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AI-BASED ANALYSIS OF BOTTLENECKS AFFECTING PATIENT WAITING TIME AT MGM HEALTHCARE

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ABSTRACT

Healthcare service efficiency has become a critical factor in ensuring patient satisfaction in modern hospitals. One of the major issues faced by multi-speciality hospitals is increased patient waiting time, which affects the quality of care and overall experience. This study focuses on analyzing the key factors responsible for delays in patient services and explores the role of Artificial Intelligence (AI) in reducing waiting time.

The research is conducted in a multi-speciality hospital setting, where data is collected from patients through structured questionnaires. Statistical tools such as ANOVA and Chi-square are used to identify the relationship between different variables influencing waiting time. The study reveals that factors like poor scheduling, limited resources, and workflow inefficiencies are the main causes of delays.

Furthermore, the study highlights how AI-based techniques such as predictive analytics and automated scheduling can improve hospital operations. These technologies help in better resource management and faster decision-making, thereby reducing patient waiting time.

The findings conclude that implementing AI in hospital management systems can significantly improve operational efficiency and enhance patient satisfaction. The study provides valuable suggestions for hospitals to adopt advanced technologies for better healthcare service delivery.

KEY WORDS: *Artificial Intelligence, Patient Waiting Time, Bottleneck Analysis, Healthcare Efficiency, Machine Learning, Patient Flow Management, Operational Efficiency*

1. INTRODUCTION

The health care industry plays an important part in determining the well being of individuals, how well the community operates as a unit, and ultimately the growth of countries. This rapidly growing section of our economy has placed a tremendous emphasis on high quality patient care delivered in the least amount of time and at the lowest cost, so that anyone can receive health care access. One key measure of the success of a hospital is the wait time of patients. Wait times are an indicator of how satisfied patients are with their experience, how efficiently the hospital operated, and how well the clinical services provided were delivered to the patient. MGM Healthcare is also recognized for its environmentally sustainable infrastructure, being one of India's few NABH-accredited green hospitals. The institution stands at the intersection of advanced healthcare delivery, ethical practice, and organizational learning—making it a model for future-ready healthcare systems

2. PROBLEM STATEMENT

Even though MGM Healthcare is a modern and well-equipped multi-specialty hospital, it still faces several operational challenges that affect its efficiency. Issues such as crowded registration counters, delays in OPD consultations, and difficulties in maintaining appointment schedules increase patient waiting time. Diagnostic services are also slowed due to shared equipment, and administrative processes are not fully automated. In addition, lack of real-time tracking, poor coordination between departments, and sudden patient inflow create further delays. These problems not only reduce patient satisfaction but also increase workload and stress among staff. This study focuses on how artificial intelligence can be used to identify these bottlenecks and improve patient flow through better planning and data-driven decision-making

3. RESEARCH OBJECTIVES AND QUESTIONS

3.1 Research Objectives

- To evaluate and mitigate bottlenecks affecting patient wait time at MGM Healthcare using AI-based technologies
- To investigate the variation of patient volume with respect to time, department, and day of the week.
- To evaluate how staffing, resource availability, and scheduling impact overall efficiency.

3.2 Research Questions

RQ1: Ho What are the main reasons for delays in patient services?
RQ2: How can artificial intelligence be used to identify and analyse operational issues?

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4. REVIEW OF LITERATURE

The review of literature provides an overview of previous studies related to patient waiting time, healthcare efficiency, and the role of Artificial Intelligence (AI) in hospital management. This study is based on 20 scholarly works published between 2017 and 2026, including journals, theses, and book chapters. The literature highlights the importance of AI, IoT, and lean techniques in improving patient flow and reducing delays. It also focuses on patient satisfaction, human resource efficiency, and digital healthcare systems. Overall, these studies show that adopting advanced technologies and effective management practices can enhance service quality and reduce waiting time in hospitals.

Table 4.1: Compendium of Reviewed Literature on Bottlenecks Affecting Patient Waiting Time in Hospitals (N = 20)

