

**AI-Enhanced Web-Based Medical Appointment System with Automated
Notifications and PWD Accessibility for Emilio Aguinaldo College Medical Center**

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Thesis Writing

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CHAPTER I - INTRODUCTION

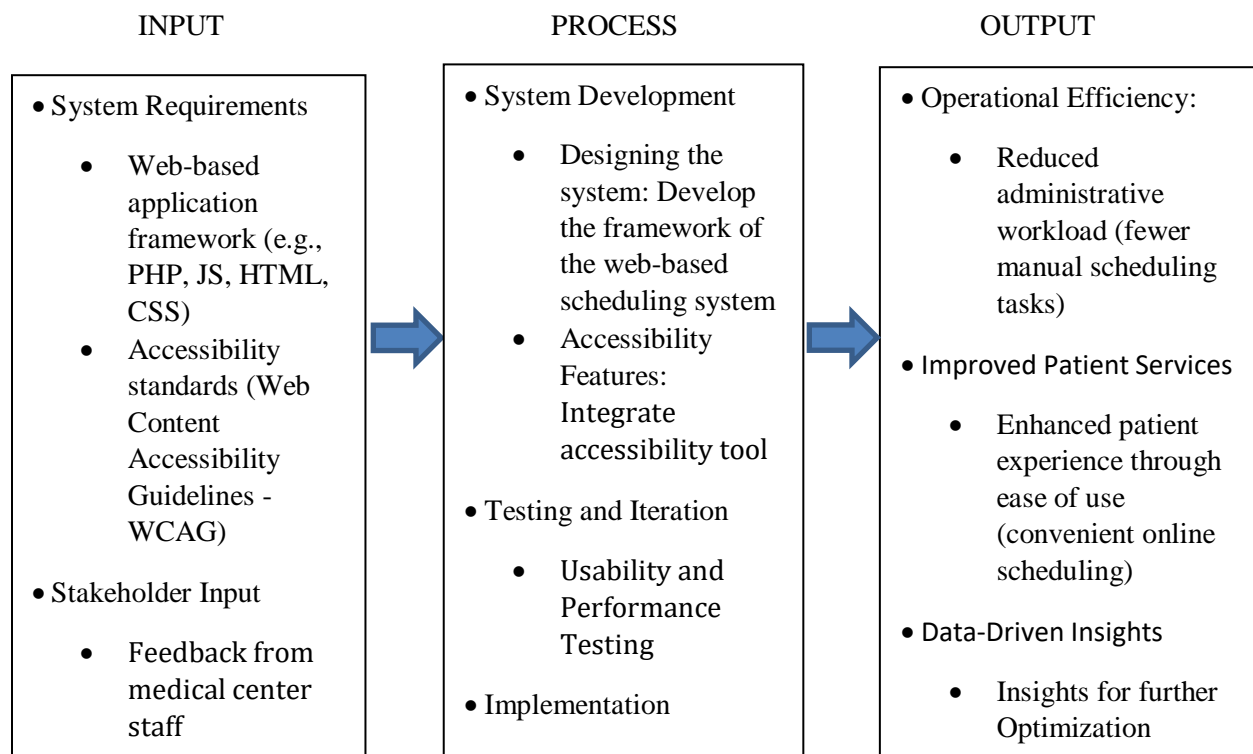
Objectives of the study:

The broad objective was to develop a web-based medical appointment scheduling system in the Emilio Aguinaldo College Medical Center.

The specific objectives of the study were:

- Enhance accessibility for persons with disabilities (PWDs) by integrating user-friendly features, ensuring ease of access and equal opportunity for scheduling medical appointments.
- Utilize data-driven insights to improve patient services and healthcare management by identifying trends, peak hours, and bottlenecks, while improving overall patient satisfaction through automated notifications and efficient scheduling.
- Develop an optimized, automated appointment scheduling system that minimizes administrative workload, reduces patient wait times, and ensures efficient allocation of healthcare resources.

Conceptual Framework



Significance of the study

Patients. The Development of a web-based medical appointment scheduling system with automated notifications will amplify the patient's experience by improving the overall communication with the medical center, simplifying appointment management which leads to ease of access, and reducing wait time of all patients.

Healthcare Providers and Staff. Through implementation of an efficient scheduling system, healthcare providers and administrative staff of Emilio Aguinaldo College Medical Center will benefit from reduction of manual workload, which leads to improvement of management and operational efficiency, smooth workflow, and enhanced service delivery.

Persons with disabilities. The system will ensure the PWDs have equal access to healthcare services by offering an interface that is compliant with web accessibility standards. This system will also bridge the gap in healthcare access for PWS, a group often underserved by some traditional healthcare systems.

Emilio Aguinaldo College Medical Center. The medical center will benefit from improved operational efficiency, which leads to reduction of missed appointments and scheduling conflicts. The system will also

incorporate features to cater persons with disabilities, which aligns with healthcare industry standards and promotes inclusive healthcare service.

Research. Future researchers may find grounds for further investigations on healthcare accessibility and improvement in operational efficiency through this study. This study's focus on the adoption of accessibility features in healthcare systems may, therefore, prompt more research into the application of inclusive design principles in healthcare technologies.

