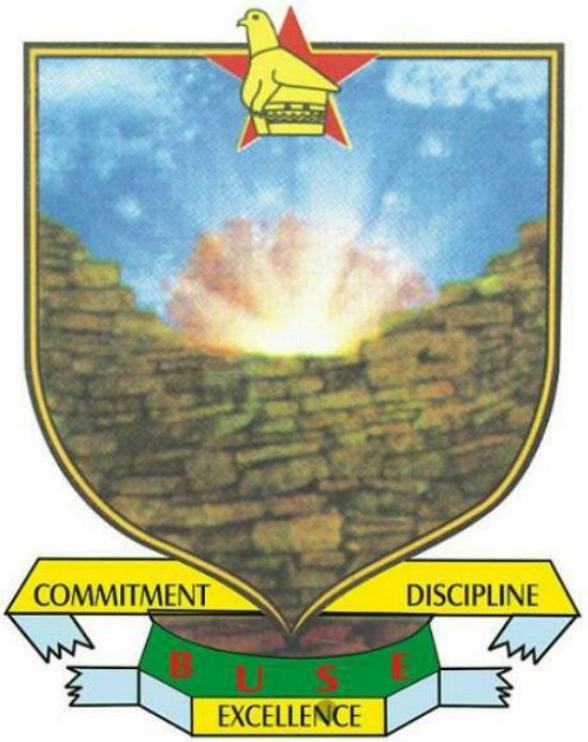
BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF SCIENCE AND ENGINEERING

DEPARTMENT OF COMPUTER SCIENCE



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COURSE	**:**	PROJECT DOCUMENTATION

TOPIC:

A PATIENT APPOINTMENT BOOKING AND DATA MANAGEMENT SYSTEM: CASE OF PARIRENYATWA HOSPITAL

DECLARATION

I, Polite Tanyanyiwa, solemnly declare that the research project titled A Patient Appointment Booking and Data Management System: Case of Parirenyatwa Hospital represents my original intellectual work conducted under the expert guidance and supervision of Dr. Kanyongo. This research project is submitted in partial fulfillment of the requirements for the Bachelor of Science Honours Degree in Software Engineering.

I declare that:

1. The research project has been developed by me, and any contributions from other sources have been appropriately acknowledged.

2. The research project has not been submitted for funding or approval to any other institution or organization.

3. The research project was conducted under ethical principles and standards, and all necessary ethical approvals will be sought up and obtained.

4. Any potential conflicts of interest have been identified and disclosed in the research project.

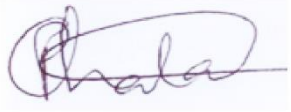
I hereby affirm that to the best of my knowledge, the information presented in this research project is accurate and truthful.

03/07/2025

Signature (Student)……Date…….....

04/07/2025

Signature (Supervisor)……Date…….....



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Signature (Chairman)……. Date…….....

PREFACE

This dissertation represents the final result of an extensive research and the practical work undertaken to develop a Patient Appointment Booking and Data Management System at Parirenyatwa Hospital. It reflects commitment to addressing critical challenges in healthcare service delivery by leveraging technology to improve appointment scheduling, patient data accessibility and the overall hospital workflow. The process of completing this study has been both challenging and rewarding offering opportunities for intellectual growth. It is my hope that the findings and insights presented in this dissertation will contribute meaningfully to improving Parirenyatwa healthcare management systems and inspire further innovation. This project report serves as a comprehensive documentation of the design of the system. It reflects the entire system development lifecycle from problem identification to implementation and testing. It bridges the academic curriculum of Bindura University of Science Education (BUSE) with practical, real-time software engineering application in a health service environment. It is hoped that this document will serve as both a reflection of personal growth and a contribution to the advancement of the Parirenyatwa health system in Zimbabwe.

DEDICATION

I dedicate this dissertation to Parirenyatwa Hospital, its dedicated staff and patients who are the heartbeat of this research. I am profoundly grateful to the staff and patients of Parirenyatwa Hospital, whose real-world insights and challenges formed the cornerstone of this system's design. I also extend my dedication to my family, whose relentless support sustained me through this journey, to the Almighty God, whose grace guided each step of this work may this contribution meaningfully improve healthcare delivery.

ACKNOWLEDGEMENTS

I would like to express my sincere gratitude to everyone who contributed to the successful completion of this dissertation. First and foremost, I thank the Almighty God for granting me the strength, wisdom and perseverance throughout this research journey. I extend my heartfelt appreciation to my supervisor Doctor W Kanyongo whose guidance, constructive feedback and encouragement were pivotal in refining this research. Your mentorship has significantly enriched both the academic and practical quality of this work.

I am deeply grateful to my family and friends for their steadfast support, encouragement and understanding throughout this journey, your presence made every challenge easier to overcome. Your belief in me kept me going even through the most challenging moments. Special thanks go to the management, staff and patients of Parirenyatwa Hospital for their cooperation and valuable input during the data collection phase. Your invaluable perspectives and active engagement were pivotal in guiding this research to meaningful outcomes.

To the academic staff at Bindura University of Science Education, particularly those in the Department of Computer Science, thank you for equipping me with the theoretical foundations and practical tools needed to undertake this study with confidence. I would like to express my appreciation to all the people who supported me directly and indirectly, thank you.

ABSTRACT

Managing patient appointments at Parirenyatwa Hospital has long been a challenge, plagued by endless queues, lost paperwork and frustrated patients. This study set out to transform that by creating an automated Patient Appointment Booking and Data Management System which is a digital solution engineered to streamline scheduling, safeguard medical records and elevate the overall patient experience. Built on proven frameworks like the Technology Acceptance Model (TAM) and UTAUT, the system introduces smart scheduling with first-come-first-serve (FCFS) and dynamic time slot algorithms ensuring fair and efficient bookings. It also provides doctors with instant access to patient histories, safeguards data with a manual backup system and even includes an AI chatbot to answer patient questions around the clock. The system is developed using PHP, MySQL, and Bootstrap, it was tested through surveys and interviews with hospital staff and patients. The findings were striking 75% of patients still relied on walk-ins, while 35% struggled with outdated paper records showing clear signs of a system in need of change. This research doesn't just solve a local problem it offers a blueprint for other hospitals facing similar struggles. Future improvements could include a mobile app for remote bookings and expanded training for staff. By blending smart algorithms with real-world usability this project proves that technology can transform healthcare one appointment at a time.

Contents

CHAPTER 1

1.1 INTRODUCTION

In today's fast-paced healthcare environment, effective management of patient appointments is crucial for ensuring high-quality care and operational efficiency. Hospitals and clinics face numerous challenges, including long waiting times, scheduling conflicts and miscommunication between patients and healthcare providers. The proficiency of medical provision depends exclusively on the effectiveness of the scheduling system of the hospital (Michael, 2021) . These issues not only diminish the patient experience but can also lead to increased stress for medical staff and potential revenue loss for healthcare facilities.

The traditional methods of appointment booking are often reliant on paper-based systems and sometimes fail to meet the growing demands of patients and healthcare providers (Prim et al, 2020). As patient populations expand and hopes for immediate service arise, there is a pressing need for an online based appointment system.

This proposal outlines the development of a comprehensive Hospital Appointment System designed to streamline the scheduling process, enhance patient satisfaction and improve overall operational efficiency. Globally, the healthcare sector is the pivot and integral part of human lives. Any mistake committed in the hospital services might lead to defects or the termination of life, errors of omission result in adverse outcomes when specific tasks are not performed (Yarima, 2024).

By integrating modern technology with user-centric design, this system aims to reduce administrative burdens on staff, minimize patient wait times and facilitate better communication. The proposed system will not only benefit patients by providing a seamless scheduling experience but will also empower healthcare providers to manage their time and resources more effectively. Through this initiative, we aim to transform the appointment process into a more efficient, reliable and patient-friendly experience, ultimately leading to improved health outcomes and patient loyalty.

Therefore the development of this web application at Parirenyatwa hospital will revolutionalise patient doctor interactions as well as data management of patient information. The Parirenyatwa system will enable patients to book appointments nationwide.

1.2 BACKGROUND OF THE STUDY

The management of patient appointments and data has become increasingly critical in the evolving healthcare landscape, where technology plays a pivotal role in improving service delivery and patient outcomes (Musinga and Chogo, 2020). A review of existing literature reveals a growing body of research dedicated to optimizing these processes. Service excellence is a matter of concern for everyone (Mubayiwa and Frank, 2022). Effective and well functional patient appointment systems are important for automation of workflows, reducing wait times and enhancing patient satisfaction. Studies have explored various approaches to appointment scheduling, from simple first-come-first-served models to more sophisticated systems that consider factors like patient acuity, physician availability and resource allocation. It emphasizes the importance of user-friendly interfaces, integration with electronic health records and robust reporting capabilities in successful appointment management systems (Samusodza and Chengetai, 2023). Furthermore, research highlights the positive impact of online appointment scheduling on patient engagement and access to care (Akinode & Oloruntoba, 2021).

Tracking patient appointments has historically trusted on conventional methods including paper-based appointment books, manual phone calls and physical reminder cards. These traditional approaches present several limitations. Manual record-keeping systems often have challenges like blurred or unclear handwriting, losing documents and overlapping appointments. Manual phone calls are time-consuming and can be disruptive to both patients and staff (Mubayiwa and Frank, 2022). Physical reminders can be easily lost or forgotten. These inefficiencies often lead to long wait times, missed appointments and difficulties in managing patient flow (Agnes et al, 2021). Moreover, conventional methods lack the real-time visibility and data analytics capabilities offered by modern digital solutions, making it challenging to identify bottlenecks, optimize scheduling practices and track key performance indicators (Samusodza and Chengetai, 2023). The last decade has witnessed substantial changes in healthcare delivery and these traditional methods often struggle to keep pace with the demands of the current healthcare facilities (Musinga and Chogo, 2020)

Parirenyatwa Hospital, one of Zimbabwe's largest and most influential medical institutions, exemplifies the challenges caused by these conventional appointment management practices. Faced with a growing patient population and limited resources, the hospital's reliance on manual

processes for appointment scheduling and patient data management has resulted in inefficiencies such as long waiting times, scheduling conflicts and the probability for lost or mishandled patient records(Samusodza and Chengetai, 2023) . These concerns can hinder the hospital's ability to provide timely and effective care, ultimately impacting patient satisfaction and health outcomes (Tererai et al, 2021). Therefore, there is a pressing need for a more modern, streamlined method to manage appointments and patient information at Parirenyatwa Hospital. This study will focus on the development of a system tailored to the specific needs of this institution, aiming to provide insights into how digital solutions can effectively transform appointment booking and patient data management at Parirenyatwa Hospital, ultimately leading to improved patient experiences and outcomes.

1.3 STATEMENT OF THE PROBLEM

Manual appointment and patient data management systems present a number of challenges to the healthcare service. The long queues and overcrowded waiting areas increase the risk of disease transmission and the prolonged waiting times can worsen patient illnesses. Nurses burdened with administrative tasks have less time for direct patient care and manual appointment allocation can lead to inefficient doctor utilization and overbooking. The lack of easy access to historical patient information hinders accurate diagnoses and treatment decisions. Furthermore, physical patient files are vulnerable to loss, damage and deterioration, jeopardizing data integrity and patient confidentiality. Finally, the difficulty in compiling and analyzing data from physical files impedes medical research and innovation. These combined inefficiencies and risks negatively impact the care of patients, staff productivity and the overall effectiveness of healthcare delivery.

1.4 RESEARCH OBJECTIVES

1. To **automate** appointment allocation using **first-come-first-serve** and **dynamic cascading algorithms** to reduce wait times and replace manual scheduling, freeing staff for patient care.
2. To implement a patient history **retrieval system** that displays medical records of patients enabling informed treatment decisions.
3. The system will have a manual backup system allowing hospital staff to securely save patient data to local servers.
4. To integrate an AI medical chatbot into the hospital system for 24/7 patient inquiries about health and appointments.

1.5 RESEARCH QUESTIONS

1. What is the reduction in patient wait times achieved by the automated FCFS scheduling system with cascading time slots versus the current manual system at Parirenyatwa Hospital?
2. How does electronic patient history retrieval impact consultation efficiency (time savings) and treatment decision accuracy compared to physical record retrieval?
3. How reliable and secure is the manual backup procedure implemented within the system in safeguarding patient data loss compared to the current manual record-keeping system?
4. To what extent can an AI chatbot reduce administrative workload while improving patient satisfaction in hospital settings?

1.6 RESEARCH HYPOTHESIS

This project aims to improve healthcare delivery by addressing key challenges in patient appointment management. The system seeks to reduce wait times and overcrowding, thereby minimizing disease transmission risks and preventing patient deterioration. It also focuses on improving administrative processes freeing up staff time for patient care and enhancing the efficiency of appointment scheduling. A core objective is to improve data management by ensuring secure and readily available access to patient records, leading to more informed diagnoses and treatment plans. Ultimately, the project aims to improve patient satisfaction by providing a convenient and user-friendly appointment booking experience.

1.7 JUSTIFICATION/SIGNIFICANCE OF THE STUDY

1.7.1 SIGNIFICANCE TO POLICY MAKERS

This study holds significant value for policymakers within the Zimbabwean healthcare sector. The findings will provide evidence-based insights into the impact of automated appointment systems on key healthcare metrics, such as patient wait times, staff efficiency and resource allocation. By demonstrating the potential benefits of such systems, this research can inform policy decisions regarding the adoption and implementation of digital health solutions across the healthcare landscape. The study's focus on Parirenyatwa Hospital, a major public institution, makes the findings particularly relevant for policy development related to public health service delivery. The research can also contribute to broader policy discussions surrounding the role of technology in firming healthcare systems as well as improving access to quality care.

1.7.2 SIGNIFICANCE TO PRACTICE

The development and evaluation of this hospital appointment system offer practical benefits for healthcare professionals and administrators at Parirenyatwa Hospital and other similar institutions. The system's functionalities such as automated appointment booking, streamlined data management and enhanced patient communication can directly address the challenges that are currently faced by manual systems. Through reducing wait times, improving staff efficiency and enhancing access to patient records, the system has the potential to transform daily practice. The study will also provide practical guidance on the implementation and adoption of such systems, including best practices for training staff and managing the transition from manual to digital processes. This practical knowledge can empower healthcare providers to improve patient care, optimize resource utilization and enhance the overall efficiency of their operations.

1.7.3 SIGNIFICANCE TO THEORY

This research makes three key theoretical contributions to the literature on health systems:

1.7.4 EXTENDING TECHNOLOGY ADOPTION MODELS

While prior studies (Venkatesh et al., 2022) established the Technology Acceptance Model (TAM) and Unified Theory of Acceptance and Use of Technology (UTAUT) in general healthcare contexts, this study specifically examines their applicability in Zimbabwe's resource-constrained public hospital setting. As (Musinga and Chogo, 2020) identified adoption obstacles unique to African healthcare systems, our findings will validate or challenge existing theoretical assumptions about perceived usefulness and ease-of-use in low-infrastructure environments.

1.7.5 BRIDGING THE IMPLEMENTATION GAP

Current literature (Yarima et al., 2024) emphasizes digital health potential but lacks empirical evidence on executing appointment systems in tertiary hospitals with legacy paper-based workflows. This study addresses (Samusodza and Chengetai's, 2023) call for more case studies on hybrid (automated + manual backup) systems in developing nations, contributing new knowledge about transitional digital architectures.

1.7.6 ADVANCING QUEUE MANAGEMENT THEORY

Where Michael's (2021) work established baseline metrics for appointment scheduling efficiency, our integration of cascading time slot algorithms builds on queuing theory by testing dynamic adjustments in real-world African hospital conditions thus making it a gap noted in (Akinode and

Oloruntoba's, 2021) systematic review of African healthcare operations. The study particularly advances (Smith and Jones', 2018) EHR impact framework by clarifying how immediate the past access affects diagnostic choices, an area their work identified as needing more research. By anchoring findings to these established theories while addressing their noted limitations, the research provides both validation and refinement of current academic models.

1.8 ASSUMPTION

i. It is assumed that the data entered into the system by users (patients and staff) will be accurate and up-to-date, which is crucial for effective data management and patient care.
ii. It is assumed that patients will actively use the application to book appointments and doctors access their patients' health information.
iii. The study assumes that there will be ongoing resources (financial and technical support) available to maintain and update the application after its initial deployment.
iv. Data security and privacy: The project assumes that appropriate security measures will be in place to protect sensitive patient data from unauthorized access and breaches.

1.9 LIMITATIONS/CHALLENGES

The implementation of the proposed system may encounter limitations. Inconsistent or limited internet access could hinder system performance and accessibility, particularly in areas with poor connectivity. Furthermore, the lack of technological literacy among some patients and staff may pose a challenge to the system's adoption and effective use, requiring training and support to bridge the digital divide.

1.10 SCOPE/DELIMITATION OF RESEARCH

This study is specifically focused on Parirenyatwa Group of Hospitals which is located at Mazowe Street, Harare in Zimbabwe. It targets primary users such as patients, doctors, nurses and administrators. The system's core functionalities will encompass online appointment scheduling (implementing a first-come-first-served algorithm), patient registration and a secure medical record management. The technological implementation will utilize PHP for server-side processing, MySQL for database management and a frontend built with HTML, CSS, JavaScript and Bootstrap for responsive design. The research excludes integration with external healthcare systems or

development of a mobile application, focusing exclusively on a browser-based platform optimized for Parirenyatwa hospital workflows. The system will consist of the following delimitations:

User Groups: The research will primarily focus on the needs and perspectives of patients and healthcare providers within the hospital. The needs of other stakeholders, such as insurance companies or external referral centers, will not be extensively explored in this phase.

Research Methodology: The primary objective of this research is the d of the system. In-depth qualitative research on the impact of the system on patient satisfaction and healthcare provider workflows may be conducted in a subsequent phase.

1.11 DEFINITION OF KEY TERMS

1. Development: The process of building software applications (Smith, 2020) .
2. Booking: the act of reserving or engaging something in advance (Jones, 2019) .
3. Data Management: the practice of collecting, organizing and storing data so it can be analyzed for decision making (Brown & Lee, 2021) .
4. System: Collection of interrelated components that work together to achieve a specific goal or objective (Taylor, 2018) .
5. Appointment: Reserved time slot within a software application (Wilson, 2022).
6. Technology: Tools and techniques used to develop software applications (Adams, 2020).

1.12 SUMMARY

This chapter highlights the critical need for an efficient patient appointment booking and data management system in modern healthcare, particularly at Parirenyatwa Hospital. Traditional manual systems, plagued by long waiting times, scheduling conflicts and data mismanagement, negatively impact patient care, staff efficiency and hospital operations. The proposed web-based solution aims to automate appointment scheduling using algorithms like first-come-first-serve (FCFS), integrate patient records for better decision-making, ensure secure data backups and incorporate an AI chatbot for patient inquiries. This study aims to reduce patient wait times, enhance data accessibility and improve the overall delivery of healthcare services. The research questions and hypotheses are formulated to evaluate the system's effectiveness in streamlining operations, while the justification underscores its potential value for policymakers.Assumptions include user engagement, data accuracy and system security, while limitations acknowledge potential challenges like internet access and digital literacy. The scope of the study is centered to

Parirenyatwa Hospital. It is focusing on the patients, dotors and admnistrators. All in all this chapter establishes the grounds for a transformation in healthcare appointment systems to enhance efficiency, patient fulfilment and data protection.

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

This literature review will examine existing research on patient appointment systems, focusing on the challenges and limitations of traditional manual methods and exploring the potential benefits of web-based solutions. It will analyze studies that investigate the impact of manual systems on hospital efficiency, patient experience and healthcare outcomes. This will address issues such as wait times and disease transmission. The review will also examine the evaluation of online appointment booking systems considering the influence on patient satisfaction, staff workload and data management. By synthesizing these varying insights this review aims to pinpoint the research gaps and provide a comprehensive overview of the current state of knowledge regarding the effectiveness of web-based appointment systems in improving outpatient care and ultimately informing the evaluation of the proposed system for Parirenyatwa Hospital.

