

Improving Hospital Queuing System Using Kim and Mauborgne's Four Actions Framework

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Abstract

This paper explores the inefficiencies in traditional hospital queuing systems and proposes strategic improvements using Kim and Mauborgne's Four Actions Framework (ERRC) from the Blue Ocean Strategy. The study emphasizes the need to eliminate outdated practices such

as manual token systems, repetitive registrations, and rigid scheduling; reduce overreliance on staff, paper-based documentation, and variability in waiting times; raise transparency, comfort, and convenience through digital displays, SMS/app notifications, and improved waiting areas; and create innovative solutions including an AI-based queue time prediction engine, multilingual virtual assistants, and family or guardian queue access. These initiatives aim to transform hospital queuing from a frustrating, inefficient experience into a patient-centered, technology-driven system. The paper highlights how digital transformation can enhance operational efficiency, improve patient satisfaction, and reduce staff burden. In conclusion, adopting ERRC-based innovations is presented as a strategic necessity for modern healthcare institutions to meet evolving patient expectations and operational demands.

Keywords: Hospital queuing system, Four actions framework (ERRC), Strategic transformation

1. Introduction

The hospital queuing system is a systematic way for patients to wait their turn to access medical services such as registration, consultation, diagnostics, or medication. Long queues, manual registration, and a lack of real-time updates are the norm in most public and even some private healthcare facilities. These inefficiencies result in patient frustration and dissatisfaction, employee fatigue, and reduced quality of care (Ting et al., 2022). In an age of digitalization, the hospital's queuing system is quite manual and requires business transformation to enhance operational efficiency and improve the patient experience. This report aims to address the disadvantages of the current hospital queuing system using Kim and Mauborgne's four actions framework (ERRC). The ERRC Framework, developed by Kim and Mauborgne as part of the Blue Ocean Strategy, is a strategic tool used to reinvent products or services in a way that creates new value for the customers and breaks away from traditional competition. The framework primarily focuses on four key actions: eliminate, reduce, raise, and create. As businesses increasingly compete on the same set of features, such as price, quality, or service level, most industries see firms converging on common strategies. Over time, these forms crowd "red oceans," with firms battling intensely yet unable to differentiate. The ERRC Framework recommends a different path: instead of building on established offerings, it calls for businesses to question industry assumptions and create value in ways that render the competition obsolete.

2. Research Methodology

The study utilizes a specific strategic business tool, Kim and Mauborgne's Four Actions Framework (ERRC) from the Blue Ocean Strategy. ERRC stands for Eliminate, Reduce, Raise, and Create, and the researchers apply these four pillars to evaluate and propose changes to hospital queuing systems systematically. This is a conceptual analysis paper. This study is exploratory and solution-oriented. It explores current inefficiencies, proposes strategic improvements, and argues for digital transformation as a strategic necessity. While existing healthcare management literature extensively documents the operational bottlenecks of traditional hospital queuing, proposed solutions often default to incremental administrative

tweaks or isolated technological upgrades rather than a systemic overhaul. To bridge this gap between merely identifying inefficiencies and achieving meaningful digital transformation, this study adopts Kim and Mauborgne's Four Actions Framework (ERRC) as its core theoretical lens. Unlike conventional queuing theories that focus solely on managing wait times, the ERRC framework introduces a strategic value-innovation perspective. By systematically categorizing the pain points identified in the current literature into factors to be eliminated, reduced, raised, or created, this framework transcends basic IT implementation. It provides a rigorous, structured methodology to translate documented industry flaws into a fundamentally redefined, patient-centric digital queuing strategy. The following discussion is based on the four components of the ERRC framework (i.e., eliminate, reduce, raise, and create).

3. Eliminate

To effectively improve the current hospital queuing system, it is vital to remove outdated practices that no longer add value to patients or staff. Removing these practices can simplify processes and enhance overall service efficiency. Specific practices that need to be eliminated to achieve this include manual token systems, repetitive patient registrations, unnecessary waiting room time, and outdated calling systems.