Healthcare Industry. The findings of this research study may, hence, be of beneficial insight to healthcare organizations regarding why automated systems and access features have to be added to operational systems. This study may also be used as a benchmark by other hospitals and clinics in the quest to improve their techniques of appointment scheduling and management of healthcare care to differing patient demographics, including those that are disabled.

DEFINITION OF TERMS

MySQL - is an Oracle-backed open source relational database management system (RDBMS) based on Structured Query Language (SQL). MySQL runs on virtually all platforms, including Linux, UNIX and Windows. Although it can be used in a wide range of applications, MySQL is most often associated with web applications and online publishing.

Algorithms - is a finite sequence of mathematically rigorous instructions, typically used to solve a class of specific problems or to perform a computation.

Appointment Management System (AMS) - a software application designed to streamline the process of scheduling, tracking, and managing appointments.

Bottlenecks - a narrow section of road or a junction that impedes traffic flow.

Cloud-based - refers to services, applications, or resources that are hosted and delivered via the internet, rather than being stored or run on local hardware or on-premises systems.

Cross-platform - software, applications, or systems that are designed to work seamlessly across multiple operating systems or environments.

E-booking - the action of making a reservation or an appointment for a service via the internet

MongoDB - is a non-relational document database that provides support for JSON-like storage. The MongoDB database has a flexible data model that enables you to store unstructured data, and it provides full indexing support, and replication with rich and intuitive APIs.

PHP - is a general-purpose scripting language geared towards web development. It was originally created by Danish-Canadian programmer Rasmus Lerdorf in 1993 and released in 1995.

Plagued - cause continual trouble or distress to.

Operational Efficiency – Refers to the ability of healthcare systems to deliver services in a cost-effective manner while optimizing the use of available resources, reducing waste, and improving overall workflow.

Patient-Centeredness – A healthcare approach that prioritizes the needs, preferences, and values of patients, actively involving them in decision-making processes regarding their care.

Stochastic Approximation (SA) – A mathematical method used to find approximate solutions to optimization problems that include randomness or uncertainty in data.

Stochastic Programming (SP) – A mathematical optimization technique that incorporates uncertainty in decision-making, particularly used to model and solve problems where outcomes are influenced by random variables, such as patient appointment scheduling.

Queueing System – A mathematical model used to study waiting lines or queues, which helps in analyzing patient waiting times and the utilization of healthcare resources.

Structured System Analysis and Design Methodology (SSADM) – A systematic approach used for designing information systems, including those in healthcare, focusing on a detailed analysis of user requirements and data flows to create an efficient system design.

E-booking System – A digital platform that allows patients to schedule, manage, and cancel appointments online, improving convenience and accessibility compared to traditional appointment methods.

Multi-Appointment Scheduling – A process in healthcare where patients need to visit multiple resources (e.g., doctors, diagnostic centers) sequentially, and each visit must be efficiently scheduled to minimize waiting times and ensure timely care.

No-Show Rate – The percentage of scheduled appointments where patients fail to appear without prior cancellation, leading to inefficiencies in healthcare resource utilization and potential loss of revenue.

Health Information Technology (HIT) – The application of information technology systems to manage healthcare data, enhance patient care, and improve operational processes within medical facilities.

Nonattendance – The act of missing a scheduled appointment, which can disrupt clinic schedules, waste resources, and reduce the effectiveness of healthcare delivery.

Congestion-Induced Behavior – Refers to the actions or reactions of a system (such as a healthcare provider) when it becomes overloaded with tasks or patients, often leading to delays or inefficiencies.

Capacity Adjustment Policies – Strategies implemented by healthcare providers to modify the number of appointments or resources available based on predicted or observed patient demand, often influenced by seasonal patterns.

Patient Foldback – A disruption in clinical operations that occurs when patients either cancel, reschedule, or fail to attend appointments, leading to inefficiencies in the healthcare system.

Lean Approach – A methodology that aims to improve efficiency by eliminating waste in processes, often applied in healthcare to enhance appointment scheduling systems.

Constant Work in Process (ConWIP) – A lean production strategy that limits the amount of work being processed at any given time to ensure smooth workflows and avoid bottlenecks.

Service Composite Quality – An overarching measure of quality in healthcare services that integrates various dimensions such as compliance, patient experience, and environmental factors to assess overall service performance.

Telemedicine – The use of telecommunications technology to provide clinical healthcare remotely, allowing patients to consult with healthcare providers without the need for in-person visits.

SERVPERF Model – A performance-based service quality measurement model used to assess healthcare services based on five dimensions: tangibles, reliability, responsiveness, assurance, and empathy.

Lean Six Sigma (LSS) – A methodology that combines Lean manufacturing principles and Six Sigma tools to improve efficiency and reduce errors in healthcare systems, leading to enhanced patient satisfaction and reduced service time.

Appointment Scheduling System (APS) – A software or digital tool designed to help healthcare facilities organize and manage patient appointments, optimizing the allocation of healthcare resources and improving patient access to care.