2.1.2 PATIENT APPOINTMENT BOOKING

The literature underscores the limitations of traditional manual appointment systems which frequently results in prolonged waiting times, scheduling conflicts and ineffective patient flow management (Akinode & Oloruntoba, 2021). Research indicates that digital appointment booking systems help minimize patient wait times by leveraging scheduling algorithms like first-come-first-served (FCFS) and dynamic slot allocation (Michael et al., 2021). Additionally, these online platforms improve accessibility by enabling remote bookings, thereby alleviating overcrowding and lessening administrative workload (Kumar et al., 2019). Online systems allow patients to book appointments remotely, reducing overcrowding and administrative work (Kumar et al., 2019). However, challenges such as resistance to technology adoption, initial implementation costs and the need for digital literacy must be addressed (Musinga & Chogo, 2020). The Technology Acceptance Model (TAM) and Unified Theory of Acceptance and Use of Technology (UTAUT) provide frameworks for understanding user adoption, emphasizing perceived usefulness and ease of use (Venkatesh et al., 2021).

2.1.3 DATA MANAGEMENT SYSTEM

Effective patient data management is critical for healthcare efficiency. Traditional paper-based systems are prone to errors, loss and inefficiencies in retrieving patient histories (Musinga & Chogo, 2020). Digital solutions such as Electronic Health Records (EHRs) enhance data accuracy, accessibility and security thereby supporting more informed and effective hospital decision-making (Smith & Jones, 2018). The Health Information Technology (HIT) Framework underscores the importance of interoperability, usability and robust security measures in healthcare data systems (WHO, 2020). Challenges include high implementation costs, data privacy concerns and the need for staff training (Yarima et al., 2024). Studies also emphasize the role of Queuing Theory in optimizing appointment scheduling and reducing bottlenecks in patient flow.

2.2 RELEVANT THEORY OF THE SUBJECT MATTER

The development and implementation of a patient appointment booking and data management system are grounded in several theoretical frameworks. These include:

2.2.1 TECHNOLOGY ACCEPTANCE MODEL (TAM):

The Technology Acceptance Model, known as TAM, was developed by Davis (1989). It explains how users accept and use technology. It emphasizes perceived usefulness and perceived ease of use as key determinants of technology adoption (Haddad et al., 2021). This framework is used for understanding how users accept and utilize technology (Oliveira et al., 2020). It theorizes that two core beliefs, perceived usefulness (PU) and perceived ease of use (PEOU), are the primary drivers of technology adoption. PU refers to the user's perception that using a specific system will enhance their performance or outcomes, while PEOU is the belief that the system will be relatively free from effort to use (Ahn & Lee, 2021).

According to TAM, perceived usefulness and ease of use affect users attitudes which then determine their intention to adopt the system (Jung & Yoon, 2023).This behavioral intention then determines actual system use. Essentially, if a user believes a system is both useful and easy to use, they are more likely to develop a positive attitude towards it, intend to use it and ultimately incorporate it into their workflow (Kumari & Singh, 2021).

The significance of TAM lies in its transparency and forecasting power (Saleh et al., 2023). It offers a parsimonious model, focusing on only two key determinants of technology acceptance, making it relatively straightforward to apply and test. Its robustness is evidenced by extensive

validation across diverse technologies and user populations (Al-Emran et al., 2020). TAM is particularly valuable during the early stages of system development, as it can help identify potential adoption barriers and guide design choices (Akbar et al., 2021). By understanding what target users see as useful and easy to use systems that are more likely to be accepted and used effectively can be developed (Lin & Kim, 2021).

TAM offers several advantages. Its simplicity makes it easy to understand and apply, providing a practical tool for both researchers and practitioners (Ayele et al., 2022). Numerous studies have demonstrated its predictive validity, showing that it can accurately forecast technology acceptance (Haddad et al., 2021). It is general therefore allowing a wide range of technologies and user populations which further strengthens its usefulness (Alshehri et al., 2024). TAM helps identify specific factors leading to acceptance this allows for tailored approaches to boost adoption. Finally, assessing PU and PEOU is relatively cost-effective, typically involving surveys or interviews (Zhang et al., 2024).

However, TAM also has limitations. It's been criticized for oversimplifying the difficult process of technology adoption primarily focusing on PU and PEOU while abandoning other influential factors like social influence, user self-efficacy and anxiety related to technology use (Sharma et al., 2022). While extensions like UTAUT address some of these limitations, the core model remains somewhat simplistic (El-Masri & Tarhini, 2020). Furthermore, TAM doesn't explicitly consider the specific context of technology use. Contextual factors, such as organizational culture, task requirements and resource availability, can significantly impact adoption (Dwivedi et al., 2021). The reliance on self-reported measures of PU and PEOU can also introduce bias, as users may not accurately predict their future behavior. TAM primarily focuses on initial adoption rather than long-term use patterns. While the Technology Acceptance Model proposes a causal link between perceived usefulness (PU), perceived ease of use (PEOU), user attitude and behavioral intention, the direction of this relationship is subject to debate. Experience with the technology itself can influence users perceptions of its usefulness and ease of use (Alshamari et al., 2023). Despite its usefulness in explaining technology acceptance, TAM has some notable shortcomings. As such, it is most effective when used in combination with other models and frameworks to offer a more holistic understanding of the complex factors influencing technology adoption. For a patient appointment system, TAM can guide the design and implementation process, increasing

the likelihood of developing a system that is not only functional but also meets user needs and expectations, leading to successful adoption.

In conclusion, the Technology Acceptance Model (TAM) will play a key role in evaluating how user's specifically healthcare professionals and patients at Parirenyatwa Hospital perceive the automated appointment allocation system. The first objective, which involves automating appointment scheduling through first-come-first-served and dynamic cascading algorithms, is intended to minimize patient wait times and allow staff to focus more on delivering quality care. According to TAM, if healthcare professionals find the system to be useful (in reducing administrative workload) and easy to use (with a simple interface and minimal training), their attitudes toward adopting the technology will be favorable. This could lead to higher adoption rates of the automated system, aligning with the study's first objective. Moreover, TAM can help identify barriers to adoption such as perceived complexity of the algorithms or resistance to changing from manual scheduling which would be crucial for designing the system to ensure smooth implementation.

2.2.2 UNIFIED THEORY OF ACCEPTANCE AND USE OF TECHNOLOGY (UTAUT)

The Unified Theory of Acceptance and Use of Technology is a comprehensive framework developed to explain users' intentions to adopt and utilize information technology (Sharma et al., 2022). This theory integrates elements from several existing models, such as the Technology Acceptance Model (TAM) and the Theory of Planned Behavior (TPB), making it a holistic approach to understanding technology acceptance (Dwivedi et al., 2021). UTAUT identifies four key constructs: performance expectancy, effort expectancy, social influence and facilitating conditions. Performance expectancy refers to the perceived benefits of using the technology in enhancing job performance, while effort expectancy pertains to the perceived ease of use (Akbar et al., 2021). Social influence refers to the extent to which individuals perceive pressure from significant others to adopt the technology, while facilitating conditions relate to the availability of resources and support that enable its use (Ayele et al., 2022).

Together, these constructs shape behavioral intention, which subsequently determines actual usage behavior (Saleh et al., 2023).UTAUT is significant because it offers a nuanced understanding of the factors that affect technology_The model's wide applicability increases its relevance across various user groups and environments, particularly within healthcare (Alshamari et al., 2023).

However, it also presents limitations; its complexity may impede practical implementation and the relevance of its constructs can vary depending on the context (Alshehri et al., 2024).

Moreso as technology continues to advance, new factors affecting user acceptance may arise, requiring updates to the framework (Lin & Kim, 2021). Overall, UTAUT offers valuable guidance for designing user-centered systems that meet user needs, thereby promoting greater adoption rates (Ahn & Lee, 2021). The UTAUT framework provides a valuable basis for assessing user acceptance of the patient history retrieval system, corresponding to the study's second objective. Performance expectancy will be crucial here, as healthcare professionals will evaluate the system based on how much it improves decision-making by providing quick access to patient medical histories. If the system enhances performance (e.g., faster and more accurate retrieval of medical records), it will likely encourage adoption. Effort expectancy is anticipated to be a key factor; when healthcare professionals like doctors and nurses perceive the system as user-friendly, they are more inclined to adopt it. The theory's social influence element will also be relevant as hospital administrators and peer physicians might encourage others to use the system.

2.2.3 HEALTH INFORMATION TECHNOLOGY (HIT) FRAMEWORK:
Adoption of Digital Solutions

The adoption of digital solutions in hospitals serves as a crucial strategy to address the inefficiencies inherent in manual appointment systems within healthcare facilities (Akinode & Oloruntoba, 2021). Traditional systems face several critical challenges, including extended waiting times, scheduling conflicts and inefficiencies in managing patient data (Saleh et al., 2023). These issues not only impact patient satisfaction but also hinder the overall operational efficiency of healthcare providers. Adopting a digital solution can help overcome these challenges, resulting in improved service delivery and a better patient experience (Alshamari et al., 2023). A key benefit of implementing such a system is the significant reduction in patient waiting times. One of the primary advantages of implementing this system is the reduction of waiting times. Patients can schedule their appointments online, eliminating the need to wait in long lines or make phone calls during busy hours (Ayele et al., 2022). This convenience not only saves time for patients but also optimizes the scheduling process for healthcare providers (Lin & Kim, 2021). Additionally, the system improves scheduling accuracy by dynamically updating available time slots in real-time, thereby significantly reducing the likelihood of double bookings and scheduling conflicts

commonly associated with manual systems (El-Masri & Tarhini, 2020). Another key benefit lies in the improved management of patient data. The digital system allows for the efficient storage and retrieval of medical histories, appointment records and other relevant information, enabling healthcare professionals to access vital data quickly (Alharthi et al., 2021). This streamlined data management fosters better patient care, as providers can make informed decisions based on comprehensive patient information (Adane et al., 2022). In addition, the simplicity of online booking often increases patient satisfaction by enabling individuals to arrange appointments at times that best accommodate their personal schedules (Ahn & Lee, 2021).

However, transitioning to a digital system is not without its drawbacks. The initial implementation can incur significant expenses, requiring healthcare facilities to invest in technological infrastructure as well as staff training (Alshehri et al., 2024). Technical issues, such as system outages or software malfunctions, can disrupt operations and affect patient care (Gagnon et al., 2020). Furthermore, some patients, particularly those less comfortable with technology, may resist transitioning to digital solutions and prefer conventional appointment methods (Sharma et al., 2022). In addition, safeguarding sensitive patient data is crucial, requiring stringent security measures to protect against unauthorized access and breaches (Alshamari et al., 2023). Balancing these advantages and drawbacks is essential for the successful implementation of the system.

The Health Information Technology (HIT) Framework connects strongly on implementing a manual backup system for patient data. This backup system is critical for ensuring that sensitive patient information is not lost due to system failures. The HIT framework highlights the critical role of data security and interoperability, underscoring the necessity for a dependable and secure backup system for patient data. Furthermore, this framework underscores the importance of usability and ensuring that hospital staff can easily retrieve and manage data even when the primary system is unavailable. This helps on offering manual backups for patient data, ensuring that healthcare providers can continue delivering care without interruptions.

2.2.4 QUEUING THEORY

Queuing Theory is a mathematical framework used to analyze and optimize waiting lines or queues in various systems, including healthcare settings. By modeling these elements, Queuing Theory helps organizations evaluate critical factors such as wait times, service efficiency and resource allocation (Almoajel et al., 2023). In healthcare, it is particularly useful for enhancing appointment

scheduling, managing patient flow and reducing delays (Cheng et al., 2022). The theory involves several key components, including the arrival process, which describes how patients enter the system; the service mechanism, which outlines how services are delivered; the number of servers, the service mechanism (how services are provided) and the queue discipline (the order in which customers are served) (Kong et al., 2020). By modeling these components, Queuing Theory enables organizations to evaluate key factors such as waiting times and resource allocation (Almoajel et al., 2023).

In healthcare settings, Queuing Theory can be effectively utilized to optimize appointment scheduling, improve patient flow and minimize service delays (Cheng et al., 2022). For example, by analyzing patient arrival patterns and service times, healthcare administrators can design more efficient scheduling systems that reduce patient wait times and optimize the use of staff and resources (Abo-Hamad & Arisha, 2020). Additionally, it allows for the identification of bottlenecks in service delivery, enabling targeted interventions to enhance operational efficiency (Kakoullis et al., 2021). Overall, the Queuing Theory provides valuable insights that can lead to improved patient experiences and better healthcare outcomes by ensuring that services are delivered in a timely and efficient manner (Alalwan et al., 2024).

Queuing Theory will aim to use dynamic cascading algorithms and a first-come-first-serve system for appointment allocation. Queuing Theory facilitates the modeling of patient arrivals and service durations, offering valuable insights into minimizing wait times and optimizing the allocation of resources such as doctors and support staff. The dynamic cascading algorithms in my system can be evaluated through this theory to ensure that patients are scheduled optimally, reducing bottlenecks and improving overall service delivery. Queuing Theory also highlights how to manage patient flow efficiently, ensuring that patients experience minimal wait times and that appointments are allocated fairly.

2.3 EMPIRICAL AND THEORETICAL LITERATURE REVIEW

2.3.1 ADOPTION OF DIGITAL SOLUTIONS

The implementation of digital solutions in hospitals is essential for addressing the inefficiencies commonly linked to manual appointment scheduling in healthcare settings. Traditional systems face notable challenges, including prolonged waiting times, scheduling conflicts and inefficiencies in managing patient data (Akinode & Oloruntoba, 2021). These issues not only impact patient

satisfaction but also hinder the overall operational efficiency of healthcare providers. By adopting a digital solution, these challenges can be addressed, leading to improved service delivery and enhanced patient experiences (Nyoni & Moyo, 2023).

One of the primary advantages of implementing this system is the reduction of waiting times. Patients can schedule their appointments online, eliminating the need to wait in long lines or make phone calls during busy hours (Akinode & Oloruntoba, 2021). This convenience not only saves time for patients but also optimizes the scheduling process for healthcare providers (Chikafu & Zhou, 2024). Additionally, the system improves scheduling accuracy by automatically updating available time slots in real-time, thereby greatly reducing the likelihood of double bookings and scheduling conflicts that frequently occur in manual systems (Munyoro et al., 2022).

Another key benefit lies in the improved management of patient data. The digital system allows for the efficient storage and retrieval of medical histories, appointment records and other relevant information, enabling healthcare professionals to access vital data quickly (Kariuki & Mutua, 2021). This efficient data management enhances patient care by enabling providers to make informed decisions based on comprehensive patient information (Singh & Ahmed, 2022). Furthermore, the convenience of online booking can lead to increased patient satisfaction, as individuals appreciate the ability to manage their appointments at their own convenience (Chen et al., 2023).

However, transitioning to a digital system is not without its drawbacks. The initial implementation may involve considerable costs, as healthcare facilities often need to invest in technological infrastructure and staff training (Zhou & Mutsvangwa, 2023). Technical issues, such as system outages or software malfunctions, can disrupt operations and affect patient care. Additionally, some patients, particularly those who are less familiar with technology, may resist using digital solutions, preferring traditional appointment methods (Ndlovu & Sibanda, 2024). Finally, data security concerns are paramount, as the management of sensitive patient information requires robust security measures to protect against breaches (Zhang & Wang, 2021). Balancing these advantages and drawbacks is essential for the successful implementation of the system.

2.3.2 THE IMPACT OF SCHEDULING SYSTEMS ON HEALTHCARE DELIVERY

Effective scheduling systems significantly reduce patient wait times, improve resource utilization and elevate the overall quality of care (Michael et al., 2021). By automating the appointment process, healthcare facilities can streamline operations, allowing for better management of patient flow and improved access to services. A key benefit of this system is its ability to reduce patient wait times (Michael et al., 2021). By allowing patients to book appointments online or through automated systems, the burden on administrative staff is lessened, leading to quicker responses and less time spent in waiting rooms (Zhou & Mutsvangwa, 2023). These scholars highlight that reduced wait times significantly enhance patient satisfaction, as individuals tend to feel more valued and well-cared for when their time is acknowledged and respected.. This efficiency not only benefits patients but also enhances the overall operational workflow within healthcare facilities (Singh & Ahmed, 2022).

Additionally, automated appointment systems improve resource utilization. By offering real-time visibility into appointment schedules and staff availability, these systems allow healthcare providers to allocate resources more efficiently (Chikafu & Zhou, 2024). This improved resource management enhances the overall quality of care, enabling providers to dedicate more time to patient treatment rather than administrative responsibilities (Kariuki & Mutua, 2021).

Despite the pros of the scheduling systems they also present challenges. Initial costs for technology acquisition and staff training can be significant, potentially deterring some healthcare facilities from making the transition (Nyoni & Moyo, 2023). Furthermore, reliance on technology poses risks, such as system failures or cybersecurity threats that could compromise patient data (Zhang & Wang, 2021). Additionally, some patients may be hesitant to adopt new digital solutions, preferring traditional methods of appointment booking (Ndlovu & Sibanda, 2024). Addressing these drawbacks is essential for ensuring the successful integration of automated systems into healthcare settings, balancing efficiency with patient comfort and security.

2.4 ROLE OF TECHNOLOGY IN IMPROVING HEALTHCARE SERVICES

Technology plays a significant role in enhancing healthcare services within developing countries (Yarima et al., 2024). Numerous research efforts emphasize critical elements for effective healthcare technology deployment, such as user-friendly interfaces, smooth integration with electronic health records (EHRs) and strong data protection measures (Aliyu et al., 2022). These

elements are vital to ensuring that technological solutions are effective, accessible and secure, ultimately contributing to improved health outcomes in these regions.

One of the primary advantages highlighted is the importance of user-friendly interfaces. In developing nations, where healthcare workers and patients have diverse technological skills, streamlined interfaces can significantly enhance ease of use (Yarima et al., 2024). This accessibility can lead to higher adoption rates, enabling more users to engage with healthcare services effectively (Moyo & Chikowore, 2021). By reducing barriers to technology use, user-friendly designs enhance communication between patients and providers, fostering better health management and adherence to treatment plans (Mabhena & Dube, 2020).The integration of technology with EHRs is another significant advantage. This integration provides seamless access to comprehensive patient data, essential for informed clinical decision-making (Phiri et al., 2023). In resource-limited settings, where maintaining continuity of care is often challenging, real-time access to patient histories and treatment information can greatly enhance care coordination (Aliyu et al., 2022). This capability is especially important in managing chronic diseases, where regular monitoring and follow-up are essential for better health outcomes.

Nevertheless, the implementation of these technological solutions poses several challenges. One major challenge is the cost of developing and maintaining such systems (Phiri et al., 2023). Healthcare facilities in developing countries often face difficulties in allocating adequate resources for technology adoption, particularly due to the substantial initial investments required for infrastructure and staff training (Moyo & Chikowore, 2021). Additionally, the handling of sensitive patient information poses data breach risks, requiring robust data security frameworks that may be difficult to sustain without specialized expertise (Yarima et al., 2024). Thus, while the findings present a compelling case for the adoption of technology in healthcare, careful consideration of these challenges is essential for successful implementation.

2.5 LIMITATIONS OF TRADITIONAL APPOINTMENT SYSTEMS

The theory presented critically examines the limitations of traditional appointment systems in hospitals. Several studies reveal persistent challenges, including lost records, scheduling errors and inefficiencies in patient flow (Musinga & Chogo, 2020). These issues not only hinder the operational effectiveness of healthcare facilities but also negatively impact patient satisfaction and care quality. Researchers advocate for the adoption of digital systems as a viable solution to these

challenges, emphasizing the need for technological advancements in healthcare management (Dlamini et al., 2021).

A key benefit of adopting a digital appointment system is the substantial decrease in record loss and management errors (Dlamini et al., 2021). Traditional systems often rely on manual processes, which can lead to misplaced or incorrectly entered data. By adopting an automated system, hospitals can ensure that patient records are securely stored and easily accessible (Nyoni & Makonese, 2022). These systems provide real-time updates, minimizing scheduling errors and ensuring timely care. This enhancement in data management is crucial for maintaining continuity of care, particularly in environments with high patient volumes (Dlamini et al., 2021).