3.1 Manual Number Token System

In the current system, most hospitals still use physical number tokens/tickets or handwritten registers at service counters. This practice requires patients to collect a number indicating their place in the queue and to physically wait in the designated waiting area to monitor their turn, which is usually displayed on a ticket counter. This method of collecting a waiting number leads to overcrowding in the waiting area and inaccurate estimates of waiting times. Eliminating this practice of physical ticket collection will significantly reduce the number of patients waiting endlessly in the waiting area for their turn. Indirectly, this can also reduce contact between sick patients, reducing the unnecessary spread of viruses and bacteria. It can also enhance patients' psychological comfort by lowering their stress levels, which may be caused by overcrowding. With the introduction of digital queue systems, patients can use mobile apps or SMS to monitor their place in line and arrive precisely on time, significantly improving the waiting experience.

3.2 Unnecessary Waiting Room Time

Generally, due to overcrowding in hospitals, caused by static scheduling systems that do not account for delays or early completions of appointments, patients often wait a long time for their turn. In addition, overbooking during peak periods, such as weekends or public holidays, can lead to hospital congestion. It was found that the average waiting time in hospitals ranged from 18 to 85 minutes from the time of their appointment, depending on the specific department consulted (Ir M. et al., 2011). This is very unsatisfactory, as patients waiting more than an hour will become restless and frustrated in the healthcare system. One way to circumvent this problem is to eliminate rigid time-block scheduling and shift to dynamic, real-time scheduling. By moving towards real-time scheduling, hospitals can minimize

unnecessary idle time in waiting areas and manage patient flow more effectively.

3.3 Repetitive Re-registration at Different Counters

At most hospitals, patients are asked to re-register or provide documentation at different service points (e.g., after a visit to a general doctor, then again at radiology, pharmacy, or lab). Registration repetition is a waste of time and frustrates patients. This is primarily because hospital medical records are paper-based, mainly requiring the hospital team to obtain prior medical records from other departments. A study of Chinese hospitals found that those with many departments sharing resources experience long wait times at the registration counter (Tian et al., 2017). Removing such duplicated entries through an integrated hospital information system (HIS) with centralized patient profiles ensures seamless service handoffs and eliminates duplication. These centralized patient profiles could also be stored in a central database and shared across hospitals, allowing patients to choose their preferred hospital more easily than having only a single option.

3.4 Outdating Calling Systems

Some hospitals, particularly rural or public hospitals, still use outdated call systems that rely solely on voice announcements to summon patients to consultation rooms. Using technology, such as IoT, for digital queuing will also eliminate the need for outdated calling systems that rely on verbal or manual announcements. As hospitals are usually noisy, this can also minimize miscommunication and confusion among patients, especially for elderly patients and those with hearing issues. By eliminating these voice-only systems and replacing them with integrated visual and audio display screens, we can significantly improve clarity and accessibility for patients.

4. Reduce

To reduce is to identify areas where the current hospital system is over-engineered or uses excessive resources without providing adequate value. By examining these elements and reducing them, hospitals can further enhance operational efficiency and reduce cost burdens. Digital transformation and strategic improvements are justified by their ability to reduce staff reliance on routine guidance, paper-based forms and documentation, and variability in waiting times.

4.1 Staff Dependency for Routine Guidance

Most hospitals are large and operate at high patient volume daily. Thus, patients must rely on frontline staff, such as clerks, receptionists, or nurses, for guidance on navigating the hospital and addressing procedural queries. Some of these questions include where the registration counter is located, where the specific department is located or even updates on their appointments. On a typical day, this might not pose a significant problem. However, during peak hours, this reliance on hospital staff may divert them from their tasks, potentially leading to bottlenecks. One way hospitals can automate these interactions and reduce patients' dependence on staff is by using digital applications, such as touch-screen kiosks that display interactive hospital maps, similar to those in shopping malls, and mobile applications that

provide real-time information. According to Chao et al. (2025), implementing a mobile healthcare system can significantly improve patient care through real-time communication. In addition, the implementation of technology in the healthcare industry has been shown to reduce the burden on nursing staff and decrease the error rate among healthcare personnel.

