hospitals in readmission predictions (Ravi et al., 2019; Frownfelter et al., 2020).

**Medical Imaging and Diagnostics**: AI is being used to interpret medical images, like CTs and MRIs, to diagnose diseases. Zebra Medical Vision uses AI for this purpose (Lakshmi et al., 2018; Rauschecker et al., 2020).

**Personalised Medicine**: AI is being used to tailor treatments to individual characteristics, for example, IBM Watson Oncology for cancer patients (Londhe and Bhasin, 2019; Zhou et al., 2019).

**Drug Discovery**: AI accelerates drug discovery by predicting drug interactions in a patient (Ahmed et al., 2020; Fernandez-Luque et al., 2021). Insilico Medicine uses AI for biomarker and drug development (Bakula et al., 2018; Zhavoronkov and Aspuru-Guzik, 2020).

**Hospital Workflow Management**: AI is used to predict patient admissions, optimizing staff allocation, hence reduces wait times (Dawoodbhoy et al., 2021; Samer and Nour, 2019). For instance, Qventus aids real-time decision-making (Robinson et al., 2022; Alaskar et al., 2022).

**Telemedicine and Remote Patient Monitoring**: AI-powered services like Ada Health and Babylon Health provide remote medical consultations (Babylon Health UK, 2023; Johnson and Miller, 2022; Jain and Chawla, 2021).

*Table 3. Key Findings of the research work identified*

| Reference | Key Findings |
|---|---|
| Efthymiou - Egleton *et al.*, (2020) | The study found that AI-powered technologies have made incremental progress in addressing critical challenges but have yet to have a significant overall impact on the global healthcare system. |
| Lee and Yoon, (2021) | This study found that AI can improve access to medical care, diagnosis, and monitoring outside of hospitals. Additionally, the inclusion of AI in medical school training should be considered for future physicians. |
| Jiang *et al.*, (2017) | This study reveals that while the use of AI technologies has garnered significant attention in medical research, their practical implementation still encounters obstacles. The primary challenge arises from regulations that lack standards for evaluating the safety and effectiveness of AI systems. |
| Londhe and Bhasin, (2019) | The results of this research indicate that using AI has produced positive outcomes in areas that were previously unexplored, especially in the field of cancer care, creating new standards however, it is crucial to emphasize the significance of the training process in the algorithm. |
| Frownfelter *et al.*, (2020) | This study found that the Jvion AI solution was feasible for oncology practice. The machine-generated insights for depression risk were actionable and could be incorporated into the workflow, resulting in an increased number of identified patients. |
| Lakshmi *et al.*, (2018) | The finding of this study shows that, Zebra Medical Vision algorithm has demonstrated a notable degree of precision in detecting suspicious lesions. This high level of accuracy is particularly instrumental in discriminating between distinct types of breast cancer, thereby mitigating the probability of erroneous predictions. |
| Liu, Jiao and Liu, (2020) | This study demonstrates that the utilization of artificial intelligence in the domain of medical imaging is still at infant stage. It is reasonable to infer that ongoing advancements in AI-assisted disease prediction and medical visualization will continue to evolve and demonstrate its tremendous potentials and enhance rapid applications for clinicians in the coming decades. |

| | |
|---|---|
| Ahmed *et al.*, (2020) | The study shows that the field of precision medicine is advancing despite numerous obstacles. it is crucial to confront ethical and societal concerns pertaining to the safeguarding and confidentiality of healthcare data while achieving an optimal equilibrium. |
| Dawoodbhoy *et al.*, (2021) | The finding shows that, Artificial Intelligence exhibits promising potential to enhance patient flow across three primary domains: clinical decision-making, operational efficiency, and continuous monitoring. |

#### 2.2.1.2. Benefits of AI in Healthcare Management

The integration of AI in healthcare management offers numerous benefits, revolutionising traditional practices for a more efficient, personalised, and cost-effective system.

**Enhanced Decision-Making**: AI processes data swiftly, aiding informed decisions (Klumpp et al., 2021; Nasseef et al., 2022).

**Improved Efficiency**: AI automates tasks, freeing up time for patient care (Chen and Decary, 2020; Kerasidou, 2020).

**Better Patient Outcomes**: AI can predict readmission rates and customise treatments, for example, Google's DeepMind Health can accurately detect eye disease (Sunarti et al., 2021b; Horgan et al., 2019).

**Cost Savings**: AI simplifies tasks, aids in accurate diagnoses, and reduces readmissions (Sunarti et al., 2021b; Le Nguyen and Do, 2019).

**Increased Accessibility**: AI-driven telemedicine like NHS 111 online and Babylon Health provide medical consultation based on medical history and common knowledge (Senbekov et al., 2020; Shah and Khang, 2023).

While AI offers many benefits, it faces challenges like data privacy, infrastructure investment, job displacement, and the need for evolving regulations.

## 2.3. AI in Uganda's Healthcare Sector

AI is a technology that enables machines to perform tasks requiring human-like intelligence. In Uganda's healthcare, it aids doctors and nurses to quickly and accurately diagnose disease (Kamulegeya et al., 2019).

### 2.3.1. Analysis of existing AI-enabled systems in Uganda's healthcare.

AI usage in Uganda's public healthcare is limited. AI systems are mainly deployed in private hospitals. For example;

**Automated Diagnosis** is used by Kampala Hospital for diagnosing common diseases like malaria, tuberculosis and diabetes based on medical images and lab test results. **Predictive Analytics** is used by International Hospital Kampala (IHK) to anticipate disease outbreaks or trends, allowing hospitals to prepare and allocate resources efficiently (C-Care Uganda, 2023). **Medical Imaging Analysis** is used by Nakasero Hospital for analysing X-rays, CT scans, and MRI images to aid radiologists in detecting abnormalities (Nakasero Hospital, 2023).

The government is actively pursuing digital solutions, including AI, in public health units. Initiatives like "The Innovation Lab," in partnership with UNICEF, aim to develop tech-based solutions for healthcare and social challenges. Furthermore, efforts are underway to establish digital health policies and regulations for AI integration into the healthcare sector (Ministry of Health-Uganda, 2017). International organisations, like the European AI Alliance, are supporting AI application in low-resource settings, potentially benefiting countries like Uganda. This includes exploring AI's use for disease surveillance, diagnosis, and management (European Union, 2023).

### 2.3.2. Success stories and challenges faced.

This study has not been able to identify existing literature for comprehensive information on successful AI application in Uganda's healthcare sector. However, Uganda has a growing interest in integrating AI and digital technologies to address healthcare challenges identified in Section 1.1.3. Notable digital health initiatives in Uganda focus on disease surveillance, data management, and patient care, laying a foundation for future AI application.

The absence of success stories may be attributed to:

**Resource Constraints**: AI development and implementation demand substantial human and financial resources, including IT infrastructure, training, and maintenance. This poses challenges in resource-limited settings like Uganda (Meyer et al., 2020).

**Data Privacy and Security**: Protecting patient data is crucial in AI healthcare applications (Murdoch, 2021; Price and Cohen, 2019). This goes hand in hand with **Regulatory Challenges** as Rapid AI advancements often outpace regulatory frameworks, leading to uncertainties and challenges (Neher et al., 2023). Uganda needs robust data protection regulations to ensure the secure handling of sensitive information.

**Digital Divide**: Uganda faces a digital divide, with uneven access to digital tools and the internet between urban and rural areas, limiting the reach of AI-enabled healthcare solutions (Mabweazara, 2021).

### 2.3.3. Gap identification in the existing literature

Key gaps in research related to AI in Uganda's healthcare sector include:

**Limited Localised Research**: There is a scarcity of research specifically focusing on AI's application in Uganda's healthcare, hindering the evaluation of its potential impact given the country's unique healthcare landscape and demographics.

**Insufficient In-depth Analysis**: Detailed analysis of challenges and successes specific to Uganda's AI implementation is lacking. While broader challenges are discussed, a deeper examination considering Uganda's context is needed.

**Impact Evaluation Gap**: There is a noticeable absence of studies evaluating the impact of existing AI solutions in Uganda's healthcare. This includes assessing cost-effectiveness, healthcare delivery improvement, patient satisfaction, and overall public health impact.

**Policy and Regulatory Void**: Literature lacks a comprehensive analysis of Uganda's policy and regulatory framework for AI in healthcare. This includes understanding current regulations, identifying gaps, and offering suggestions for enhancements.

**Socio-cultural Neglect**: The influence of socio-cultural factors on AI acceptance and utilisation in Ugandan healthcare is underexplored. Understanding these factors is vital for technology acceptance and maximising its benefits.

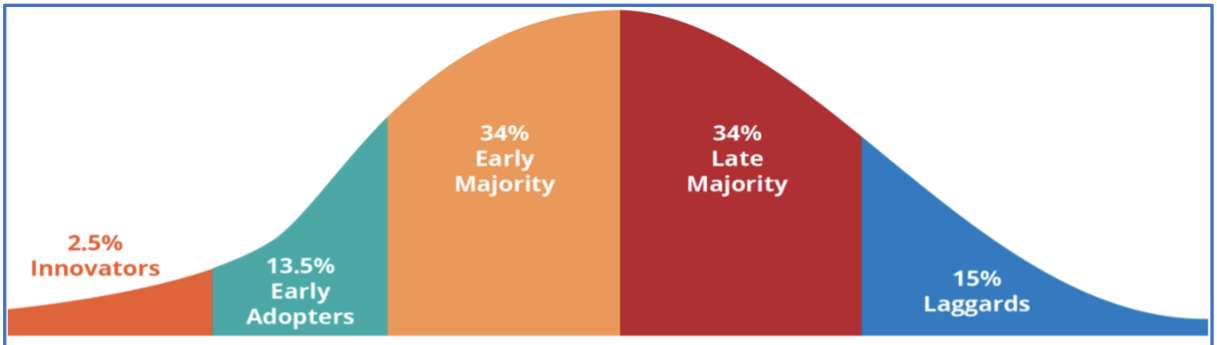
This research aims to address these gaps and provide insights into AI's application and impact in Uganda's healthcare. It seeks to guide policymakers, healthcare professionals, and tech developers in creating effective, acceptable, and beneficial AI tools for the country's healthcare sector.

## 2.4. Theoretical Framework

AI's application in healthcare can be analysed using diverse theoretical frameworks, each providing a distinct perspective on its integration and impact within healthcare systems.

**Diffusion of Innovations Theory(DOI):** Developed by Everett Rogers, offers insights into the spread of new ideas and technology (Dearing and Cox, 2018; Vargo, Akaka, and Wieland, 2020). AI, as a technological innovation, can be analysed through DOI, considering factors like relative advantage, compatibility, complexity, trialability, and observability. This framework helps clarify the varying rates of AI adoption in healthcare systems globally, including in Uganda.

*Fig. 3. DOI Framework*

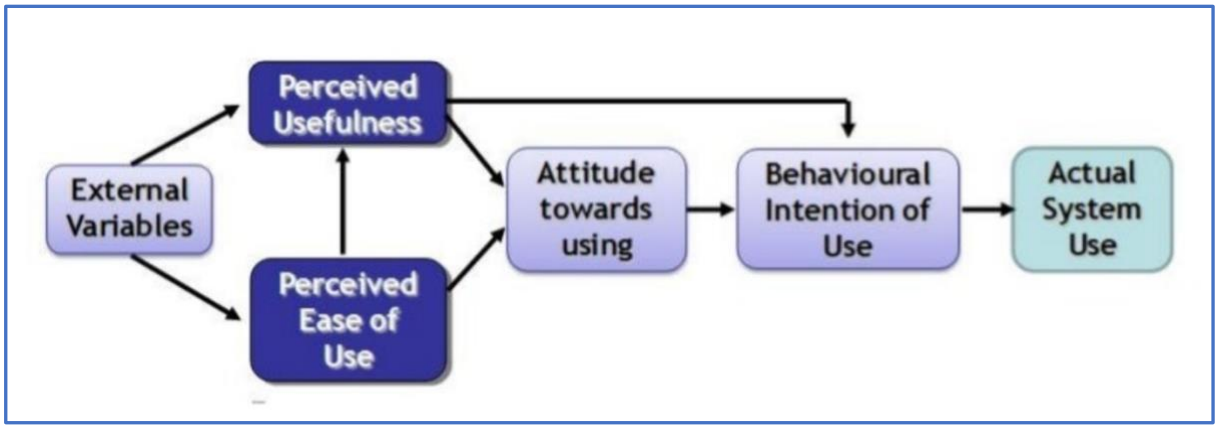



| Adopter category | Definition |
|---|---|
| Innovators | Innovative people are open to risks and have high status, financial stability, and access to resources. They can adopt new tech and absorb failures. |
| Early Adopters | Early adopters are opinion leaders who tend to have high social status, education, and financial stability. They choose their adoptions carefully to maintain a central communication position. |
| Early Majority | The Early Majority adopt new innovations slower than innovators and early adopters. They have high social status, connect with early adopters, and rarely lead opinions in a system. |
| Late Majority | Late Majority adopts innovations after most people have already embraced them, and they are hesitant towards new ideas due to limited resources and social status. |
| Laggards | This group resists change, prefers tradition, and has lower social status, less money, and is older than other adopters. They keep close company with family and friends and don't influence others' opinions. |

*Image Source: SmartInsights.com*

**Technology Acceptance Model (TAM):** Developed by Fred Davis, examines how users accept and utilize technology (Rahimi et al., 2018; Portz et al., 2019). It advances that perceived usefulness and perceived ease of use influence an individual's intention to use a system, like AI in healthcare (Nguyen et al., 2020; Tubaishat, 2018). TAM is valuable for assessing the readiness of healthcare professionals in Uganda to embrace AI tools in their practice.