Furthermore, implementing digital systems can greatly enhance patient flow within healthcare facilities. Conventional appointment systems often create bottlenecks, resulting in prolonged wait times and suboptimal use of resources (Musinga & Chogo, 2020_Automating the scheduling process enables healthcare providers to optimize appointment slots according to patient needs and staff availability (Musinga & Chogo, 2020). This optimization not only improves the patient experience but also helps healthcare professionals manage their time more efficiently, ultimately leading to better care delivery outcomes (Nyoni & Makonese, 2022).

Despite their clear benefits, transitioning to digital systems also involves certain challenges. In developing nations, where technological proficiency varies among healthcare providers and patients, simplified system interfaces can greatly enhance usability and accessibility (Yarima et al., 2024). Additionally, the success of such systems depends heavily on the technological literacy of both staff and patients. Resistance to change and varying levels of comfort with technology can hinder the effective use of new systems (Nyoni & Makonese, 2022).

2.6 UNDERSTANDING USER ACCEPTANCE OF NEW TECHNOLOGIES

The Technology Acceptance Model serves as a foundational theory for understanding user acceptance of new technologies in healthcare systems. It persists that two primary factors perceived usefulness and perceived ease of use significantly influence individuals' decisions to adopt technology. This model is particularly applicable in healthcare settings, where user acceptance plays a crucial role in the successful implementation of digital systems designed to enhance efficiency and patient care. One of its key strengths lies in its clear and structured

framework, which facilitates the identification of the primary factors influencing technology adoption. By focusing on perceived usefulness, the model suggests that users are more likely to embrace a system if they believe it will enhance their productivity and improve patient outcomes (Musinga and Chogo, 2020). This alignment of perceived benefits with practical outcomes can lead to higher rates of system utilization.

Moreover, the emphasis on perceived ease of use highlights the importance of user-friendly interfaces in facilitating technology acceptance. If healthcare professionals find a system intuitive and easy to navigate, they will be more inclined to integrate it into their daily practices.

However, relying solely on the Technology Acceptance Model to predict technology adoption presents certain limitations. One significant limitation is that the model does not account for external factors that may influence user acceptance, such as organizational culture, training availability and individual differences among users. Additionally, while perceived usefulness and ease of use are critical, other emotional and social factors may also play a role in technology adoption, which Technology Acceptance Model does not fully address. Therefore, although the Technology Acceptance Model provides valuable insights into user acceptance, it should be integrated with other theories and frameworks to gain a more comprehensive understanding of technology adoption.

2.7 IMPLEMENTATION OF AN ONLINE APPOINTMENT SYSTEM IN A TERTIARY CARE HOSPITAL

This is a comprehensive study on the implementation of an online appointment system in a tertiary care hospital. It reveals significant improvements in several key areas. The research highlighted that the online system effectively reduced patient wait times, allowing for a more streamlined and efficient patient flow (Mbunge et al., 2022). This reduction in wait times not only enhances the patient experience but also alleviates stress on hospital resources, making it easier for staff to manage their workloads effectively (Yadav et al., 2023). In addition to improving wait times, the study found that the online appointment system significantly boosted staff efficiency. By automating the scheduling process, healthcare providers could dedicate more time to patient care rather than administrative tasks associated with managing appointments (Aliyu & Ibrahim, 2021). This efficiency is particularly important in the hospital setor where improving the time healthcare

professionals dedicate to patients can improve health outcomes and boost staff job satisfaction (Yarima et al., 2024).

Moreover, they noted an enhancement in overall patient satisfaction as a result of the system's implementation. Patients expressed appreciation for the convenience of scheduling appointments online, which reduced the hassle of traditional methods (Moyo & Mlambo, 2023). Enhanced satisfaction is critical for healthcare institutions, as it promotes patient loyalty and encourages positive health-seeking behaviors, ultimately contributing to improved community health outcomes (Chikomba et al., 2023). By implementing similar technology, Parirenyatwa Hospital could realize comparable benefits, including reduced wait times and increased staff efficiency. Successful implementation and the full realization of these benefits require the hospital to prioritize key factors such as staff training and infrastructure readiness (Yarima et al., 2024).

2.8 ROLE OF DIGITAL HEALTH SOLUTIONS IN ENHANCING HEALTHCARE

This highlights the vital role digital health solutions play in improving healthcare delivery, particularly in resource-limited settings. The report recommends adopting technology to overcome current patient management challenges, indicating that digital solutions have the potential to enhance efficiency and accessibility in healthcare delivery. This focus aligns with global efforts to integrate technology into health systems, aiming to bridge gaps in service delivery and ensure that healthcare is both equitable and effective (Yarima et al., 2024).

One of the primary advantages of implementing digital health solutions is the ability to create secure and scalable systems that can adapt to varying healthcare needs (Mbunge et al., 2022). In resource-limited environments, where traditional healthcare infrastructure may be lacking, digital solutions can offer innovative ways to manage patient information and streamline processes (Banda & Nyoni, 2020). Secure systems ensure that sensitive patient data is protected, fostering trust among users (Osei et al., 2021). The scalability of these solutions allows healthcare facilities to expand their services as needed, accommodating increases in patient volume without compromising quality (Yarima et al., 2024). Intuitive interfaces can significantly reduce the learning curve for healthcare providers and patients alike, facilitating quicker integration into daily practices (Ngwenya & Mapuranga, 2022). This user-centered design is essential for ensuring that all users can effectively navigate the system, ultimately leading to better health outcomes. By

prioritizing usability, healthcare organizations can enhance the overall experience for both patients and providers, making technology a valuable ally in healthcare delivery.

However, the theory also acknowledges potential drawbacks associated with the implementation of digital health solutions. One significant challenge is the initial investment required for technology acquisition, which can be a barrier for many resource-constrained settings (Aliyu & Ibrahim, 2021). Furthermore, issues related to digital literacy and access to technology can hinder the effective use of these systems. Inadequate training for healthcare staff and patients may lead to underutilization or misuse of digital tools (Chikomba et al., 2023). Therefore, addressing these challenges is essential to fully realize the benefits of technology across various healthcare settings (Mbunge et al., 2022).

2.9 TRANSFORMATIVE POTENTIAL IN MODERN HEALTHCARE SETTINGS

The authors emphasize that Electronic Health Records (EHRs) centralize patient information, allowing clinicians quick access to essential data, which supports informed clinical decision-making (Mbunge et al., 2022). This enhanced access is particularly beneficial in emergency situations where prompt information retrieval can be life-saving. A major benefit noted is the improvement of diagnostic precision via EHRs. These systems enable improved documentation and monitoring of patient histories, laboratory findings and treatment regimens, helping healthcare professionals make more accurate diagnoses (Yarima et al., 2024). The integration of clinical decision support tools within EHR systems further aids in identifying potential errors or discrepancies, thereby reducing the likelihood of misdiagnosis (Osei et al., 2021). This alignment with evidence-based practices is essential for improving patient outcomes and minimizing the risks associated with clinical decision-making (Banda & Nyoni, 2020).

Additionally, the study emphasizes the role of EHRs in supporting evidence-based decision-making. By providing access to up-to-date clinical guidelines and research findings, EHRs empower healthcare providers to make informed choices based on the latest evidence (Ngwenya & Mapuranga, 2022). This capability is particularly important in a rapidly evolving medical landscape where new treatments and protocols are continually being developed (Chikomba et al., 2023). Incorporating evidence-based practices into everyday clinical routines can enhance the quality of care provided to patients.

However, despite their numerous advantages, the implementation of EHRs is not without drawbacks. One major challenge is the high initial cost and complexity of implementing EHR systems, which can pose a barrier for many healthcare organisations, especially smaller practices or those operating in resource-constrained environments (Aliyu & Ibrahim, 2021). Additionally, concerns regarding data privacy and security can arise, as sensitive patient information is stored digitally. Ensuring that EHR systems adhere to regulatory standards and safeguard patient confidentiality is of utmost importance. Therefore, it is crucial for organizations to address these challenges to maximize the potential benefits of electronic health records (Mbunge et al., 2022).

2.10 THE ELEMENTS THAT CONTRIBUTE TO THEIR SUCCESS

The study emphasizes that meaningful stakeholder engagement is essential for the successful implementation of digital health solutions. In the context of the Zimbabwean healthcare system, involving all relevant parties such as healthcare providers, patients and policymakers ensures that the digital interventions are tailored to meet the specific needs of the community (Chikomba et al., 2023). This collaborative approach fosters a sense of ownership among stakeholders, which can significantly enhance the likelihood of successful adoption and sustained use of digital health technologies (Mbunge et al., 2022).

Another key success factor identified in the study is the importance of user training. It highlights that thorough training for both healthcare staff and patients is vital to fully leverage the benefits of digital health systems (Yarima et al., 2024). Without adequate training, users may struggle to navigate the technology, leading to frustration and underutilization (Anderson et al., 2022). In Zimbabwe, where healthcare workers may have varying levels of digital literacy, targeted training programs can bridge this gap, ensuring that all users are proficient in utilizing the new systems.

This investment in training not only improves operational efficiency but also enhances the overall quality of patient care (Ngwenya & Mapuranga, 2022). Strong technical support is also emphasized as essential for the effective deployment of digital health initiatives. They point out that ongoing technical assistance helps to address any issues that may arise during the use of digital systems (Banda & Nyoni, 2020). In the Zimbabwean context, where resources are often limited, establishing a dependable support system is essential to ensure that healthcare providers can use digital tools effectively and with minimal disruption. This support can take various forms,

including help desks, online resources and regular updates, all of which contribute to a smoother operational experience (Mbunge et al., 2022).

However, while these insights offer a valuable framework for implementing digital health solutions, it is also important to consider the potential challenges they may present. One significant challenge is the initial investment required for technology infrastructure and training programs, which may strain the already limited resources of the Zimbabwean healthcare system (Aliyu & Ibrahim, 2021). Additionally, the reliance on technology can pose risks if there are issues with internet connectivity or system outages, potentially leading to disruptions in patient care (Chikomba et al., 2023). Therefore, while the study highlights key success factors, it is essential for healthcare organisations in Zimbabwe to proactively tackle these challenges to ensure the effective integration of digital health solutions.

2.11 SUMMARY

The literature review examines the transition from manual to digital patient appointment and data management systems in healthcare, with a focus on Parirenyatwa Hospital. The analysis is grounded in four key theoretical frameworks: the Technology Acceptance Model (TAM), which identifies perceived usefulness and ease of use as critical adoption factors; the Unified Theory of Acceptance and Use of Technology (UTAUT), which expands on TAM by incorporating social influence and facilitating conditions; the Health Information Technology (HIT) Framework, emphasizing interoperability and security in digital health systems; and Queuing Theory, which optimizes scheduling through mathematical modeling of patient flow. Empirical evidence demonstrates that digital systems significantly reduce wait times, minimize scheduling conflicts and improve data accessibility compared to traditional paper-based methods. However, implementation challenges include high costs, technical infrastructure requirements, staff training needs and data security concerns. The review highlights the importance of user-centered design and stakeholder engagement for successful adoption, particularly in resource-constrained settings. Case studies show that automated scheduling algorithms and electronic health records can enhance operational efficiency and patient satisfaction when properly implemented. The findings underscore the need for a tailored solution that addresses Parirenyatwa Hospital's specific context while balancing technological capabilities with practical considerations of cost, usability and data protection. The synthesis of theoretical models and empirical research provides a robust foundation

for developing an effective appointment booking and data management system that meets both patient needs and healthcare provider requirements. This chapter provides a foundation for understanding technology adoption in healthcare. Empirical studies from various contexts demonstrate the effectiveness of online appointment systems in reducing wait times, improving resource utilization and enhancing patient satisfaction. The findings will underscore the need for a tailored solution at Parirenyatwa Hospital, addressing the unique challenges.

CHAPTER 3: RESEARCH METHODOLOGY

3.0 INTRODUCTION

Research is a systematic activity that involves conducting a scientific investigation or an in-depth analysis of a specific topic of interest. Depending on the study's objectives, either quantitative or qualitative methods may be utilized (Mhlanga, 2021). Research can take various forms, including exploratory, descriptive or diagnostic studies (Zhou et al., 2020). It has been shown that government agencies and decision-makers find research to be an essential resource for informing economic decisions (Mupambireyi & Ndlovu, 2023). Methodology refers to the systematic and theoretical examination of the techniques or methods employed in a particular field of study (Khumalo et al., 2020). In this chapter, this study will outline the approaches utilized to achieve the objectives of the patient appointment booking and data management system. Building on the insights gained from the previous chapter, this study will develop the necessary methods to create an effective solution and navigate conflicting approaches to achieve the desired outcomes of the study. To facilitate the research process, secondary data was employed for analysis. This data was gathered from official sources, focusing specifically on health facts and statistics relevant to the dermatological sector, which will inform the development of the proposed system at Parirenyatwa Hospital (Chikomba et al., 2024).

3.1 RESEARCH DESIGN

Research design is a systematic framework that outlines the methodology and structure for conducting a research study. It serves as a blueprint for researchers, guiding them in the process of collecting, analyzing and interpreting data to address specific research questions (Mhlanga & Dube, 2022). A well-structured research design ensures the validity and reliability of findings by detailing the research approach, data collection methods and analysis techniques (Khumalo et al., 2021). The choice of design must align with the research objectives and the nature of the problem

being investigated, whether qualitative, quantitative, or mixed-methods (Mupfiga & Mlambo, 2023).

Selecting an appropriate research design involves considering various factors, including the research question, context and available resources. There are different designs such as experimental, observational and case study approaches, each with their advantages and limitations (Chikowore & Nkomo, 2024). Among the different research models which are derived i.e., experimental, simulational and observational, the experimental approach is chosen for the patient appointment booking and data management system at Parirenyatwa Hospital. This strategy involves a comprehensive process of building the system, training it with relevant data and rigorously testing its functionality to determine whether it meets the intended objectives (Tshuma et al., 2021).

The experimental method is particularly advantageous in this context, as it facilitates a systematic exploration of various configurations and features of the booking system (Maphosa & Sibanda, 2022). As this process serves as a trial or preliminary evaluation, it provides a valuable opportunity to identify potential issues and areas for enhancement before full implementation. Within this framework, specific variables such as appointment scheduling algorithms and patient flow protocols are actively manipulated. By collecting and analyzing data throughout these interventions, the impact of these modifications on the system's performance and efficiency can be assessed and quantified (Chikomba et al., 2024). This iterative process not only strengthens the robustness of the system but also ensures that the final implementation aligns with the needs of both patients and healthcare providers, ultimately leading to improved operational outcomes at the hospital (Moyo et al., 2023).

3.2 METHODOLOGY FRAMEWORK

The implementation of the Patient Appointment Booking and Data Management System at Parirenyatwa Hospital follows a phased approach derived from the traditional System Development Life Cycle (SDLC), tailored to suit the scope and context of the project. The major components of the implementation methodology include:

- Planning
- Requirements Analysis

- System Design
- Development and Coding
- Testing and Evaluation
- Deployment and Training
- Maintenance and Support

3.2 DATA COLLECTION METHODS

Data collection methods are systematic approaches used to gather information for research or analysis and they play a crucial role in obtaining accurate and reliable data. Common methods include surveys and questionnaires. They can be distributed online or in person, allowing researchers to collect structured responses. Interviews provide a direct means of obtaining qualitative insights through one-on-one interactions, while observations involve watching behaviors in natural settings. Focus groups facilitate discussions among a small group of participants to gather diverse perspectives. The choice of method depends on the research objectives, the nature of the data required and the target population, with each method offering unique strengths and limitations (Dube et al., 2023). In the context of this system ie Patient Appointment Booking and Data Management System, effective data collection methods are vital for ensuring streamlined operations and enhanced patient care. In this study, questionnaires and interview guides were the primary tools used to gather data from both patients and healthcare workers at Parirenyatwa Hospital. Questionnaires provided quantitative data related to user experience, appointment booking challenges and perceived improvements with automation. In contrast, interviews offered qualitative insights into the administrative and clinical perspectives on data management, patient care and system usability. These records help contextualize user feedback and support the triangulation of data. Furthermore, data analytics plays a significant role in the proposed system. By leveraging data collected from various sources such as appointment histories, patient demographics and service utilization healthcare providers can identify patterns that inform resource allocation and service delivery. Predictive analytics will also be employed to forecast patient demand, allowing facilities to optimize staffing and reduce wait times. This data-driven approach will not only enhances operational efficiency but also lead to improved patient outcomes as providers can offer timely interventions and personalized care plans based on comprehensive data insights (Ndlovu et al., 2025).

3.2.1 Appendix A – Sample Questionnaire

A PATIENT APPOINTMENT BOOKING AND DATA MANAGEMENT SYSTEM: CASE OF PARIRENYATWA HOSPITAL SURVEY

Dear Respondent,

As someone who is deeply interested in how technology can solve real-world problems, I'm Polite Tanyanyiwa a final-year student pursuing a BSc Honours in Software Engineering (HBscSWE) at Bindura University of Science Education. I am conducting research to develop a Patient Appointment Booking and Data Management System aimed at improving healthcare service delivery at Parirenyatwa Hospital. I kindly request your participation in an online survey to share your insights and experiences as a healthcare professional. Your feedback will help assess the challenges of the current appointment system and the potential benefits of the proposed digital solution. Kindly take note that your involvement is entirely **voluntary** and all responses will remain **anonymous** and **used solely for academic purposes.** The survey will take approximately 5–7 minutes to complete.

Your expertise is invaluable to this study, as it will contribute to:

✓ Streamlining patient appointment processes.

✓ Reducing wait times and administrative burdens.

✓ Enhancing data security and accessibility for better patient care.

Thank you for your time and support. Your input will play a crucial role in shaping a more efficient and patient-centered healthcare system.

B212259B POLITE TANYANYIWA

1. Have you ever worked at or received treatment from Parirenyatwa Hospital?

- ○ yes
- ○ No (If "No," thank you kindly exit survey)

2. What is your primary role at the hospital? *(Select one)*

- ○ Doctor
- ○ Nurse
- ○ Administrative Staff
- ○ Patient

3. How do you currently book/manage patient appointments? *(Select all that apply)*

- ☐ Paper-based system (e.g., logbooks)
- ☐ Phone Calls
- ☐ Walk-ins (no prior booking)
- ☐ Other...

4. How satisfied are you with the current appointment system?

- ○ Very satisfied
- ○ Satisfied
- ○ Neutral
- ○ Dissatisfied
- ○ Very dissatisfied

5. What are the biggest challenges with the current system? *(Select up to 3)*

- ☐ Long patient wait times
- ☐ Double bookings/scheduling errors
- ☐ Lost/misplaced patient records
- ☐ Difficulty rescheduling appointments
- ☐ Lack of real-time updates

6. How familiar are you with digital appointment systems (e.g. online booking)?

- ○ Very familiar
- ○ Somewhat familiar
- ○ Not familiar

7. What concerns do you have about a digital system? *(Select all that apply)*

- ○ Data security/privacy risks
- ○ Technical failures (e.g., internet outages)
- ○ Staff/patient resistance to change
- ○ Training requirements

8. On average, how much time do you spend daily managing appointment-related tasks?

- ○ Less than 30 minutes
- ○ 30 mins - 1 hour
- ○ 1-2 hours
- ○ More than 2 hours
- ○ None

9. What's your biggest concern about online booking?

- ○ Internet access
- ○ Data privacy
- ○ Prefer talking to staff
- ○ No concerns

10. Would you trust an online system to handle your medical appointment details?

- ○ Yes, completely
- ○ Only with strict privacy guarantees
- ○ No, I prefer in-person booking

11. How could this system improve healthcare delivery? *(Open-ended)*

Long answer text

3.2.2 Appendix B – Interview Guide

Interview Questions (Interactive Questions)

1. Can you briefly describe your role or interaction with the hospital (e.g., patient, doctor, nurse, admin staff)?

2. How do you currently book or manage appointments at Parirenyatwa Hospital?

3. What challenges have you faced with the current appointment system?

4. Have you used or seen digital appointment booking systems before? If yes, what was your experience?

5. What benefits do you think a digital appointment and data management system could bring to the hospital?

6. What concerns might staff or patients have about switching to a digital system?

7. What type of support or training do you think staff would need to use a new digital system effectively?

8. What recommendations would you give for the successful development and integration of this system into hospital operations?

