

OPTIMIZING PATIENT WAIT TIMES IN HEALTHCARE ORGANIZATIONS

Vinutha M, Venugopal, Sudeep Patil, Vinay G, Sumanth G S

Department of Artificial Intelligence and Machine Learning, Acharya Institute of Technology, Bengaluru

ABSTRACT

The healthcare industry faces significant challenges due to long patient waiting times, which causes stress and inactivity. Patient's long lines of symptoms can affect their mood. With real-time updates on long lines throughout the app, patients can make informed decisions about where to go, resulting in reduced unnecessary waiting times and increased overall patient satisfaction. This new approach not only improves the patient experience, but also improves the allocation of hospital resources, making the treatments patients need more efficient and responsive. The aim of the ongoing study is to examine the impact of queue management in intensive care waiting areas on patient satisfaction using an Android app. Current solution do not provide users with a central point where they can access data from multiple hospitals in real time, which limits their ability to make decisions. High choice according to current conditions. Emergency Department (ED) may come into play due to current technology issues. Waiting in line is an important and unavoidable part of daily life. However, you can do something valuable with the time you spend waiting in line. E-queue is dedicated to reinventing the experience by providing quality, comprehensive and cost-effective solutions. One way to solve this problem is to establish a management system that can track the people in the queue and provide instant information about the number of patients who have to wait for a doctor or how long a nurse should wait. Thus, patients can spend more time using E-Queue than waiting in line. Thanks to this application platform, many competitive issues can be taken into account when analysing the current system. E-Queue combines a smartphone application, a cloud-based database and online data sharing to provide important information to patients. It also gives the hospital the opportunity to manage waiting times and make the most of the patient's time.

KEYWORDS

queue management, emergency department, E-queue, hospital resource.

1. INTRODUCTION

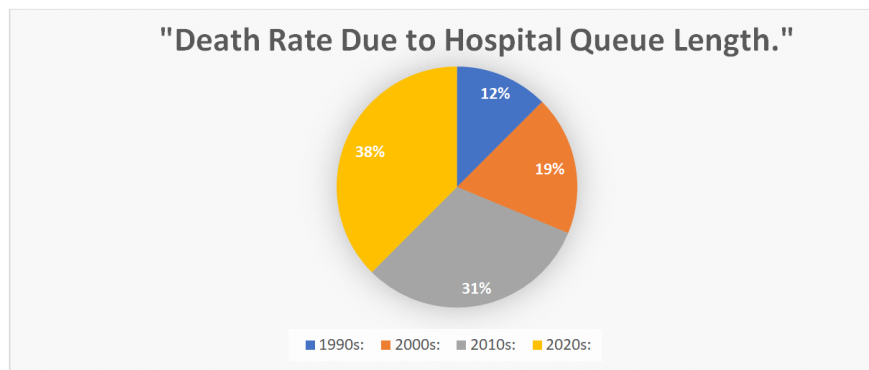
Nearly a century ago, research at Erlang laid the foundations for Danish queuing theory. Despite the many years that have passed since the early foundations of mathematics, the basic principles of mathematical competition have not changed much. As has been noted, this is partly because "sometimes the psychology of queuing is more important than the statistics of delays." When we have clear expectations about how long we will wait, our patience increases. It is also believed that time passes faster than we expect while playing games. Patients leaving in stress without receiving care, poor behaviour of patients and relatives, increased stress for staff and patients. This increasing concern has led to an increased interest in patient management. Hospital management information (HMIS) usually has many integrated systems that support clinical and non-clinical environments. These systems include service facilities such as patient registration desks, billing offices, test laboratory requests, sample or report counters, pharmacies and outpatient clinics, and patient waiting areas for appointments. The new system is important in tertiary healthcare facilities. With the rise of mobile devices and technology worldwide, the use

of intelligent and quality management systems (QMS) has become increasingly important to improve patient experience and optimize hospital performance measures to provide quality healthcare services. Although queuing systems are not widely developed, especially in developing countries like Nigeria, there have been some improvements in public services. Traditionally, people have to queue one by one and despite problems such as staff shortages, facilities shortages, and hospital's ability to operate in the public sector, people still have to wait in line. services they need. Over the years, developing countries have adopted various solutions including pre-selection of lines and ticket counting. Poor health outcomes and reduced satisfaction when resources do not meet needs. This often leads to a misunderstanding of the hospital experience. Nigeria has implemented strategies to effectively address and manage these challenges.