*Fig. 4. TAM Framework*

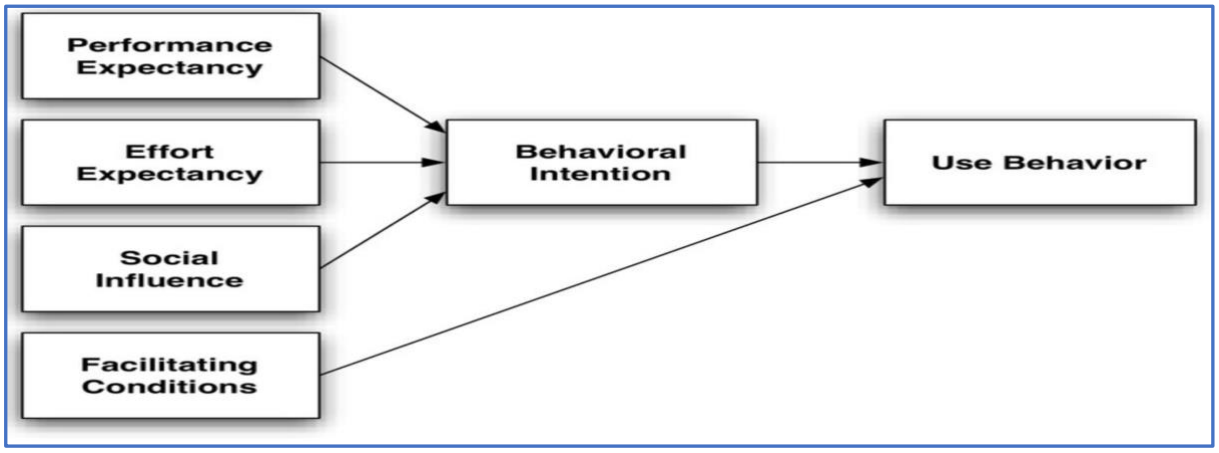



*Source: Slideshare.com*

**Health Information Technology Acceptance Model (HITAM):** An TAM, integrates elements from the Health Belief Model to expound technology adoption in healthcare (Jeffrey et al., 2019). It considers factors like perceived health threat and self-efficacy, offering insights tailored to healthcare practitioners and patients (Middlemass, Vos, and Siriwardena, 2017; Kavandi and Jaana, 2020).

**Unified Theory of Acceptance and Use of Technology (UTAUT):** Amalgamates elements from eight prominent technology adoption models, encompassing TAM and DOI. It advances four key factors shaping technology acceptance and use: performance expectancy, effort expectancy, social influence, and facilitating conditions. UTAUT offers a comprehensive framework for understanding AI adoption in healthcare contexts (Zhou et al., 2019; Kwak, Seo, and Ahn, 2022; Philippi et al., 2021).

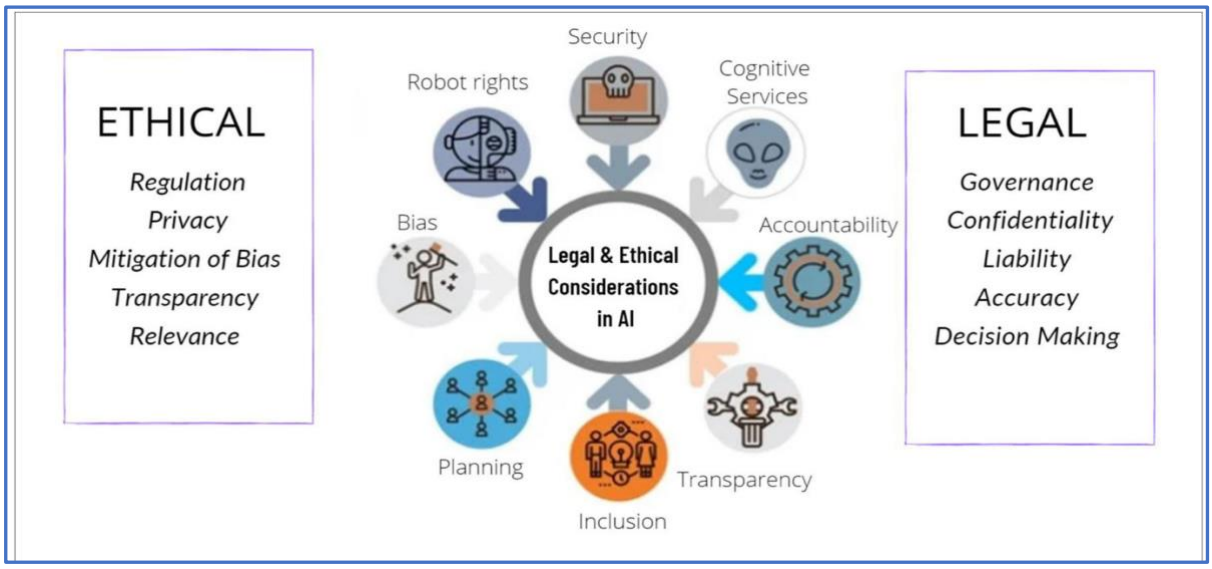
*Fig. 5. UTAUT Framework*




*Source: Osswald et. al (2012). Pp.51-58.*

**Ethical, Legal, and Social Implications (ELSI) Framework**: Is vital in AI, particularly in healthcare, addressing ethical, legal, and social concerns. It examines issues such as privacy, data security, patient consent, transparency, and fairness in AI applications (Čartolovni, Tomičić, and Lazić Mosler, 2022; Matimba et al., 2019; Zaami et al., 2021).

*Fig. 6. ELSI Framework*




*Source: (Naik et al., 2022, p. 3)*

### 2.5. Limitations of the study

The validity and generalizability of the results of this study have been limited by the following factors;

1. **Limited Sample Size and Scope**

It is important to note that collecting data from only two hospitals out of hundreds, and from only two regions out of five in Uganda, can result in a limited perspective. This may not fully represent the diversity of healthcare institutions and regions in the country, ultimately limiting the generalizability of the findings.

2. **Online Survey Method**

The use of an online survey may have potentially limited participation to individuals with internet access and technological literacy. Consequently, there could be a selection bias

among the respondents, which might render them unrepresentative of the broader population of healthcare professionals and stakeholders in Uganda.

### 3. Lack of In-Depth Qualitative Insights

The survey and literature review may not provide in-depth qualitative insights into complex matters such as cultural factors, individual experiences, or organizational dynamics. This limitation could restrict the understanding of specific aspects related to healthcare challenges and AI implementation, potentially impacting the depth of the analysis.

### 4. Potential Response Bias

The respondents' perceptions and opinions may be influenced by personal biases, experiences, or how survey questions were framed, which may affect the accuracy and reliability of the findings and lead to skewed interpretations.

### 5. Dependence on Existing Literature

Exclusively relying on existing literature may restrict the analysis to outdated or irrelevant information, potentially overlooking recent advancements, innovative approaches, or location-specific factors that are relevant to Uganda's healthcare system. These limitations can adversely affect the accuracy and effectiveness of the analysis, potentially missing out on the most relevant insights.

### 6. Potential Lack of Expert Insights

The study may not have fully captured the perspectives of key experts or stakeholders in AI, healthcare management, and policy-making. Consequently, the absence of expert insights might have limited the comprehensiveness and depth of understanding regarding AI integration and its challenges. It is crucial to interpret the findings of this study with caution due to the identified limitations. While the insights obtained are valuable in offering perspectives on the research questions, the constraints related to sample size, methodology, and scope may constrain the applicability of the results to the broader context of healthcare management in Uganda.

# CHAPTER 3: METHODOLOGY

## 3.1. Introduction

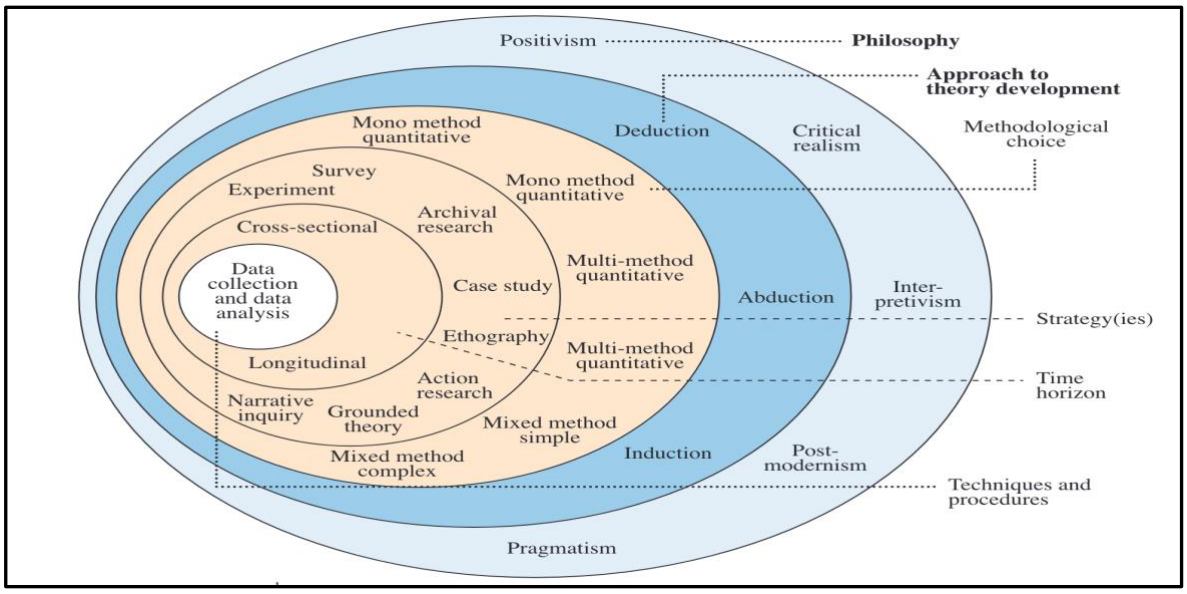
This study aims to investigate the impact of artificial intelligence (AI) on the efficiency of healthcare management in Uganda using a mixed-methods approach.
A mixed-method approach involves using both qualitative and quantitative methods for data gathering and analysis (Kajamaa et al., 2020). The decision to use mixed methods in this study is based on its ability to provide a thorough and contextual understanding of the topic (Schanz *et al.*, 2023). This is particularly helpful when dealing with complex phenomena that cannot be fully captured by a single method (Butt *et al.*, 2022).

Secondly, a mixed-method approach also helps to gain a more nuanced perspective on the topic being studied (Butt *et al.*, 2022); (Hidayat-ur-Rehman *et al.*, 2021). Thirdly, validation and triangulation of findings are necessary (Jack *et al.*, 2021). Additionally, the need to address potential biases or limitations associated with using only one method (Okello Otieno, Obura and Owino, 2023). The flexibility of research design (Hidayat-ur-Rehman *et al.*, 2021) and the ability to bridge gaps in existing literature (Nemakonde and Van Niekerk, 2017); (Duxbury, Frizzell and Lindsay, 2018) provided by mixed method is another reason.

## 3.2. The theoretical context of this study

This research utilized the research onion framework for a contextual examination of AI's impact on healthcare management efficiency in Uganda. This structured framework begins with philosophical assumptions and proceeds to data collection and analysis methods.

*Fig. 7. Research Onion Framework*




*Source: Aleksandras Melnikovas, 2018, p. 33*

At the research core lies the philosophical stance, with a positivist approach chosen for its emphasis on objectivity and empirical evidence, aligning with the study's aim of analysing AI's impact on healthcare management in Uganda through quantitative analysis. Moving outwards, the research approach employed deductive quantitative reasoning, facilitating the measurement of AI-related variables and enabling statistical analysis.

The research strategy involved an online survey and literature review, providing a snapshot of AI adoption in Ugandan healthcare. The mixed-method approach was used to uncover relationships between AI adoption and healthcare management efficiency. The additional theoretical context was drawn from the scoping Review by Milne-Ives et al., (2022), which explored AI in mental health mobile applications. The review underscores the possibility of employing AI to enhance mental health apps, shedding light on both the advantages and obstacles that could inform the implementation of AI in healthcare management in Uganda.

Moreover, Alnamrouti, Rjoub, and Ozgit's study (2022) explore how strategic human resource management practices and AI enhance the sustainability of non-governmental organisations, illustrating AI's potential role in long-term organisational viability. This insight has relevance for healthcare management efficiency in Uganda. Deng et al. (2022) propose a multi-dimensional smart health framework integrating Internet of Things (IoT), big data, cloud

computing, and AI to enhance healthcare efficiency and sustainability. This framework provides valuable insights into AI's potential applications in Ugandan healthcare management.

Additionally, Fusco et al. (2020) discuss the use of blockchain technology as a strategic tool for effective healthcare management. Blockchain can improve data sharing, data mining, and evidence-based decision-making, contributing to enhanced healthcare management efficiency in Uganda.

These sources offer insights into AI's potential applications and benefits in healthcare management efficiency in Uganda.

### 3.3. Research Design

The mixed-methods design was chosen to leverage the strengths of qualitative and quantitative methods. The qualitative aspect provides a deep understanding of AI implementation in Uganda's healthcare and global contexts, identifying obstacles and areas of impact. The quantitative part, via surveys, quantifies healthcare professionals' attitudes toward AI, offering a broader perspective.

One benefit of this approach is triangulating findings, as discussed by Lyons et al. (2020). Combining qualitative and quantitative data enhances research credibility and reliability through cross-validation. This is essential in studies like Lyons et al. (2020), which explored the effects of increased product variety on business processes. Mixed methods also deepen understanding, as seen in Ray et al.'s (2020) study using natural language processing for e-learning adoption analysis. Blending qualitative and quantitative data enriches the exploration of complex phenomena (Kajamaa et al., 2020).

Using a mixed-method approach in research serves to explore and validate research questions within a single study, as exemplified by Lyons et al. (2020). This approach provides flexibility, allowing researchers to use qualitative data to clarify quantitative findings or quantitative data to examine and explain relationships identified in qualitative data. However, there are challenges associated with this approach. It can be time-consuming and complex, requiring expertise in both qualitative and quantitative methods and potentially a larger research team (Kajamaa et al., 2020). Integrating diverse data formats and analytical

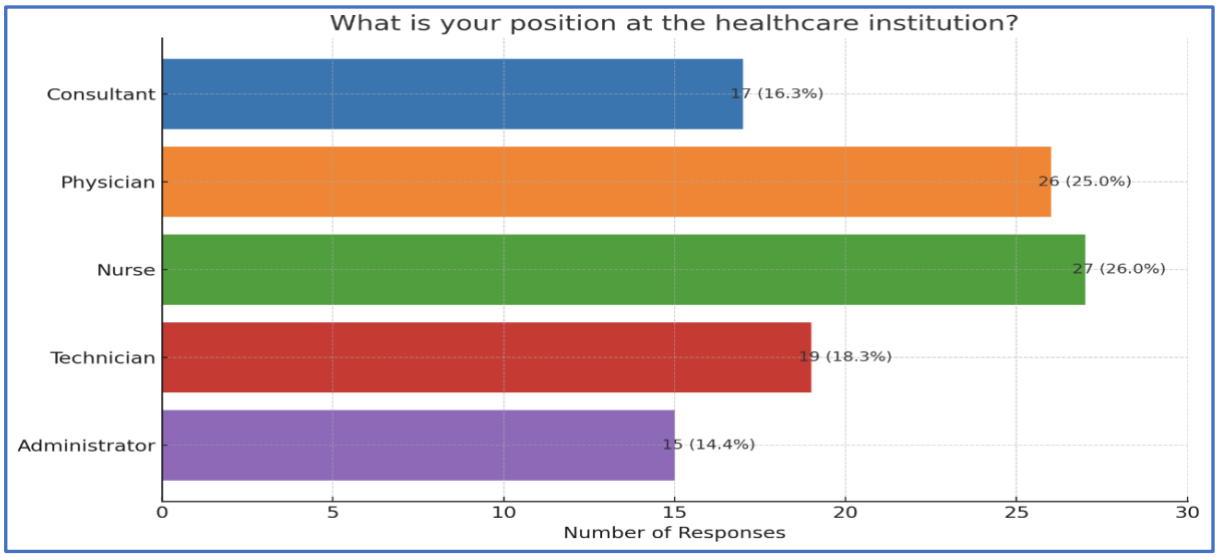
techniques can also pose difficulties due to the differences between qualitative and quantitative data (Kajamaa et al., 2020).

