# Theoretical Review for Solution Recommendation on Waiting Time Issue at Malaysian Government Hospital

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## ABSTRACT

Excessive patient waiting time remains a critical issue in Malaysian government hospitals, leading to reduced healthcare efficiency, overcrowding, and decreased patient satisfaction. This study presents a theoretical review of existing literature and frameworks addressing waiting time reduction through facility planning, service design, Lean principles, and resource optimization. The review highlights that long waiting times stem from systemic inefficiencies including poor spatial layouts, inadequate scheduling systems, outdated administrative procedures, and insufficient staffing. Using a systematic literature review method across Scopus, IEEE Xplore, and Web of Science databases, a total of 45 relevant studies were analyzed. Findings reveal that strategic service redesign, efficient facility layout, and the adoption of Lean methodologies significantly improve patient flow and operational performance. Concepts such as Patient Flow Engineering, Casemix Index (CMI) application, and integrated facilities planning emerged as effective approaches for addressing service bottlenecks without requiring major capital investment. The review also emphasizes the interdependence between facility layout, process design, and scheduling systems, suggesting that improvements in one area must align with the others to achieve sustainable outcomes. Moreover, digital integration—such as electronic health records and data-driven decision-making tools—further enhances coordination and reduces administrative delays. The study concludes that a multidisciplinary approach combining Lean thinking, facilities optimization, and technology adoption is essential to reduce waiting times and improve healthcare delivery efficiency. These findings contribute to a conceptual framework that can guide future empirical studies and policy reforms aimed at enhancing the operational performance of Malaysian government hospitals.

**Keywords**— Waiting Time, Government Hospitals, Facility Planning, Patient Flow Engineering, Lean Approach, Casemix Index

## INTRODUCTION

In the dynamic and demanding environment of public healthcare, particularly within government hospitals, optimizing operational efficiency is essential for delivering timely and quality care to patients. Government hospitals play a crucial role in providing healthcare services to a large segment of the population, especially in developing countries. However, these hospitals often face significant challenges that hinder their ability to

deliver timely and efficient care. One of the most critical challenges faced by these institutions is excessive patient waiting time, which can negatively impact service delivery, patient satisfaction, and overall healthcare outcomes. Restructuring processes to reduce waiting times not only improves patient experience but also enhances the hospital's ability to manage resources more effectively.

Long waiting times in healthcare settings can lead to a range of adverse effects, including patient frustration, increased stress levels, a decline in trust towards healthcare providers, and potentially worsened health outcomes

[1][2][3][4]. Prolonged waiting can result in the deterioration of medical conditions, especially for chronic and time-sensitive illnesses. Moreover, patients who experience long waiting periods are often forced to seek alternative healthcare options, which may lead to overcrowding in other healthcare facilities or an over-reliance on emergency departments.

In government hospitals, particularly in low to middle-income countries, long waiting times have become a pervasive issue, affecting both the quality of healthcare delivery and patient satisfaction. These hospitals, which cater to a large proportion of the population, are often overwhelmed by the sheer volume of patients requiring medical attention. Consequently, extended waiting times for consultations, diagnostic tests, and treatments are commonplace, creating a significant barrier to effective healthcare. Long waiting times not only negatively impact patients' health outcomes but also contribute to inefficiencies within the hospital system, leading to overcrowding, delays in care, and increased healthcare costs. These inefficiencies are further exacerbated by limited resources, insufficient staffing, and outdated administrative processes.

The problem of long waiting times is multifaceted and arises from various factors, including hospital management issues, resource allocation challenges, and the lack of streamlined patient flow processes. In many government hospitals, a significant number of patients are treated in a centralized manner, with insufficient differentiation between urgent and non-urgent cases. This results in unnecessary delays for patients requiring non-critical care while patients with critical needs face prolonged waits due to bottlenecks in the system. Furthermore, these hospitals are often overburdened, leading to inadequate staffing and a lack of medical infrastructure, which can further delay service delivery.

Resource limitations are one of the core reasons contributing to long waiting times in government hospitals. Many of these hospitals operate with limited budgets and face difficulty in hiring and retaining skilled medical professionals. This leads to staffing shortages, particularly in specialized areas where expert care is most needed. The scarcity of trained healthcare workers' forces hospitals to work with fewer personnel, leading to longer consultation times, delays in diagnosis, and extended waiting periods for surgery or other treatments. The result is a strained workforce that is unable to meet the growing demand for healthcare services on time.