4.2 Paper-Based Forms and Documentation

Although digitization trends are gaining popularity, most hospitals continue to use paper forms for day-to-day processes, such as patient registration, consent forms, billing information, and feedback collection. Physical forms are time-consuming, error-prone, and easy to lose or copy. They also lengthen service processing, particularly when forms must be physically moved from one department to another or scanned into systems afterward. By reducing reliance on paper forms and documentation and adopting a more digitized system, operations can be significantly improved and streamlined. This has also been demonstrated in a case study by Laurenza et al. (2018), which shows that digitizing healthcare business processes significantly improves response times, efficiency, and service quality for patients and medical staff. In addition, reducing the use of paper forms can reduce the risk of lost medical records or damage due to unexpected circumstances, as most digital records are kept in an off-site data center with multiple backups in the event of data loss.

4.3 Waiting Time Variability

Another area that can be improved through reduction is the high variability in waiting times across departments and services. Most hospital queuing systems cannot monitor patient numbers in real time. As mentioned previously, average hospital waiting times can vary from 20 minutes to nearly 1.5 hours. This indicates an inefficient distribution of cases within the hospital, with some specialists overburdened while others are underutilized. To efficiently reduce this variability, one method is to introduce a real-time queue management system. This system can actively monitor the number of cases assigned to each specialist and dynamically assign underutilized specialists to additional cases. In this manner, not only will the patient wait times be significantly reduced, but the workload on healthcare staff will also be distributed fairly, thereby indirectly reducing their work stress and increasing their productivity.

5. Raise

To raise is to identify and improve elements of the hospital that bring value to patients but are currently underemphasized. By identifying and elevating these aspects, hospitals can enhance their services and improve patient outcomes and satisfaction. The strategy emphasizes increased transparency into patient waiting times and real-time communication, along with comfort and convenience for patients through improved waiting areas, digital displays, SMS or app notifications, and e-prescribing and integration for the medicine collection process.

5.1 Transparency on Patient Waiting Time and Real-Time Communication

In the healthcare industry, the factors that need to be raised well above the industry standard are transparency in patient waiting times and real-time communication. In most government

hospitals, there is a lack of information on wait times or queue progression because the queuing method is a number system. Currently, patients must physically arrive at the hospital before opening hours to queue to take a number. Patients take a physical ticket with a number and wait for their number to be served. A digital display will be placed to show the “now serving” number. Even for follow-up appointments, patients still typically need to physically check in at a counter with their appointment card to obtain the number. This numbering system does not provide patients with real-time queue progress and often lacks visibility into their waiting times. This leads to frustration and anxiety, especially for elderly senior citizens and parents with babies. To address this issue, the proposed initiative is to install large digital display screens in the waiting area that display real-time queue numbers and estimated wait times for different departments. This initiative increases transparency into patient waiting times, reduces anxiety by providing clear information, and increases overall satisfaction, aligning with the study by Thompson et al. (2016). This also indirectly improves operational efficiency by reducing repetitive questions to staff about waiting times, allowing staff to focus on other important clinical tasks. The next initiative is personalized SMS/app notifications. A system can be developed to send patients SMS updates or in-app notifications about their current queue status and estimated wait time. Proactive communication via SMS alerts or app notifications reduces perceived waiting time and increases trust (Bielen et al., 2007). This provides patients with the “wait anywhere” capability, a completely new value proposition. This “wait anywhere” capability allows patients to use their waiting time to work, study or run errands. Even if the actual wait time remains the same, being able to engage in other activities while waiting for their turns makes the wait feel significantly shorter and less burdensome.