In conclusion, a mixed-method approach in research provides the benefit of both exploring and confirming research questions. Nevertheless, it presents challenges in handling the complexity of integrating qualitative and quantitative data. Researchers should carefully consider their research goals and available resources before choosing a mixed-method approach.

### 3.4. Population and Sampling

This study targeted healthcare professionals at Lira and Mulago hospitals which are government-owned healthcare facilities. To manage the diversity of this population, a stratified sampling approach was employed, categorizing individuals into distinct strata: Consultants, Nurses, Physicians, Technicians, and Administrators. Questionnaires were then randomly distributed to members within each stratum.

*Fig. 8: Population Strata*



### 3.5. Data Collection Methods

For the quantitative aspect of the study, an online questionnaire was created and distributed to healthcare professionals at two Ugandan institutions: Lira Regional Referral Hospital in the northern region and Mulago National Referral Hospital in the central region. The survey encompassed topics concerning familiarity with, utilisation of, and attitudes toward AI technology in healthcare management.

### 3.6. Data Analysis

The quantitative data collected underwent analysis using the Statistical Package for the Social Sciences (SPSS). This analysis aimed to identify descriptive statistics, including frequencies and percentages. These statistics were employed to summarize and quantify patterns within the data and communicate the study's results.

### 3.7. Ethical Considerations

Ethical considerations have been a cornerstone of this research, ensuring its integrity and quality through the following measures:

**Informed Consent**: Participants were fully informed about the research's purpose, methods, potential uses, and risks. Their consent was obtained before participation, ensuring their understanding and voluntary involvement.

**Confidentiality and Anonymity**: No personal or sensitive participant information was collected, preserving their anonymity and privacy.

**No Harm to Participants**: The research was designed to prevent physical or emotional harm to participants. Careful assessment of questions and methods ensured they did not cause distress or discomfort.

**Transparency and Honesty**: The research maintained transparency and honesty in conveying its aims, procedures, and potential conflicts of interest to all stakeholders.

**Compliance with Legal and Institutional Guidelines**: The study adhered to all applicable laws and regulations, including data protection and intellectual property rights. Necessary

approvals and permissions were obtained from relevant authorities, following UWTSD research committee guidelines.

**Respect for Diversity and Inclusion**: The research embraced diversity, treating all participants with dignity and respect, regardless of their background, race, gender, or any other characteristic.

**Avoidance of Deception**: Participants were not provided with misleading or false information at any stage of the research.

These ethical principles were upheld to ensure the research's validity, reliability, and the protection of the rights and dignity of all participants involved.

# CHAPTER 4: RESEARCH FINDINGS

## 4.1. Introduction

In this research section, raw data gathered were converted into insights through tables, charts, and graphs for visualizing the information. It was then analysed and interpreted to address the initial research questions.

## 4.2. Data Presentation

This section analyses data to address research questions and objectives, using visuals to illustrate key findings and trends.

### 4.2.1. Participants' Profile

Participants here encompass Gender and Age Ranges. This information is vital for ensuring that the study captures a diverse range of perspectives and experiences among healthcare professionals. It will later serve as a foundation for making comparisons with findings, identifying trends, and tailoring recommendations to address the complexities of AI integration in healthcare management effectively.

In the study, out of the total sample of 104 participants, the majority identified as male, comprising 54.8% (n = 57) of the participants and 45.2% (n = 47) as female. Furthermore, analysis of the age range revealed a diverse representation of ages. Out of the total participants, 5.8% (n = 6) were in the 18-25 years range, 35.6% (n = 37) were in the 26-35 range, and 38.5% (n = 40) were aged between 36-45 years. Additionally, 14.4% (n = 15) were in the 46-55 category, while 4.8% (n = 5) were 56 years and above as shown in the descriptive results presented in Table 1 below.

*Table 4. Descriptive statistics for Participants*

| Gender | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| Female | 47 | 45.2 | 45.2 | 45.2 |
| Male | 57 | 54.8 | 54.8 | 100.0 |
| Total | 104 | 100.0 | 100.0 | |
| **Age Range** | | | | |
| 18-25 | 7 | 6.7 | 6.7 | 6.7 |
| 26-35 | 37 | 35.6 | 35.6 | 42.3 |
| 36-45 | 40 | 38.5 | 38.5 | 80.8 |
| 46- 55 | 15 | 14.4 | 14.4 | 95.2 |
| 56 and above | 5 | 4.8 | 4.8 | 100.0 |
| Total | 104 | 100.0 | 100.0 | |

### 4.2.2. Demographic Profile of Organisation

This demographic encompasses the position held at the institution and the time spent in the institution. These profiles are crucial for understanding the organisational dynamics, decision-making processes, and potential challenges associated with AI integration in healthcare management. They will later help to tailor strategies, anticipate barriers, and ensure that the study accounts for the diverse range of experiences and perspectives within the healthcare institution.

#### a) Position at Institution

The distribution of positions within the institution portrayed a diverse representation of roles. Among the 104 participants, 14.4% (n = 15) identified as 'Administrator,' while 16.3% (n = 17) held the designation of 'Consultant.' Furthermore, 26.0% (n = 27) of participants were 'Nurse,' and 25.0% (n = 26) were categorized as 'Physician.' Additionally, 'Technician' accounted for 18.3% (n = 19) of the participants.

#### b) Duration of Stay at the Institution

The distribution of durations of stay within the institution displayed a diverse range of experiences. Among the participants, 25.0% (n = 26) reported working at the institution for 1-3 years, while 30.8% (n = 32) indicated working for 4-6 years. Additionally, 22.1% (n = 23) of participants had worked for 7-10 years. A smaller proportion, 3.8% (n = 4), reported working for Less than 1 year. Meanwhile, 18.3% (n = 19) of participants had stayed at the institution

for Over 10 years. The cumulative percent offers a comprehensive view of the distribution of these durations of stay across the participant pool.

*Table 5. Descriptive Statistics for Position and Duration at Institution*

| **Position** | **Frequency** | **Percent** | **Valid Percent** | **Cumulative Percent** |
|---|---|---|---|---|
| Administrator | 15 | 14.4 | 14.4 | 14.4 |
| Consultant | 17 | 16.3 | 16.3 | 30.8 |
| Nurse | 27 | 26.0 | 26.0 | 56.7 |
| Physician | 26 | 25.0 | 25.0 | 81.7 |
| Technician | 19 | 18.3 | 18.3 | 100.0 |
| Total | 104 | 100.0 | 100.0 | |
| **Duration** | | | | |
| 1-3 year | 26 | 25.0 | 25.0 | 25.0 |
| 4-6 years | 32 | 30.8 | 30.8 | 55.8 |
| 7-10 years | 23 | 22.1 | 22.1 | 77.9 |
| Less than 1 year | 4 | 3.8 | 3.8 | 81.7 |
| Over 10 years | 19 | 18.3 | 18.3 | 100.0 |
| Total | 104 | 100.0 | 100.0 | |

### 4.2.3. Trends

The survey revealed trends in Uganda's healthcare, covering challenges, AI awareness, benefits, risks, integration strategies, considerations, barriers, and solutions. These trends offer insights into current challenges and AI integration possibilities.

#### a) Healthcare Management Challenges in Uganda

This trend emerged as a focal point of inquiry within the study, encompassing a total of 104 participants. The distribution of responses regarding the challenges encountered by the institution provided insights into the prevailing concerns.

The most commonly reported challenge was Insufficient funding with 47.1% (n = 49) of participants citing this as a significant issue. This was closely followed by a combined challenge of Insufficient funding, Lack of skilled personnel, Limited access to medical

equipment, and Inadequate infrastructure (laboratory, Ambulance, Health Unit) at 15.4% (n = 16). Additionally, 11.5% (n = 12) of participants reported a combination of Insufficient funding, Lack of skilled personnel and Limited access to medical equipment.

The distribution of other challenges included Insufficient funding, Limited access to medical equipment and Inadequate infrastructure at 5.8% (n = 6). Lack of skilled personnel at 4.8% (n = 5), and Limited access to medical equipment at 3.8% (n = 4). Inadequate infrastructure (laboratory, Ambulance, Health Unit) was identified by 3.8% (n = 4) of participants.

Smaller proportions of participants indicated challenges such as Insufficient funding and Limited access to medical equipment at 1.9% (n = 2). Combination of Insufficient funding, Lack of skilled personnel and Inadequate infrastructure at 2.9% (n = 3) and Lack of skilled personnel, Limited access to medical equipment and Inadequate infrastructure at 1.0% (n = 1).

These findings provide answers to the research question about the current healthcare management challenges faced by healthcare institutions in Uganda.

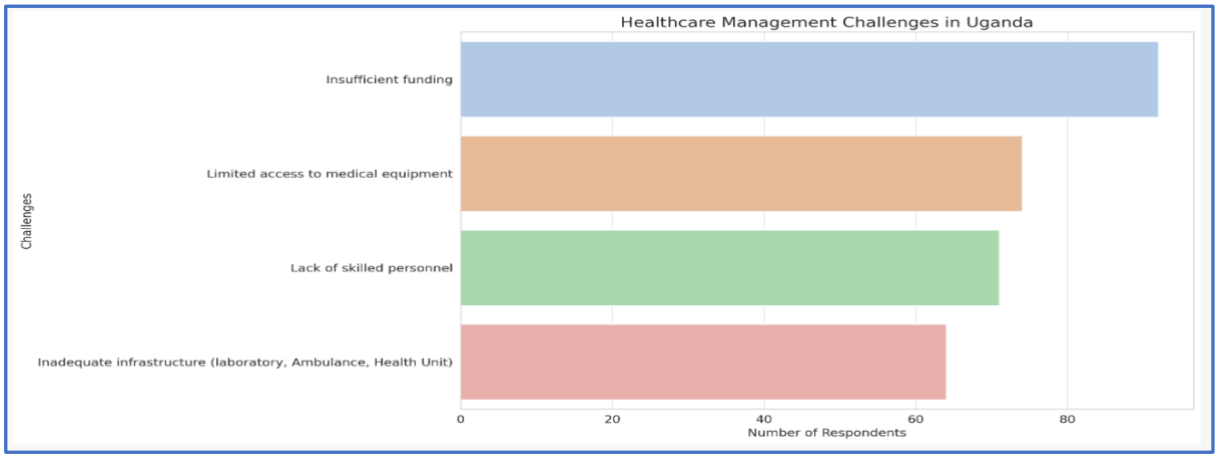
*Table 6*.

| Challenges | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| ○ Inadequate infrastructure (laboratory, Ambulance, Health Unit) | 4 | 3.8 | 3.8 | 3.8 |
| ○ Insufficient funding | 16 | 15.4 | 15.4 | 19.2 |
| ○ Insufficient funding<br>○ Lack of skilled personnel | 5 | 4.8 | 4.8 | 24.0 |
| ○ Insufficient funding<br>○ Lack of skilled personnel<br>○ Inadequate infrastructure (laboratory, Ambulance, Health Unit) | 3 | 2.9 | 2.9 | 26.9 |
| ○ Insufficient funding<br>○ Lack of skilled personnel<br>○ Limited access to medical equipment | 12 | 11.5 | 11.5 | 38.5 |

| | | | | |
|---|---|---|---|---|
| ○ Insufficient funding<br>○ Lack of skilled personnel<br>○ Limited access to medical equipment<br>○ Inadequate infrastructure (laboratory, Ambulance, Health Unit) | 49 | 47.1 | 47.1 | 85.6 |
| ○ Insufficient funding<br>○ Limited access to medical equipment | 1 | 1.0 | 1.0 | 86.5 |
| ○ Insufficient funding<br>○ Limited access to medical equipment<br>○ Inadequate infrastructure (laboratory, Ambulance, Health Unit) | 6 | 5.8 | 5.8 | 92.3 |
| ○ Lack of skilled personnel | 2 | 1.9 | 1.9 | 94.2 |
| ○ Limited access to medical equipment | 4 | 3.8 | 3.8 | 98.1 |
| ○ Limited access to medical equipment<br>○ Inadequate infrastructure (laboratory, Ambulance, Health Unit) | 2 | 1.9 | 1.9 | 100.0 |
| Total | 104 | 100.0 | 100.0 | |

These findings emphasize the prevalence and complexity of challenges in Uganda's health institutions, notably funding and resource-related issues.

*Fig. 9. Summative bar chart of Healthcare management challenges in Uganda*



### b) Awareness of AI Application in Healthcare

The variable "Awareness of AI Application in Healthcare" was another central point of investigation in this study, involving a total of 104 participants. The distribution of responses regarding awareness of AI's application in the healthcare sector provides insights into the participants' level of knowledge in this domain.

Of the 104 participants, 90.4% (n = 94) affirmed that they were aware of AI applications in healthcare, while 9.6% (n = 10) reported having no awareness. This distribution indicates a notable level of awareness among the respondents regarding the use of AI in healthcare settings.

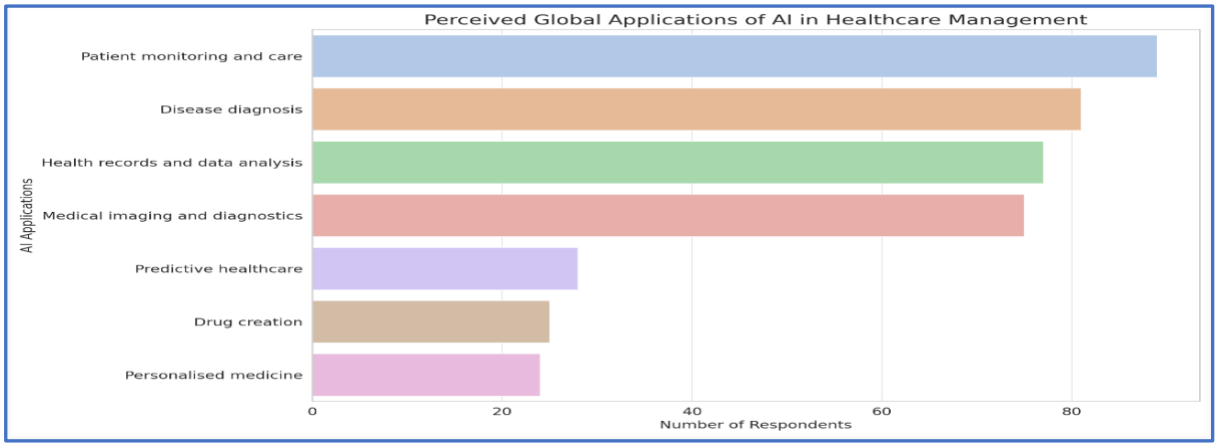
*Table 7. Descriptive Statistics for* Awareness *of AI Application in Healthcare globally*

| Awareness | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| No | 10 | 9.6 | 9.6 | 9.6 |
| Yes | 94 | 90.4 | 90.4 | 100.0 |
| Total | 104 | 100.0 | 100.0 | |

These findings highlight participants' substantial awareness of AI applications in healthcare, a crucial factor in answering the research question about the global application of artificial intelligence technology in healthcare management.