Integrated Practice Unit (IPU) – A healthcare delivery model that brings together multidisciplinary teams to provide patient-centered care, often involving both in-clinic and virtual consultations.

Screen Reader Compatibility – A feature that allows visually impaired individuals to access digital content through auditory feedback, making web-based systems more accessible.

SERVQUAL – A service quality framework used to assess customer expectations versus perceptions across five dimensions: reliability, assurance, tangibles, empathy, and responsiveness, frequently applied in healthcare settings.

Pharmaceutical Medical Information Services – Systems that provide healthcare professionals with updated and accurate pharmaceutical information, ensuring they can make informed treatment decisions.

Scope and limitation

This study focuses on the development and implementation of a web-based medical appointment scheduling system with automated notifications at Emilio Aguinaldo College Medical Center. The system is designed to enhance operational efficiency, improve patient services, and increase accessibility for persons with disabilities. This study will only focus on creation of an appointment scheduling system with integration of accessibility features following Web Content Accessibility Guidelines (WCAG) and analyzing how the system reduces administrative tasks and minimizes scheduling conflicts.

Furthermore, while the system adheres to Web Content Accessibility Guidelines (WCAG) standards, the study does not delve into the full range of disabilities. The system primarily focuses on common disabilities such as auditory and motor impairment disabilities.

Lastly, the study's geographical and institutional focus is on Emilio Aguinaldo College Medical Center and its immediate patients. The effectiveness of the system is evaluated in this specific context, and findings may not be directly generalizable to other hospitals or healthcare institutions. The system is developed based on the operational practices and patient demographics at the medical center. Variations in workflows or patient needs in other facilities may not be addressed.

LITERATURE REVIEW:

This chapter presents the related literature and studies found local and foreign sources examined with depth by the researchers. Through this, natures, strategies, and methods used in different related studies and published articles are presented to help for the full understanding of the study to be conducted.

Foreign Studies

Implementing an effective system is one of the most important advancements facing healthcare organizations as they continue to improve. The establishment of a web-based medical scheduling system, which forms the basis for improving patient care and operational efficiency, is a significant advancement in this field of study. As mentioned by Zhao, P. et al. (2017), Health care is changing with a new emphasis on patient-centeredness. Fundamental to this transformation is the increasing recognition of patients' role in health care delivery and design. Medical appointment scheduling, as the starting point of most non-urgent health care services, is undergoing major developments to support active involvement of patients. By using the Internet as a medium, patients are given more freedom in decision making about their preferences for appointments and have improved access.

On the other hand, According to Odey, J.A et al., (2020), Lengthy waiting times for registering and booking an appointment to see a doctor is challenging in Nigeria, particularly in government hospitals. Also, missed healthcare appointments are the main cause of preventable incompetence that affects a patient's well-being and medication results, as there is no machinery to notice patients when appointments are deferred or canceled. To address these issues, a web-based medical appointment scheduling system with SMS alert notification using the University of Calabar Teaching Hospital (UCTH) as a case study is proposed. This study adopted the Structured System Analysis and Design Methodology in the development of the system. MySQL was used to design the database for this study and the proposed system was implemented using the PHP programming language.

Heng Xie et al. (2020) argues that an online clinic appointment system (OCAS) is an example of health information technology (HIT) innovation in the healthcare industry. An OCAS can help healthcare organizations to improve the efficiency of information exchange for patients and transform a clinic-centered practice into patient-centered practice. While Sana Saeed et al. (2018) states that missing health care appointments without canceling in advance results in a *no show*, a vacant appointment slot that cannot be offered to others. No show can be reduced by reminding patients about their appointment in advance. In this regard, mobile health (mHealth) strategy is to use text messaging (short message service, SMS), which is available on all cellular phones, including cheap low-end handsets. Nonattendance for appointments in health care results in wasted resources and disturbs the planned work schedules.

Nevertheless, Zixiang Wang & Ran Liu (2021), a master of computer science from Syracuse University states that patient appointments are an effective method to reduce patient waiting time. However, not all patients can make an appointment before receiving medical services. This leads to formulation of the problem as a stochastic programming (SP) model to reduce the patient waiting time and increase server utilisation. Considering the service system as a time-varying queuing system with dual-class patients, we propose two methods to evaluate the patients waiting times and the server utilisation for a given patient appointment schedule. Meanwhile, Mazaheri M. et al. (2019), concludes that online appointment scheduling systems have been designed in response to the problems of the traditional ones. In Iran, most outpatient clinics and our study

population suffer from high patient no-show rate and long waiting times because of not using online appointment scheduling systems. Five clinics were selected as the intervention group and five clinics as the control group. The use of an online appointment scheduling system was successful in improving several evaluation metrics in our target population and resulted in continued usage in intervention group clinics. According to Louis Raymond et al. (2021), Medical appointment scheduling (MAS) systems are among the most essential technologies. Prior studies on MAS systems have taken either a user-oriented perspective, focusing on perceived outcomes such as patient satisfaction, or a technical perspective, focusing on optimizing medical scheduling algorithms. MAS systems in family medicine clinics lead to greater accessibility and availability of care for their patients and the general population. Valuable insight has also been provided on how to identify the clinics that would benefit most from such digital health solutions.