5.2 Comfort and Convenience of the Patients

The next factor that requires a raise is patient comfort and convenience. The current waiting areas in hospitals are often functional but not conducive to patients' comfort and well-being, especially during extended waits. During peak periods, especially when wait times are longer and patient volumes are high, waiting areas become very crowded. This leads to a lack of personal space, increased noise levels, and a higher risk of germ spread and transmission, which is very concerning in the healthcare environment. This overcrowded environment is a considerable risk, especially for the elderly and babies, given the increase in Influenza and HFMD. One intervention to enhance patient comfort and convenience is to revamp the waiting area with comfortable seating, quiet zones, charging stations for devices, and Wi-Fi access. To enhance comfort, providing access to filtered water, clean restrooms, or vending machines for light refreshments will create a pleasant environment for the patient. Other than that, establishing a kids' zone with interactive games, playing mats, and books can keep children engaged and busy. This intervention enables patients to work, relax or entertain themselves while waiting, making the wait feel shorter. At the same time, separating the quiet zone and kids zone reduces stress and anxiety for sensitive patients, keeps children occupied and calmer, and helps keep the area clean.

5.3 Current Medicine Collection Process

Besides that, the current medication collection process is a significant bottleneck and a source of frustration for patients, and it needs improvement. In the current process, patients must queue multiple times: first for registration, then for doctor consultation, followed by tests, and finally for the prescription to be sent, and then at the pharmacy, which leads to patient frustration. One way to improve the process is to implement e-prescribing and integration. E-prescribing is a process in which healthcare professionals, such as doctors or nurse practitioners, use a secure electronic system to create, transmit, and store patient prescription information. The doctor's prescription is sent directly to the hospital's pharmacy system. With this e-prescription, patients no longer need to queue to drop physical prescriptions (in the form of slips) at the pharmacy counter. This can speed up the collection of medicines. Once the pharmacy receives the prescription, it can immediately prepare the necessary medicines, rather than waiting for patients to send it manually. A study by Sadi et al. (2019) demonstrates that this e-prescription initiative reduces waiting time from 21.5 min to 4 min. However, for follow-ups or scheduled appointments, allowing doctors to send prescriptions in advance can speed up the process, enabling pharmacies to begin preparation before the patient even finishes their consultation. Besides that, hospitals can also segregate counters into "New Prescriptions," "Repeat Prescriptions," "Discharge Medications," and "Express Pick-up" (for pre-prepared or simple repeats). This helps separate counters for patients with typical or pre-packed medications, speeding up straightforward cases and easing pressure on the central queue. For example, suppose the patient is prescribed only one medication. In that case, they can use the "Express Pick-up" because preparing and checking just one medicine would not take much time, allowing pharmacists to get it ready faster. In addition, introducing Queue Management Systems can help manage crowds and prevent overcrowding at the pharmacy counter. In the QMS, people can be notified when their medication is ready and pick it up. This ensures patients wait more comfortably without worrying about not hearing their number or names being called. By establishing a Community Pharmacy Collection Hub for non-urgent or routine medications, patients can collect their medications at a community pharmacy closer to their home. This initiative not only offloads the hospital pharmacy (Yeo et al., 2021) but also enables patients to obtain their medications without visiting the hospital. This aligns with a study by Loh et al. (2017), which found that collecting medications without physically visiting the pharmacy significantly reduces waiting time and enhances patient experience.

6. Create

In the modern, patient-focused healthcare setting, traditional hospital queuing systems often lack efficiency, transparency, and personalization. Not only must the current procedures be improved, but also completely new value components that rethink how patients interact with healthcare services must be developed to address these limitations. Real-time queue visibility, virtual pre-triage tools, mobile-enabled interfaces, and queuing platforms are just a few of the creative solutions hospitals are using to transform the queuing process from a frustrating experience into one that is patient-focused, accessible, and productive. These solutions not only improve operational efficiency but also significantly increase patient satisfaction and

trust.

6.1 AI-Based Queue Time Prediction Engine

The AI-based queue time prediction engine is an innovative system that leverages the latest technological intelligence to predict each patient's waiting time at the hospital. This system uses real-time data and historical patterns, which are analyzed to provide an accurate outcome. At this point, most of the hospitals are still practicing the conventional method, which is the manual ticketing system whereby the patients register themselves at the registration counter and receive a queue number, and this requires the patients themselves to keep track of the current running numbers and force them to wait at the designated areas where the display screens are available. Moreover, the conventional method does not provide a personalized estimated time. If a patient asks how long they should wait to meet the doctor, the assistant nurses reply, "Please wait for your number," or generally, "5 patients ahead of you." Hence, there is no proper information on the actual waiting time or whether there are any delays. This AI-based system will display real-time information, such as personalized estimated wait times for users' turns. While waiting, they could move freely and easily, heading to the cafe for breakfast or sitting in any convenient area, as the system would remind them of their status.