The graph below illustrates the healthcare management areas where respondents identified AI utilisation.

*Fig. 10. Perceived areas of AI Application in Healthcare management globally*



### c) Benefits of AI in Healthcare

The trend “Potential Benefits of AI Integration in Healthcare Management” was another focal point of inquiry within the study. The distribution of participant opinions regarding the potential benefits of incorporating AI into healthcare management offers insights into their perceived advantages of such integration.

The most commonly cited potential benefit was 'Improved efficiency' acknowledged by 46.2% (n = 48) of participants. A substantial proportion, 14.4% (n = 15), recognised the combined benefits of Improved efficiency, Better patient outcomes, Enhanced data analysis and Reduction in healthcare costs, highlighting the multifaceted advantages of AI integration.

Participants also identified Better patient outcomes (8.7%, n = 9) and Enhanced data analysis (2.9%, n = 3) as significant benefits. A smaller percentage noted the combined benefits of Improved efficiency, Better patient outcomes and Enhanced data analysis (5.8%, n = 6) while Enhanced data analysis and Reduction in healthcare costs were pointed out by 1.9%, (n = 2).

Additionally, Reduction in healthcare costs (1.9%, n = 2) was also identified as a potential benefit by the participants. Other combinations of benefits, including Improved efficiency, Better patient outcomes and Reduction in healthcare costs had 4.8%, (n = 5) and Improved efficiency and Enhanced data analysis (3.8%, n = 4), were also reported.

These findings address the research question about the potential benefits and limitations of using AI technology in healthcare management.

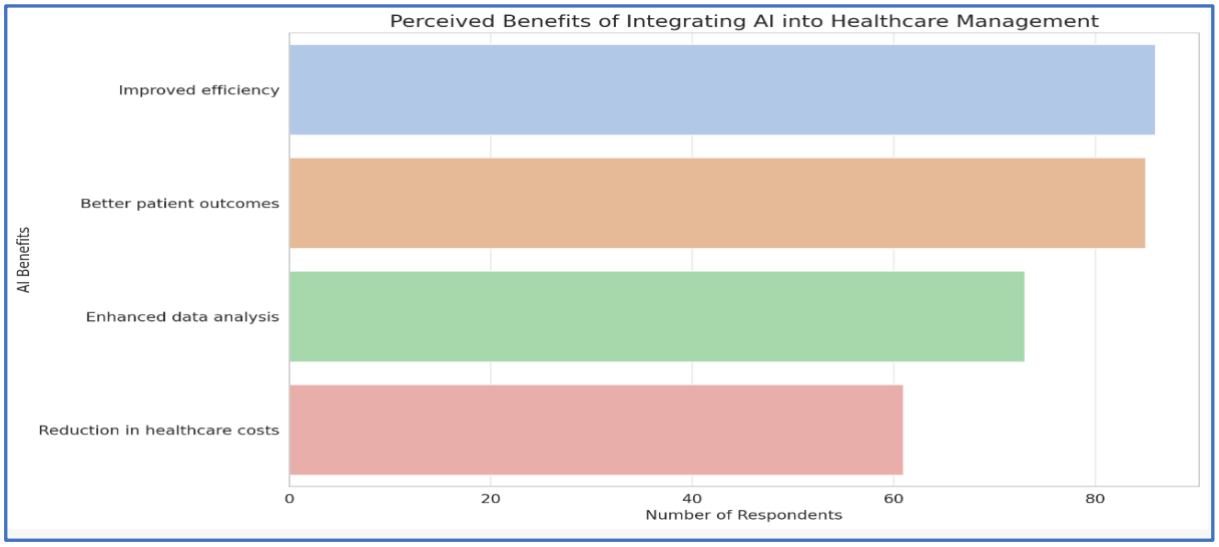
*Table 8. Descriptive Statistics for Potential Benefits of AI Integration in Healthcare Management*

| Potential Benefit | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| ○ Better patient outcomes | 9 | 8.7 | 8.7 | 8.7 |
| ○ Better patient outcomes<br>○ Reduction in healthcare costs | 2 | 1.9 | 1.9 | 10.6 |
| ○ Enhanced data analysis | 3 | 2.9 | 2.9 | 13.5 |
| ○ Enhanced data analysis<br>○ Reduction in healthcare costs | 2 | 1.9 | 1.9 | 15.4 |
| ○ Improved efficiency | 6 | 5.8 | 5.8 | 21.2 |

| | | | | |
|---|---|---|---|---|
| ○ Improved efficiency<br>○ Better patient outcomes | 6 | 5.8 | 5.8 | 26.9 |
| ○ Improved efficiency<br>○ Better patient outcomes<br>○ Enhanced data analysis | 15 | 14.4 | 14.4 | 41.3 |
| ○ Improved efficiency<br>○ Better patient outcomes<br>○ Enhanced data analysis<br>○ Reduction in healthcare costs | 48 | 46.2 | 46.2 | 87.5 |
| ○ Improved efficiency<br>○ Better patient outcomes<br>○ Reduction in healthcare costs | 5 | 4.8 | 4.8 | 92.3 |
| ○ Improved efficiency<br>○ Enhanced data analysis | 4 | 3.8 | 3.8 | 96.2 |
| ○ Improved efficiency<br>○ Enhanced data analysis<br>○ Reduction in healthcare costs | 1 | 1.0 | 1.0 | 97.1 |
| ○ Improved efficiency<br>○ Reduction in healthcare costs | 1 | 1.0 | 1.0 | 98.1 |
| ○ Reduction in healthcare costs | 2 | 1.9 | 1.9 | 100.0 |
| Total | 104 | 100.0 | 100.0 | |

These findings emphasize participants' views on potential AI integration benefits, including improved efficiency, enhanced patient outcomes, data analysis, and cost reduction. The diagram below illustrates the distribution of these perceived benefits across the study sample, providing a comprehensive overview.

*Fig. 11. Survey result on perceived benefits of AI integration in Healthcare management*




### d) Awareness of AI Risks in Healthcare

The trend "Awareness of AI Risks in Healthcare Management" was also examined in this study encompassing responses from a total of 104 participants. The distribution of responses regarding the awareness of potential risks associated with the integration of AI into healthcare management provides insights into participants' knowledge in this area.

Of the participants, 90.4% (n = 94) indicated that they were aware of AI-related risks in healthcare management, while 9.6% (n = 10) reported having no awareness. This distribution highlights a notable level of awareness among participants regarding the potential risks linked to AI integration in healthcare management.

*Table 9. Descriptive Statistics for Awareness of AI Risks in Healthcare Management*

| Awareness | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| No | 10 | 9.6 | 9.6 | 9.6 |
| Yes | 94 | 90.4 | 90.4 | 100.0 |
| Total | 104 | 100.0 | 100.0 | |

This result highlights participants' considerable awareness of AI integration risks in healthcare management, enhancing the credibility of responses to the research question on AI's potential benefits and limitations in healthcare management.

### e) Strategies for effective AI integration in Uganda Healthcare.

The study explored various strategies for the effective integration of AI in Uganda's healthcare system, based on responses from 104 participants. The distribution of these strategies provides insights into participants' perspectives on key approaches to harnessing AI's potential in healthcare management.

Among the identified strategies, “Implementing AI in remote diagnosis and telemedicine services” emerged as a significant approach with 32.7% (n = 34) of participants endorsing this strategy. Additionally, a combination of strategies involving Implementing AI in remote diagnosis and telemedicine services, Partnering with international tech firms to introduce advanced AI technologies in the Ugandan healthcare system and Consolidating the use of AI technologies to streamline administrative processes in healthcare facilities were favoured by 26.9% (n = 28) of participants.

Other strategies included Consolidating the use of AI technologies in training and education for healthcare professionals and Partnering with international tech firms to introduce advanced AI technologies in the Ugandan healthcare system (8.7%, n = 9). Implementing AI in remote diagnosis and telemedicine services, Consolidating the use of AI technologies in training and education for healthcare professionals and Partnering with international tech firms to introduce advanced AI technologies in the Ugandan healthcare system (8.7%, n = 9).

Responses also indicated support for strategies such as Consolidating the use of AI technologies in training and education for healthcare professionals and Partnering with international tech firms to introduce advanced AI technologies in the Ugandan healthcare system (1.9%, n = 2). Implementing AI in remote diagnosis and telemedicine services; Consolidating the use of AI technologies in training and education for healthcare professionals, Consolidating the use of AI technologies to streamline administrative processes in healthcare facilities (2.9%, n = 3) and Implementing AI in remote diagnosis and telemedicine services and Partnering with international tech firms to introduce advanced AI technologies in the Ugandan healthcare system (3.8%, n = 4).

Findings emphasize diverse strategies deemed essential by participants for AI integration in Uganda's healthcare system, addressing the research question on effective AI integration for improved management efficiency and healthcare delivery.

The cumulative percent provides an overview of the prevalence of these strategies across the participant sample as shown in the descriptive results in Table 10 below.

*Table 10. Descriptive Statistics for strategies for the effective integration of AI in Uganda's healthcare*

| Strategies | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| ○ Consolidating the use AI technologies in training and education for healthcare professionals.<br>○ Partnering with international tech firms to introduce advanced AI technologies in the Ugandan healthcare system | 2 | 1.9 | 1.9 | 1.9 |
| ○ Consolidating the use AI technologies in training and education for healthcare professionals.<br>○ Partnering with international tech firms to introduce advanced AI technologies in the Ugandan healthcare system<br>○ Consolidating the use AI technologies to streamline administrative processes in healthcare facilities. | 2 | 1.9 | 1.9 | 3.8 |
| ○ Consolidating the use AI technologies to streamline administrative processes in healthcare facilities. | 1 | 1.0 | 1.0 | 4.8 |
| ○ Implementing AI in remote diagnosis and telemedicine services. | 6 | 5.8 | 5.8 | 10.6 |

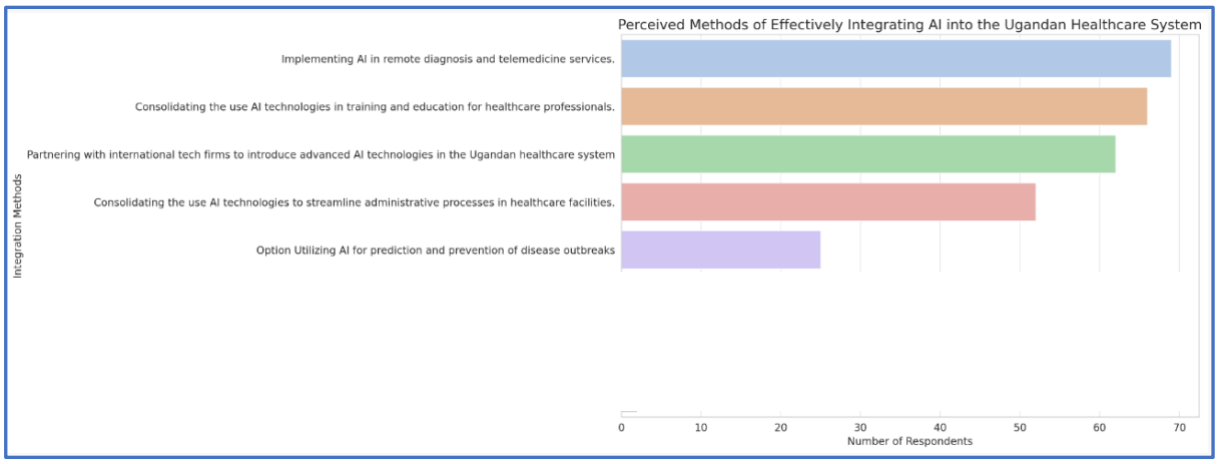
| | | | | |
|---|---|---|---|---|
| ○ Implementing AI in remote diagnosis and telemedicine services.<br>○ Consolidating the use AI technologies in training and education for healthcare professionals. | 5 | 4.8 | 4.8 | 15.4 |
| ○ Implementing AI in remote diagnosis and telemedicine services.<br>○ Consolidating the use AI technologies in training and education for healthcare professionals.<br>○ Consolidating the use AI technologies to streamline administrative processes in healthcare facilities. | 3 | 2.9 | 2.9 | 18.3 |
| ○ Implementing AI in remote diagnosis and telemedicine services.<br>○ Consolidating the use AI technologies in training and education for healthcare professionals.<br>○ Partnering with international tech firms to introduce advanced AI technologies in the Ugandan healthcare system | 9 | 8.7 | 8.7 | 26.9 |

| | | | | |
|---|---|---|---|---|
| ○ Implementing AI in remote diagnosis and telemedicine services.<br>○ Consolidating the use AI technologies in training and education for healthcare professionals.<br>○ Partnering with international tech firms to introduce advanced AI technologies in the Ugandan healthcare system.<br>○ Consolidating the use AI technologies to streamline administrative processes in healthcare facilities. | 28 | 26.9 | 26.9 | 53.8 |
| ○ Implementing AI in remote diagnosis and telemedicine services.<br>○ Option Utilizing AI for prediction and prevention of disease outbreaks.<br>○ Consolidating the use AI technologies in training and education for healthcare professionals.<br>○ Consolidating the use AI technologies to streamline administrative processes in healthcare facilities. | 1 | 1.0 | 1.0 | 54.8 |

| | | | | |
|---|---|---|---|---|
| ○ Implementing AI in remote diagnosis and telemedicine services.<br>○ Option Utilizing AI for prediction and prevention of disease outbreaks.<br>○ Consolidating the use AI technologies in training and education for healthcare professionals.<br>○ Partnering with international tech firms to introduce advanced AI technologies in the Ugandan healthcare system.<br>○ Consolidating the use AI technologies to streamline administrative processes in healthcare facilities. | 34 | 32.7 | 32.7 | 87.5 |
| ○ Implementing AI in remote diagnosis and telemedicine services.<br>○ Option Utilizing AI for prediction and prevention of disease outbreaks.<br>○ Partnering with international tech firms to introduce advanced AI technologies in the Ugandan healthcare system | 1 | 1.0 | 1.0 | 88.5 |
| ○ Implementing AI in remote diagnosis and telemedicine services.<br>○ Partnering with international tech firms to introduce advanced AI technologies in the Ugandan healthcare system | 4 | 3.8 | 3.8 | 92.3 |
| ○ Utilizing AI for prediction and prevention of disease outbreaks | 1 | 1.0 | 1.0 | 93.3 |

| | | | | |
|---|---|---|---|---|
| ○ Utilizing AI for prediction and prevention of disease outbreaks.<br>○ Consolidating the use of AI technologies in training and education for healthcare professionals. | 2 | 1.9 | 1.9 | 95.2 |
| ○ Utilizing AI for prediction and prevention of disease outbreaks.<br>○ Consolidating the use of AI technologies in training and education of healthcare professionals.<br>○ Consolidating the use of AI technologies to streamline administrative processes in healthcare facilities. | 2 | 1.9 | 1.9 | 97.1 |
| ○ Partnering with international tech firms to introduce advanced AI technologies in the Ugandan healthcare system | 3 | 2.9 | 2.9 | 100.0 |
| Total | 104 | 100.0 | 100.0 | |

*Fig. 12. Summative bar chart of strategies for the effective integration of AI in Uganda's healthcare*



### f) Considerations for AI Implementation

This study explored critical considerations for implementing AI in Uganda's healthcare management, drawing insights from responses provided by 104 participants. The distribution of considerations highlights participants' perspectives on the crucial factors that need to be addressed for successful AI integration in the healthcare sector.