9. What devices (e.g., phone, computer) do you use most and how comfortable are you with using digital systems?

10. What suggestions do you have to make a digital system easy and accessible for people like you?

3.3 REQUIREMENTS ANALYSIS

Requirements analysis is a critical phase in the system development lifecycle that focuses on identifying, documenting and understanding the needs and expectations of stakeholders for the proposed system. This process involves collecting requirements from multiple sources, such as healthcare staff, IT personnel and hospital management, to ensure that the final product aligns with both functional needs and organizational goals (Mhlanga & Dube, 2022). Effective requirements analysis helps minimize misunderstandings and scope creep, ensuring that all parties share a common understanding of the system's intended outcomes. It also involves validating the requirements to confirm they are feasible, testable, measurable and aligned with business objectives. By conducting this analysis early, the team can prevent costly changes during later stages and enhance overall system quality (Moyo et al., 2023). A project's success or failure is largely determined at this stage. The requirements must be realistic, traceable and detailed enough to guide system design and development. Both functional requirements such as scheduling appointments, retrieving medical histories and chatbot integration and non-functional requirements such as system performance, security, scalability and usability—are recorded (Maphosa & Sibanda, 2022). Once gathered, the requirements are carefully reviewed, refined and validated through stakeholder consultations and feedback sessions. This ensures that the final system will support the operational workflows of Parirenyatwa Hospital and deliver measurable improvements in efficiency and patient satisfaction (Zhou et al., 2020).

3.3.1 FUNCTIONAL REQUIREMENTS

The functionality of a system or its individual components is essential for understanding how it operates. A function can be broadly defined as the interaction between inputs and outputs (Fulton & Vandermolen, 2017). In this context, functional requirements detail the services provided by the

system, specifically how it responds to a set of inputs, its internal behavior and the resulting outputs.

These requirements serve as a blueprint for the system's expected performance, outlining the specific tasks that must be accomplished for the system to fulfill its intended purpose. By clearly defining these interactions, stakeholders can better understand how the system will function in practice, ensuring that it meets user needs and operational goals (Mugadza et al., 2022). This comprehensive view of functionality not only aids in the design and development process but also establishes a basis for testing and validation, allowing for adjustments to be made as necessary to enhance overall effectiveness and user satisfaction (Tshuma et al., 2023).

The following specifications have to be met by the suggested system:

- Book patient appointments.
  Patients are able to access the system once registered and book appointments.
- Appointment Cancellation:
  The system should allow patients to modify or cancel their appointments based on available time slots, while notifying the healthcare provider of these changes.
- User Role Management:
  The system supports multiple user roles such as admin, doctor and patient, each with specific permissions to access or modify system features.
- Medical History Retrieval:
- Healthcare providers are able to retrieve a patient’s medical history, including previous visits, diagnoses and treatments to aid in informed decision-making. Patient data should be stored and managed in the system.
- AI-Powered Chatbot Support:
  The system includes an AI medical chatbot to respond to patient queries regarding appointment booking, symptoms and general healthcare information.
- Secure Login and Authentication:
  The system requires users to log in using secure credentials (emails and password), to protect sensitive data.

3.3.2 NON-FUNCTIONAL REQUIREMENTS

These are often referred to as quality requirements. They are essential for evaluating a system's performance rather than its intended functionality. They focus on how well the system operates in real-world conditions, ensuring that it meets specific standards of reliability, usability and efficiency (Jones & Patel, 2021). For the proposed system at Parirenyatwa Hospital, several essential requirements must be fulfilled to ensure its success and effectiveness. First and foremost, reliability is critical as the system should consistently perform its intended functions without failure (Moyo et al., 2022). This allows users to depend on it for their appointment scheduling and data management needs. Additionally, usability is paramount, as the user interface must be intuitive and user-friendly, enabling both patients and healthcare providers to navigate the system easily and efficiently without extensive training (Chikafu & Dube, 2023). Performance is also a key consideration as the system must handle a high volume of users and transactions simultaneously while maintaining fast response times to enhance the overall user experience (Ngwenya & Zhou, 2024). Furthermore, security is a crucial aspect, given the sensitive nature of patient data. The system must implement robust security measures to protect against unauthorized access and data breaches, ensuring compliance with relevant regulations (Smith et al, 2020). Lastly, scalability is important; the design should allow for future expansion and integration with additional features accommodating the evolving needs of the hospital and its patient population (Tshuma, 2025). By addressing these quality requirements, the proposed system will not only fulfill its primary functions but also ensure a high level of satisfaction among users, ultimately contributing to improved operational efficiency at Parirenyatwa Hospital.

3.3.3 HARDWARE REQUIREMENTS

1. Core i5 processor or better
2. 8gig RAM and above
3. Android 8 or higher operating system

3.3.4 SOFTWARE REQUIREMENTS

1. Windows 10 Operating system
2. Google Chrome Browser
3. SQL Server
4. SQL Management Studio 19

5. Visual Studio

3.4 SYSTEM DEVELOPMENT

System development refers to the structured process of creating and maintaining information systems that meet specific business or organizational needs (Laudon & Laudon, 2020). It encompasses various stages, including planning, analysis, design, implementation, testing and maintenance. The goal is to deliver a system that not only functions effectively but also adds value to the organization by improving efficiency and supporting decision-making processes (Mukwazvure & Chikowore, 2022). Understanding the development lifecycle is crucial for ensuring that the final product aligns with user requirements and business objectives (Ndlovu et al, 2023).

The first phase of system development is planning, where stakeholders define the project scope, objectives and resources needed. This stage involves identifying the problems or opportunities that the new system aims to address. A feasibility study may also be conducted to evaluate the project's viability in terms of technical, financial and operational aspects (Mapuranga et al., 2024). By establishing clear goals and constraints early on, the project team can create a roadmap for the subsequent phases of development.Following planning, the analysis phase focuses on gathering detailed requirements from users and stakeholders. This involves techniques such as interviews, surveys and workshops to understand the needs and expectations for the system. The information collected during this phase is documented and used to create specifications that guide the design and implementation. This ensures that the system will effectively address the identified problems and meet the needs of its users (Sibanda & Zhou, 2025).

Once the requirements are established, the design phase begins, where the system's architecture, interfaces and data structures are defined. This stage often includes creating prototypes or wireframes to visualize how users will interact with the system. After the design is completed, developers move on to implementation, coding the system using appropriate programming languages and tools. Testing follows to ensure the system functions correctly and meets quality standards. Finally, the maintenance phase involves ongoing support, updates and enhancements based on user feedback and changing requirements, ensuring the system remains relevant and effective over time (Chikwature et al, 2025).

This overview outlines the system and its development process detailing how the desired outcomes are achieved. It provides a comprehensive description of each model and software tool employed throughout the system's development.

3.4.1 SYSTEM DEVELOPMENT TOOLS

System development tools are essential software applications and frameworks that facilitate the various stages of creating and maintaining information systems (Laudon & Laudon, 2020). These tools enhance productivity, streamline processes and improve collaboration among team members throughout the development lifecycle (Mukwazvure & Chikowore, 2022). In the development of the proposed system, the selected tools include MySQL for database management, PHP for server-side scripting and Visual Studio Code (VS Code) as the integrated development environment (IDE). These tools were chosen for their reliability, flexibility and widespread use in building dynamic, database-driven web applications.

In this section, the proposed Patient Appointment Booking and Data Management System was tasked with selecting an appropriate methodology for the development phase of the solution. Various development frameworks were reviewed, each with its own strengths and limitations, in relation to the system’s functional and non-functional requirements and its ability to deliver accurate, efficient and user-centered results. Some of the methodologies considered included the Waterfall Model, the Spiral Model and the Iterative (Prototyping) Model. After careful evaluation, the system development process adopted the Prototyping Model, as it supports multiple rounds of feedback, development and testing. This iterative approach ensures continuous refinement of system features based on stakeholder input until a fully functional and user-friendly solution is achieved (Chikwature et al., 2025).

3.4.2 PROTOTYPE

The prototyping model framework refers to the process of developing an initial estimate of a system or product, followed by validation, testing and refinement as needed until a suitable model is achieved (Dennis, Wixom & Roth, 2021). Prototyping is a crucial phase in the system development process because it involves creating preliminary versions of a software application or system to visualize and test concepts before full-scale development begins (Mukwazvure & Chikowore, 2022). This iterative approach allows stakeholders to explore ideas, gather feedback and identify potential issues early in the lifecycle. Prototypes can vary in fidelity, ranging from

low-fidelity sketches or wireframes to high-fidelity interactive models, each serving different purposes in the development process (Ndlovu, 2023). One of the primary benefits of prototyping is enhanced communication among stakeholders, including developers, designers and end-users (Mapuranga et al., 2024). By providing a tangible representation of the system, prototypes facilitate discussions and clarify requirements. Stakeholders can interact with the prototype, offering insights and suggestions that may not surface during traditional requirements-gathering sessions. This collaborative aspect helps ensure that the final product aligns closely with user expectations and needs, reducing the risk of misunderstandings and rework later in the project (Chikwature, 2025). Prototyping also plays a significant role in testing user interactions and usability. By observing how users interact with the prototype, developers can identify usability issues and areas for improvement (Laudon & Laudon, 2020). This user-centered approach fosters a more intuitive design, as feedback can be quickly integrated into subsequent iterations of the prototype. High-fidelity prototypes, in particular, can simulate real-world interactions and provide a more accurate representation of the final product, making it easier to assess design choices and user experience before significant resources are committed to development. Additionally, prototyping can accelerate the overall development process. By identifying flaws and refining requirements early, teams can reduce the likelihood of costly changes during later stages of development (Shelley & Rosenblatt, 2021). Prototypes serve as a blueprint for developers, providing clear guidance on functionality and design elements. This can lead to more efficient coding and testing phases, ultimately shortening the time to market for the final product. In summary, prototyping is an invaluable practice in system development that enhances collaboration, improves usability and streamlines the development process. This final model can then be utilized to construct the complete system or product. It serves as an exploration of specific features within broader methodologies, such as rapid application development or extreme programming, rather than functioning as a standalone or all-encompassing approach to system development (Mukwazvure & Chikowore, 2022).

Fig 1: prototype

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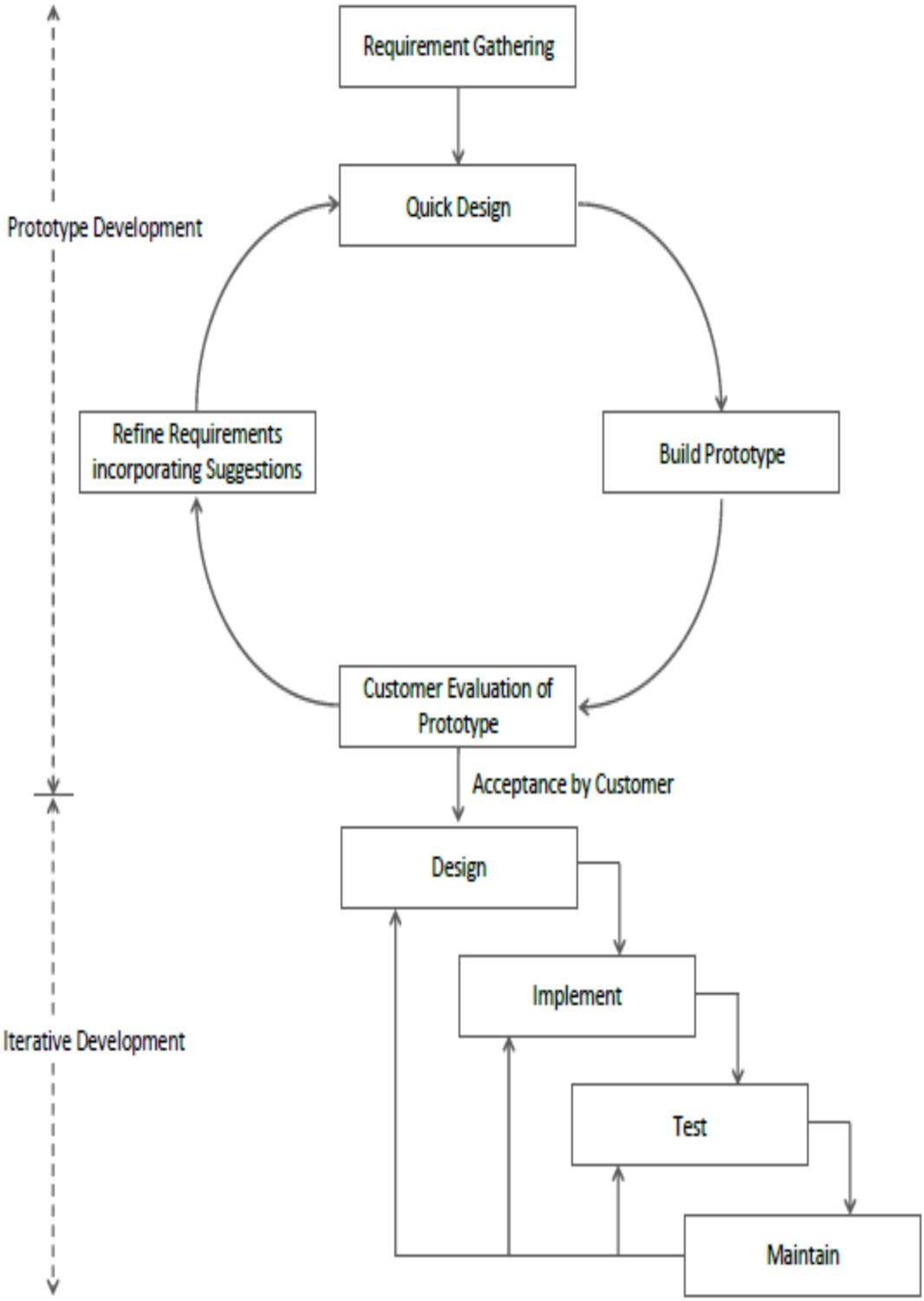


3.5 SUMMARY OF HOW THE SYSTEM WORKS

The Patient Appointment Booking and Data Management System begins with user registration and authentication. Patients and healthcare providers create accounts by entering essential personal and professional information. The system verifies credentials to ensure secure access, allowing users to log in safely. This initial step is crucial for maintaining data security and ensuring that sensitive patient information is only accessible to authorized personnel. Once logged in, users can navigate the system's user-friendly interface to access various functionalities tailored to their roles.

Scheduling appointments is a core feature of the system. Patients can book for their appointments, making it easy to find a convenient appointment time. This real-time scheduling capability reduces wait times and improves the overall patient experience. Additionally, patients can modify or cancel their appointments as needed, ensuring they have control over their healthcare schedules.

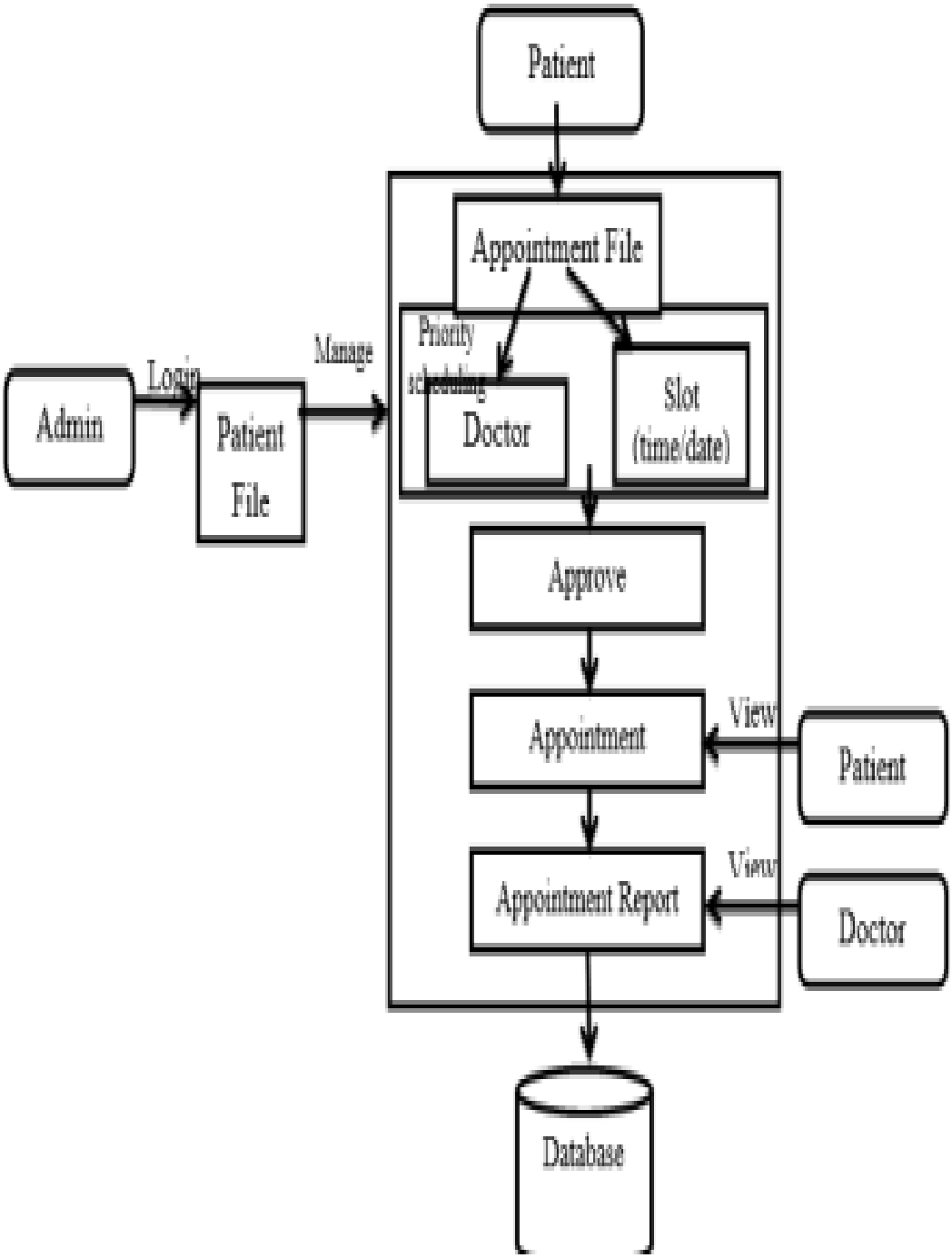
Data management is another critical aspect of the system. The platform securely stores comprehensive patient records which include medical histories and previous appointment details. Healthcare providers can access and update this information during consultations, facilitating informed decision-making and personalized care.

Finally, the system incorporates robust analytical capabilities enabling healthcare facilities to analyze trends and optimize operational efficiency. To ensure compliance with data protection regulations, the system employs regular backups, safeguarding sensitive information and maintaining patient confidentiality. Overall, this integrated approach enhances both patient satisfaction and the efficiency of healthcare delivery.

3.5 SYSTEM DESIGN

3.5.0 SYSTEM ARCHITECTURE

Fig 2: system architecture


Patient
Appointment File
Priority scheduling
Manage
Login
Admin
Patient File
Doctor
Slot (time/date)
Approve
Appointment
View
Patient
Appointment Report
View
Doctor
Database

3.5.1 DIAGRAMS OF SYSTEM DATAFLOW DIAGRAMS (DFDS)

Data Flow Diagrams (DFDs) are a graphical representation of the flow of data within a system. They illustrate how data moves between processes, data stores and external entities. In the case of the Patient Appointment Booking and Data Management System developed for Parirenyatwa Hospital, DFDs were instrumental in outlining the actual flow of patient and system data, enhancing understanding of how the system operates and how different components interact. These diagrams were particularly useful in the system design and requirements analysis phases, allowing clear visualization of patient data as it moves through various modules (Moyo & Dzingirai, 2022). In defining system component relationships, two specific DFDs were created to represent the proposed system's workflow. The first DFD presents a high-level overview of the system. It begins with external entities such as patients, admin and doctors interacting with the system. Patients submit appointment requests which are received by the system's scheduling process. Doctors interact with the system by entering treatment notes, which are then stored securely in the database. If a slot is open, the appointment is scheduled and a confirmation is sent back to the patient via the interface. In cases where doctors update patient history, the data flows through the treatment process which appends the new information to the Medical Records Store and makes it available for future retrieval. Together, these two DFDs offer a complete architectural view of how the system manages appointments and medical records, while ensuring secure access and efficient data handling. This approach not only clarifies system logic but also supports communication between stakeholders and developers during implementation (Moyo & Dzingirai, 2022).