Government hospitals in Malaysia are struggle with persistent challenges of prolonged patient waiting times and systemic inefficiencies, which poorly affect the quality of healthcare delivery. According to the Chanel New Asia dated 16th of February 2023, patients have been reported to endure extended waiting times exceeding 24 hours for hospital admission due to bed shortages and severe overcrowding in emergency departments, particularly in facilities like Hospital Kuala Lumpur where nearly 100 patients were stranded during peak hours [5]. The Straits Time [6] reported that a wait time at government hospital in Sabah could extend up to two days or even beyond four to five days (Fig. 1).

**Fig. 1** Headlines from The Straits Time [6].

Prasanthi et al. [7] revealed that the average median waiting times for walk-in patients were around 60 minutes, compared to 15 minutes for pre-registered patients [8][9]. These inefficiencies are often attributed to a combination of possible systemic issues including understaffing, outdated administrative procedures, poor scheduling systems, and the lack of integrated digital health solutions. Abdullah et al. [10] reported that inadequate computer resources and heavy workloads prompted staff to implement workarounds in hospital information systems always occur in hospital.

Administrative inefficiencies also play a significant role in exacerbating waiting times. The government hospitals often rely on outdated or manual systems for scheduling appointments, managing patient flow, and communicating between departments. This lack of integration between departments, along with inefficient scheduling practices, results in unnecessary delays. Additionally, the administrative burden placed on healthcare workers for non-medical tasks (such as patient registration, insurance verification, and documentation) can detract from their ability to provide timely care. As a result, patients experience longer waiting times for services that could have been expedited with better coordination and more efficient administrative practices.

Another contributing factor to prolonged waiting times is the lack of real-time data tracking and patient management systems in many government hospitals. Without access to up-to-date information on patient status, medical histories, or available resources, healthcare providers may struggle to prioritize cases effectively, leading to further delays in care. Furthermore, inefficient triage processes, where patients are not properly assessed for the urgency of their conditions upon arrival, can result in the misallocation of resources and prevent timely treatment for critical patients.

The issue of overcrowding also complicates the problem of long waiting times. With government hospitals serving large populations, especially in urban areas or regions with limited access to healthcare, overcrowding becomes a common occurrence. Hospitals often operate at or beyond capacity, which results in longer waits for appointments and procedures. Overcrowding also strains the hospital's infrastructure, including waiting rooms, diagnostic facilities, and treatment areas. As a result, patients may experience not only delays in care but also a decrease in the overall quality of their hospital experience, including reduced privacy, discomfort, and dissatisfaction.

These systemic issues not only compromise patient care but also place immense pressure on healthcare professionals, leading to burnout and further exacerbating staff shortages. Addressing these challenges is critical to enhancing the efficiency and effectiveness of Malaysia's public healthcare system.

The impact of long waiting times on patients is profound. Delayed treatments, consultations, or diagnostic tests can worsen medical conditions, particularly for patients with chronic or time-sensitive illnesses such as cancer, cardiovascular diseases, or infections. For example, delayed treatment for cancer patients may result in the progression of the disease to a more advanced and difficult-to-treat stage, ultimately affecting the patient’s prognosis. Similarly, waiting for a diagnostic test or surgery can result in the deterioration of a patient's condition, making the treatment less effective when it is finally provided. As waiting times increase, patients may also experience increased levels of anxiety, stress, and frustration, further reducing their trust in the healthcare system.

In addition to the direct impact on patients, long waiting times and inefficiencies also have financial implications for both patients and the healthcare system. As patients are forced to seek alternatives, either through emergency departments or private facilities, the cost of healthcare escalates. Public health systems, already under financial strain, face increased operational costs related to inefficiencies and delays. Hospital administrators and policymakers must confront the challenge of balancing high demand with the resources available to deliver timely and effective care.

Reducing waiting times and enhancing operational efficiency in Malaysian government hospitals are critical for improving the overall quality of care. This multifaceted issue stems from resource constraints, administrative inefficiencies, high patient volumes and poor facilities and service design. Addressing these challenges necessitates a comprehensive approach that includes strengthening hospital management,

optimizing resource allocation, and integrating technological solutions.