This engine first collects data from several dedicated hospital systems and then integrates them. Data from other systems, such as the patient registration system, doctor scheduling system, and electronic medical records, will be collected. Then, the engine will use machine learning algorithms to estimate how long a patient will wait. This algorithm is based on several data points, such as the type of patient's visit (regular consultation or emergency), the day and time, the number of patients ahead of them, and the consultation duration of current and previous doctors. Each of these estimations will be personalized for the users. The predictions can then be displayed in a few mediums, such as mobile apps, self-service kiosks, and digital screens in all waiting areas, providing estimated durations for different types of queues. This engine improves over time through continuous learning, comparing predicted and actual waiting times, and amending its predictions based on users' feedback, peak-hour visiting patterns, and doctors' exact consultation times. A study by Mishra et al. (2025) found that reducing waiting-time uncertainty could significantly enhance the patient experience through machine learning (ML)-based predictive models.

The existence of this AI-based queue prediction engine offers several operational benefits for visitors and medical staff. Patients tend to be more satisfied with this feature than with the conventional method, as seeing the estimated waiting time and having lower expectations reduces their anxiety and improves their patience. Research by Kumari et al. (2024) indicates that patients' experiences and anxiety levels during hospital stays decrease when real-time wait-time estimation using predictive analytics provides precise information about anticipated wait times. They are also well informed about their waiting hours and do not have to ask the staff there repeatedly. Moreover, patients can manage their time well once they arrive at hospitals, where they can plan their break time or light refreshments without fear of missing their turn in the queue. As for the doctors and medical staff, they will be able to allocate

resources efficiently. This will help their team avoid bottlenecks and distribute staff equally across hospitals based on volume.

6.2 Multilingual Virtual Assistant

Communication has been the most important aspect when it comes to developing interaction between people and delivering accurate and precise messages to avoid any

misunderstanding and wrong interpretation. In hospital queuing systems, communication plays a pivotal role, serving as a bridge to address gaps in message delivery. Therefore, a multilingual virtual assistant can be created to enhance hospital queueing systems. It is a voice- and text-enabled AI system that helps guide patients through hospital procedures in a few languages. Sezgin (2024) reported that virtual assistants, such as voice assistants, chatbots, and dialogue-based interactive applications, are widely used for remote monitoring and health care communication. This system includes hospital procedures such as registration, triage indication, route finding, appointment status, and queue information, and provides human-like interaction through natural language processing. This is a significant added value for hospitals, as they are venues where people of various ethnicities and spoken languages often visit. This assistant will be invaluable for senior citizens, enabling them to communicate in their native language, as not all are proficient in the national or dominant language.

This multilingual virtual assistant could easily replace the current practices being applied in hospitals. Most hospital systems or signboards are only available in single or dual languages. This does not provide real-time assistance for those unfamiliar with both available languages, especially foreigners visiting hospitals for consultation and medication. Most of the time, patients ask receptionists at the front counter for help with questions such as directions, registration procedures, and service information. This action sometimes causes long queues, putting staff in stress mode. The current system in hospitals has limited accessibility, where senior citizens with language problems, as well as those with visual and hearing challenges, often struggle to obtain proper hospitality.

This virtual assistant allows patients to walk directly to the nearest kiosks in the hospital, speak or type in their preferred language, such as Malay, English, Mandarin, or Tamil and then continue to enjoy the features. Besides, hospital mobile apps or websites will have additional features, such as a designed chatbot or voice assistant that interacts with patients like a human and guides them remotely based on their enquiries and needs for the day. The primary function of this virtual assistant will be to assist in multiple languages with registration, help fill out digital forms, and provide document reminders to patients to avoid delays in consultations or appointments. It also provides queues and appointment guidance to avoid frequent enquiries about waiting times and patient dissatisfaction. The system's added feature will include a navigator that provides directions to dedicated locations to avoid congestion in certain walking areas of the hospital, and a frequently asked questions segment, where the system will respond to patients' basic symptom-related enquiries. This initiative not only benefits patients but also enhances the hospital's reputation as an innovative, accessible, and patient-focused institution, especially among international patients.