Marie-Claude Trudel et al. (2014) states that managing appointments in private medical practices and ambulatory care settings is a complex process. Various strategies to reduce missed appointments can be implemented. E-booking systems, which allow patients to schedule and manage medical appointments online, represents such a strategy. They invested in a showcase project involving six private medical clinics. The patients and physicians targeted by this showcase project showed a growing interest in the e-booking system as the number of users, time slots made available by physicians, and online appointments grew steadily over time. E-booking systems seem to represent a win-win solution for patients and physicians in private medical practices. In the study conducted by Frederick North et al. (2021), Web-booking of flights, hotels, and sports events has become commonplace in the travel and entertainment industry, but self-scheduling of health care appointments on the web is not yet widely used. An electronic health record that integrates appointment scheduling and patient web-based access to medical records creates an opportunity for patient self-scheduling. The Mayo Clinic developed and implemented a feature in its Patient Online Services (POS) web and mobile platform that allows software-managed self-scheduling of well-child visits. They found that self-scheduling can generate a significant number of finalized appointments, decreasing the need for staff scheduler time. In another study conducted by Corine Laan et al. (2017), Appointment schedules for outpatient clinics have great influence on efficiency and timely access to health care services. The number of new patients per week fluctuates, and capacity at the clinic varies because physicians have other obligations.

One of the most persistent challenges in administering healthcare is scheduling appointments efficiently, which is frequently conflicted by delays, miscommunications, and accessibility barriers. These kinds of impediments not only hinders operational efficiency, but also have an impact on patients' care quality. Addressing these issues is critical for medical centers like Emilio Aguinaldo College Medical Center in order to provide efficient and effective patient care. As Leila F. Dantas et al. (2018) states, No-show appointments (also commonly referred to as broken or missed appointments) are a burden to essentially all healthcare systems, significantly impacting revenue, cost and use of resources. It is a well-known fact that no-show decreases the provider's productivity and efficiency, increases healthcare costs, and limits the health clinic's effective capacity.. As Leila F. Dantas et al. (2018) states, No-show appointments (also commonly referred to as broken or missed appointments) are a burden to essentially all healthcare systems, significantly impacting revenue, cost and use of resources. It is a well-known fact that no-show decreases the provider's productivity and efficiency, increases healthcare costs, and limits the health clinic's effective capacity. Negative effects are also felt by patients who keep their appointments, such as dissatisfaction with high waiting time and perception of overall decrease in service quality. In addition to creating financial costs for providers, non-attendance generates social costs related to unused staff time, ineffective use of equipment and possible misuse of patients' time. In the study conducted by Joren Marynissen et al. (2019), They present the multi-appointment scheduling problems in hospitals. In these problems, patients need to

sequentially visit multiple resource types in a hospital setting so they can receive treatment or be diagnosed. Therefore, each patient is assigned a specific path over a subset of the considered resources and each step needs to be scheduled. The main aim of these problems is to let each patient visit the resources in his or her subset within the allotted time to receive timely care. This is important because a delayed diagnosis or treatment may result in adverse health effects. Additionally, with multi-appointment scheduling, hospitals have the opportunity to augment patient satisfaction, allowing the patient to visit the hospital less frequently. Another study conducted by Jacob Feldman et al. (2014), They develop appointment scheduling models that take into account the patient preferences when they would like to be seen. The service provider dynamically decides which appointment days to make available for the patients. Patients arriving with appointment requests may choose one of the days offered to them or leave without an appointment. Patients with scheduled appointments may cancel or not show up for the service.

In another study conducted by Ho-Yin Mak et al. (2014), explore distribution-free models for appointment scheduling that aim to minimize waiting and overtime costs by utilizing limited information about job durations. Their study formulates scheduling problems as conic programs, focusing on the worst-case scenarios where only the moments of job durations are known. The research shows that sequencing jobs based on duration variance can optimize time allowances. While their work is theoretical, it aligns with our project's practical goal of improving appointment scheduling efficiency in healthcare. The insights from their study on minimizing delays can be applied to our web-based system to enhance patient flow and service delivery at Emilio Aguinaldo College Medical Center. Meanwhile, According to Sionnadh McLean (2014), missed appointments are an avoidable cost and a resource inefficiency that impacts on the health of the patient and treatment outcomes. Health-care services are increasingly utilising reminder systems to counter these negative effects. Missed appointments in healthcare settings contribute to resource inefficiencies and adversely affect patient health outcomes, prompting the adoption of reminder systems to enhance attendance rates (NIHR, 2012). This study explored the differential effectiveness of various reminder strategies across patient demographics through three interrelated reviews of quantitative and qualitative evidence. Findings from 31 randomized controlled trials and 11 systematic reviews revealed that reminder systems significantly reduce non-attendance, with simple reminders proving effective for most patients and 'reminder plus' systems—providing additional appointment details—particularly beneficial for first-time and screening appointments. The study identified key factors influencing reminder effectiveness, including reminder accessibility and the reminder–patient interaction. It concluded that while simple and enhanced reminders should be implemented widely, further research is needed to understand the varying effects of these systems among diverse patient groups and to optimize reminder strategies for improved adherence (NIHR, 2012).