In conclusion, the problem of long waiting times in government hospitals is a complex issue that arises from a combination of resource constraints, administrative inefficiencies, and high patient volumes. The negative effects of extended waiting times are felt by patients, healthcare providers, and the healthcare system, making it a critical area of concern for policymakers and hospital administrators. By addressing the root causes of waiting times and implementing strategies to improve efficiency, government hospitals can enhance patient care, reduce overcrowding, and provide more effective healthcare services to the public.

# METHODOLOGY

To ensure that the literature review produced is comprehensive, structured, and relevant to the research topic, a systematic approach was adopted in the process of searching, selecting, and evaluating academic articles. Three major databases were utilised for this purpose: IEEE Xplore, Scopus, and the Web of Science (WoS). These databases were selected due to their strong reputations and credibility in providing access to high-impact and up-to-date research publications in relevant fields.

The literature review process began with the identification of key search terms directly related to the research topic. These keywords included technical terms, synonyms, and common phrases used in similar areas of research. For instance, if the study focused on artificial intelligence in healthcare, keywords such as “artificial intelligence”, “machine learning”, “healthcare”, and “medical diagnosis” were used both individually and in various logical combinations (e.g., using Boolean operators like AND, OR, and NOT) to refine the search results and ensure relevancy.

Each database was accessed separately. In IEEE Xplore, emphasis was placed on articles published in journals or conference proceedings related to engineering and computer technologies. In Scopus and WoS, the focus was on articles from highly indexed journals with strong impact factors. Filters were applied based on the year of publication (typically within the last 5 to 10 years), document type (only journal articles and conference proceedings), and language (only English-language articles were selected).

In total, approximately 15 journal articles were selected from each database, resulting in a cumulative dataset of around 45 articles. These articles were then read and analysed thoroughly. Important content such as research objectives, methodologies used, key findings, and future recommendations were identified and recorded. Manual techniques such as note-taking and content coding were employed to extract recurring themes and patterns across the studies.

After the content evaluation phase, the findings from the selected articles were organised into specific themes or categories — for example, based on technical approaches, identified challenges, or proposed solutions. This thematic organisation enabled a structured literature review that not only compared various approaches but also highlighted gaps in existing research that have yet to be fully explored.

Overall, this systematic methodology ensured that the literature review was based on credible sources, captured the breadth and depth of existing research, and aligned well with the objectives of the current study.

**Review Result**

As emphasized by Pathirana and De Silva [11], "efficiency in healthcare facilities is largely determined by the strategic design of physical spaces and patient flow pathways". In the context of reducing patient waiting times in government hospitals, effective facilities planning and service design are crucial to optimizing operational performance. Hospitals worldwide face challenges related to overcrowded spaces, inefficient layouts, and poorly designed service processes, all of which contribute to longer patient wait times and lower satisfaction levels. These challenges are particularly prevalent in public healthcare systems, where limited resources and high patient volumes exacerbate the situation.

Addressing these challenges requires the implementation of strategies that not only reduce waiting times but

also enhance overall hospital efficiency. The implementation of strategies such as electronic health records, appointment scheduling systems, and streamlined patient flow processes has been shown to significantly reduce patient waiting times and improve overall healthcare efficiency [12]. Additionally, Huang et al. [13] found that optimizing the roles of medical and administrative staff, enhancing communication between departments, and utilizing data-driven decision-making systems such as real-time tracking and dispatch technologies have been shown to significantly reduce service delays and improve overall healthcare efficiency.

**Service Design and Patient Flow Engineering**

In addition to physical infrastructure, the design of service processes plays a crucial role in shaping patient experiences and optimizing hospital efficiency. Service design in healthcare focuses on restructuring patient pathways, improving interaction points, and removing inefficiencies within the service delivery system.

Huang et al. [13] explored the importance of decision-making frameworks for enhancing hospital service efficiency. Their research investigated how well-designed service models could reduce operational complexity, enhance staff coordination, and consequently lower patient waiting times. They emphasized a patient-centred approach where each step in the service pathway is meticulously crafted to minimize redundancies and delays.

In a complementary study, Morales et al. [14] proposed a hybrid strategy that integrated decision support systems with service design optimization. Morales introduced dynamic patient flow models capable of adapting to fluctuating service demands, thereby smoothing patient arrivals and reducing peak-time congestion. The hybrid models combined elements of predictive analytics and service reengineering, offering a modern solution to longstanding inefficiencies.