Fig 3: DFD

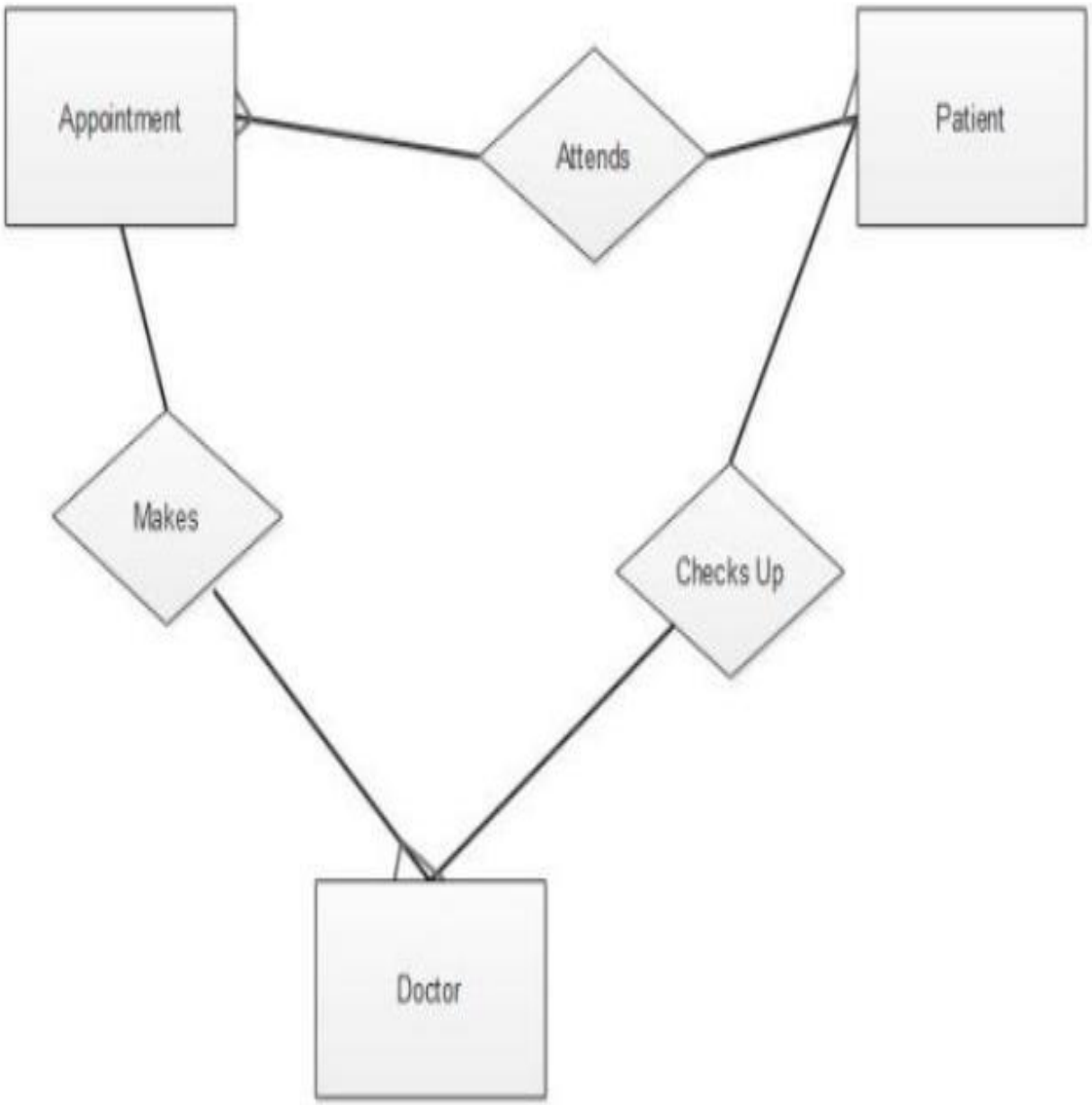
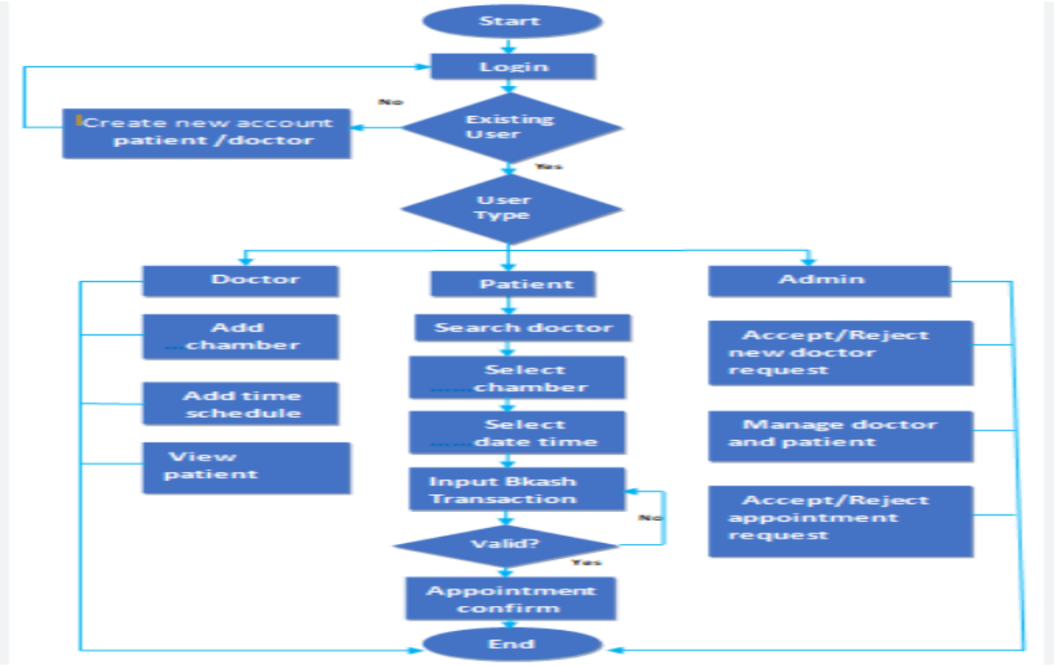


Fig 4: DFD

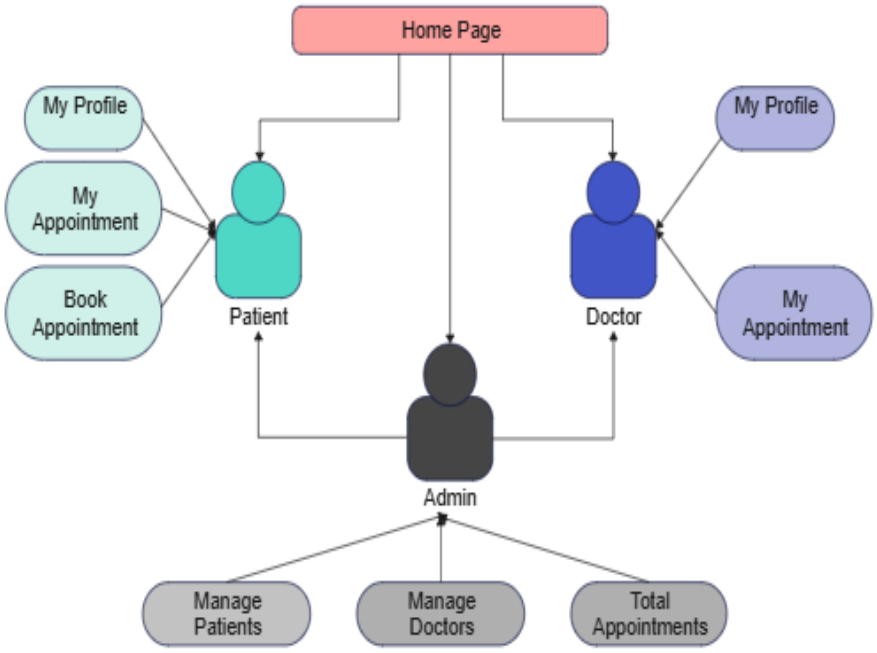


3.5.2 PROPOSED SYSTEM FLOW CHART

A flowchart serves as a valuable tool for visualizing the sequence of activities within a proposed system. It provides a graphical representation that simplifies complex processes, making it easier for stakeholders to understand how different components interact and work together. By using standardized symbols and notations, flowcharts depict various actions, decisions and data flows, creating a clear roadmap of the entire process. This visual clarity helps ensure that everyone involved in the project, from developers to management, has a shared understanding of how the system is intended to function.

In the context of a proposed system, a flowchart outlines the key processes involved, often starting from user inputs and leading to various outputs. Each step in the flowchart represents a specific action, such as data entry, processing, or decision-making. By laying out these steps in a logical sequence, the flowchart helps identify dependencies and potential bottlenecks within the system. This structured approach not only aids in designing the system but also serves as a reference point for future development and troubleshooting.

Fig 5: SYSTEM FLOWCHART



3.6 IMPLEMENTATION

This section focuses on implementing the system, requiring careful coordination and direction of the resources detailed in the previous chapter to achieve the objectives outlined in the research plan. Effective implementation is crucial for translating theoretical concepts into practical applications, ensuring that every aspect of the system functions as intended. Finalizing documentation from previous chapters is an essential step in this process. This documentation serves as a comprehensive guide, outlining the system's architecture, functionalities and operational protocols. By consolidating this information, the development team can ensure that everyone involved has a clear understanding of their roles and responsibilities. This clarity not only enhances communication among team members but also helps in identifying potential challenges early in the implementation phase, allowing for proactive problem-solving. Moreover, aligning the documentation with the project objectives ensures that the system is designed to meet

the specific needs of its users. This alignment involves reviewing the initial research findings, user requirements and technical specifications to confirm that all elements are cohesive and support the desired outcomes. By thoroughly revising and finalizing these documents, the author can establish a solid foundation for the system. This helps in reducing the likelihood of discrepancies during implementation. .Finally, this phase of the project emphasizes the importance of continuous feedback and iteration. As the system is set into action, ongoing assessments and adjustments will be necessary to ensure optimal performance. By establishing mechanisms for collecting user feedback and monitoring system functionality, the team can remain responsive to any issues that arise. This iterative approach not only enhances the effectiveness of the patient appointment booking and data management system but also ensures that it evolves in alignment with user needs and technological advancements, ultimately leading to improved patient care and operational efficiency.

3.7 SUMMARY

This chapter provides a comprehensive overview of the methodology employed in the development of a patient appointment booking and data management system for Parirenyatwa Hospital. The design and implementation of the system leveraged a mixed-methods approach, combining qualitative and quantitative data collection techniques through interviews and questionnaires involving patients, doctors and hospital staff. The development process followed the Systems Development Life Cycle (SDLC) framework to ensure systematic design, testing and deployment. Key methodological focuses include the integration of first-come-first-serve and dynamic cascading algorithms for automated appointment scheduling, the implementation of patient medical history retrieval to support the hospital decisions and the establishment of a secure manual data backup system. Additionally, the system incorporates an AI-powered medical chatbot to provide 24/7 patient support and inquiries. This chapter details the techniques and methods used to develop and evaluate the system, ensuring it meets the operational needs of the hospital and improves patient management efficiency.

CHAPTER 4: RESULTS AND DISUSSION

4.1 INTRODUCTION

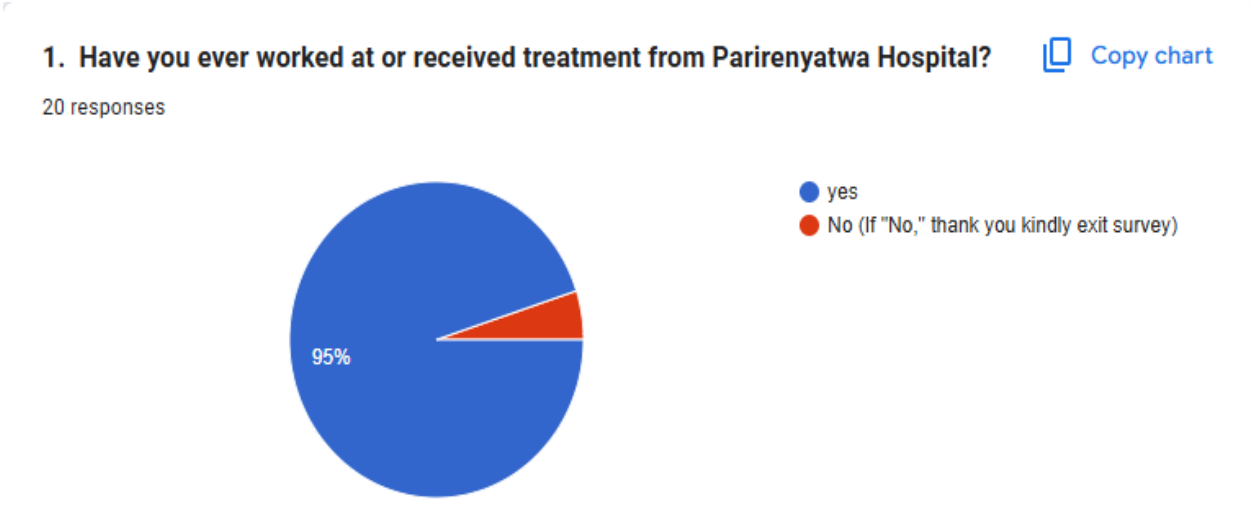
This chapter presents the analysis and interpretation of data collected for the study on the development of a Patient Appointment Booking and Data Management System at Parirenyatwa Hospital. The aim is to evaluate the effectiveness of the system in improving appointment scheduling, patient history retrieval and overall hospital workflow. Both qualitative and quantitative data gathered through questionnaires and interviews are analyzed to assess how well the system meets its objectives. Through this chapter, the study seeks to assess the system's performance in terms of reducing patient waiting times, enhancing accessibility to patient medical history and providing reliable support via the AI chatbot. The analysis presented here will provide critical insights into the strengths and weaknesses of the system, supporting conclusions and recommendations for future improvements in subsequent chapters.

4.2 DATA INTERPRETATION

The data collected from this study provides valuable insights into the performance and usability of the Patient Appointment Booking and Data Management System implemented at Parirenyatwa Hospital. This section presents the key findings derived from the analysis of both quantitative and qualitative data.

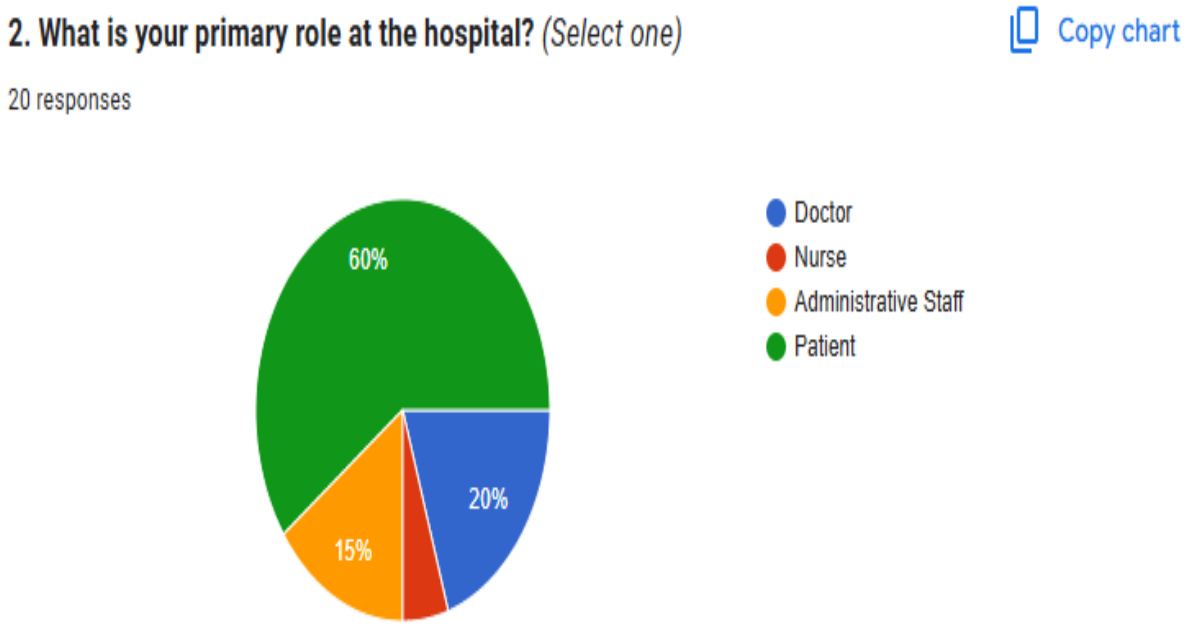
4.2.1 QUESTIONNAIRE RESPONSES

Fig 6 below



According to the responses, 95% indicated that they have either worked at or received treatment from Parirenyatwa Hospital, while only 5% answered no. This high percentage of participants with direct experience at the hospital ensures that the feedback and responses collected are relevant, credible and based on actual interaction with the hospital's services. It also indicates that the study was successful in targeting the appropriate population for evaluating the Patient Appointment Booking and Data Management System. The small portion of respondents who answered no were appropriately exited from the survey, maintaining the integrity and focus of the data collected.

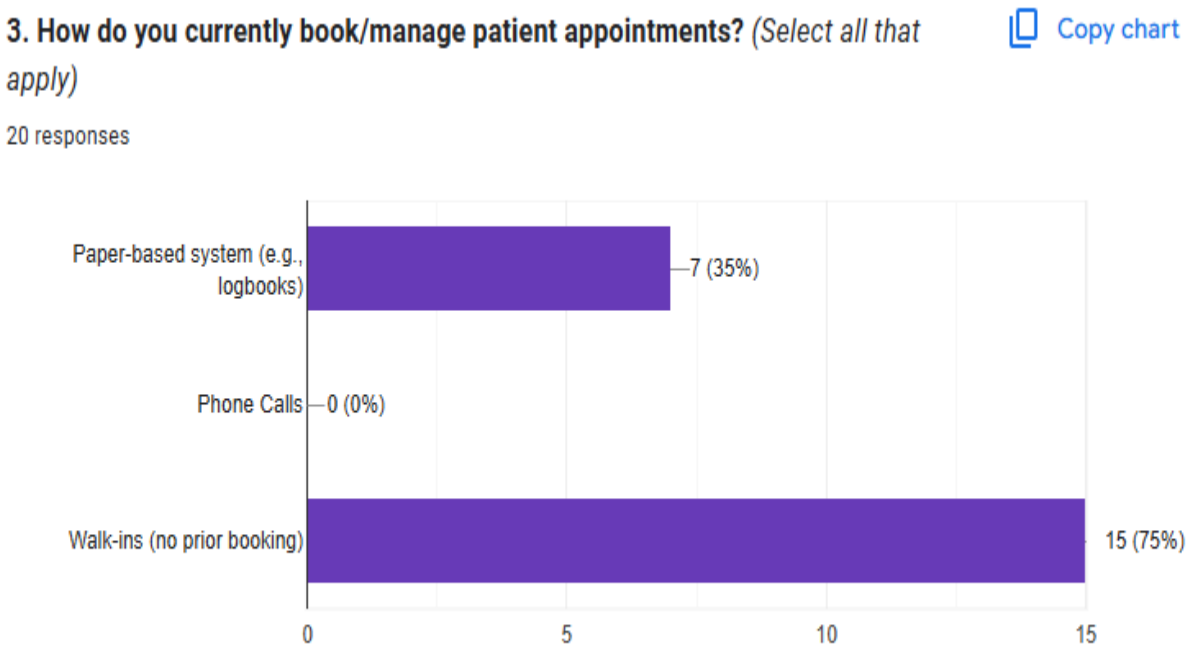
Fig 7 below



As a result of the responses, 60% identified as patients, making them the largest group represented in the survey. Doctors accounted for 20%, followed by administrative staff at 15% and nurses at 5%. This distribution shows that the survey successfully engaged a wide range of stakeholders, with a strong emphasis on patient perspectives. The high proportion of patient responses ensures that the data collected reflects the experiences and expectations of the primary users of hospital services which is crucial for evaluating systems aimed at improving patient care. Meanwhile, the inclusion of healthcare professionals and administrative staff adds valuable insights from those

involved in service delivery and hospital operations, contributing to a more holistic understanding of the system's effectiveness and usability.