Among the identified critical considerations, “Adequate funding” emerged as a significant factor, noted by 48.1% (n = 50) of participants. This was closely followed by a combination of considerations, including Adequate funding, Government support, Training of healthcare professionals, Availability of necessary infrastructure, Data privacy and security which garnered the attention of 11.5% (n = 12) of participants.

Other important considerations included; Government support (4.8%, n = 5), Government support and Training of healthcare professionals (2.9%, n = 3), and Training of healthcare professionals (4.8%, n = 5). Responses also indicated recognition of factors like; Availability of necessary infrastructure (1.9%, n = 2) and Data privacy and security (1.0%, n = 1).

Furthermore, considerations encompassing Training of healthcare professionals, Availability of necessary infrastructure and Government support, Training of healthcare professionals and Availability of necessary infrastructure each represented 1.9% (n = 2) of responses. Government support, Training of healthcare professionals, Availability of necessary infrastructure, Data privacy and security were also highlighted by 1.0% (n = 1) of participants.

These findings emphasize the multifaceted critical considerations for successful AI integration in Uganda's healthcare management, addressing the research question on effective integration for improved management efficiency and healthcare delivery.

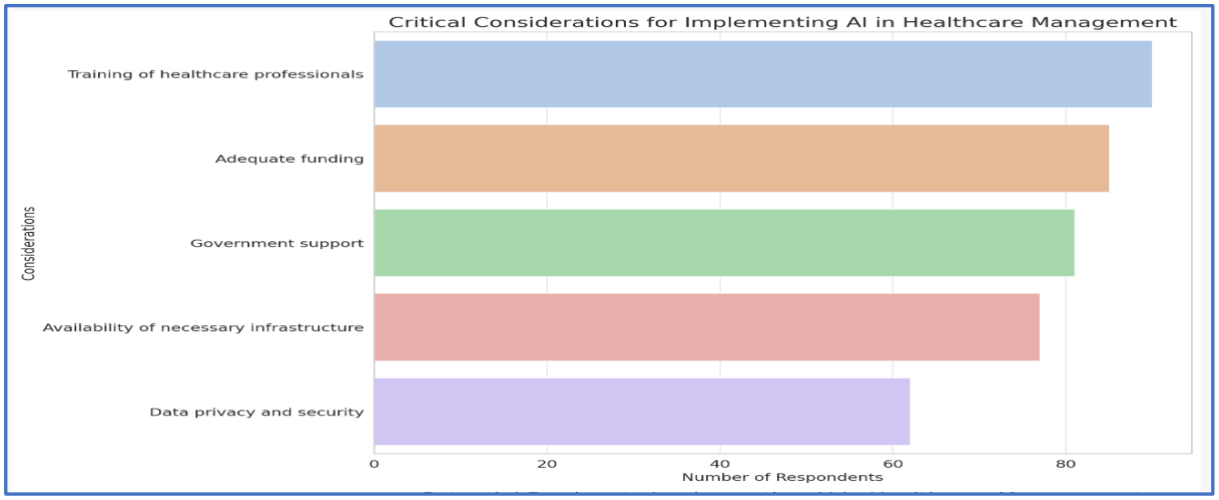
*Table 11. Descriptive Statistics for strategies for the effective integration of AI in Uganda's healthcare*

| Factors for consideration | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| ○ Adequate funding | 2 | 1.9 | 1.9 | 1.9 |
| ○ Adequate funding<br>○ Availability of necessary infrastructure | 1 | 1.0 | 1.0 | 2.9 |
| ○ Adequate funding<br>○ Government support<br>○ Availability of necessary infrastructure | 1 | 1.0 | 1.0 | 3.8 |
| ○ Adequate funding<br>○ Government support<br>○ Availability of necessary infrastructure<br>○ Data privacy and security | 1 | 1.0 | 1.0 | 4.8 |
| ○ Adequate funding<br>○ Government support<br>○ Data privacy and security | 1 | 1.0 | 1.0 | 5.8 |
| ○ Adequate funding<br>○ Government support<br>○ Training of healthcare professionals | 4 | 3.8 | 3.8 | 9.6 |
| ○ Adequate funding<br>○ Government support<br>○ Training of healthcare professionals<br>○ Availability of necessary infrastructure | 12 | 11.5 | 11.5 | 21.2 |
| ○ Adequate funding<br>○ Government support<br>○ Training of healthcare professionals<br>○ Availability of necessary infrastructure<br>○ Data privacy and security | 50 | 48.1 | 48.1 | 69.2 |

| | | | | |
|---|---|---|---|---|
| ○ Adequate funding<br>○ Government support<br>○ Training of healthcare professionals<br>○ Data privacy and security | 2 | 1.9 | 1.9 | 71.2 |
| ○ Adequate funding<br>○ Training of healthcare professionals | 3 | 2.9 | 2.9 | 74.0 |
| ○ Adequate funding<br>○ Training of healthcare professionals<br>○ Availability of necessary infrastructure | 2 | 1.9 | 1.9 | 76.0 |
| ○ Adequate funding<br>○ Training of healthcare professionals<br>○ Availability of necessary infrastructure<br>○ Data privacy and security | 5 | 4.8 | 4.8 | 80.8 |
| ○ Adequate funding<br>○ Training of healthcare professionals<br>○ Data privacy and security | 1 | 1.0 | 1.0 | 81.7 |
| ○ Availability of necessary infrastructure | 2 | 1.9 | 1.9 | 83.7 |
| ○ Data privacy and security | 1 | 1.0 | 1.0 | 84.6 |
| ○ Government support | 5 | 4.8 | 4.8 | 89.4 |
| ○ Government support<br>○ Training of healthcare professionals | 3 | 2.9 | 2.9 | 92.3 |
| ○ Government support<br>○ Training of healthcare professionals<br>○ Availability of necessary infrastructure | 1 | 1.0 | 1.0 | 93.3 |

| | | | | |
|---|---|---|---|---|
| ○ Government support<br>○ Training of healthcare professionals<br>○ Availability of necessary infrastructure<br>○ Data privacy and security | 1 | 1.0 | 1.0 | 94.2 |
| ○ Training of healthcare professionals | 5 | 4.8 | 4.8 | 99.0 |
| ○ Training of healthcare professionals<br>○ Availability of necessary infrastructure | 1 | 1.0 | 1.0 | 100.0 |
| Total | 104 | 100.0 | 100.0 | |

*Fig. 13. Summative bar chart of strategies for the effective integration of AI in Uganda's healthcare*



### g) Barriers to AI implementation

This study examined potential barriers to the implementation of AI in Uganda's healthcare management, based on responses from 104 participants. The distribution of these barriers provides insights into the perceived challenges that could hinder the successful integration of AI within the healthcare sector.

Among the identified potential barriers, the most prevalent was “Insufficient funding” highlighted by 33.7% (n = 35) of participants. This was closely followed by a combination of barriers including; Insufficient funding, Lack of skilled professionals, Limited infrastructure, Lack of knowledge about AI and Data privacy concerns, identified by 14.4% (n = 15) of participants.

Participants also recognised Limited infrastructure (1.9%, n = 2) and Lack of skilled professionals, Limited infrastructure, Lack of knowledge about AI (2.9%, n = 3) as barriers. Furthermore, responses indicated concerns related to Data privacy concerns (1.0%, n = 1) and Lack of knowledge about AI (1.9%, n = 2).

Additionally, barriers involving combination of Insufficient funding, Lack of skilled professionals, Limited infrastructure and Data privacy concerns (14.4%, n = 15). Insufficient funding, Lack of skilled professionals, Limited infrastructure, Lack of knowledge about AI and Data privacy concerns (33.7%, n = 35) were also noted.

These findings highlight the multifaceted challenges participants see as potential barriers to AI implementation in Uganda's healthcare management, offering insights into the research question about key considerations and potential barriers in healthcare management.

*Table 12. Descriptive Statistics for* potential *barriers to the implementation of AI in Uganda's healthcare management*

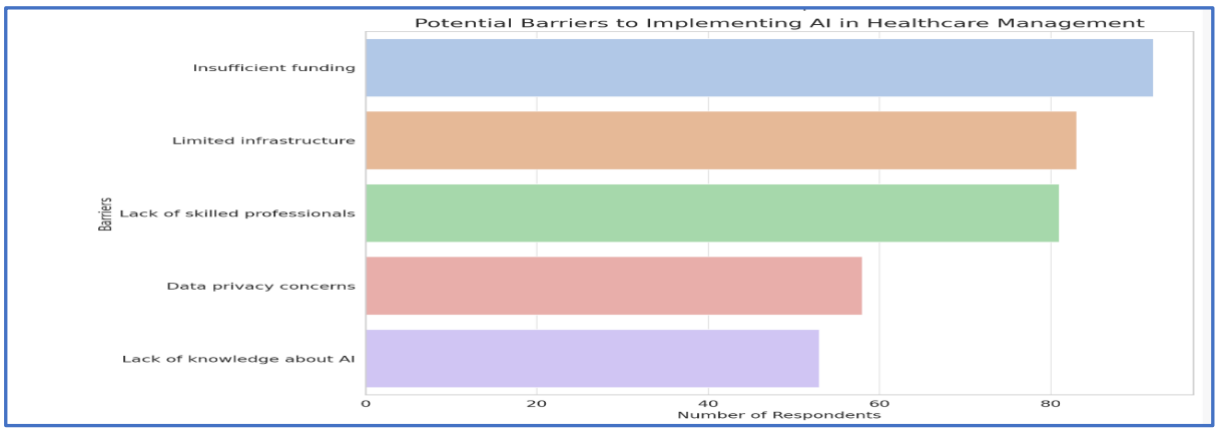
| Barriers | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| ○ Data privacy concerns | 1 | 1.0 | 1.0 | 1.0 |
| ○ Insufficient funding | 9 | 8.7 | 8.7 | 9.6 |
| ○ Insufficient funding<br>○ Data privacy concerns | 1 | 1.0 | 1.0 | 10.6 |
| ○ Insufficient funding<br>○ Lack of knowledge about AI | 1 | 1.0 | 1.0 | 11.5 |
| ○ Insufficient funding<br>○ Lack of skilled professionals | 2 | 1.9 | 1.9 | 13.5 |
| ○ Insufficient funding<br>○ Lack of skilled professionals<br>○ Lack of knowledge about AI | 2 | 1.9 | 1.9 | 15.4 |
| ○ Insufficient funding<br>○ Lack of skilled professionals<br>○ Lack of knowledge about AI<br>○ Data privacy concerns | 1 | 1.0 | 1.0 | 16.3 |
| ○ Insufficient funding<br>○ Lack of skilled professionals<br>○ Limited infrastructure | 15 | 14.4 | 14.4 | 30.8 |
| ○ Insufficient funding<br>○ Lack of skilled professionals<br>○ Limited infrastructure<br>○ Data privacy concerns | 15 | 14.4 | 14.4 | 45.2 |

| | | | | |
|---|---|---|---|---|
| ○ Insufficient funding<br>○ Lack of skilled professionals<br>○ Limited infrastructure<br>○ Lack of knowledge about AI | 4 | 3.8 | 3.8 | 49.0 |
| ○ Insufficient funding<br>○ Lack of skilled professionals<br>○ Limited infrastructure<br>○ Lack of knowledge about AI<br>○ Data privacy concerns | 35 | 33.7 | 33.7 | 82.7 |
| ○ Insufficient funding<br>○ Limited infrastructure | 2 | 1.9 | 1.9 | 84.6 |
| ○ Insufficient funding<br>○ Limited infrastructure<br>○ Data privacy concerns | 1 | 1.0 | 1.0 | 85.6 |
| ○ Insufficient funding<br>○ Limited infrastructure<br>○ Lack of knowledge about AI | 1 | 1.0 | 1.0 | 86.5 |
| ○ Insufficient funding<br>○ Limited infrastructure<br>○ Lack of knowledge about AI<br>○ Data privacy concerns | 3 | 2.9 | 2.9 | 89.4 |
| ○ Lack of knowledge about AI | 2 | 1.9 | 1.9 | 91.3 |
| ○ Lack of skilled professionals | 2 | 1.9 | 1.9 | 93.3 |
| ○ Lack of skilled professionals<br>○ Limited infrastructure | 1 | 1.0 | 1.0 | 94.2 |

| | | | | |
|---|---|---|---|---|
| ○ Lack of skilled professionals<br>○ Limited infrastructure<br>○ Lack of knowledge about AI | 3 | 2.9 | 2.9 | 97.1 |
| ○ Lack of skilled professionals<br>○ Limited infrastructure<br>○ Lack of knowledge about AI<br>○ Data privacy concerns | 1 | 1.0 | 1.0 | 98.1 |
| ○ Limited infrastructure | 2 | 1.9 | 1.9 | 100.0 |
| Total | 104 | 100.0 | 100.0 | |

The cumulative percentage offers a comprehensive view of the prevalence of these barriers across the participant sample.

*Fig. 14. Summative bar chart of potential barriers to the implementation of AI in Uganda's healthcare management.*



### h) Strategies to Overcome the Barriers

This study examined strategies to overcome the identified barriers to implementing AI in Uganda's healthcare management, drawing insights from responses provided by 104 participants. The distribution of strategies highlights participants' perspectives on potential approaches to address the challenges hindering effective AI integration in the healthcare sector.