In contrast, A study from Leroux et al., (2017) states that while there were slight improvements in appointment availability, it only shows minimal improvement in appointment availability. While statistically significant, the slight increase in appointment availability was too small for patients to notice any difference; additionally, further research is needed to explore other potential advantages of the model. On the other hand, Twomey et al. (2020) found that patients struggles to recall and retrieve their medical histories during appointments, which leads to missing or incorrect information and after reviewing 49 studies that lasts for 43 years, the researchers discovered three major barriers to memory recall: forgetfulness, low health literacy, and the patient's emotional condition. These findings highlighted the difficulty that both patients and caregivers experience when attempting to provide accurate medical histories. The paper also presents a conceptual model to better comprehend memory recall in these contexts, while highlighting research gaps that require additional investigation to improve this process.

A study from Yan C. et al., (2015) emphasized the importance of scheduling for efficient clinic operation and patients' satisfaction. The researchers developed a scheduling method that scales the need of patients and the profits of the clinic, the study found that allowing patients to freely choose their scheduled appointments leads to an decreased number of no-shows but the profits also decreased due to loss of scheduling flexibility. In order to address the issue, the researchers introduced two algorithms in order to make the scheduling process more efficient by focusing more on the important factors and speeding up decisions. Additionally, Cayirli & Gunes (2017) examined appointment systems that use access and scheduling criteria to manage seasonal swings in walk-ins. The authors tailor capacity adjustment policies to weekly and monthly walk-in patterns, and they elaborate on the double booking or opening of slots depending on specific departures in walk-ins from annual averages. This research concludes the capacity and scheduling considerations, which are frequently considered to be separate and to provide a more comprehensive view. The researchers also examine patient wait times, physician idle hours, and overtime using simulation optimization to provide healthcare practitioners with practical assistance on creating effective appointment systems in the midst of seasonal walk-ins.

Furthermore, Taiwo S. et al. (2020) investigate the challenge of selecting the best appointment scheduling decision in the context of patient no-show behavior and random walk-ins within a certain time window. When the arrival rate of walk-ins is moderate in comparison to the clinic's capacity, the policy that specifies an appropriate time frame for their arrival outperforms the general random walk-in arrival (open walk-in) policy, according to the analysis. In example, implementing the optimal time window policy can result in a reasonable reduction in system costs while maintaining an elevated degree of patient access to care. Additionally, Zhang Z. et al. (2019) address an appointment scheduling problem in which the server responds to system congestion. Using waiting time as a proxy for how far behind schedule the server is, they describe the server's congestion-induced behavior as a function of a customer's waiting time. The researcher presents theoretical results for both models and conducts a series of experiments to demonstrate the characteristics of the optimal schedules and to assess the importance of accounting for a server's response to congestion when scheduling appointments, using an outpatient clinic at a large medical center as an example. Finally, they highlight the most relevant managerial findings from this study. According to Huang Jia-Yen (2015), one of the most critical issues for hospitals is lowering patient waiting time. In Taiwan, outpatient appointment times are scheduled based on experience, and various elements that influence prediction accuracy are overlooked, causing patients to feel uncomfortable. Data from a medical center in central Taiwan is collected throughout the sampling process. Three approaches for estimating outpatient appointment times were tested and compared: the hospital method, the moving average method, and the logistic regression method. The experimental results suggest that an appointment scheduling system based on our proposed algorithm can effectively improve service quality by enhancing prediction accuracy for outpatient appointment times. Additionally, Duan Y. et al. (2024) claim that patient foldback commonly disturbs clinical operations, lowers productivity, and causes patient congestion. The researcher presented a stochastic approximation (SA) to reduce the predicted weighted total of costs related to physician idle time and patient wait times. Numerical experiments show that the proposed SA algorithm significantly reduces solution time when compared to the sample average approximation (SAA)-based algorithm, confirming the proposed algorithm's efficiency and effectiveness. The researchers also discover that the optimal job allowances retain a 'dome' shape; however, there is a marked steep increase at the beginning of the curve.

Meanwhile, Atinga R. et al. (2021) used the qualities of an innovation theory to hypothesize and assess the extent to which perceived APS attributes such as relative advantage, compatibility, and complexity influence patient satisfaction and treatment adherence in a neurology clinic at a large teaching hospital in Ghana. The researcher suggested that making the APS system more patient-friendly can significantly enhance patient experience satisfaction and adherence to medical treatment, which results in more effective

therapeutic outcomes. The researchers further suggest that, given the benefits to patient care and outcomes, APS should be prioritized above walk-in services at developing-country specialist clinics. Chabouh S. et al. (2021) discuss daily appointment scheduling (AS) for patients at a hospital-integrated facility where outpatients and inpatients are treated concurrently and share crucial resources. They offer a lean approach based on the pull-strategy "Constant Work in Process" (ConWIP) for developing strong and simple AS rules. Numerical experiments using a real-life case study are conducted to evaluate the performance of the suggested appointment criteria and compare them to AS guidelines developed in the literature. The findings show the robustness of our technique and demonstrate its practical applicability.