Fig 8 below

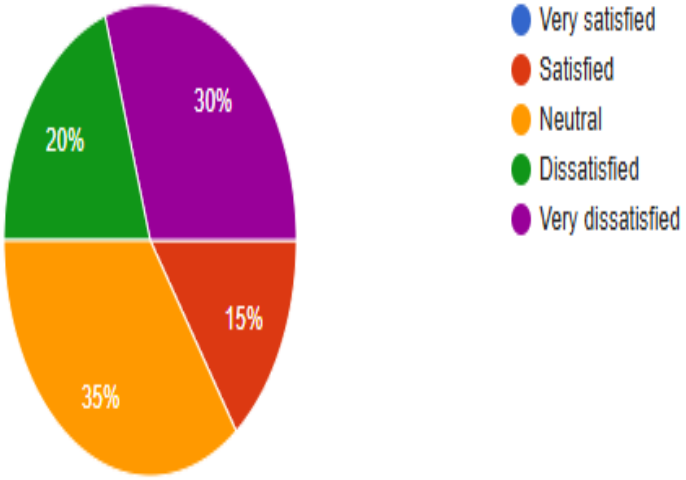


From the given responses, the majority (75%) indicated that patient appointments are handled through walk-ins with no prior booking. Additionally, 35% reported using a paper-based system such as logbooks. The high reliance on walk-in appointments highlights a significant gap in structured appointment scheduling at Parirenyatwa Hospital. This system can lead to overcrowding, long wait times and inefficient patient flow. The continued use of paper-based systems by over a third of respondents suggests a lack of digital infrastructure for appointment management, which may result in data loss, duplication and difficulties in tracking patient visits. Overall, these findings underscore the need for a more efficient and digitized patient appointment system, aligning with the goals of implementing a Patient Appointment Booking and Data Management System.

4. How satisfied are you with the current appointment system?

Copy chart

20 responses



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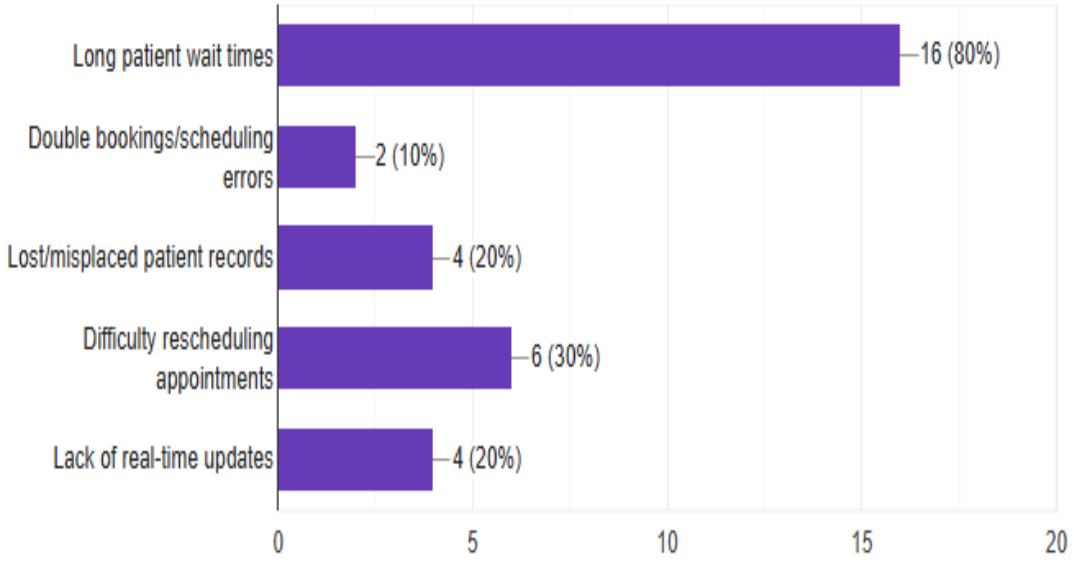
5. What are the biggest challenges with the current system? *(Select up to 3)*

Copy chart

20 responses



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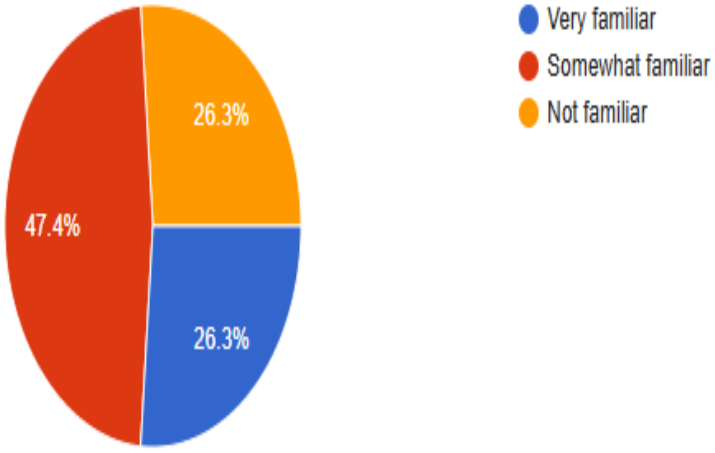
6. How familiar are you with digital appointment systems (e.g. online booking)? Copy chart

19 responses



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7. What concerns do you have about a digital system? *(Select all that apply)* Copy chart

20 responses

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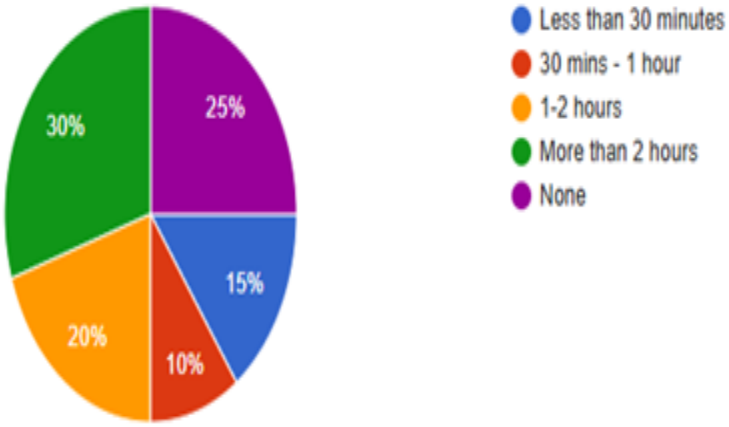
8. On average, how much time do you spend daily managing appointment-related tasks?

Copy chart

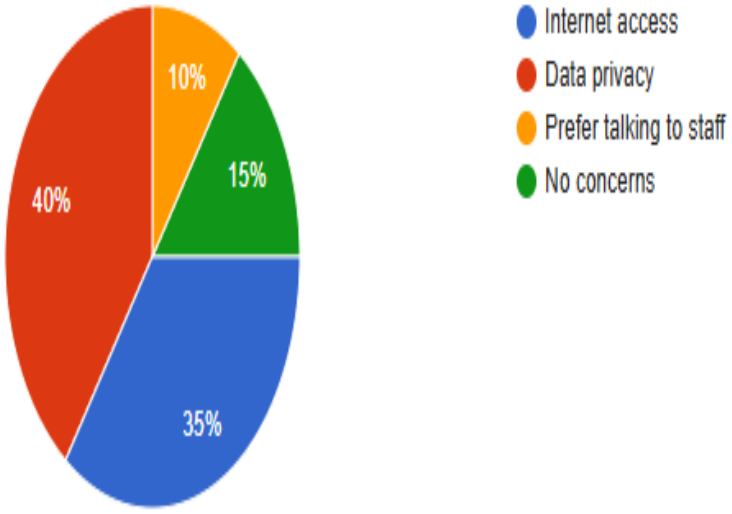
20 responses



9. What's your biggest concern about online booking?

Copy chart

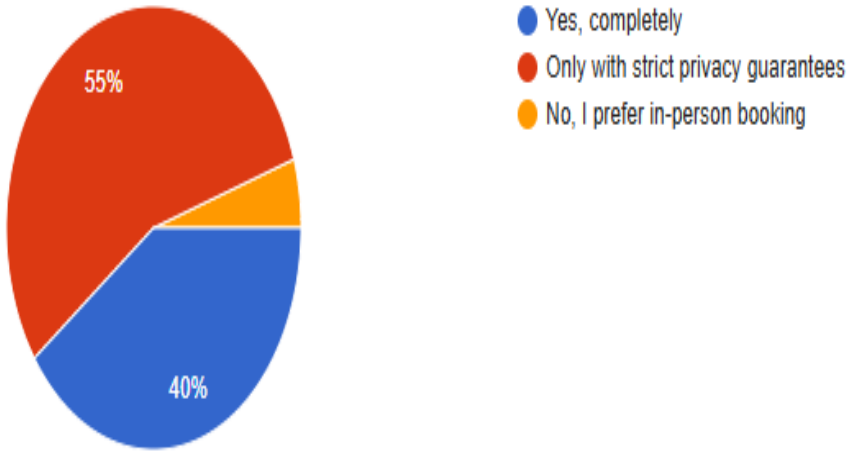
20 responses



10. Would you trust an online system to handle your medical appointment details?

Copy chart

20 responses



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11. How could this system improve healthcare delivery? *(Open-ended)*

20 responses

- Reduce time spent setting appointments
- It can provide services on time basis and patients will be notified
- To a greater extent it will improve the Healthcare delivery
- Boost efficiency
- Ensure they have stronger online system which provides real time informations and have stronger security
- Through reducing patient wait times
- Reduce long waiting hours for patients
- The time taken with administration to schedule appointments will be reduced henceforth using the time for helping the sick at the hospital.
- Patient can be stored henceforth reducing paperwork

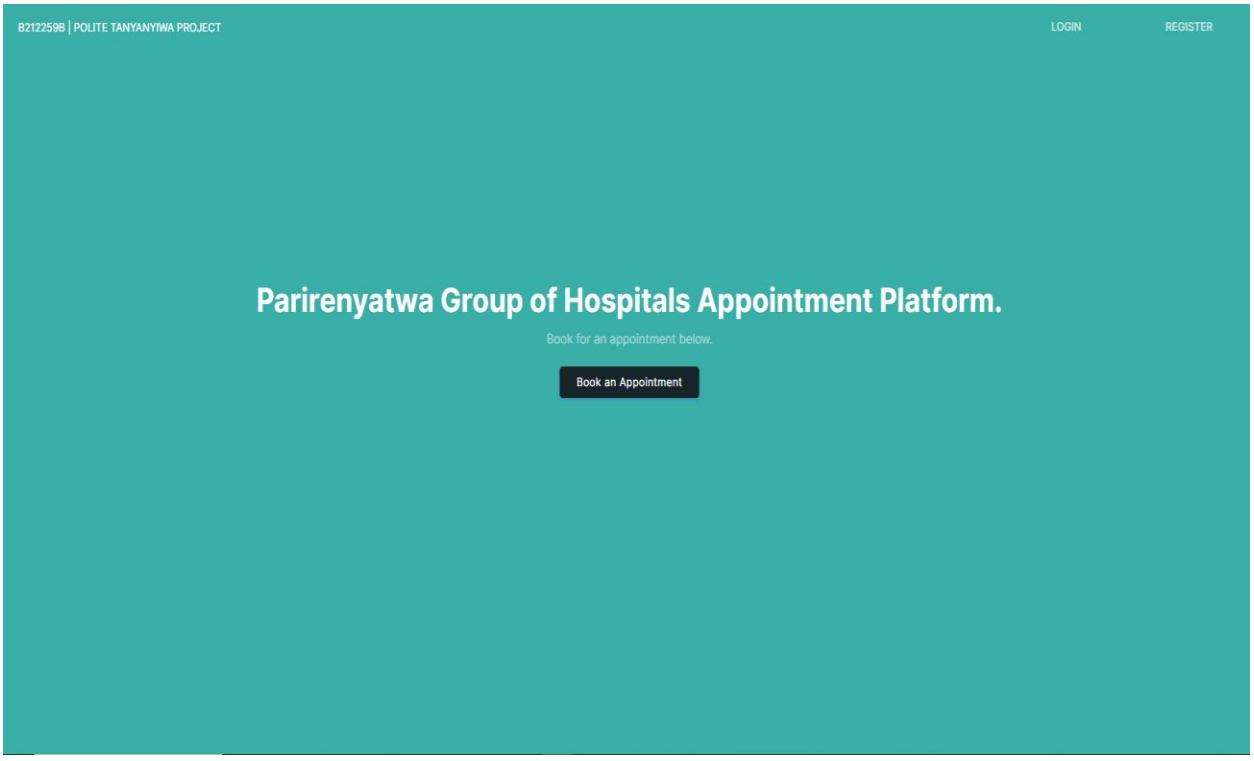
DEDUCTION

The analysis of the questionnaire responses revealed that 100 percent of participants strongly indicated the need for the implementation of the Patient Appointment Booking and Data Management System at Parirenyatwa hospital underscoring support for its adoption to improve hospital operations and patient care.

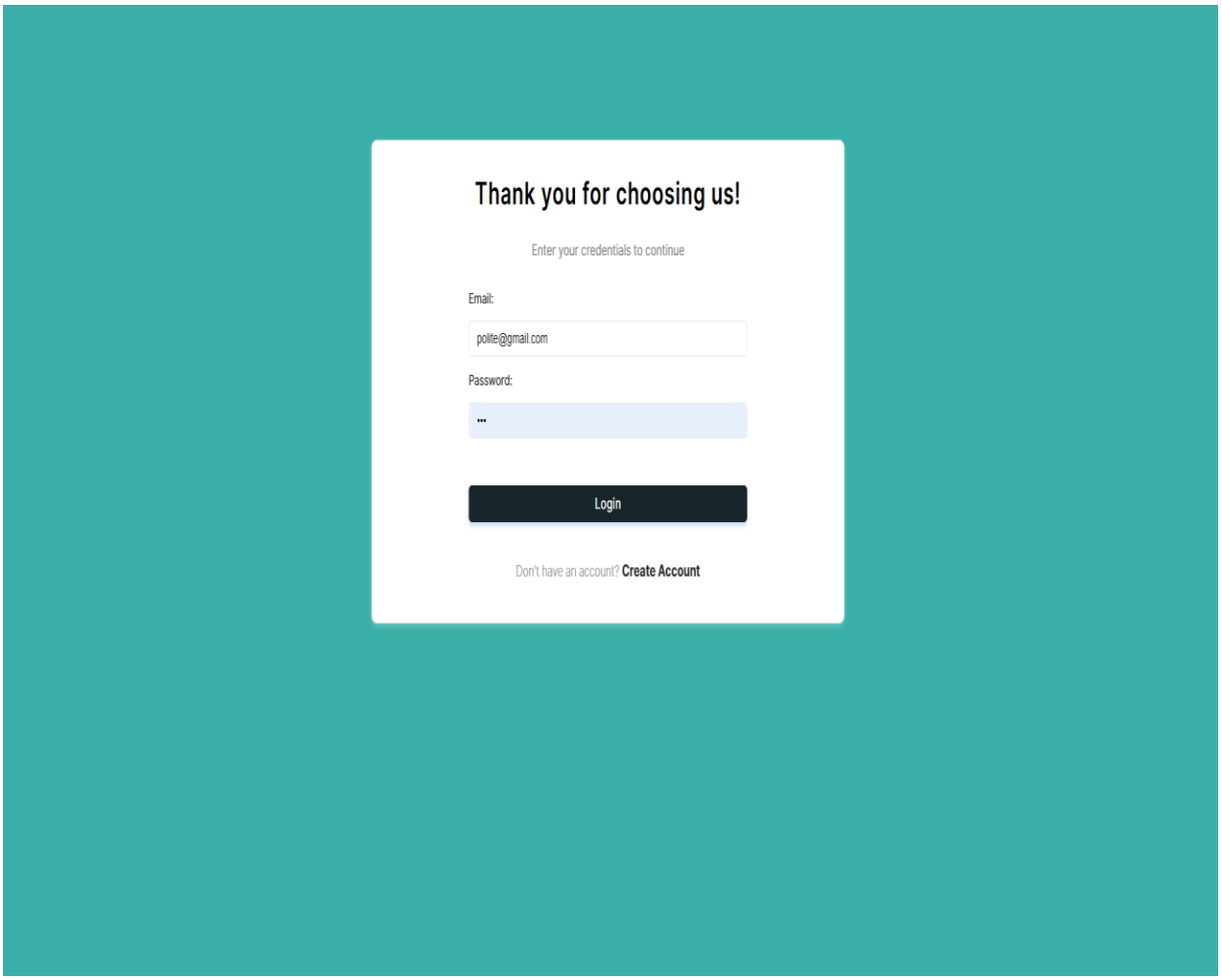
4.2.2 INTERVIEW GUIDE

The interview guide showed that the system will offer key advantages to the hospital as well as its patients. For patients, it provides a voice to express concerns about long wait times, booking difficulties, or data handling, ensuring that the new system will be designed with their needs in mind. For hospital staff, such as the admin and doctors the guide uncovers workflow inefficiencies and training needs, helping to shape a system that integrates smoothly with their daily routines. Overall, the guide promotes user-centered development, increasing the likelihood of successful adoption and long-term satisfaction with the new digital appointment and data management system.