6.3 Queue Access to Family and Guardian

Understandably, not all patients visiting hospitals can come alone and complete registration procedures, as they need someone to guide them throughout their visit. This situation is highly referred to several groups of people, such as senior citizens, children, infants and patients with disabilities or severe illnesses. Hence, features like family or guardian access allow patients to pass their queuing information to a trusted individual, such as a family member or caretaker. Details like the queue number, estimated wait time, and any appointment updates could also be visible to the second individual through channels like a mobile application or text message (SMS). This feature allows the family member or caretaker to manage the patient's hospital visits, both in person and remotely.

The current practice is unlike the queue access feature. This is because most hospitals still send notifications only to patients via phone calls, email, or SMS. The queuing number requested by patients is also tied to their credentials, such as their phone number or physical tickets. Patients who are unable to complete these processes on their own need someone physically present to track the progress of their visit that day. Although the patient is supported by a guardian during the visit, the guardian had to leave the patient for a moment to enquire about the waiting time and procedures at the front counter, making it difficult for the guardian to handle both the physical procedures and the patients who need constant support. Similarly, suppose the family member is busy handling payment, buying food, or parking. In that case, they have a higher risk of missing the turn and are afraid to restart the queuing process.

Queue access begins at registration, where the patient can add a family member or guardian as the emergency contact and notification recipient. This can be done through mobile apps that provide details such as the individual's phone number, ID details, and their relationship with the patient for addressing purposes. As this process is done, the system links both registered users. It allows real-time updates, such as the queue number and estimated waiting time, notifications when the patient's next turn to visit the doctor is, and notifications of any delays while waiting for the patient's turn. These can also be monitored remotely, far from the waiting area or outside the hospital, allowing patients and their guardians to plan their journey to their consultation. Additional features can be added to this system, such as live location sharing to locate the patient within the hospital and one-tap support, allowing guardians to call staff for assistance or emergencies related to the patient if needed. This system delivers operational benefits, including improved patient safety, reduced hospital congestion, and increased patient satisfaction with their hospital experience.

7. Conclusion

In conclusion, applying Kim and Mauborgne's Four Actions Framework (ERRC) to improve the hospital's queuing system enables the transition from outdated, ineffective procedures to a patient-centered, intelligent, and organized service model. Hospitals can significantly enhance operational flow by eliminating outdated practices such as manual registration and static number systems, and by reducing over-dependence on frontline staff and paper-based workflows. At the same time, higher standards for patient comfort and transparency lay the

foundation for a caring, involved care experience. Above all, the development of cutting-edge solutions such as family queue access, multilingual virtual assistants, and AI-based queue-time prediction engines demonstrates a forward-thinking dedication to operational efficiency, inclusivity, and personalization. These improvements make the system viable by lowering hospital staff workloads and improving patient satisfaction. Changes to hospital queuing systems are now strategically necessary to meet the changing expectations of healthcare customers in the current era of modernization and technology, rather than just an operations enhancement. By recontextualizing Kim and Mauborgne's Four Actions Framework within healthcare operations management, this research moves beyond a mere catalog of technological solutions to offer a replicable, strategic model for systemic reform. It demonstrates how principles of value innovation, typically applied in corporate strategy, can be operationalized to resolve entrenched inefficiencies in public service delivery. Consequently, this study bridges the gap between strategic management theory and healthcare administration, providing future researchers with a robust analytical lens for evaluating patient-centric digital transformations.

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Authors contributions

Vikneswaran Ramasubramaniam, Padmaloshene Govindarajoo, and Balamuregen Balu were responsible for conducting the study and collecting information. Tan Owee Kowang drafted the manuscript, and Ong Choon Hee revised it. All authors read and approved the final manuscript.

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No additional data are available.

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