Among the identified strategies, “Increased government funding” emerged as a significant approach, endorsed by 27.9% (n = 29) of participants. This was closely followed by a combination of strategies, including Increased government funding, More AI training for staff, Infrastructure improvements, Public awareness campaigns about AI, Strict data privacy and security measures, favoured by 20.2% (n = 21) of participants.

Additionally, respondents also recognised the importance of strategies such as Infrastructure improvements (1.9%, n = 2), More AI training for staff, Infrastructure improvements (1.9%, n = 2), and Increased government funding, More AI training for staff, Infrastructure improvements and Public awareness campaigns about AI (15.4%, n = 16).

Furthermore, responses indicated support for a combination of strategies including Increased government funding, More AI training for staff, Infrastructure improvements, Strict data privacy and security measures (27.9%, n = 29) while Increased government funding, More AI training for staff and Public awareness campaigns about AI (4.8%, n = 5). Moreover, strategies including More AI training for staff, Infrastructure improvements, Public awareness campaigns about AI, Strict data privacy and security measures'(1.0%, n = 1) were also highlighted.
These findings emphasize the multifaceted strategies participants consider vital for overcoming barriers to AI implementation in Uganda's healthcare management, providing answers to the research question on effective integration for improved management efficiency and healthcare delivery.

*Table 13. Descriptive Statistics for strategies to overcome the barriers*

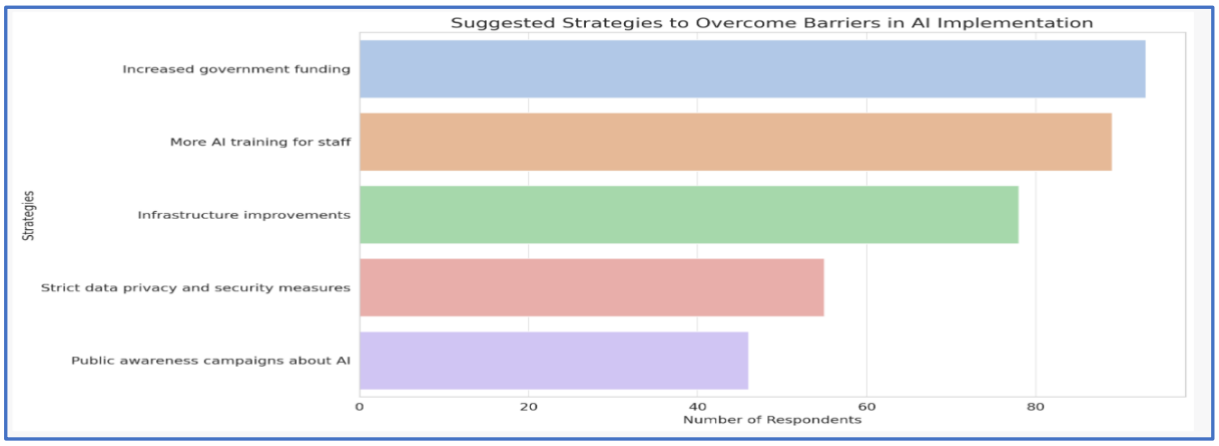
| Strategies | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| ○ Increased government funding | 8 | 7.7 | 7.7 | 7.7 |
| ○ Increased government funding<br>○ Infrastructure improvements | 2 | 1.9 | 1.9 | 9.6 |
| ○ Increased government funding<br>○ Infrastructure improvements<br>○ Public awareness campaigns about AI<br>○ Strict data privacy and security measures | 1 | 1.0 | 1.0 | 10.6 |
| ○ Increased government funding<br>○ Infrastructure improvements<br>○ Strict data privacy and security measures | 1 | 1.0 | 1.0 | 11.5 |
| ○ Increased government funding<br>○ More AI training for staff | 5 | 4.8 | 4.8 | 16.3 |
| ○ Increased government funding<br>○ More AI training for staff<br>○ Infrastructure improvements | 16 | 15.4 | 15.4 | 31.7 |
| ○ Increased government funding<br>○ More AI training for staff<br>○ Infrastructure improvements<br>○ Public awareness campaigns about AI | 3 | 2.9 | 2.9 | 34.6 |

| | | | | |
|---|---|---|---|---|
| ○ Increased government funding<br>○ More AI training for staff<br>○ Infrastructure improvements<br>○ Public awareness campaigns about AI<br>○ Strict data privacy and security measures | 29 | 27.9 | 27.9 | 62.5 |
| ○ Increased government funding<br>○ More AI training for staff<br>○ Infrastructure improvements<br>○ Strict data privacy and security measures | 21 | 20.2 | 20.2 | 82.7 |
| ○ Increased government funding<br>○ More AI training for staff<br>○ Public awareness campaigns about AI | 5 | 4.8 | 4.8 | 87.5 |
| ○ Increased government funding<br>○ More AI training for staff<br>○ Public awareness campaigns about AI<br>○ Strict data privacy and security measures | 1 | 1.0 | 1.0 | 88.5 |
| ○ Increased government funding<br>○ Public awareness campaigns about AI<br>○ Strict data privacy and security measures | 1 | 1.0 | 1.0 | 89.4 |
| ○ More AI training for staff | 3 | 2.9 | 2.9 | 92.3 |
| ○ More AI training for staff<br>○ Infrastructure improvements | 2 | 1.9 | 1.9 | 94.2 |
| ○ More AI training for staff<br>○ Infrastructure improvements<br>○ Public awareness campaigns about AI | 2 | 1.9 | 1.9 | 96.2 |

| | | | | |
|---|---|---|---|---|
| ○ More AI training for staff<br>○ Infrastructure improvements<br>○ Public awareness campaigns about AI<br>○ Strict data privacy and security measures | 1 | 1.0 | 1.0 | 97.1 |
| ○ More AI training for staff<br>○ Public awareness campaigns about AI | 1 | 1.0 | 1.0 | 98.1 |
| ○ Public awareness campaigns about AI | 2 | 1.9 | 1.9 | 100.0 |
| Total | 104 | 100.0 | 100.0 | |

The cumulative percent provides a comprehensive view of the prevalence of these strategies across the participant sample.

*Fig. 15. Summative bar chart of strategies to overcome the barriers*



# CHAPTER 5: ANALYSIS AND DISCUSSION

## 5.1. Analysis

In this chapter, I delve into a detailed analysis and discussion of the findings obtained during the course of this study. To provide a clear framework for my discussion, I begin by enumerating the key study variables considered in this chapter. These variables include;

- Participants,
- Organisation,
- The most significant challenges faced by healthcare institutions,
- Awareness of AI applications in healthcare globally,
- Potential benefits of AI integration in healthcare management,
- Awareness of AI-related risks in healthcare management,
- Critical considerations for AI implementation in healthcare management,
- Potential barriers to AI implementation in Uganda's healthcare system,
- Strategies to overcome the barriers.

General findings have already been presented in Chapter 4. I will now proceed to engage in a comprehensive exploration of these findings vis-à-vis the existing literature. This chapter's overarching purpose is to establish a contextualized understanding of the study's outcomes by drawing comparisons between my findings in Uganda and the observations documented by researchers in various African and global contexts. While I refrain from generalisations due to the limited data available for generalisation in the literature review, I emphasize a comparative approach. Specifically, I will compare and contrast my findings with specific articles and studies referenced in the literature review. To enhance clarity and comprehension, I will also provide graphic illustrations of other researchers' findings and elucidate the implications and insights that emerge from these comparisons.

**Study Variable: Participants**

The study's participant gender distribution is relatively balanced, with 54.8% identifying as male and 45.2% as female, indicating a diverse sample essential for a comprehensive understanding of the research topic. In terms of age distribution, the majority (about 79.8%) fall between 26 to 45 years, ensuring insights from various age groups within the healthcare context.

**Study Variable: Organisation**

The participant distribution across various healthcare positions reflects a diverse sample. Nurses make up the largest group (26%), followed closely by physicians (25%), technicians (18.3%), consultants (16.3%), and administrators (14.4%), ensuring a wide perspective on AI integration in healthcare institutions. Moreover, participants' varied lengths of stay at healthcare institutions, with the majority having spent 4-10 years, encompass perspectives from both newcomers and experienced professionals, facilitating a holistic analysis of AI integration in healthcare management.

**Study Variable: Most Significant Challenge Faced by the Institution**

The distribution of responses regarding the most significant challenges faced by healthcare institutions shows that a substantial majority (85.6%) of participants perceive multiple challenges. These include insufficient funding, a shortage of skilled personnel, limited access to medical equipment, and inadequate infrastructure. This multifaceted perspective underscores the complexity of challenges in healthcare management and the necessity for comprehensive solutions.

**Study Variable: Awareness of AI Application in Healthcare Globally**

A significant majority of participants (90.4%) reported awareness of AI applications in global healthcare. This high level of awareness among healthcare professionals suggests a readiness to engage with AI technologies in the sector.

**Study Variable: Potential Benefits of AI Integration in Healthcare Management**

The distribution of responses regarding the potential benefits of AI integration in healthcare management reveals that 46.2% of participants recognize a combination of benefits, including improved efficiency; better patient outcomes; enhanced data analysis and reduced healthcare costs. This view underscores the potential for AI to deliver multifaceted advantages.

**Study Variable: Awareness of AI Risks in Healthcare Management**

A substantial majority of participants (90.4%) reported awareness of AI-related risks in healthcare management. This high level of awareness reflects a recognition of the potential challenges and pitfalls associated with AI integration.

**Study Variable: Critical Considerations for AI Implementation in Healthcare Management**

The distribution of critical considerations for AI implementation reveals a multifaceted approach, with participants emphasising various factors, including adequate funding;

government support; training of healthcare professionals; availability of necessary infrastructure; and data privacy and security. These considerations reflect the complexity of implementing AI in healthcare management.

**Study Variable: Potential Barriers to Implementation of AI in Uganda Healthcare**

Participants identified multiple potential barriers to AI implementation, with the most prevalent being insufficient funding (33.7%) and a combination of barriers involving funding; skilled professionals; infrastructure; knowledge about AI; and data privacy concerns (33.7%). These findings underscore the multifaceted challenges that must be addressed to facilitate successful AI integration in Uganda's healthcare.

**Study Variable: Strategies to Overcome the Barriers**

Participants proposed diverse strategies to overcome barriers, including increased government funding. The most common strategies involved a combination of funding; staff training; infrastructure improvements; public awareness campaigns about AI; and stringent data privacy measures. These strategies underscore the need for comprehensive approaches to effectively address the identified barriers.

In conclusion, the study benefits from a diverse and informed participant sample, featuring balanced gender distribution, a broad age range, and a variety of roles within healthcare institutions. The findings highlight the complexity of challenges, benefits, and strategies related to AI integration in Uganda's healthcare management. This underscores the importance of comprehensive and informed approaches to unlock AI's potential in the sector.

## 5.2. Discussion

The effective application of AI in Uganda’s healthcare could be a great leap in administration and a transformational force for overcoming the issues identified in this study.

### a) Challenges in Healthcare Management

The survey results reveal common healthcare management challenges shared by many countries, especially in developing regions. These challenges encompass insufficient funding, restricted access to medical equipment, inadequate infrastructure, and a shortage of skilled personnel. The scarcity of expertise, particularly in emerging technologies like AI, is a global

concern highlighted in numerous studies. Developed countries also encounter issues related to data privacy, security, and integration complexities.

### b) Barriers to Implementing AI in Healthcare

The survey revealed various barriers hindering AI adoption in Uganda, such as insufficient funding, a shortage of AI-trained professionals, inadequate infrastructure, and limited awareness or knowledge of AI. These barriers are consistent with challenges observed in many other countries worldwide. Additionally, global research has emphasized concerns related to data privacy, security, and ethical considerations of AI in healthcare, which may become more prominent concerns as Uganda further integrates AI.

### c) Strategies to Overcome Barriers

Numerous studies emphasize the importance of government support, including policies and funding, for the effective integration of AI in the healthcare sector. Training and capacity-building are recurring themes in the literature, reflecting the global nature of this challenge. Collaborations and partnerships between academia, tech companies, and healthcare institutions are frequently highlighted as vital for driving innovation and tailoring AI solutions to address specific healthcare needs.

*Table 14*. **AI APPLICATION TRENDS IN HEALTHCARE**

| Author | Date of Publication | What was measured | Findings |
|---|---|---|---|
| Gopalakrishnan K. et al. | 23 February 2023 | Applications of Microwaves in Medicine Leveraging Artificial Intelligence | This study found that integrating AI in the use of microwaves can significantly improve patient care. |
| Hamza R. et al. | 16 February 2023 | The increasing trend of using wearable devices and smart accessories for health monitoring | This study highlights the benefits of integrating intelligent technologies with healthcare monitoring, enhancing learning outcomes and ensuring security and efficiency. |
| Rohit Kaul, et al. | 21 November 2022 | The role of AI for developing digital twins in healthcare | This study shows that combining AI with digital twins can streamline data integration from diverse sources, leading to better diagnosis and treatment.. |

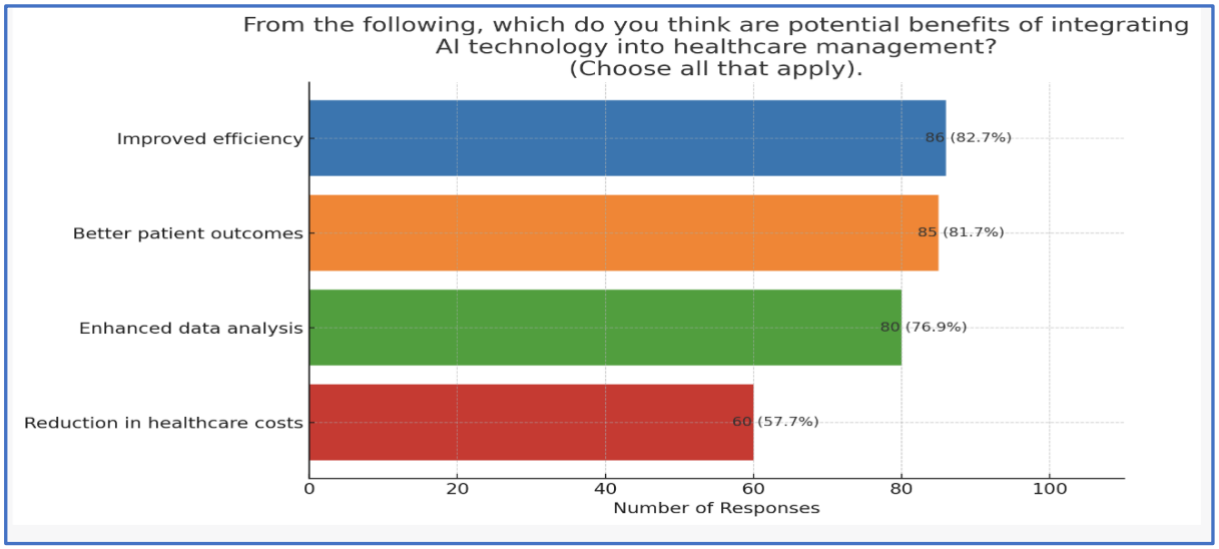
| | | | |
|---|---|---|---|
| Nawfal A. et al. | 20 November 2022 | the increasing utilization of AI in healthcare in Saudi Arabia | This study highlights the significant role of AI in diagnostic radiology and the development of personalised healthcare plans. |
| Sreenidhi P. et al. | 01 November 2022 | To identify the ethical concerns of AI applications in healthcare. | This study suggests a multifaceted approach involving policymakers, developers, healthcare providers, and patients is needed to address ethical issues. |
| Alabdulatif, A. et al. | 31 October 2022 | The security challenges and countermeasures in smart healthcare environments | This study proposes using AI and blockchain-based secure architecture to improve the security and safety of wearable devices. |
| Kunal B. et al. | 01 September 2022 | The emerging trend of the Metaverse and its potential applications AV/VR in healthcare.<br><br>AR= Argumented Reality<br><br>VR= Virtual Reality | This study highlights the transformative impact of augmented and virtual reality on healthcare. From improving surgical precision to therapeutic interventions, AR/VR technology offers promising solutions to long-standing challenges in healthcare. |
| Pandiaraj M. et al. | 25 July 2022 | The importance of AI in enhancing the capabilities of IoMT and point-of-care (POC) devices. | This study found that integrating AI can improve the functionality, detection accuracy, and decision-making ability of point-of-care devices. |

The literature analysis table above indicates that, the current trend in AI application in healthcare globally are;

### Applications of Microwaves in Medicine with AI

Gopalakrishnan et al. (2023) explore the integration of AI with microwaves in medical applications, suggesting that such integration holds the potential for significant advancements in patient care. This assertion aligns with the findings of this study, which indicate that AI application can indeed result in improved efficiency and better patient outcomes, as presented in the chart below.