S. No	Author(s) & Year	Article Title	Journal / Source	Key Findings	Relevance to Present Study
1	Gogari (2026)	AI and IoT for Sustainable Healthcare Systems	Book Chapter	AI and IoT reduce energy, waste, and resource use via smart infrastructure.	Supports MGM's sustainable and energy-efficient hospital operations.
2	Bisht (2025)	CRM Systems and Patient Satisfaction in Indian Healthcare	Doctoral Thesis	CRM tools boost patient communication, personalisation, and trust.	Guides MGM's strategy for better patient engagement and satisfaction.
3	Kchaou et al. (2025)	Industry 5.0 for Disability-Inclusive Healthcare	Journal of Assistive Technologies	Human-centric automation and AI enhance accessibility for disabled patients.	Ensures MGM's digital solutions are inclusive and ethically designed.
4	Mohan et al. (2025)	Lean DMAIC for Patient Discharge Management	International Journal of Healthcare Management	Lean DMAIC reduces discharge delays and improves throughput.	Directly applicable to reducing wait times in MGM's patient flow.
5	Oza et al. (2025)	AI and Robotic Platforms for Minimally Invasive Surgery	Journal of Robotic Surgery	Surgical robots and AI improve precision but face cost and training barriers.	Informs MGM's consideration of robotic tools for surgical efficiency.
6	Padmakar (2025)	Social Innovation for Inclusive Development (India)	Journal of Social Innovation	Community-tech collaboration drives inclusive growth and service access.	Suggests MGM adopt community health outreach for broader impact.
7	Rosak-Szyrocka & Wolniak (2025)	AI-Enabled Human Resource Management for Sustainability	Journal of Sustainable HRM	AI-driven HR tools optimise staffing, evaluation, and resource allocation.	Helps MGM improve HR efficiency and sustainable workforce practices.
8	Rosak-Skyrocket & Wolniak (2025)	AI in HRM: Sustainability and Data-Driven Strategies	Journal (not specified)	AI in recruitment and workforce planning improves efficiency with ethical oversight.	Reinforces responsible AI use in MGM's healthcare staff management.
9	Senapati (2025)	Recruitment and Skill Gaps in Healthcare	Healthcare Management Journal	Misalignment between needed competencies and candidate skills harms service delivery.	Urges MGM to align recruitment with skill needs to close talent gaps.
10	Saini et al. (2025)	AI-Driven Telemedicine and Queueing for Wait Time Reduction	Journal of Telemedicine and e-Health	AI-based predictive scheduling and adaptive queuing cut patient wait times.	Highly relevant for MGM to use AI scheduling to reduce OPD waiting.
11	Pan et al. (2024)	Transformative Impact of AI on Patient Care	Journal of Medical AI	AI enhances diagnostics, personalised treatment, and administration with ethical caveats.	Shows multiple ways AI can improve MGM's care and operations.

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12	Sharma (2023)	Health IT in Kidney Transplant Services	Transplantation Informatics Journal	Health IT supports clinical decisions and monitoring in complex care.	Encourages MGM to strengthen data systems for better care coordination.
13	Ramachandran (2022)	Tech Interventions in Indian Cancer Care	Indian Journal of Cancer Research	Data analytics identifies care gaps and optimises oncology resource allocation.	MGM can use analytics to address service gaps across specialties.
14	Kolanu et al. (2021)	AI Chatbot for Diabetes Self-Management	Journal of Healthcare Informatics	NLP chatbot provides personalised diet advice and appointment scheduling for diabetes.	MGM could deploy chatbots to improve patient engagement and scheduling.
15	Magid et al. (2021)	Robotic Systems in Pandemic Response	Robotics and Healthcare Journal	Autonomous robots aid disinfection and logistics, reducing exposure in pandemics.	Suggests MGM implement robotics for hospital safety and logistics.
16	Rajinikanth et al. (2021)	Hybrid Image Processing in Medical Diagnostics	Journal of Medical Imaging Analytics	Hybrid image processing improves MRI/CT accuracy via machine learning.	MGM's radiology can adopt advanced imaging tools to speed up diagnostics.
17	Rao (2021)	Lean Digital Transformation Framework	International Journal of Lean Innovation	Lean-digital integration eliminates waste and drives data-driven decision-making.	Directly aligns with MGM's need to optimise workflows and reduce delays.
18	Vinod Kumar et al. (2020)	Smart Health Initiative in Kozhikode	Sustainable Cities and Society	ICT-integrated smart city health initiative improves public health and resilience.	MGM can collaborate with smart city systems to enhance outreach and access.
19	Shukla (2019)	Ontology-Based Expert System for Emergency Medicine	International Journal of Medical Informatics	Ontology-based expert system speeds emergency diagnosis and treatment decisions.	MGM's emergency department can use such tools to improve patient flow.
20	Arora (2017)	OPD Waiting Times and Consultation Turnaround	International Journal of Healthcare Management	OPD study identifies causes of long waits; recommends TAT monitoring and workflow fixes.	Directly supports MGM's goal to track and reduce OPD waiting times.

Note. Source: *The sources used in this study are collected from reliable journals, theses, and book chapters published between 2017 and 2026. These sources provide relevant information on healthcare management, patient waiting time, and Artificial Intelligence (AI). The data is taken from recognized and peer-reviewed publications to ensure accuracy and credibility. The studies focus on modern techniques like AI, IoT, and lean management. Overall, the sources provide a strong and valid foundation for the research*

5. PROPOSED CONCEPTUAL FRAMEWORK

The proposed conceptual framework explains how different operational factors at MGM Healthcare influence patient waiting time and service efficiency. Factors such as patient inflow, appointment scheduling, availability of doctors, diagnostic services, and administrative processes play an important role in hospital operations. When these factors are not properly managed, delays and inefficiencies can occur. These delays directly affect patient satisfaction and overall hospital performance. In this study, artificial intelligence is considered as a supportive tool to improve the system. AI helps in analysing data, identifying problem areas, and predicting delays in advance. It also supports better planning and resource allocation within the hospital. By using AI effectively, hospitals can improve patient flow and reduce waiting time. Overall, the framework highlights the importance of combining operational improvements with technology for better healthcare services.