Further, Alodan et al. [15] specifically examined outpatient pharmacy services, where long waiting times are common. Their findings suggested that service redesigns such as introducing fast-track lanes for patients with simple prescription pickups that could significantly cut down queuing times and increase overall throughput.

Together, these studies advocate for the critical role of service design thinking in healthcare. By mapping patient journeys, redesigning service steps, and applying Lean principles to remove wasteful activities, hospitals can achieve faster, more efficient, and patient-friendly services.

Patient Flow Engineering is all about finding smarter ways to manage how patients move through different stages of healthcare services. The goal is simple but crucial: to reduce long waiting times, make services run more smoothly, and ensure patients feel cared for, not just processed. This approach brings together ideas from industrial engineering, operations management, and healthcare systems to create a patient journey that is efficient, predictable, and meaningful at every step.

Albalawi et al. [16] showed in their systematic review that using Lean techniques in outpatient clinic is a big part of Patient Flow Engineering that can make a real difference. By cutting out unnecessary steps, reorganizing work areas, and standardizing procedures, clinics were able to speed up patient flow and stabilize their daily operations. Their findings highlight how careful planning of patient movement can improve not just speed, but also the overall quality of healthcare delivery.

In a study by Sun et al. [17] at a large public hospital in China, redesigning patient pathways and better organizing service points led to shorter waiting times and more satisfied patients. Their work clearly illustrates how rethinking how patients move through a hospital can be led to tangible improvements in both service efficiency and patient experience.

To design better patient flows, several tools are often used, like Value Stream Mapping (VSM), Spaghetti Diagrams, Bottleneck Analysis, and Simulation Modeling. As explained by Tompkins et al. [22] in Facilities Planning (4th Edition), looking carefully at the physical flow of people and materials is essential to cut down wasted movement and ensure spaces work as they should. In healthcare settings, applying these tools helps not just the physical layout but also the way services are delivered, addressing inefficiencies at every level.

Morales et al. [14] offered another perspective by introducing a hybrid decision-support model. Her work

combined real-time data analysis with smarter workflow design to improve how patients move through hospitals. The results showed that by managing patient flow actively and intelligently, hospitals can dramatically reduce waiting times while also balancing workloads for staff that create a win-win situation for both patients and healthcare workers.

In outpatient pharmacies, Alodan et al. [15] found that delays weren't always about having too few resources. Often, the real problem was in how tasks were organized. By redesigning the flow, assigning specialized tasks, and improving queuing systems, they significantly reduced patient waiting times, showing that even small changes can have a big impact.

Especially in government hospitals, where staff and resources are often stretched thin, Patient Flow Engineering becomes even more important. Instead of requiring huge new investments, small but strategic changes a better layout, smarter scheduling, and streamlined processes can help hospitals serve more patients efficiently.

In short, Patient Flow Engineering offers a structured, practical way to fix one of healthcare's biggest challenges: long waiting times. By focusing on the patient journey, not just isolated steps, it helps build healthcare systems that are faster, more efficient, and, most importantly, more caring toward those who need them most.

**Facilities Efficiency and Resource Optimization**

Beyond layout and service design, the efficiency of facilities depends heavily on the strategic allocation of resources such as staff, equipment, and physical space. Effective resource management ensures that the capacity of the hospital is optimally aligned with patient demand patterns.

Abdulrahman et al. [23] employed the Casemix Index (CMI) method to evaluate resource allocation efficiency across Saudi Arabian government hospitals. Their study highlighted those imbalances in resource distribution not necessarily a lack of resources, were responsible for service delays and extended waiting times. The CMI approach allowed hospitals to identify areas of overuse and underuse, leading to better workload balancing and operational improvements.

Likewise, Albalawi et al. [16] conducted a systematic review on Lean interventions in outpatient clinics. Their research underscored the importance of synchronizing layout improvements with human resource adjustments. They concluded that integrating Lean facility redesigns with effective staff management practices created a synergistic effect, leading to significant reductions in outpatient waiting times and enhancements in overall service delivery.

These studies underline the necessity of a holistic approach where facilities planning, resource optimization, and workflow management are considered interdependent components for achieving operational excellence in healthcare environments.