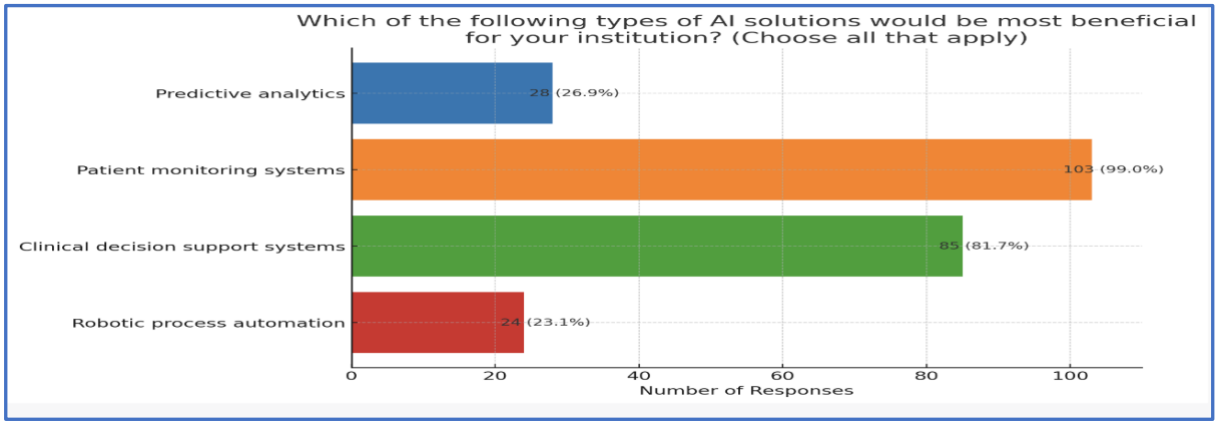
*Fig. 16. Potential benefits of AI in Healthcare Management*




## Wearable Devices and Smart Accessories for Health Monitoring

Rafik, Maizate, and Ettaoufik (2023) emphasize the growing trend of using smart wearables and accessories for health monitoring. Their core finding suggests that integrating AI technologies like Machine Learning, Deep Learning, and Reinforcement Learning can provide a more secure and efficient health monitoring system. This argument aligns with the findings of this study, which also indicate that AI usage can enhance patient monitoring, as shown in the chart below.

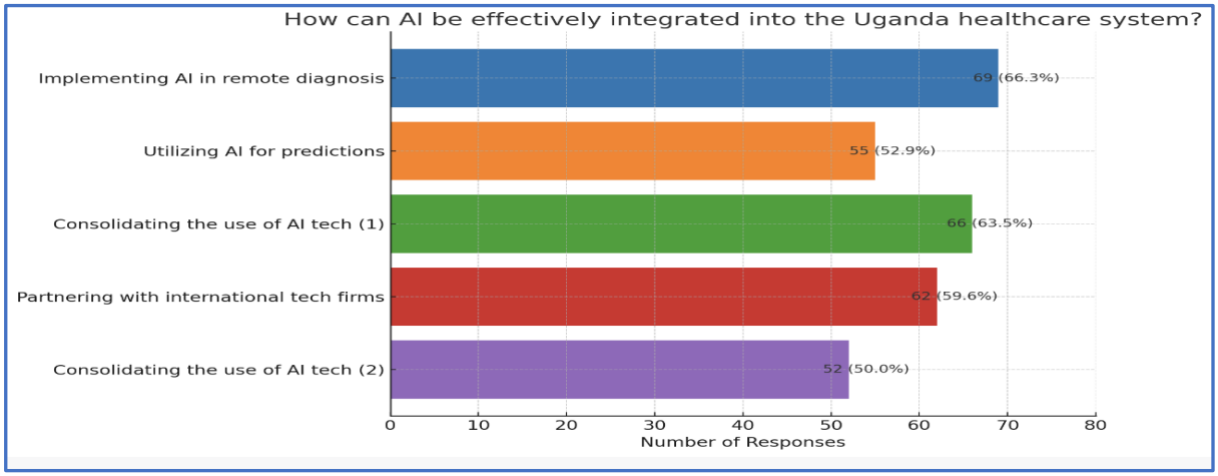
*Fig. 17. Choice of AI Application*



### AI in Developing Digital Twins for Healthcare

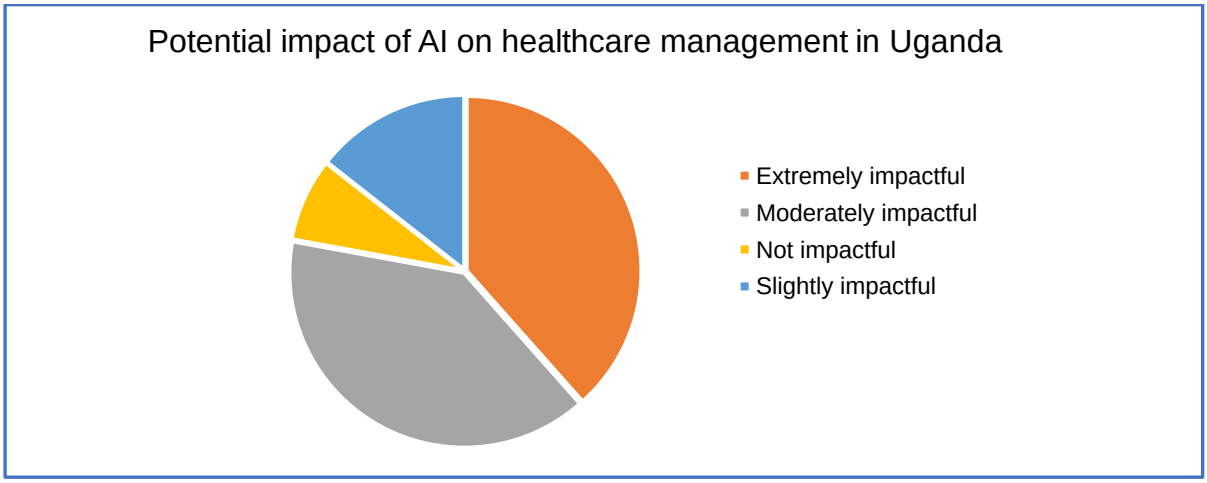
Kaul et al. (2023) investigated the role of AI in developing digital twins, which are virtual representations of real-world patients, medical devices, or processes in healthcare. They emphasize that the fusion of digital twins with AI can facilitate the integration and processing of extensive data from various sources, ultimately resulting in improved diagnostic and treatment decisions. This argument aligns with the findings of this study, where 66.3% of respondents suggest that integrating AI in remote diagnosis can be beneficial, as shown below.

*Fig. 18. Effective Integration of AI Application in Uganda's Healthcare*




Furthermore, Aljerian et al. (2022) shed light on the increasing adoption of AI in healthcare in Saudi Arabia, highlighting its significant role, especially in diagnostics. Similarly, Bhugaonkar, Bhugaonkar, and Masne (2022) discuss the emerging trend of the Metaverse and its potential applications in the healthcare sector, emphasizing the transformative possibilities of augmented and virtual reality in healthcare, from enhancing surgical precision to therapeutic applications. Additionally, Manickam et al. (2022) underscore the importance of AI in augmenting the capabilities of the Internet of Medical Things (IoMT) and point-of-care (POC) devices. Their findings reveal that AI can notably enhance the functionality, detection accuracy, and decision-making ability of these devices, a perspective that aligns with the survey responses in this study on the impact of AI on Uganda's healthcare management efficiency.

*Fig. 19. Potential Impact of AI Application in Uganda's Healthcare*




### Security in Smart Healthcare Environments

Alabdulatif, Khalil, and Saidur Rahman (2022) investigated security challenges in smart healthcare settings. Their findings suggest the potential of AI and blockchain-based architectures in analysing threats, such as malware and network attacks, particularly on wearable devices.

The findings of this study on AI in Uganda's healthcare also underscore safety concerns related to data privacy, as indicated in the descriptive table below.

Table 15. Awareness of AI Risks

| Awareness of AI risks in Healthcare management | | | | | |
|---|---|---|---|---|---|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | No | 10 | 9.6 | 9.6 | 9.6 |
| | Yes | 94 | 90.4 | 90.4 | 100.0 |
| | Total | 104 | 100.0 | 100.0 | |

Additionally, Prakash et al. (2022) identify ethical challenges presented by AI applications in healthcare. Their research emphasizes the necessity of a comprehensive approach involving various stakeholders, including policymakers, developers, healthcare providers, and patients, to address these ethical concerns.

In summary, there are both commonalities and discrepancies between the survey findings and existing research. Both global studies and the survey results highlight obstacles related to funding, infrastructure, and the need for skilled AI specialists. Additionally, they emphasize the

importance of collaboration, education, and raising public awareness. However, there are also differences.

The survey in Uganda places more emphasis on infrastructural challenges and basic awareness about AI, reflecting the early stages of AI adoption in the country. In contrast, existing research from more developed regions such as Europe and America delves deeper into challenges concerning data privacy, ethical considerations, and the complexities of integrating AI with existing healthcare systems.

As AI continues to evolve and gain traction globally, the challenges and strategies to address them may evolve as well. For instance, as foundational issues like infrastructure and awareness are addressed in Uganda, more advanced challenges like data integration, ethics, and specialized AI applications may become prominent. Additionally, ongoing research, technological advancements, and global collaborations could accelerate the pace at which countries like Uganda can fully harness the potential of AI in healthcare.

### 5.3. Implications

This research conducted in Uganda identified that similar challenges are encountered by countries worldwide. However, it also emphasized the specific context and degree of AI implementation in Uganda's healthcare. Importantly, it underscores the need to customize healthcare AI approaches to align with regional needs while incorporating successful practices from across the globe.

### 5.4. Future Research

Future research could benefit from a more expansive and diverse data collection approach, incorporating mixed methods (quantitative and qualitative), engaging with a broader range of stakeholders, and focusing on a more representative sample of regions and healthcare institutions. This would enhance the robustness, validity, and generalizability of the findings, providing a more comprehensive understanding of the impact of AI on healthcare management efficiency in Uganda.

# CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

## 6.1. Summary

A) Research Questions and Objectives

1. Challenges in Healthcare management in Uganda

The analysis identified significant challenges, including insufficient funding, lack of skilled personnel, limited access to medical equipment, and inadequate infrastructure. These challenges form the foundational understanding of the current state of healthcare in Uganda.

2. AI-enabled systems in Healthcare management

The study identified obstacles to implementing AI in healthcare management and suggested ways to overcome them. These insights can help identify the necessary requirements for successfully integrating AI into Uganda's healthcare.

3. Evaluating AI's role in addressing challenges and improving Healthcare delivery

The analysis underscored the potential of AI to enhance healthcare delivery by addressing existing challenges. Key barriers were identified, along with actionable strategies to overcome them, paving the way for informed and effective AI integration in Uganda's healthcare system.

B) General and Specific Objectives

1. Examining the impact of AI on Healthcare management efficiency

The findings present a compelling case for the potential positive impact of AI on healthcare management efficiency in Uganda. However, they also emphasize existing barriers that must be addressed to realize this potential.

## 6.2. Conclusion

This study provides an understanding of the current healthcare landscape in Uganda and the role that AI can play in enhancing management efficiency. The insights derived from the survey offer a roadmap for integrating AI into healthcare, addressing existing challenges, and leveraging opportunities. However, the successful integration of AI in healthcare management

in Uganda is dependent upon a multifaceted approach involving strategic planning, collaboration, investment, education, and ethical considerations.

### 6.3. Recommendations

Based on the research questions, objectives, findings, and the above conclusion, this study recommends the following;

1. Enhance Financial Support and Investment: Government entities, donors, and private investors should prioritize allocating funds for the integration of AI in healthcare. This funding should encompass infrastructure development, technology acquisition, and training programs.
2. Promote AI Education and Training Initiatives: Collaborative efforts between educational institutions, healthcare providers, and technology companies are needed to establish specialized AI training and education programs for healthcare professionals. These initiatives aim to bridge the skills gap, nurture expertise in AI applications and drive innovation.
3. Improve Technological Infrastructure and Accessibility: The government should make substantial investments in enhancing technological infrastructure, such as internet connectivity and data centres, to facilitate the seamless integration and operation of AI-enabled systems.
4. Promote Public Awareness and Engagement: Government initiatives should include public awareness campaigns to educate both healthcare professionals and the general public about the potential benefits, limitations, and ethical considerations surrounding AI in healthcare.
5. Ensure Equitable Implementation: Government efforts should emphasize the development and implementation of AI solutions with a strong focus on equity and accessibility. This approach ensures that the advantages of AI reach all segments of the population, including those in rural and underserved areas.
6. Encourage Research and Development Initiatives: The government should provide support for research and development initiatives aimed at exploring innovative AI applications tailored to Uganda's unique healthcare landscape.