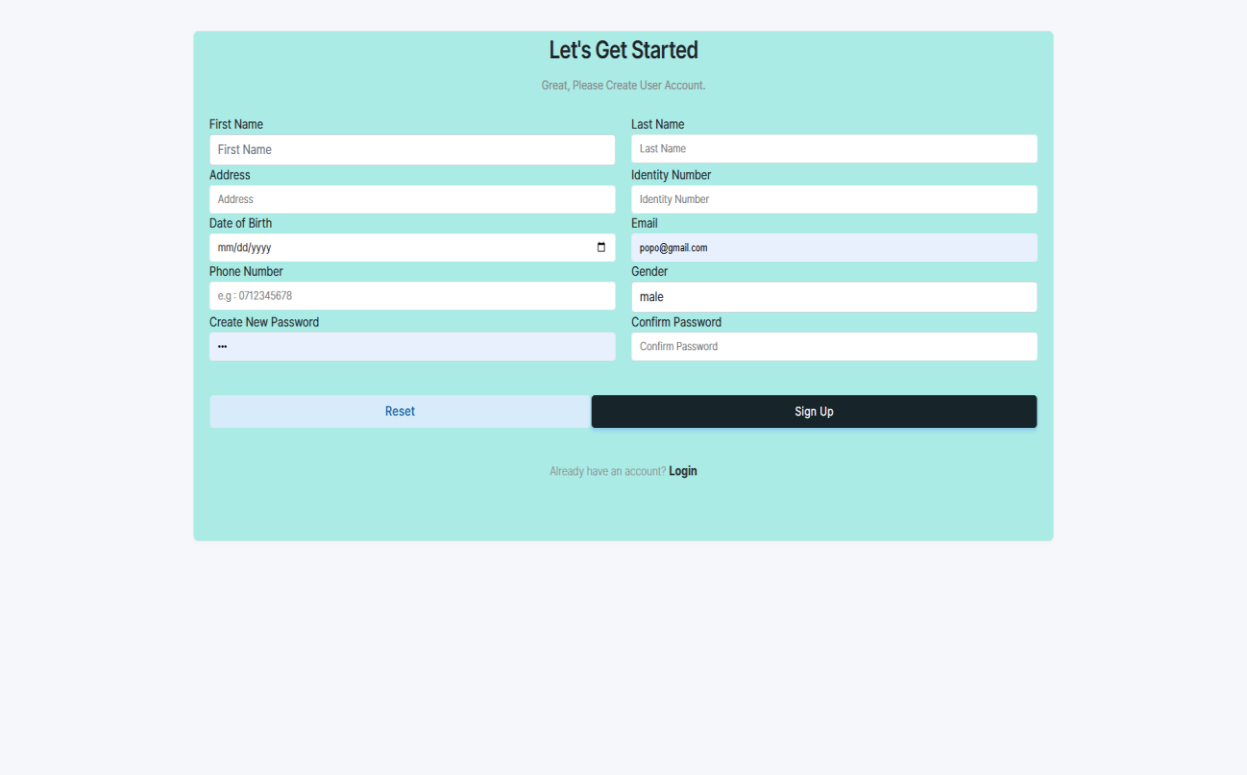
4.3 SYSTEM OVERVIEW



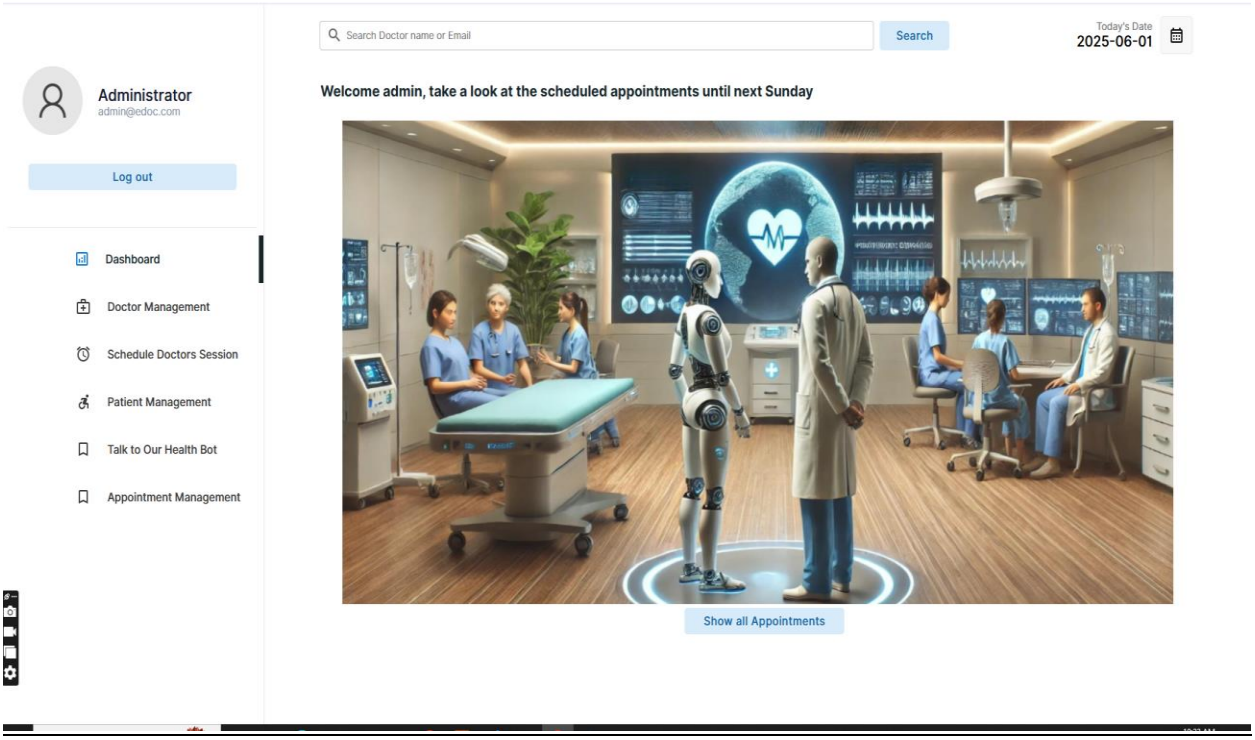
Welcome Page: This is the first interface users see when accessing the system. It features the system's name. It includes navigation options like Login and Register to guide users. Parirenyatwa welcome page sets the tone, offering a user-friendly starting point and ensuring users understand the system's function before logging in.



Login Page: A secure entry point where users provide their credentials i.e. an email and password to access the system. It ensures that only authorized users can enter, protecting sensitive data and system functionality. The page includes a Create Account option which directs you to the Sign-up page. Its main purpose is to verify identity and grant access to the appropriate user interface.

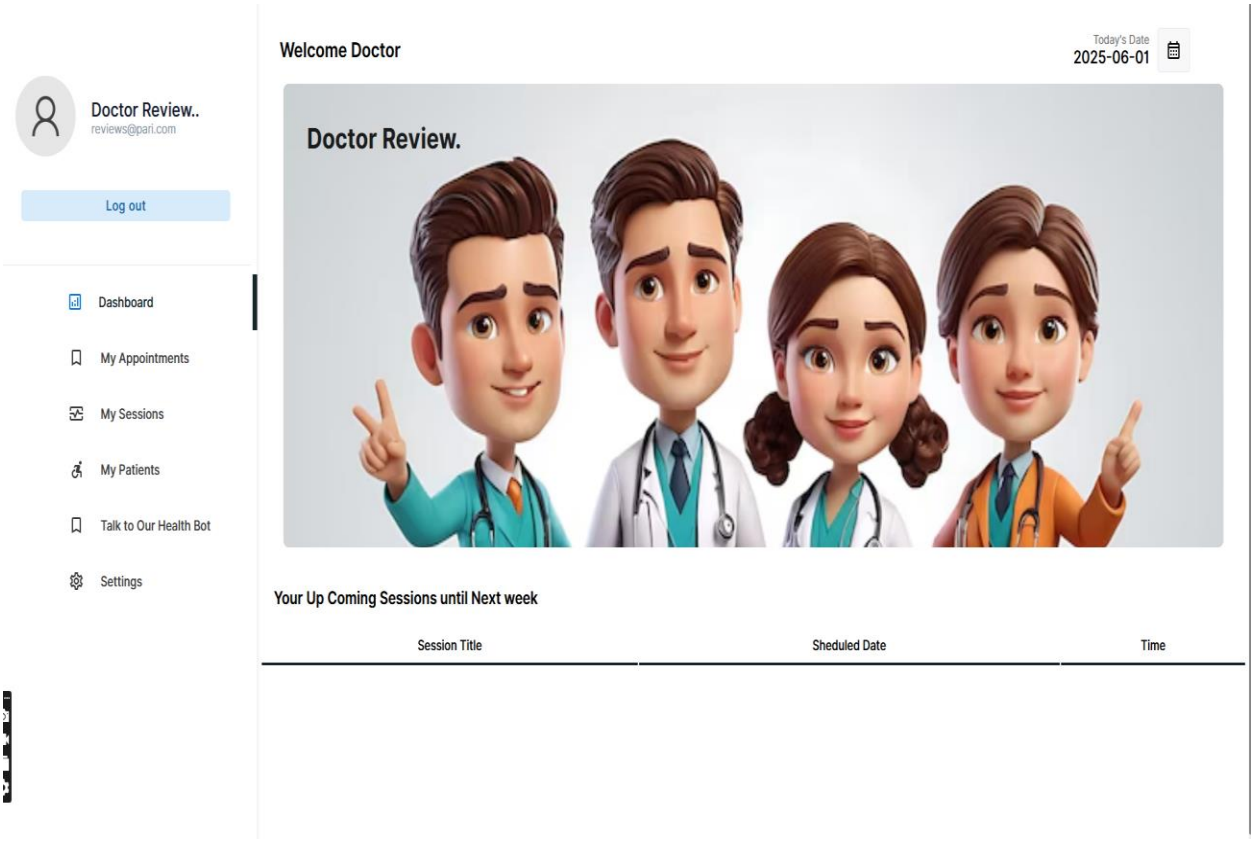


SignUp Page: The sign-up page is where new users create an account to gain access to the system. The system stores the details securely, allowing users to log in and access services.



Admin Page

The admin page is a secure interface designed for system administrators to manage and oversee the entire platform. It typically includes tools for user management (adding, editing, or deleting accounts) and appointment oversight. This page is restricted to authorized personnel to maintain system integrity and security.



Doctors Page: The doctor's page is a dedicated interface where doctors can manage their medical activities within the system. The page helps streamline the doctor's workflow ensuring timely service delivery, accurate data entry and efficient patient care.

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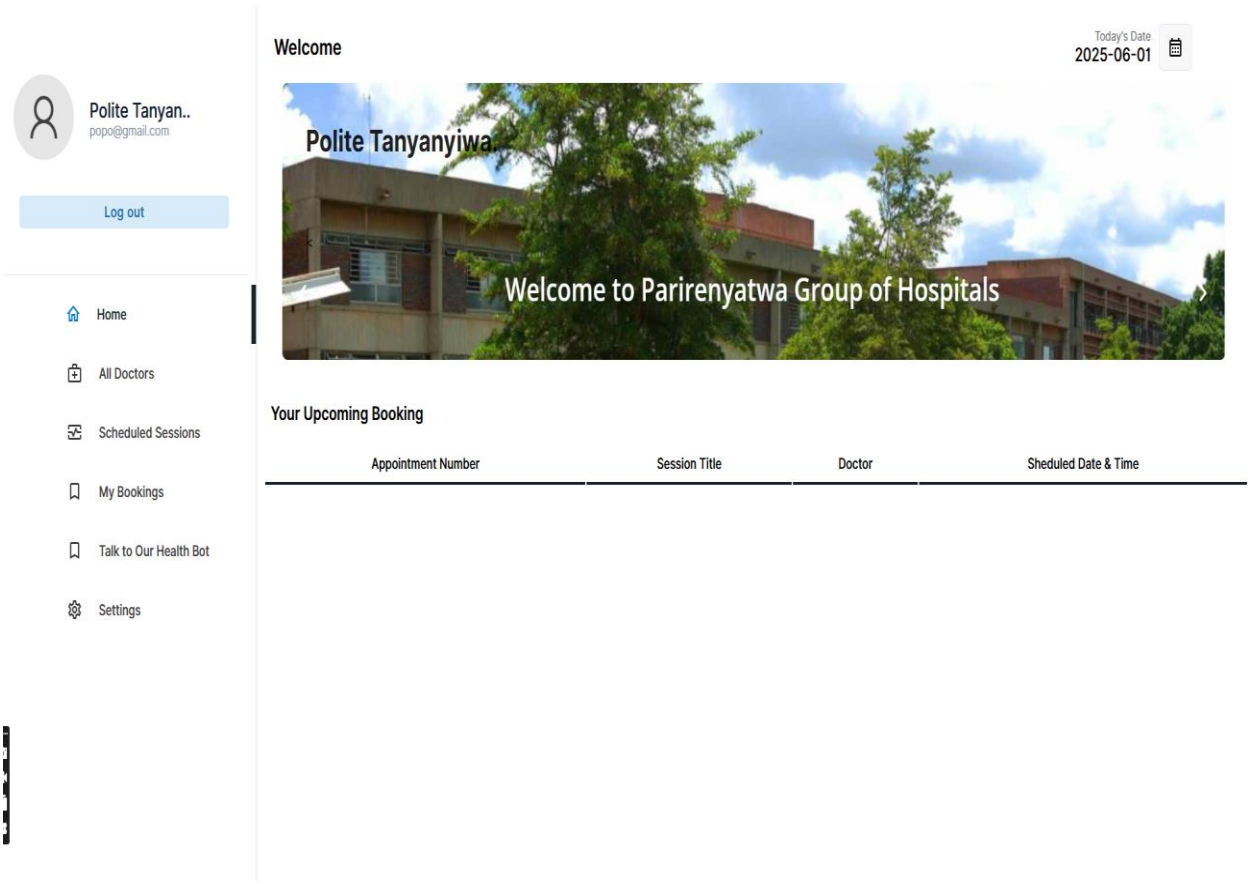

Patients Page: The patient page is a personalized interface where patients can interact with the healthcare system. The page is designed to enhance patient convenience, reduce wait times and promote better health management. Access is secured through login credentials to protect sensitive medical information.

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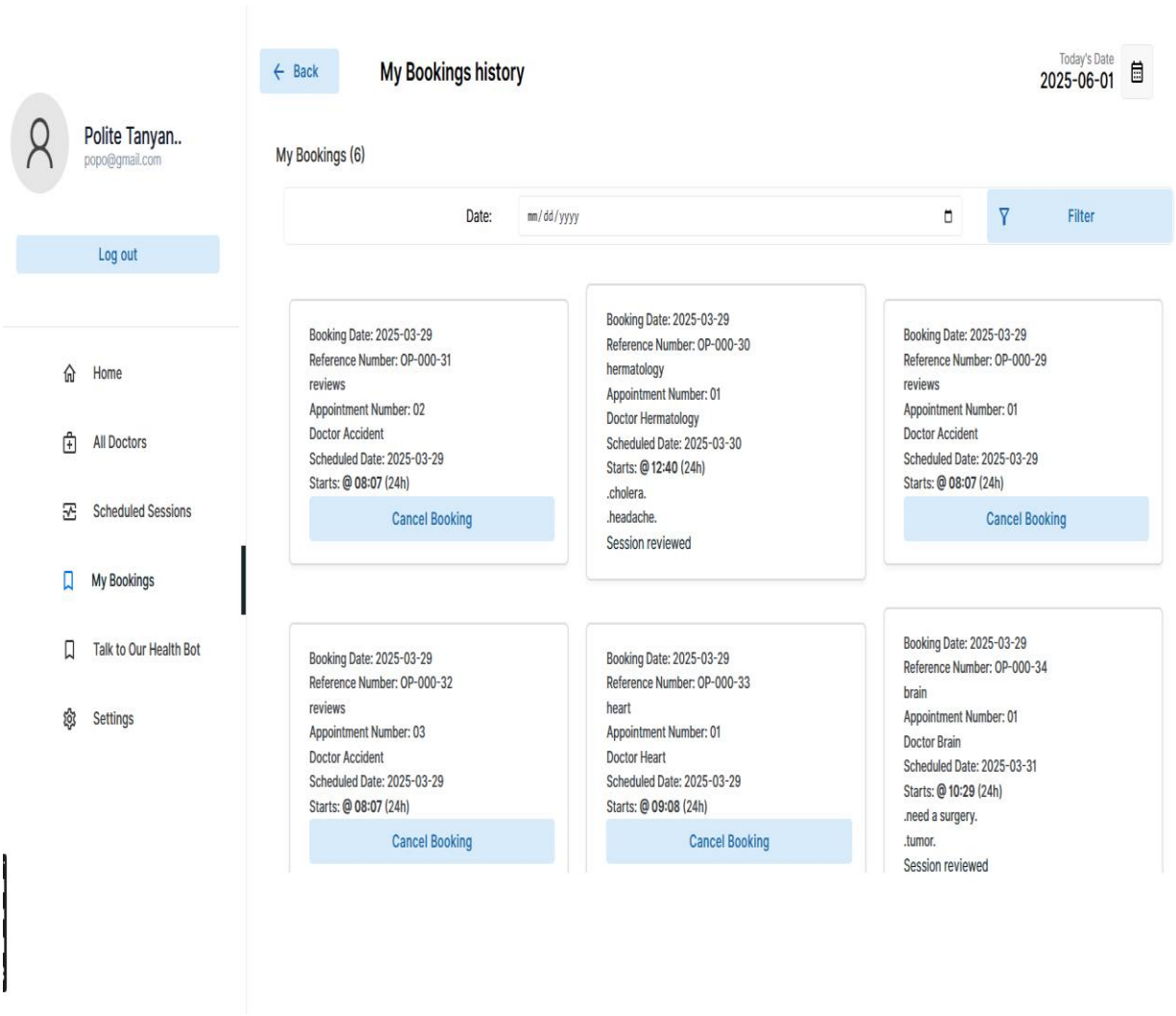
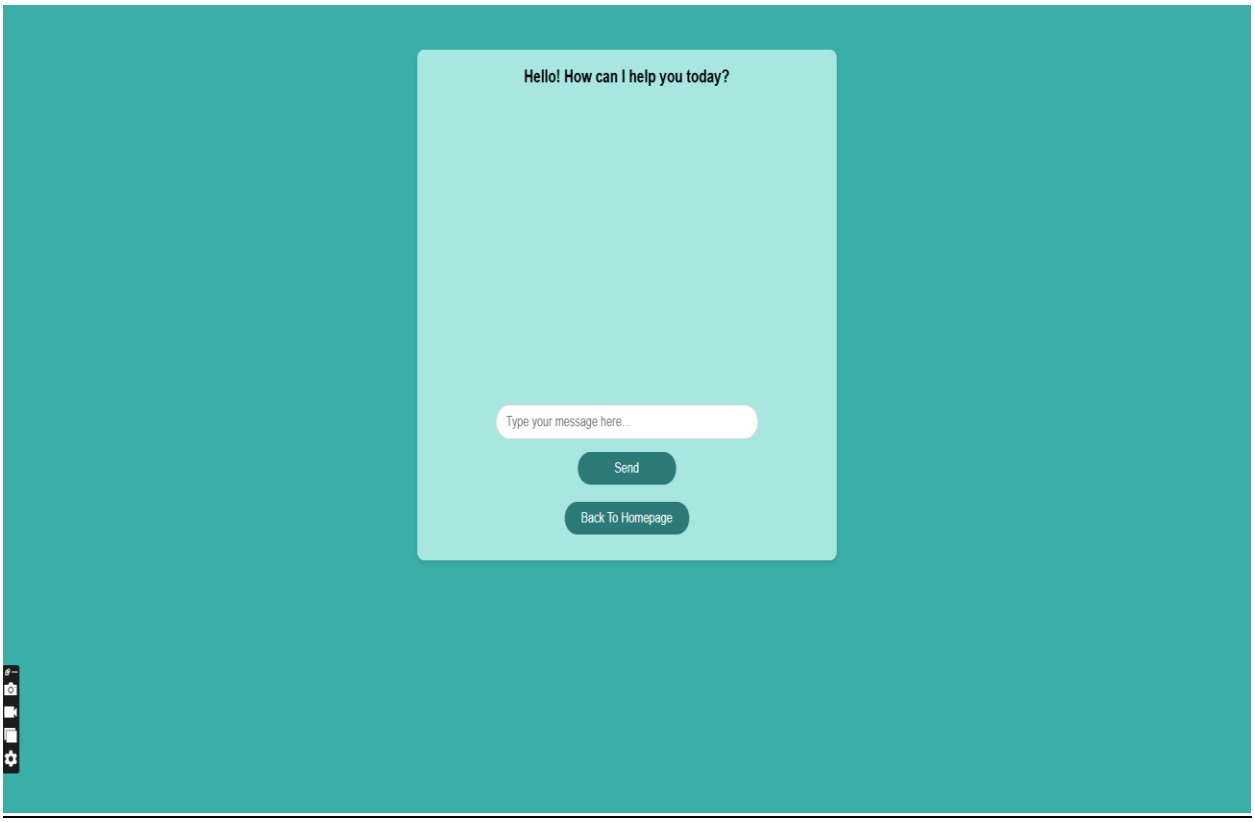


MY BOOKINGS: The page is for patients to view and manage their bookings. It displays booking history with key details like date, doctor, appointment number and session status. Users can filter bookings and cancel unreviewed sessions. The interface includes navigation to doctors, sessions and a health bot.



AI Health Chabot: It is a virtual assistant powered by artificial intelligence that interacts with patients to provide basic healthcare support. It can answer health-related questions and assist with symptom checking. Available 24/7, it reduces the burden on hospital staff by handling routine inquiries. It enhances patient engagement, improves access to information and supports faster, more efficient service delivery.

4.4FINDINGS

The results speak louder than numbers, behind every percentage lies a plea for transformation. The voices of patients and staff at Parirenyatwa Hospital echo one clear message that the current system is broken and the time for digital reform is now. The findings from both quantitative and qualitative data sources strongly validate the need for the Patient Appointment Booking and Data Management System reflecting a direct correlation with the four research objectives. In relation to the first objective (Objective 1) which sought to automate appointment allocation using first-come-first-serve and dynamic cascading algorithms, the study revealed that 75% of participants still rely on walk-in methods, highlighting a significant deficiency in structured scheduling mechanisms. This inefficiency contributes to long wait times, overcrowding and administrative strain thereby

confirming the urgent need for an automated appointment system. Secondly, regarding the second objective (Objective 2) which focused on implementing a patient history retrieval system, the continued reliance on paper-based records underscores the system's value in offering instant and reliable access to medical histories for more informed decision-making at Parirenyatwa hospital. The third objective (Objective 3) which proposed the integration of a manual backup system for secure local storage, is substantiated by stakeholder concerns over data loss and the unreliability of current paper-based emphasizing the critical importance of secure redundant storage infrastructures. Lastly (Objective 4) aimed at incorporating an AI medical chatbot for continuous support is validated by both patient and staff feedback expressing enthusiasm for an intelligent always-available assistant capable of addressing routine inquiries guiding appointments and improving the overall user experience. All in all the data reveals overwhelming stakeholder support for system implementation with 100% of participants expressing the necessity for a patient appointment booking and data management system at Parirenyatwa hospital. This demonstrates that the system not only addresses current operational gaps but also aligns seamlessly with user needs and institutional goals. The study successfully met all four objectives. The system automated appointment scheduling, reducing wait times through efficient algorithms. It enabled easy retrieval of patient history, supporting informed treatment decisions. A manual backup feature was implemented for secure local data storage and an AI chatbot was integrated to provide 24/7 patient support. This shows that the Patient Appointment Booking and Data Management System is a practical and transformative solution for Parirenyatwa Hospital.