**Application of Casemix Index (CMI) in Resource Optimization**

Abdulrahman et al. [23] used the CMI to evaluate resource allocation across Saudi Arabian government hospitals. Their study emphasized that hospitals with high patient volumes often experience inefficiencies not because of a lack of resources but because those resources are not allocated to the right patients in a manner that matches the complexity of their medical needs. For instance, patients with more severe or complex conditions require a larger amount of medical attention, equipment, and specialized staff. By using the CMI method, hospitals can analyze patient data to identify which departments or services are overburdened and which ones have excess capacity.

By applying the CMI, hospital administrators can make decisions about staffing, bed utilization, and equipment distribution. This helps to improve efficiency by ensuring that resources are directed where they are most needed, reducing both unnecessary delays and the overall strain on hospital facilities. Additionally, CMI can assist in financial planning and budgeting by providing data on the expected costs of different

patient groups, which helps ensure that hospitals do not face unexpected budget shortfalls.

**Lean Approach**

The Lean approach; originally developed within the manufacturing sector; particularly the Toyota Production System; is a philosophy centered on maximizing value for the customer while minimizing waste. In the context of healthcare, Lean has been widely adapted to streamline processes, eliminate non-value-adding activities, and improve the overall patient experience.

According to Albalawi et al. [16], the Lean approach in hospital outpatient clinics involves identifying areas of waste such as unnecessary patient movements, redundant documentation, long waiting times between services, and inefficient use of staff resources. Through the application of Lean tools like Value Stream Mapping (VSM), 5S, Kaizen, and Standardized Work, healthcare facilities can redesign their service pathways to become more patient-centered, leading to reduced waiting times and improved satisfaction.

Sun et al. [21] demonstrated the effectiveness of Lean principles by conducting interventions in a Chinese public tertiary hospital. Their study found that by applying Lean-based process improvements such as reorganizing registration counters, simplifying triage processes, and better aligning service steps. The hospital achieved measurable reductions in patient waiting times and service congestion.

The core Lean principles, as highlighted by Morales et al. [14], emphasize continuous improvement (Kaizen), respect for people (including both patients and staff), and the pursuit of perfection in service delivery. By empowering healthcare staff to identify inefficiencies and suggesting improvements, Lean fosters a culture of ongoing innovation and accountability.

Lean thinking also supports a shift in mindset from working harder to working smarter. Rather than increasing resources like staff or equipment, Lean encourages a re-evaluation of how existing resources are utilized. In outpatient settings, for example, applying Lean methods has led to faster patient processing times without the need for major financial investments [16] [17] [18] [19] [20].

Moreover, in their broader review, Alodan et al. [15] noted that Lean interventions could particularly benefit resource-constrained environments, such as public hospitals and outpatient pharmacies. Here, the strategic elimination of waste and smarter process design has proven to be critical factors in improving patient flow and optimizing service capacity.

In conclusion, the Lean approach offers healthcare organizations a powerful framework for systematically reducing inefficiencies and enhancing service delivery. By focusing on process improvements rather than simply expanding capacity, Lean methodologies help institutions deliver faster, better, and more efficient care to patients.

**Facility Layout Planning to Reduce Waiting Time**

The physical design and layout of hospital facilities have a direct and measurable impact on service efficiency and patient waiting times. Proper space utilization, logical arrangement of service units, and strategic placement of key resources are fundamental elements that determine the operational flow of a hospital.

Pathirana and De Silva [11] conducted a comprehensive study focusing on the outpatient department (OPD) of government hospitals in Sri Lanka. Their research emphasized that inefficient spatial planning led to overcrowded waiting areas, slow patient movements, and increased service delays. Through the introduction of zoning strategies, better patient routing systems, and optimized seating and registration layouts, they demonstrated a significant reduction in patient waiting times and improved flow efficiency. Their objective was clear: to establish a workplace design that enhances the overall operational performance of outpatient services.

Similarly, Sun et al. [21] applied an interrupted time series study to evaluate the impact of facility layout reorganization in a major Chinese public hospital. Their intervention involved minor but strategic adjustments

such as relocating registration counters, repositioning consultation rooms closer to diagnostic services, and better signage for patient navigation. The results showed notable improvements in service delivery times and outpatient satisfaction levels, proving that even small-scale layout changes can yield substantial operational benefits.