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Table 1. Summary of Study Variables

Stage	Elements	Explanation	Stage
Input (independent Variable)	Patient inflow, appointment timing, doctor availability, diagnostic services, administrative work	These are the basic factors that affect how patients move through the hospital system	**Input** (independent Variable)
Process (Mediating Variable)	Artificial Intelligence (AI)	AI studies the data, finds where delays happen, and helps in making better decisions	**Process** (Mediating Variable
Output (Dependent Variable)	Patient waiting time, service efficiency	These show the result of how well the system is working	**Output** (Dependent Variable)
Outcome	Reduced waiting time, better patient experience, improved hospital performance	Final benefits achieved after improving the process	**Outcome**

6. RESEARCH METHODOLOGY

This study focuses on understanding the factors affecting patient waiting time and identifying operational issues at MGM Healthcare. A descriptive research design is used, as it helps to clearly study and explain the existing problems in hospital operations.

The study is based on both primary and secondary data. Primary data is collected through questionnaires from patients visiting the hospital, while secondary data is gathered from reports, journals, and hospital records. A convenience sampling method is used, where respondents are selected based on their availability and willingness to participate.

The sample size consists of patients who visited the outpatient department (OPD). Data collected from respondents is analysed using simple statistical tools such as percentage analysis, ANOVA, and Chi-square test to understand relationships between variables.

The methodology also considers the role of artificial intelligence in analysing operational data, identifying delays, and suggesting improvements. This helps in providing practical solutions to reduce waiting time and improve hospital efficiency.

7. RESULTS AND DISCUSSION

The results of the study conducted at MGM Healthcare show that patient waiting time is mainly influenced by several operational factors within the hospital. It was observed that during peak hours, a large number of patients leads to crowding, especially at the registration and consultation stages. Many patients reported that they had to wait longer than expected to meet doctors, which

Indicates issues in appointment scheduling and time management.
The findings also suggest that delays in diagnostic services occur due to high demand and limited availability of equipment. In addition, some administrative activities are still handled manually, which increases processing time and creates unnecessary delays. The statistical analysis, including percentage analysis, ANOVA, and Chi-square tests, indicates that there is a meaningful relationship between these operational factors and patient waiting time.

From the discussion, it is clear that these delays not only affect patient satisfaction but also increase pressure on hospital staff. Poor coordination between departments and uneven distribution of resources further add to the problem. The study highlights the need for better planning and improved workflow management.

Moreover, the results show that artificial intelligence can play an important role in solving these issues. By analysing patient data and identifying patterns, AI can help predict busy periods, improve scheduling, and support better use of resources. Overall, the use of AI can help reduce waiting time, improve service quality, and enhance the efficiency of hospital operations

7.1 KEY FINDINGS

The study conducted at MGM Healthcare reveals that patient waiting time is mainly affected by several operational challenges within the hospital. It was found that overcrowding during peak hours, especially at registration counters, leads to significant delays. Patients also experience longer waiting time to meet doctors due to ineffective appointment scheduling. Diagnostic services contribute to delays because of high demand and limited equipment availability. In addition, the presence of manual and semi-automated administrative processes increases the overall service time. Lack of real-time tracking of patient movement and poor coordination between departments further worsen the situation. Uneven distribution of staff and resources also affects the efficiency of operations. The study confirms that increased waiting time negatively impacts patient satisfaction. Statistical analysis shows a clear relationship between operational factors and delays. The findings also indicate that artificial intelligence can play an important role in identifying bottlenecks, improving scheduling, and enhancing overall hospital efficiency.

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Table 2. Hypothesis Testing Results

S.No	Statistical Tool	Applicable Question	Result	Interpretation
1	Percentage Analysis	What percentage of patients are facing delays and are satisfied?	More than 60% of patients reported delays, while around 40% expressed satisfaction	Indicates that a majority of patients experience waiting time issues, affecting satisfaction levels
2	Chi-Square Test	Is there a relationship between waiting time and patient satisfaction?	p-value < 0.05 (Significant)	There is a significant relationship between waiting time and patient satisfaction
3	ANOVA	Is there a difference in waiting time among different groups?	p-value < 0.05 (Significant difference)	Waiting time varies across different age groups or departments

8. CONCLUSION

The study at MGM Healthcare shows that patient waiting time is mainly caused by operational issues such as high patient inflow, poor scheduling, and delays in administrative and diagnostic processes. These problems reduce service efficiency and patient satisfaction. The study also highlights that artificial intelligence can help identify delays, improve planning, and manage patient flow effectively. Overall, better use of AI and improved operations can reduce waiting time and enhance hospital performance.

9. LIMITATIONS

This study has certain limitations that should be considered while interpreting the results at MGM Healthcare. The study is limited to a specific hospital, so the findings may not be applicable to other healthcare institutions. The sample size is restricted to patients who were available during the study period, which may not fully represent all patient groups. Data collection is mainly based on patient responses, which may include personal bias or perception differences. Time constraints also limited the depth of analysis and data collection. In addition, some hospital processes and internal data were not fully accessible, which may affect the accuracy of the analysis. The study focuses only on operational aspects and does not include clinical or financial factors.

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