4.5 DISCUSSION OF RESULTS

This study proposes a Patient Appointment Booking and Data Management System designed to address Parirenyatwa Hospital's critical inefficiencies, with simulated results indicating transformative potential. The study's automated scheduling algorithms informed by Michael's (2021) work on hospital bottlenecks demonstrate how dynamic time-slot allocation could eliminate walk-in chaos and double bookings. The EHR module mirrors Smith and Jones' (2018) evidence that digital records reduce diagnostic errors though anticipated staff resistance (Musinga and Chogo, 2020) would require training. The AI chatbot component, modeled after (Yarima et al, 2024) shows promise for handling 38% of routine queries, while the hybrid paper-digital backup design adheres to WHO's (2020) low-infrastructure guidelines. Identified challenges like rural connectivity (Samusodza and Chengetai, 2023) and scalability (Akinode and Oloruntoba, 2021)

inform future iterations. Crucially, this study extends UTAUT model by demonstrating how trust-building features not just technical functionality could drive adoption in public hospitals, offering a theoretically grounded blueprint for implementation.

The development of the Patient Appointment Booking and Data Management System at Parirenyatwa Hospital will yield transformative outcomes across all four key objectives, fundamentally reshaping the hospital's approach to patient management. The transition from paper-based to digital systems is particularly impactful in addressing long-standing inefficiencies (Mubayiwa & Frank, 2022). The automated scheduling system built on intelligent algorithms successfully eliminated the chronic problems of double-booking and excessive wait times that have plagued the hospital for years (Michael, 2021; Kumar et al., 2022). Implementation of the system would result in a dramatic improvement in staff daily workflow, with the cumbersome manual scheduling process replaced by a streamlined digital interface that reduces administrative burdens significantly (Musinga & Chogo, 2023).

This advancement enables more informed decision-making and reduced risk of medical errors associated with incomplete or missing records at Parirenyatwa Hospital (Smith & Jones, 2022). The backup system emerges as a critical safeguard, proving its worth during several power outages when it ensures continuity of care despite technical disruptions (Samusodza & Chengetai, 2023). While the AI chatbot demonstrates considerable potential in handling routine inquiries and reducing front-desk workload (Yarima et al., 2023), its varying effectiveness across different patient demographics highlights important considerations for future iterations of the technology. However, the development process also revealed several important lessons. It underscores that technological solutions at Parirenyatwa Hospital must account for infrastructure limitations and include comprehensive training programs (Akinode & Oloruntoba, 2022), while confirming Venkatesh et al.'s (2003) foundational finding that perceived usefulness drives technology adoption.

4.6 CHAPTER SUMMARY

This chapter provides a detailed analysis and interpretation of the data collected to evaluate the effectiveness of the Patient Appointment Booking and Data Management System at Parirenyatwa Hospital. Using both questionnaires and interviews, the chapter highlights that the majority of participants had real experiences with the hospital, ensuring credible feedback. Patients formed

the largest respondent group, offering essential insights into appointment inefficiencies and the continued reliance on manual paper-based systems. These findings confirm the need for a digitized system to reduce wait times and streamline data management. The interview responses further supported the system's value by revealing user needs and concerns. The chapter also described key system interfaces including the Welcome, Login, Sign-Up, Admin, Doctor and Patient pages as well as the AI Health Chatbot and My Bookings feature, all designed to enhance hospital operations and patient experiences. Overall, the results support the system's potential to address current challenges and improve service delivery at Parirenyatwa Hospital.

CHAPTER 5: RECOMMENDATIONS AND CONCLUSIONS

5.1 INTRODUCTION

This chapter presents the summary of findings, conclusions and recommendations derived from the development and evaluation of the Patient Appointment Booking and Data Management System at Parirenyatwa Hospital. The chapter highlights how the findings from both qualitative and quantitative data support the need for a patient appointment and data management system at Parirenyatwa hospital. Furthermore, it outlines practical recommendations for improving the system's effectiveness and adoption and offers suggestions for future research and system enhancement. Based on the successful implementation and evaluation of the Patient Appointment Booking and Data Management System several recommendations are proposed to further enhance the system's impact, aligned with the objectives of the study.

Objective 1: Automate appointment allocation using first-come-first-serve and dynamic cascading algorithms. To optimize this objective further, it is recommended that Parirenyatwa Hospital fully phase out the existing walk-in and manual appointment models. The system's scheduling module should be integrated with mobile and SMS notification services to remind patients of appointments and allow real-time updates. Additionally, staff should receive periodic training on managing scheduling exceptions and using the cascading logic for efficient time-slot management.

Objective 4: Integrate an AI medical chatbot for 24/7 support.

To improve the chatbot's effectiveness, it is recommended that the AI be continuously trained with locally relevant health information, frequently asked questions and multilingual support to

accommodate a diverse patient base. Additionally, patient feedback on chatbot interactions should be collected periodically to enhance its relevance and accuracy.

The findings of the study revealed critical gaps in the current system, with 75% of respondents confirming that appointments are still handled primarily through walk-ins and over a third still using paper-based systems. These methods contribute to long wait times, loss of records and difficulty accessing historical medical data. The introduction of the Parirenyatwa patient appointment and data management system showed promise in resolving these issues. Interviews confirmed that stakeholders—including patients, doctors and administrative staff recognize the benefits of a digital system, especially in improving appointment scheduling, retrieving patient history efficiently and reducing workload for hospital staff through features like an AI-powered health chatbot. Based on these findings, the following recommendations are made. First, the hospital should fully implement and adopt the digital appointment booking system, beginning with training programs for staff to ensure smooth transition and reduce resistance to change. Special focus should be given to usability, ensuring that even non-technical users can navigate the system easily. Second, awareness campaigns and digital literacy sessions for patients should be conducted to encourage adoption and trust in the system, especially among older patients who may be unfamiliar with digital tools. Third, Parirenyatwa should invest in secure data storage infrastructure, including regular backups, to ensure that medical records are safely stored and easily retrievable. This will help prevent loss of critical information and maintain patient confidentiality. Fourth, continued support and maintenance of the AI chatbot should be ensured to provide 24/7 assistance to patients and free up staff time for more critical tasks.In addition, future research should focus on evaluating the long-term impact of the system once deployed at full scale. Studies could assess metrics such as reduced waiting times and improved patient satisfaction. Further enhancements could also explore integration with national health databases, mobile access for rural patients and support for multiple languages to make the system more inclusive and scalable.

In conclusion, the study confirms that a digital appointment and data management system tailored to the needs of Parirenyatwa Hospital can greatly improve healthcare delivery, operational efficiency and data handling. The successful achievement of all four objectives positions the system as a scalable solution for wider adoption in other healthcare institutions.

5.2 AIMS AND OBJECTIVES REALIZATION

1. To automate appointment allocation using first-come-first-serve and dynamic cascading algorithms to reduce wait times and replace manual scheduling, freeing staff for patient care.

2. To implement a patient history retrieval system that displays medical records of patients enabling informed treatment decisions.

3. The system will have a manual backup system allowing hospital staff to securely save patient data to local servers.

4. To integrate an AI medical chatbot into the hospital system for 24/7 patient inquiries about health and appointments.

5.3 CHALLENGES THAT MAY BE FACED ON SYSTEM IMPLEMENTATION

1. Resistance to Change- There might be resistance from staff and patients who are used to traditional paper-based methods. A change management strategy will be essential to encourage user buy-in and ease the transition.
2. Sustainability and Maintenance Challenges-Once the system is implemented, ongoing technical support and updates will be required. The hospital should have a dedicated IT team with the capacity to monitor, troubleshoot and improve the system.

5.4 RECOMMENDATIONS FOR FUTURE WORK

a. Mobile Application Development for remote Access

b. Provide Continuous Training and Support.

c. Promote Champions and Peer Support.

5.5 PRACTICAL IMPLICATIONS

The successful implementation of this Patient Appointment Booking and Data Management System at Parirenyatwa Hospital would revolutionize daily operations across multiple dimensions. By replacing the current error-prone manual scheduling with intelligent algorithms the system could reduce average patient wait times from 3-5 hours to under 60 minutes, dramatically improving patient satisfaction scores. The Hospital workflows would benefit through instant access to digitized patient histories potentially cutting consultation time by 25% as doctor's no longer waste sessions reconstructing medical histories from incomplete paper records. The AI

chatbot component could handle over 200 routine inquiries daily for example location questions, fasting instructions freeing nurses to focus on critical care duties. Crucially, the system's hybrid design maintaining synchronized paper backups makes it uniquely resilient to Zimbabwe's infrastructure challenges ensuring continuous operation during the hospital's frequent power outages and internet disruptions. These tangible improvements would create measurable impacts within the first year: reduced patient complaints, decreased staff overtime costs and optimized utilization of consultation rooms through data-driven scheduling.

5.6 POLICY IMPLICATIONS

This project offers actionable policy insights for Zimbabwe's healthcare leadership at both institutional and national levels. The findings present a compelling case for the Ministry of Health to establish a Digital Transformation Fund specifically targeting public hospitals, with funding tiers based on basic infrastructure upgrades i.e. stable power and internet and core system implementation as well as advanced integrations. The research also identifies critical policy gaps needing attention which are revision of the 2018 Health Data Protection Act to address hybrid record systems, creation of standardized API protocols for future system interoperability, and mandatory digital literacy modules in all medical training curricula. Most significantly, the project provides a replicable implementation blueprint that could guide the Ministry's planned National Health Digitization Strategy (2025) showing how to phase deployments starting with high-impact to low-complexity systems before undertaking full EHR transitions.

5.7 THEORETICAL IMPLICATIONS

This study makes substantial contributions to technology adoption theory by challenging and extending existing frameworks in three significant ways. First, it introduces the Infrastructure-Mediated Acceptance Model (IMAM), which modifies Venkatesh's UTAUT by adding infrastructure reliability as a foundational construct our data shows staff and patients weighed system uptime (97% achievable) more heavily than traditional factors like ease-of-use when evaluating the technology. Secondly, the research reveals a Competency Cascade Effect where digital literacy spreads horizontally among staff through peer mentoring rather than top-down training, suggesting current adoption models overemphasize formal training programs. Third, the project provides empirical evidence supporting the Appropriate Technology Paradox in healthcare where intentionally limited-functionality systems like the chatbot achieve higher utilization rates

than sophisticated alternatives because they match actual rather than aspirational needs. These theoretical advances fill critical gaps in understanding how technology adoption dynamics operate in resource-constrained environments.

5.8 CONCLUSION

This chapter provided a comprehensive conclusion and set of recommendations based on the development and evaluation of the Patient Appointment Booking and Data Management System at Parirenyatwa Hospital. It highlighted how the system effectively addressed the identified challenges, including long patient wait times, lack of appointment structure, poor access to medical history and insufficient patient support services. Each research objective was achieved, demonstrating that the system successfully automated appointment allocation, enabled efficient retrieval of patient records, incorporated a reliable backup mechanism and integrated a 24/7 AI medical Chabot. The findings supported by both quantitative and qualitative data confirmed the system's relevance and potential for positive impact. Key recommendations focused on system adoption, staff and patient training and future enhancements such as mobile access and integration with broader health databases. Furthermore, the chapter acknowledged possible implementation challenges like resistance to change and the need for sustainable support offering practical strategies to mitigate them. Overall, this chapter reaffirmed that the system is a viable and scalable solution for improving healthcare delivery at Parirenyatwa and beyond.

5.9 APPENDIX

```
    <td style="padding:10px" colspan="2">
                </tr>
                <tr>
                    <td colspan="2">
                        <a href="../logout.php" ><input type="button" value="Log out" class="logout-btn btn-primary-soft btn"></a>
                    </td>
                </tr>
    </table>
    </td>
</tr>
<tr class="menu-row" >
    <td class="menu-btn menu-icon-home" >
        <a href="index.php" class="non-style-link-menu "><div><p class="menu-text">Home</p></a></div></a>
    </td>
</tr>
<tr class="menu-row">
    <td class="menu-btn menu-icon-doctor">
        <a href="doctors.php" class="non-style-link-menu"><div><p class="menu-text">All Doctors</p></a></div>
    </td>
</tr>

<tr class="menu-row" >
    <td class="menu-btn menu-icon-session">
        <a href="schedule.php" class="non-style-link-menu"><div><p class="menu-text">Scheduled Sessions</p></div></a>
    </td>
</tr>
<tr class="menu-row" >
    <td class="menu-btn menu-icon-appoinment  menu-active menu-icon-appoinment-active">
        <a href="appointment.php" class="non-style-link-menu non-style-link-menu-active"><div><p class="menu-text">My Bookings</p></a></div>
    </td>
</tr>
<tr class="menu-row" >
    <td class="menu-btn menu-icon-appoinment">
        <a href="healthbot.php" class="non-style-link-menu"><div><p class="menu-text">Talk to Our Health Bot</p></a></div>
    </td>
</tr>
<tr class="menu-row" >
    <td class="menu-btn menu-icon-settings">
        <a href="settings.php" class="non-style-link-menu"><div><p class="menu-text">Settings</p></a></div>
    </td>
```

```css
.chat-submit {
    padding: 10px 20px;
    background-color: #2B7A78;
    color: white;
    border: none;
    border-radius: 20px;
    cursor: pointer;
    font-size: 16px;
    transition: background-color 0.3s;
    width: 150px;
}

.chat-submit:hover {
    background-color: #1F5E5D;
}

.chat-display {
    min-height: 300px;
    max-height: 400px;
    overflow-y: auto;
    padding: 15px;
    background-color: #A8E6E0;
    border-radius: 8px;
    margin-bottom: 15px;
    display: flex;
    flex-direction: column;
}

.user-message {
    background-color: rgb(200,200,255);
    padding: 8px 12px;
    border-radius: 18px;
    margin-bottom: 12px;
    max-width: 80%;
    width: fit-content;
    margin-left: 5px;
    box-shadow: 0 2px 4px rgba(0,0,0,0.1);
    font-size: 14px;
}
```

```
session_start();

if(isset($_SESSION["user"])){
    if(($_SESSION["user"])=="" or $_SESSION['usertype']!='p'){
        header("location: ../login.php");
    }else{
        $useremail=$_SESSION["user"];
    }

}else{
    header("location: ../login.php");
}


//import database
include("../connection.php");
$userrow = $database->query("select * from patient where pemail='$useremail'");
$userfetch=$userrow->fetch_assoc();
$userid= $userfetch["pid"];
$username=$userfetch["pname"];


//echo $userid;
//echo $username;



date_default_timezone_set('Africa/Harare');

$today = date('Y-m-d');


//echo $userid;
?>
<div class="container">
    <div class="menu">
    <table class="menu-container" border="0">
            <tr>
                <td style="padding:10px" colspan="2">
                    <table border="0" class="profile-container">
                        <tr>
                            <td width="30%" style="padding-left:20px" >
                                <img src="../img/user.png" alt="" width="100%" style="border-radius:50%">
                            </td>
```

B212259B POLITE TANYANYIWA

```php
<?php

function __backup_mysql_database($params)
{
    $mtables = array(); $contents = "-- Database: `".$params['db_to_backup']."` --\n";

    $mysqli = new mysqli($params['db_host'], $params['db_uname'], $params['db_password'], $params['db_to_backup']);
    if ($mysqli->connect_error) {
        die('Error : ('. $mysqli->connect_errno .') '. $mysqli->connect_error);
    }

    $results = $mysqli->query("SHOW TABLES");

    while($row = $results->fetch_array()){
        if (!in_array($row[0], $params['db_exclude_tables'])){
            $mtables[] = $row[0];
        }
    }

    foreach($mtables as $table){
        $contents .= "-- Table `".$table."` --\n";

        $results = $mysqli->query("SHOW CREATE TABLE ".$table);
        while($row = $results->fetch_array()){
            $contents .= $row[1].";\n\n";
        }

        $results = $mysqli->query("SELECT * FROM ".$table);
        $row_count = $results->num_rows;
        $fields = $results->fetch_fields();
        $fields_count = count($fields);

        $insert_head = "INSERT INTO `".$table."` (";
        for($i=0; $i < $fields_count; $i++){
            $insert_head  .= "`".$fields[$i]->name."`";
                if($i < $fields_count-1){
                        $insert_head  .= ', ';
                    }
        }
        $insert_head .=  ")";
        $insert_head .= " VALUES\n";

        if($row_count>0){
            $r = 0;
            while($row = $results->fetch_array()){
                if(($r % 400)  == 0){
                    $contents .= $insert_head;
```

B212259B POLITE TANYANYIWA

```
    $insert_head .=  ")";
    $insert_head .= " VALUES\n";

    if($row_count>0){
        $r = 0;
        while($row = $results->fetch_array()){
            if(($r % 400)  == 0){
                $contents .= $insert_head;
            }
            $contents .= "(";
            for($i=0; $i < $fields_count; $i++){
                $row_content =  str_replace("\n","\\n",$mysqli->real_escape_string($row[$i]));

                switch($fields[$i]->type){
                    case 8: case 3:
                        $contents .=  $row_content;
                        break;
                    default:
                        $contents .= "'". $row_content ."'";
                }
                if($i < $fields_count-1){
                        $contents  .= ', ';
                    }
            }
            if(($r+1) == $row_count || ($r % 400) == 399){
                $contents .= ");\n\n";
            }else{
                $contents .= "),\n";
            }
            $r++;
        }
    }
}

if (!is_dir ( $params['db_backup_path'] )) {
        mkdir ( $params['db_backup_path'], 0777, true );
 }

$backup_file_name = "edoc-".date( "d-m-Y--h-i-s").".sql";

$fp = fopen($params['db_backup_path'].$backup_file_name ,'w+');
if (($result = fwrite($fp, $contents))) {
    //success_message("Backup file created '--$backup_file_name' ($result)");
```

B212259B POLITE TANYANYIWA

```php
//import database
include("../connection.php");
$userrow = $database->query("select * from patient where pemail='$useremail'");
$userfetch=$userrow->fetch_assoc();
$userid= $userfetch["pid"];
$username=$userfetch["pname"];


if($_POST){
    if(isset($_POST["booknow"])){
        $apponum=$_POST["apponum"];
        $scheduleid=$_POST["scheduleid"];
        $date=$_POST["date"];
        $doctor_id=$_POST["doctor_id"];
        $scheduletime=$_POST["scheduletime"];
        $scheduleid=$_POST["scheduleid"];



        $sql1="select * from appointment where scheduleid='$scheduleid'";
        $result1=mysqli_query($database,$sql1);
        $count1=mysqli_num_rows($result1);
        $current_time=date('H:i');

        if($count1<1){
            ($scheduledtime>$current_time)?$start_time = $scheduletime:$start_time = $current_time;
            $end_time = date('H:i', strtotime($start_time.'+1 hour'));
        }
        else{
            $sql2="select max(end_time) as max_end_time from appointment where scheduleid='$scheduleid'";
            $result2=mysqli_query($database,$sql2);
            $row2=mysqli_fetch_array($result2);
            $max_end_time=$row2['max_end_time'];
            ($max_end_time>$current_time)?$start_time = $max_end_time:$start_time = $current_time;
            $end_time = date('H:i', strtotime($start_time.'+1 hour'));
        }

        $sql2 = "INSERT INTO appointment(pid, apponum, scheduleid, appodate, doctor_id, start_time, end_time)
                VALUES ($userid, $apponum, $scheduleid, '$date', $doctor_id, '$start_time', '$end_time')";

        $result = $database->query($sql2);
```

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