These recommendations emphasise a multi-stakeholder approach to enhance healthcare management efficiency in Uganda through Artificial Intelligence.

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# CHAPTER 8: APPENDICES

## Appendix 1: Questionnaire

# RESEARCH QUESTIONNAIRE

**THIS RESEARCH AIMS TO STUDY HOW ARTIFICIAL INTELLIGENCE TECHNOLOGY CAN BE LEVERAGED TO IMPROVE HEALTHCARE MANAGEMENT EFFICIENCY IN UGANDA**

**A brief description of AI in Healthcare**

Artificial Intelligence(AI), in healthcare, refers to the use of computerised technologies and systems such as Applications(Apps) to perform tasks that typically require human intelligence, such as analysing medical data, making diagnoses, and providing personalised treatment recommendations.

What is your Gender? *

**Demographic Information**

- [ ] Male
- [ ] Female

Which age range best describes you? *

- [ ] 18-25
- [ ] 26-35
- [ ] 36-45
- [ ] 46- 55
- [ ] 56 and above

What is your position at the healthcare institution? *

**Background Information**

- [ ] Consultant
- [ ] Physician
- [ ] Nurse

Which of the following challenges would you consider as the most significant faced by your institution in managing healthcare delivery.
(Choose all that apply). *

**Current Healthcare Management Challenges**

- [ ] Insufficient funding
- [ ] Lack of skilled personnel
- [ ] Limited access to medical equipment
- [ ] Inadequate infrastructure (laboratory, Ambulance, Health Unit)

How significantly have these challenges affected healthcare delivery in your institution? *

- [ ] A little
- [ ] Moderately
- [ ] Quite a lot
- [ ] Extremely

Are you aware of the applications of artificial intelligence (AI) in healthcare management? *

**Knowledge of Artificial Intelligence in Healthcare**

- [ ] Yes
- [ ] No

If yes, please select from the following list where AI technology has been applied in healthcare management globally *
(choose all that apply):

- [ ] Disease diagnosis
- [ ] Patient monitoring and care
- [ ] Medical imaging and diagnostics
- [ ] Drug creation
- [ ] Personalised medicine

How would you rate the potential impact of AI on healthcare management in Uganda?

- [ ] Not impactful
- [ ] Slightly impactful
- [ ] Moderately impactful
- [ ] Extremely impactful

From the following, which do you think are potential benefits of integrating AI technology into healthcare management? *
(Choose all that apply)

**Benefits and Limitations of AI in Healthcare Management**

- [ ] Improved efficiency
- [ ] Better patient outcomes
- [ ] Enhanced data analysis
- [ ] Reduction in healthcare costs

Are you aware of any limitations or risks associated with using AI technology in healthcare management?

- [ ] Yes
- [ ] No

How can AI technology be effectively integrated into the Ugandan healthcare system ? *

(Choose all that apply)

**Integration of AI in Uganda's Healthcare System**

- [ ] Implementing AI in remote diagnosis and telemedicine services.
- [ ] Option Utilizing AI for prediction and prevention of disease outbreaks
- [ ] Consolidating the use AI technologies in training and education for healthcare professionals.
- [ ] Partnering with international tech firms to introduce advanced AI technologies in the Ugandan healthcare...
- [ ] Consolidating the use AI technologies to streamline administrative processes in healthcare facilities.

What strategies would you suggest to overcome these barriers? *

(Choose all that apply)

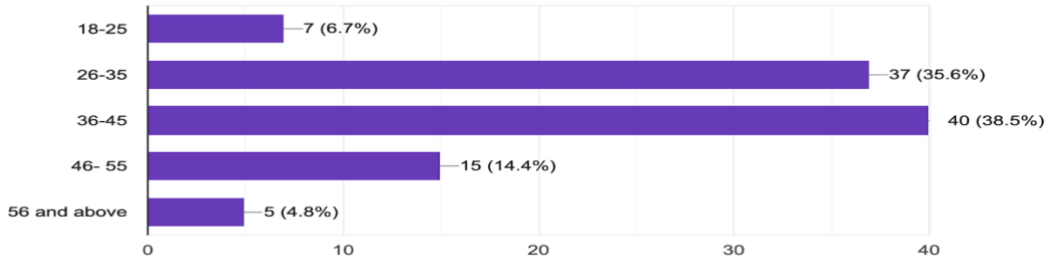
**Overcoming Barriers**

- [ ] Increased government funding
- [ ] More AI training for staff
- [ ] Infrastructure improvements
- [ ] Public awareness campaigns about AI
- [ ] Strict data privacy and security measures

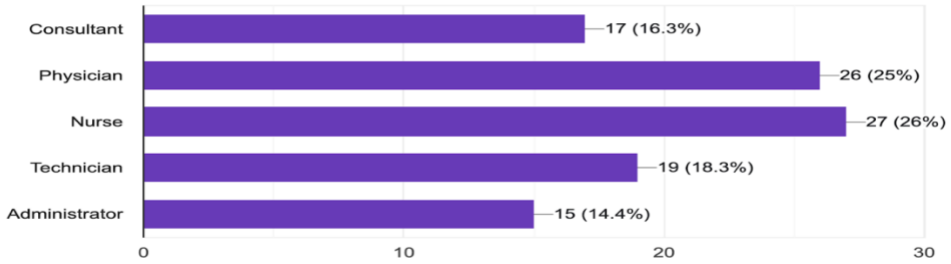
## Appendix 2: Survey Responses

What is your Gender?
104 responses

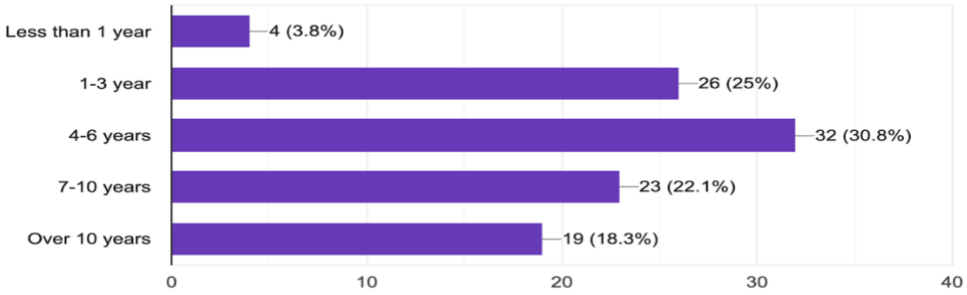
Which age range best describes you?
104 responses



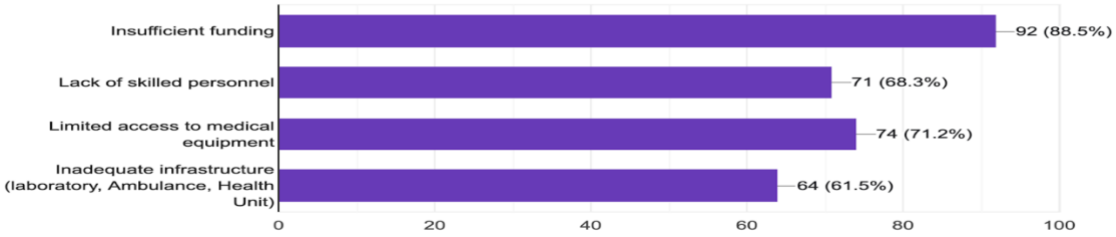
What is your position at the healthcare institution?
104 responses



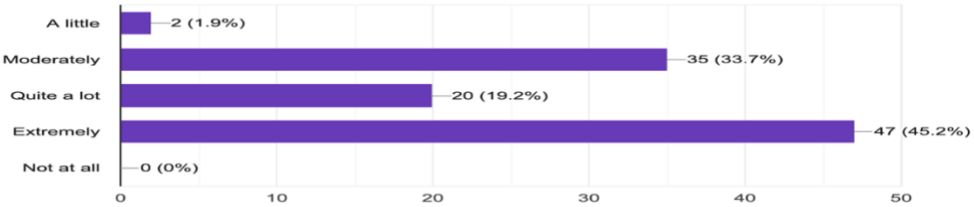

How long have you been in this position?
104 responses



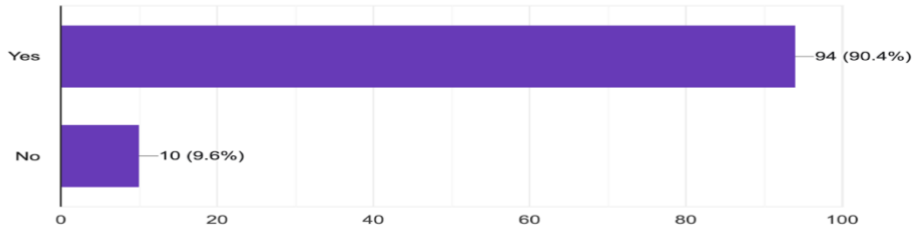

Which of the following challenges would you consider as the most significant faced by your institution in managing healthcare delivery. (Choose all that apply).
104 responses



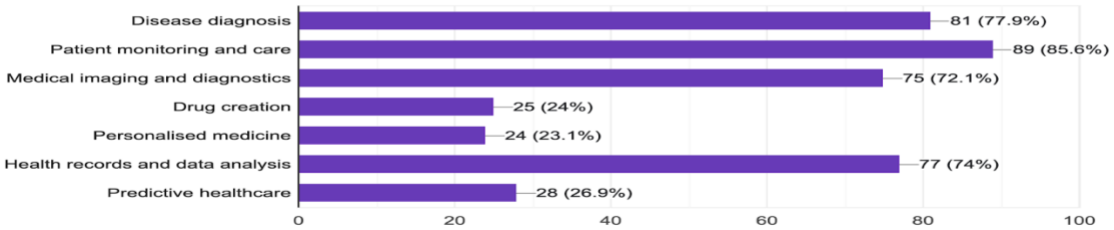

How significantly have these challenges affected healthcare delivery in your institution?
104 responses



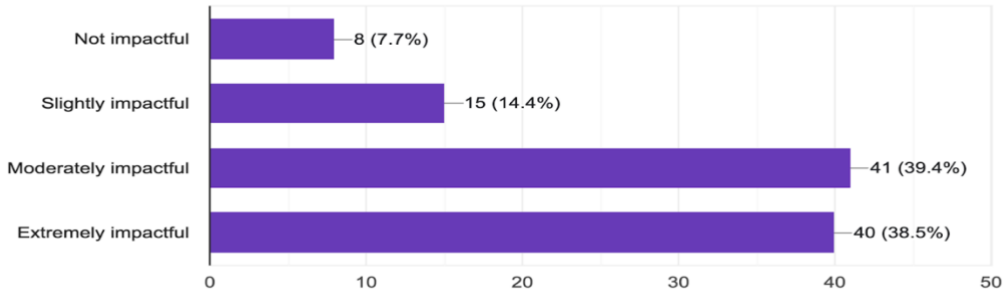
Are you aware of the applications of artificial intelligence (AI) in healthcare management?
104 responses



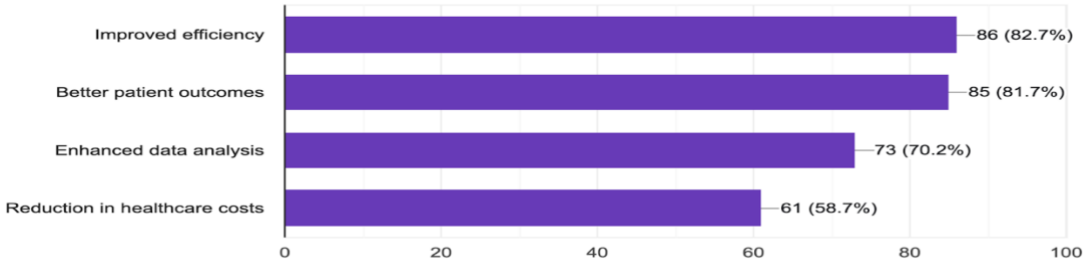
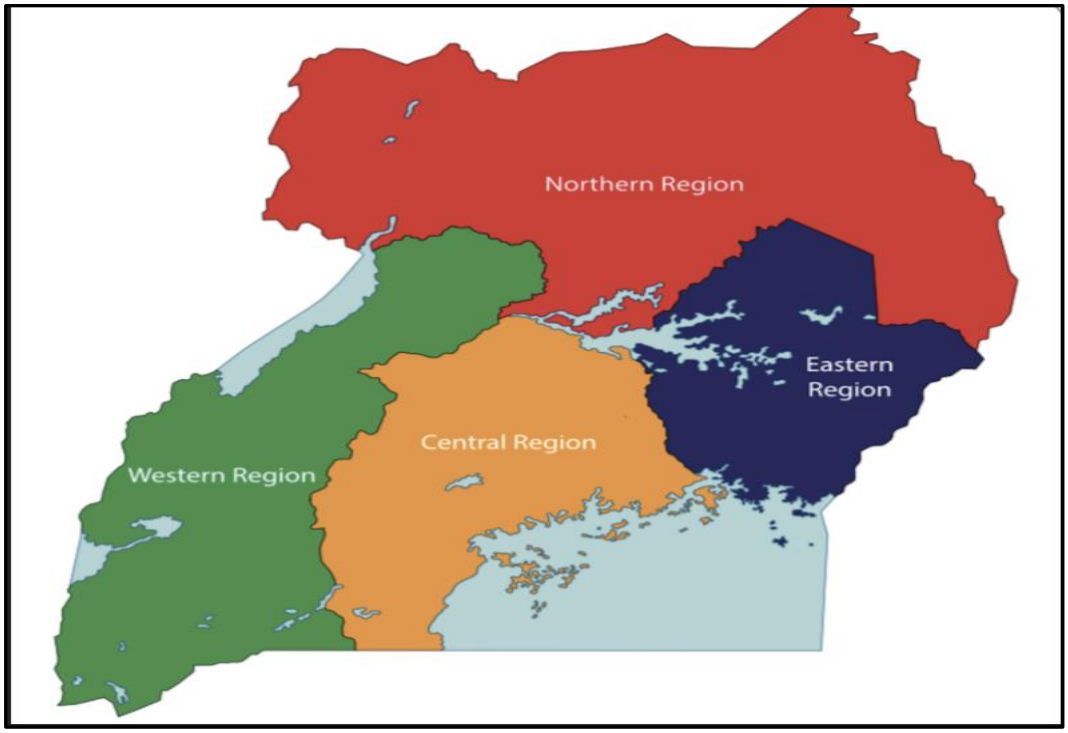

If yes, please select from the following list where AI technology has been applied in healthcare management globally (choose all that apply):
104 responses




How would you rate the potential impact of AI on healthcare management in Uganda?
104 responses




From the following, which do you think are potential benefits of integrating AI technology into healthcare management? (Choose all that apply)
104 responses



## Appendix 3: Map of Uganda showing Administrative Regions