On the other hand, Tang J. et al. (2014) states that Appointment systems are used by health clinics to manage access to service providers. In such systems, a specified number of patients are scheduled in advance, but certain patients may not arrive or 'show up' to their appointments. The existence of no-show behavior influences both the operational cost of the clinics and the waiting time of the patients. The researchers determine an optimal schedule that takes no-show behavior into account to determine the time intervals between patients under the framework of the individual-block/variable-interval rule for minimizing the overall cost of the patient waiting time, the practitioner idle time and overtime. The results show that not only do no-shows greatly affect the system performance compared with an appointment system with the same expected workload without no-shows, but they also affect the optimal scheduling behaviours in the dome-shaped distribution. In addition, overtime cannot be eliminated completely even if the day length is adequate for all patients because of the stochastic characteristic of service time.

Bhattacharjee & Ray (2018) stated that Appointment scheduling plays a key role in improving the performance of a healthcare facility and increasing patient access to health care. However, appointment systems in hospitals may receive requests for services from walk-ins and emergency arrivals in addition to the scheduled arrivals. Emergency arrivals need urgent care, and hence have higher priority to be served over the scheduled arrivals. Such emergency arrivals disrupt the scheduled appointments, and may increase the waiting times of scheduled patients and the overtime of the appointment session. Walk-ins have lower priority to be served. However, it is desirable to serve walk-ins in order to increase the utilization of the server keeping the waiting times of scheduled patients as short as possible. The researchers found that the scheduling rules are more influential than the arrival patterns of unscheduled patients. Huang J. et al. (2023) studied a coordinated scheduling problem with both Virtual Medicine patients (VM patients) and In-Clinic patients (IC patients) in a multidisciplinary setting. The problem was motivated by appointment scheduling requirements in a multi-disciplinary clinic called an Integrated Practice Unit (IPU), which incorporates differing priorities, heterogeneous service time distributions, distinct cost structures and unique care paths in a multi-station network. Through numerical examples based on IPUs being implemented by the Dell Medical School at the University of Texas at Austin, they find that the introduction of VM patients can substantially improve system performance and patient access without adding resources.

Meanwhile, Oliveira et al. (2024) conducted a study using 288 valid replies collected from medical and dental clinics in Brazil, forming a convenience sample. indicates that patient pleasure is critical in determining healthcare quality. However, its potential as a patient classification approach has yet to be investigated, leaving healthcare organizations without clear guidelines in this area. They presented a five-step model: questionnaire, data analysis, classification analysis, classification function, action, and check. The analytical backing for this technique came from factor analysis, k-means clustering, and multiple discrimination analysis. They also suggest that future studies could duplicate this methodology by using factors that capture client-specific organizational ties. This will help to refine strategies for improving service quality and patient happiness across a variety of healthcare settings. O'connor and Shewchuk (2017) have presented a study that addresses this issue by comparing and contrasting medical and nursing students'

understanding of patient service quality standards with those of patients, practicing physicians, administrators, and patient-contact personnel. Using discriminant analysis, it was discovered that medical and nursing students underestimated patient expectations in all five SERVQUAL aspects (reliability, assurance, responsiveness, empathy, and tangibles). It appears that they enter medical and nursing school with a significant misunderstanding, which does not improve significantly as they go through their four-year educational process. Furthermore, medical and nursing students have strikingly comparable appraisals of what they believe patients expect. The implications and future research directions are highlighted. Mortimer et al (2018) stated that the new model may also provide immediate benefits, such as increased motivation for clinicians to engage in quality improvement, directing their efforts toward high-value interventions, and allowing for the capture and communication of a broader range of impacts on patients, staff, and communities. Turan & Bozaykut-Bük (2016) also found that whereas service literature routinely explores issues such as perceived service quality, patient satisfaction, RI, and PWOM, few studies have focused on specialized health services for women and children with diseases. By analyzing service quality, it is envisaged that health-care management can get insight into the service quality aspects and their link with patient happiness, RI, and PWOM, with a focus on women patients. The study's findings show that reliable and responsive service, empathic personnel behaviors, and acceptable tangibles are the most important determinants in high levels of patient satisfaction, RI, and PWOM.

On the other hand, Singh et al. (2018) stated that the Indian healthcare business is expanding rapidly, adding significantly to the country's employment and revenue development. Medical tourism has recently acquired significant traction, with people from all over the world visiting India to receive economical and world-class healthcare services. As a result, providing excellent healthcare service quality and understanding the opinions of all stakeholders - patients, doctors, and employees - has become vital to the success of any healthcare facility. Over time, service providers have defined service quality characteristics based on their own opinion and attempted to supply services consistent with their assumptions. However, patient satisfaction necessitates a correct synchronization of what the patient wants and what management observes. To address this issue, six additional aspects were identified using SERVQUAL and dubbed the 'HealQual' tool, taking into account the demands of the current scenario. The study would discover the healthcare service quality characteristics that promote patient satisfaction while also generating priority weights from the perspectives of both service reviewers (patients) and service providers (doctors and workers).

while Anderson et al. (2021) undertake a multidimensional analysis to determine how hospitals' service composite quality (i.e., compliance, experiential, and environmental) affects patient well-being (readmission rate and patient experience). We use three years of secondary data from five sources (n=2,781). The findings demonstrate that there are synergies between compliance, experiential, and environmental quality, as seen by service composite quality's negative influence on readmissions and good impact on patient experience. In addition, we conduct a post-hoc study to investigate the discrete components of experience quality. The authors propose that hospital administrators integrate their efforts across all three quality measures. Several managerial implications are presented and debated.