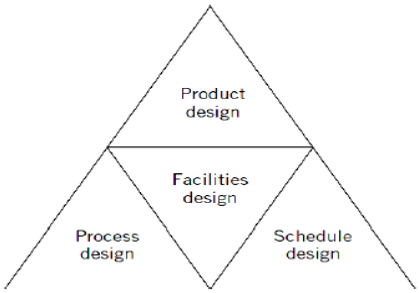
These findings consistently point to the fact that healthcare facilities must prioritize patient flow patterns and interdepartmental accessibility when planning or upgrading their physical spaces. An intelligently designed layout is not just aesthetically pleasing but operationally essential in achieving reduced waiting times and streamlined healthcare delivery.

According to Tompkins et al. [22] in Facilities Planning (4th Edition), the effective planning of facilities is inseparable from the concurrent design of products, schedules, and processes. Each element interacts with the others, creating a dynamic system that directly influences the efficiency and responsiveness of service delivery, particularly in healthcare environments where waiting time is a critical concern.

Facilities planning ensures that the physical layout supports smooth flow, minimizing unnecessary movement of patients, staff, and materials. A poorly arranged facility can cause congestion points and extended waiting periods as patients navigate between service points. Product design (in the healthcare context, referring to service design) focuses on structuring healthcare services to be patient-centered and efficient, by defining clear service offerings, streamlined pathways, and standard procedures.

Meanwhile, schedule design coordinates the timing and sequencing of services to match the demand patterns of patients. Proper scheduling of appointments, staff shifts, and resource availability prevents overloading any single point in the system, thereby reducing bottlenecks. Lastly, process design involves the detailed development of operational workflows that eliminate non-value-added activities, standardize procedures, and improve responsiveness.

**Fig. 2** Interrelationship between product, process, and schedule (PP&SS) design and facilities planning [22]




Tompkins et al. [22] emphasize that when facilities planning, product design, schedule design, and process design are considered holistically rather than independently, they collectively enhance operational efficiency (Fig. 2). For example, a redesigned facility layout that complements an optimized patient intake process, alongside a balanced appointment schedule, can significantly cut down waiting times at the OPD.

In hospital operations, overlooking any one of these aspects can negate improvements made in others. Therefore, an integrated approach is necessary: designing service processes that are in harmony with the physical environment and operational scheduling is essential to create a healthcare system that delivers timely and efficient care. This interconnected planning approach not only improves patient satisfaction but also optimizes resource usage and overall hospital performance.

## DISCUSSIONS

This paper has reviewed and analyzed the relevant literature surrounding efforts to reduce waiting times and improve service efficiency within healthcare systems, particularly in government hospital. The overview established the critical role that efficient service delivery plays in enhancing patient satisfaction and operational performance. Through the works of scholars such as Huang et al. [13], Sun et al. [21], and Ahmad

et al. [24], it became evident that waiting time reduction is not solely a matter of adding more resources, but instead requires strategic reengineering of service processes, spatial layouts, and scheduling systems.

Several key themes emerged from the literature. The first is the impact of Lean techniques and patient-centered workflow redesigns, which have been consistently shown to lower waiting times and improve system responsiveness. Studies such as those by Albalawi et al. [16] and Morales et al. [14] further support the integration of decision-support tools and simulation models to predict bottlenecks and test potential improvements before real-world implementation.

Secondly, the literature emphasized the importance of viewing healthcare delivery through the lens of Facilities Planning and Product Design. Tompkins et al. [22] provided a framework highlighting the deep interrelationship between facility layout, service design, process planning, and scheduling elements that must be integrated for any healthcare improvement effort to succeed. Patient Flow Engineering was also identified as a critical discipline, focusing on how optimizing the physical and operational movement of patients can significantly enhance service efficiency without the need for major capital investment.

The review also introduced the CMI approach as discussed by Abdulrahman et al. [23], which allows hospitals to better understand the complexity of their service loads and allocate resources more effectively. This method supports decision-making processes that are evidence-based and aligned with institutional goals for efficiency and quality improvement.

Table 1 presents a comprehensive summary of seven most important previous research studies that focus on reducing patient waiting time and improving efficiency in healthcare settings. These studies provide critical insights into various strategies, frameworks, and methodologies applied globally to tackle operational challenges in hospitals and OPD.