According to Tan et al. (2019), the healthcare business is getting more competitive, and patients want greater quality services. The purpose of this study is to model the effect of service quality (medical care processes, administrative practices, hospital image, trustworthiness, patient safety, infrastructure, staff quality, and social responsibility) on patient satisfaction. The researchers used a structured questionnaire to collect data from 194 patients at public and private hospitals in Melaka and Johor. Data were evaluated using SmartPLS, a second-generation analytical software. The results indicate that the model can explain 58% of the variation in patient satisfaction. Hospital image, patient safety, personnel quality, and social

responsibility were all important predictors of satisfaction. Personnel quality was the most significant predictor. The upshot is that hospitals should invest more in staff training to keep patients satisfied and willing to return for future treatments.

Meanwhile, Lynn Craig (2018) published research in the British Journal of Nursing claiming that service improvements in health care can improve provision, save money, streamline services, and reduce clinical errors. However, on its own, it may be insufficient to improve patient outcomes and treatment quality. The complexities of healthcare delivery makes service improvement much more difficult, and there is little evidence that improvement attempts modify healthcare practices and improve treatment. To grasp the concept of service development in health care, it is crucial to examine the national background and how the NHS has implemented improvement projects. Higher education institutions have designed courses that address the issue as part of their pre-registration programs to provide the nursing workforce with the skills needed to effect good change. However, service improvement is an acquired skill that nurses must practice in order to gain competence.

The concept of service quality in healthcare has been widely studied, as it directly affects patient satisfaction and healthcare outcomes. Akdere et al. (2018) applied the SERVPERF model to assess hospital service quality in Turkey. This model evaluates five key dimensions: tangibles, reliability, responsiveness, empathy, and assurance. The study revealed significant positive relationships among these dimensions, with the strongest correlation between reliability and responsiveness, suggesting these are crucial for improving patient perceptions of service quality. Similarly, Al-Saidat et al. (2022) explored patient perceptions of nursing care quality in Jordan's emergency departments. The study found that private sector hospitals had higher patient satisfaction scores compared to public hospitals, indicating that sectoral differences play a role in perceived service quality. These insights are crucial for our project as we aim to ensure that our scheduling system enhances accessibility, reliability, and responsiveness to improve patient satisfaction.

Noronha et al. (2023) studied the application of the Lean Six Sigma (LSS) strategy to enhance service quality in a dental college hospital in India. The study demonstrated that applying LSS techniques significantly reduced treatment time and increased patient satisfaction by addressing inefficiencies. This highlights the importance of streamlining processes, which aligns with our goal of reducing appointment scheduling time in our web-based system.

Patient feedback is an essential tool for driving improvements in healthcare systems. Berger et al. (2019) conducted a qualitative study on how hospitals in Brazil use patient feedback to improve service quality. The study revealed that hospitals that effectively utilized feedback often had structured processes in place for receiving and responding to patients' concerns. They also fostered a non-punitive culture, which encouraged staff to improve based on patient experiences. Our web-based appointment system could benefit from incorporating patient feedback mechanisms to ensure continuous improvement and responsiveness to patient needs.

Albano et al. (2019) and Jindia et al. (2022) emphasized the role of pharmaceutical medical information services in enhancing patient care. These studies showed that healthcare providers rely on timely and accurate information to make informed treatment decisions. Our system could integrate similar

informational support to assist patients in making better-informed choices when scheduling appointments or preparing for consultations.

The use of technology to improve healthcare management systems is becoming increasingly prevalent. Cohen et al. (2020) studied the role of healthcare information technology in reducing operational inefficiencies in medical centers. They found that implementing electronic health systems (EHS) improved communication between patients and healthcare providers, which led to better scheduling and fewer missed appointments. Similarly, Bodnar et al. (2021) examined the use of online booking systems in hospitals. Their research showed that patients preferred systems that provided automated reminders and clear instructions, which significantly reduced no-show rates. This supports our decision to include automated notifications in our scheduling system to enhance operational efficiency.

Huang et al. (2021) focused on developing a healthcare management system with integrated telemedicine features. The study found that combining telemedicine with traditional scheduling systems improved patient accessibility, especially for those with mobility issues. This is particularly relevant to our project, as one of our objectives is to improve accessibility for persons with disabilities. Incorporating telemedicine features would allow patients with disabilities to consult healthcare providers without physically visiting the hospital, thereby increasing convenience and accessibility.

Accessibility remains a key challenge in healthcare, particularly for persons with disabilities. Garcia et al. (2020) emphasized the importance of designing healthcare systems that accommodate individuals with varying levels of physical ability. Their study found that most healthcare facilities fail to meet accessibility standards, which discourages persons with disabilities from seeking care. Our web-based system aims to address these concerns by including features such as screen reader compatibility, adjustable font sizes, and easy navigation to ensure that patients with disabilities can easily schedule appointments.