Most of the research emphasizes the importance of Lean management techniques, simulation modeling (e.g., Arena), facility planning, and decision support systems. For example, the study by Ahmad et al. [24] highlights how Lean and Arena simulation can optimize patient flow, while Albalawi et al. [16] conducted a systematic review confirming the effectiveness of Lean approaches across outpatient clinics. Other studies, such as those by Pathirana and De Silva [11], focus on layout design and workplace planning, showcasing how physical space can influence service efficiency.

**Table 1.** Summary of previous research

| Authors | Objective/Focus | Method/Approach |
|---|---|---|
| Pathirana & De Silva [11] | To identify effective workplace planning and design strategies to minimize OPDwaiting time. | Workplace layout analysis, simulation, observation-based study. |
| Huang et al. [13] | To analyze hospital service decision-making and improve service efficiency. | Decision support system modeling, data analysis. |
| Morales et al. [14] | To propose a hybrid decision support system to reduce waiting times and enhance satisfaction. | Hybrid modeling approach combining simulation and analytics. |
| Alodan et al. [15] | To study factors affecting efficiency in outpatient pharmacy waiting times. | Quantitative analysis, observation, patient flow study. |
| Albalawi et al. [16] | To review Lean implementation in outpatient clinics to reduce waiting times. | Systematic literature review (Lean approach). |

| | | |
|---|---|---|
| Tompkins et al. [22] | To provide comprehensive guidelines on facility layout, planning, and optimization. | Theoretical concepts, design tools, case applications. |
| Ahmad et al. [24] | To apply Lean and Arena simulation to reduce patient waiting time in public healthcare. | Lean tools (e.g., VSM) and Arena simulation modeling. |

**Fig. 3** A conceptual framework summarizing the interaction between the discussed methods.

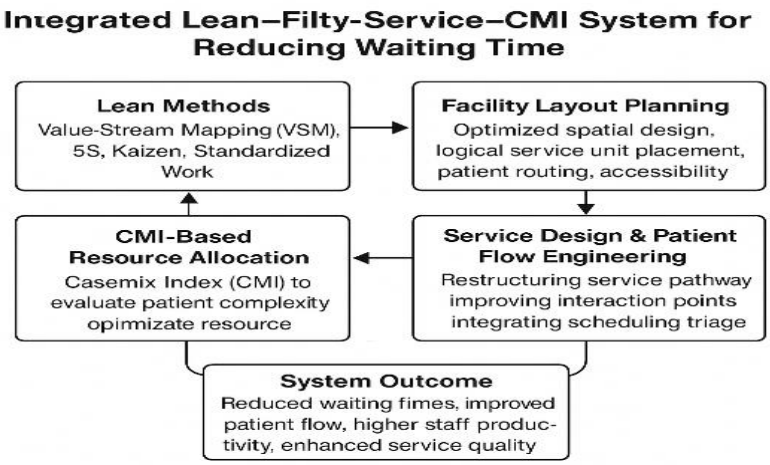



Fig. 3 outlines an Integrated Lean-Filty-Service-CMI System conceptual framework for Reducing Waiting Time in healthcare. This model connects four key components in a continuous improvement cycle to optimize healthcare service delivery. It begins with Lean Methods (like Value-Stream Mapping, 5S, Kaizen) which inform Facility Layout Planning, focusing on spatial design and patient routing. This, in turn, influences Service Design & Patient Flow Engineering by restructuring service pathways and integrating scheduling/triage. Simultaneously, CMI-Based Resource Allocation (using the Casemix Index to gauge patient complexity) optimizes resources and also informs Lean Methods. The ultimate System Outcome is the expected result which is to reduce waiting times, improve patient flow, higher staff productivity, and enhanced service quality. The flow suggests that optimized resources drive Lean practices, which facilitate better facility design, leading to improved service and flow, which then necessitates optimal resource allocation.