Shah et al. (2022) examined healthcare access challenges in rural areas, highlighting the difficulty in providing timely care to disabled individuals. The study advocated for technology-driven solutions like telemedicine and online scheduling systems, which can significantly reduce barriers to care. Our system could bridge these gaps by offering accessible online booking options, thereby reducing the need for in-person visits for simple consultations.

Automation in healthcare is essential for improving efficiency and patient outcomes. Jones et al. (2021) explored the implementation of automated scheduling systems in outpatient clinics and found that automated systems reduced administrative workload by 25% and decreased patient wait times by 15%. This study supports the integration of automated notifications in our scheduling system to enhance both operational efficiency and patient experience.

Upadhyay & Ooi (2017) discussed the challenges of implementing pharmaceutical care in developing countries. While their focus was on medication management, they highlighted the need for automated systems that help healthcare professionals monitor and manage patient care efficiently. This ties into our project's goal of creating a system that not only automates appointments but also tracks patient visits and follow-ups to optimize healthcare management.

Becker et al. (2021) discussed how digital tools can enhance communication between patients and healthcare providers. Their research found that patients who used digital platforms to communicate with their doctors had better adherence to treatment plans and higher satisfaction rates. Our scheduling system could incorporate a communication platform that allows patients to ask questions or request follow-ups with healthcare providers, which would improve both patient care and satisfaction.

Jindia et al. (2022) highlighted the impact of timely medical information services on patient care, noting that healthcare professionals who had access to up-to-date information were better equipped to make clinical decisions that positively impacted patient outcomes. This underscores the potential benefit of integrating medical information into our system, providing patients with relevant data when booking appointments.

Local Literature

The rapid advancement of technology has revolutionized the way organizations manage and optimize their operations, including the scheduling and coordination of appointments. Appointment management systems (AMS) have emerged as essential tools for streamlining this process, enhancing efficiency, and improving the overall user experience. These systems are designed to automate the scheduling of appointments, consultations, and services, allowing businesses and institutions to manage their time and resources efficiently.

In the study conducted by Mendoza, S. et al. (2019), they designed a web-based appointment scheduling system called “InstaSked”. They prioritized the reduction of waiting times for patients trying to book appointments. They used the Six Sigma methodology, DMADV (define, measure, analyze, design, and verify), and BPM (business process management) when it comes to designing their system. Meanwhile, in the study conducted by Dela Fuente, M.A. et al. (2023), they developed a cross-platform scheduling and

appointment reservation system called “Project Clinik”. They created the system using php then assessed the effectiveness and technical qualities of their system by following the ISO 25010 standards. According to the results of their assessment, their system has good quality. The high ratings they received from their respondents suggested that their system is effective, dependable, and easy to use. In another study conducted by Caballero, J.C. et al. (2021), they created a system that integrated the Availability Management and Events and Monitoring Management Information Technology Infrastructure Library (ITIL) frameworks. They called this system “LifeDoc: Availability and Monitoring System of Online Medical Consultation” which can be used by patients and doctors. The system is a mobile application only available for Android, and the development used technologies such as React Native and WebRTC. They used a cloud-hosted database called MongoDB to process the information flowing through the system. In testing the performance and functionalities of their system, they used tests based on the Institute of Electronics and Electrical Engineering (IEEE) standard for Software Test Documentation.

Healthcare research and evaluation are critical components in advancing medical knowledge, improving patient outcomes, and guiding healthcare policies and practices. As the healthcare landscape evolves with new technologies, treatments, and patient care models, the need for robust research and comprehensive evaluation becomes more vital than ever. According to Dela Cruz, R. and Ortega-Dela Cruz R. (2019), public hospitals in developing countries are the primary means of healthcare delivery. These public institutions give people access to health services, as such, it is important to assess their efficiency and whether they meet the public demand. They conducted a study that aimed to analyze what issues related to management plague the hospital facilities in the Philippines. The results of their study showed that most of the issues that the healthcare facilities face stem from the lack of financial resources, materials, equipment, and technological innovations. The study also showed that the healthcare facilities in the Philippines also faced challenges related to processes and methodologies. The study of Javier, R.J. et al. (2021) somewhat agreed with this, saying that “There were negative perceptions on essential healthcare at the community setting, given the inadequacy of medical facilities and technology, medications, and healthcare services in the locality.”

Meanwhile, in a study conducted by Alipio, M. (2020), he remarked that an effective healthcare service delivery has short patient waiting time as one of its important markers. Additionally, according to Alipio, radiology, which helps doctors and healthcare workers in diagnosing illnesses and injuries on patients, suffer from providing prompt care to patients due to increasing demands, unideal healthcare provider attitudes, and inefficient administrative and patient workflow systems. These challenges are especially prevalent for persons with disabilities, and Basa, M.L.F. et al. (2020) agrees with this, saying, “...the country is still far from becoming PWD-inclusive and policies for PWDs are not effectively enforced.”