While the reviewed literature collectively supports the positive role of Lean methods, facility layout changes, service redesign and CMI-driven allocation in reducing waiting times, a closer methodological appraisal reveals limited empirical breadth and several recurring weaknesses that weaken causal claims and generalisability. Systematic reviews and syntheses by Albalawi et al. [16] and Waiman et al. [17] provide breadth of evidence but rely on heterogeneous studies, limiting applicability to Malaysian hospitals. Quasi-experimental designs (e.g., Sun et al. [21] allow stronger inference but often lack control groups, exposing results to confounding effects. Simulation and modeling defined in Ahmad et al. [24] and Morales et al. [14] are useful for scenario testing yet depend heavily on assumptions rarely validated with real-world data. Observational studies done by Pathirana & De Silva [11] and Alodan et al. [15] demonstrate practical interventions but are mostly descriptive with small samples. CMI and administrative-data analyses (Abdulrahman et al. [23]) identify allocation inefficiencies but lack direct linkage to patient waiting-time outcomes.

Furthermore, the reviewed literature absence of multi-site Malaysian hospital studies assessing integrated frameworks, and only few controlled quasi-experimental or longitudinal investigations. Weak evidence connecting CMI-based resource optimization to real patient outcomes is also observed through the reviewing process. Limited cost and workload analyses for Lean interventions, lack of mixed-methods or implementation-science approaches and poor validation of simulation and decision-support models are found to be important lacking issues especially when considering Malaysian hospital situation.

**Policy Implication in Malaysian Hospital**

The findings from this theoretical review offer several critical policy implications for the Malaysian Ministry of Health (MOH) aimed at strategically redesigning public hospital operations to reduce excessive waiting times.

Firstly, the MOH can formalize and mandate the integration of Lean Management Principles and Patient Flow Engineering into hospital administration and operational planning. This means shifting from capacity expansion as the primary solution to a system-wide focus on process reengineering, eliminating waste, and establishing Standardized Work across all service points, from registration to discharge.

Secondly, the MOH should leverage the Casemix Index (CMI) as a core, data-driven tool for resource allocation and budgeting. Policy should require hospital administrators to use CMI data to ensure that staffing, equipment, and bed utilization are accurately matched to the complexity of patient needs, rather than simply the volume of patients.

Finally, policy should enforce a holistic and integrated approach to hospital design. Any planned facility upgrades or new constructions must concurrently integrate improvements in service design, process planning, and scheduling systems to ensure that the physical layout (Facility Planning) directly supports efficient patient flow and accessibility. The review also supports mandating the integration of digital health technologies (e.g., electronic health records and real-time data tracking) to enhance coordination and decision-making.

## CONCLUSIONS

This theoretical review demonstrates that excessive patient waiting times in Malaysian government hospitals are driven by systemic inefficiencies, limited resources, suboptimal facility layouts, and outdated administrative practices. A comprehensive, multidisciplinary strategy; integrating Lean management principles, Patient Flow Engineering, Facility Planning, and the Casemix Index (CMI); is vital to address these persistent challenges. Collectively, these approaches emphasize the need for process reengineering, data-driven scheduling, and optimized spatial configurations to enhance patient flow and operational performance.

The synthesis of literature reveals that Lean-based interventions and patient-centered service design significantly improve efficiency and satisfaction without requiring major financial investment. Furthermore, the integration of digital health technologies, such as electronic health records and predictive analytics, enhances coordination, resource utilization, and real-time decision-making. Aligning these technological and operational improvements within a cohesive system ensures sustainable reductions in waiting times.

This review contributes a conceptual framework to guide future empirical studies and policy reforms focused on operational excellence in Malaysian public healthcare. It highlights the necessity for strategic collaboration between hospital administrators, policymakers, and technology stakeholders to create data-informed, efficient, and patient-focused healthcare environments that deliver timely, equitable, and high-quality services to the Malaysian population.

As for the recommendations for future research, we plan to conduct cluster stepped-wedge or controlled ITS studies in Malaysian hospitals to evaluate integrated Lean–layout–service–CMI frameworks. We also plan to use mixed-methods designs combining quantitative performance data with qualitative feedback from staff and patients. Integrating cost-effectiveness analysis into intervention evaluation and Include long-term sustainability assessments are also recommended to be done. This research work also looking into validating a decision-support models prospectively using real hospital data. Perhaps, developing CMI linkage studies connecting case complexity, resource use, and patient flow could also be considered to find a solution.

In conclusion, although existing literature presents encouraging trends, its methodological limitations restrict causal interpretation. Rigorous, multi-site, and mixed-methods research is essential to confirm the sustainability and transferability of integrated Lean–Facility–Service–CMI frameworks in Malaysian government hospitals.

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