2. LITERATURE REVIEW

Queue management in hospitals is one of the major issues that has been affecting patient's satisfaction and making conditions worse for patients. Patient satisfaction must be higher priority than anything else. With the increasing demand for healthcare services, managing patient flow and reducing wait times have become essential goals for healthcare. Queueing theory has been applied to healthcare for several decades[1]. Early studies focused on optimizing patient scheduling and resource allocation in emergency departments (EDs). These studies laid the groundwork for more advanced approaches to queue management.

Recent research has explored various technological solutions to improve queue management[2] These include the adoption of digital tokens, online appointment booking systems, and real time monitoring of patient flow[2] Studies have shown that these technologies can significantly reduce wait times and improve patient satisfaction[2]. Researchers have employed various methodologies to analyze and optimize queue management systems[1]. These include simulation models, priority models, and statistical approaches[1]. For example, Monte Carlo simulation techniques have been used to analyze queueing patterns and optimize resource allocation[2]. Despite these advancements, there are still gaps in the research[3]. One area that requires further exploration is the integration of real-time data analytics with queue managements. There are few similar works in the past like A queue management system for patients is proposed by Hedau et al[4], in which notifications are given to the patient and an Android app interfaces with interfaces to schedule appointments with doctors. The OPD/doctor visiting area wait times are intended to be decreased by this technique. Their app also offers hospital navigation instructions. Android smartphones take the place of traditional token dispensers and token calling hardware at counters in Aizan et al "walk away "queue's management system[5] proposal for a service-based paradigm for token manufacturing and administration but the purpose of this research work is for the people's knowledge of queue length before they register or go to hospital for appointment. The advance knowledge can let them choose the hospital wisely without waiting for long queue. This approach will let people know the real time queue number and time they need to wait for particular hospital if they go there even before registering to hospital.



Img 1

3. DEFICIENCIES OF THE QUEUE MANAGEMENT INFORMATION SYSTEM

1.High Initial Outlay

The initial investment for a queue management system is often significant. This deters many companies from adopting such systems. The cost arises from various software and hardware components, with hardware generally being more expensive. Essential items like customer announcement systems, digital signage, interactive kiosks, ticket vending devices, and counter displays contribute to this higher cost. While these hardware components are durable, have a longer lifecycle, and often come with warranties, their initial expense is a key barrier.

2. Routine Maintenance

Due to the multitude of hardware components, regular maintenance is essential. In Dubai and across the UAE, it's common for businesses investing in queue management systems to enter into annual maintenance contracts. This recurring cost adds to the overall expense. Regular maintenance is especially critical for network-related issues, while interactive kiosks and ticket dispensers also require less frequent upkeep, including regular paper roll refills for ticket printing.

3. Hosting: Local vs. Cloud

The queue management software included in the system requires hosting on a server. Many businesses opt to host this software in their own data centers, which is costly and requires ongoing management and maintenance. If cloud-based solutions are chosen, businesses will still need annual maintenance services, further increasing the overall cost of the queue management solution. In both cases, businesses face additional expenses and continuous upkeep.

4. Cost-Prohibitive Software Integration

While the integration of queue management software with other business tools is typically affordable, some situations may demand costly modifications. If integration with an ERP or customer loyalty program is necessary for specific functionalities, businesses might need to invest in middleware or make changes on both ends, leading to increased expenses related to system integration.

5. Limited and Costly Hardware Upgrades

While software upgrades and customizations tend to be less expensive, hardware upgrades and modifications can be quite costly. The system has a limited capacity for hardware components. For instance, if a visitor needs to scan their Emirates ID to register but later requires facial recognition, modifying the existing interactive kiosk can be challenging and expensive. Often, businesses resort to purchasing a new kiosk model, rendering the old equipment obsolete and raising costs further. This complexity makes hardware modifications and upgrades difficult and expensive.

4. METHODS OF MANAGING OPD QUEUES IN INDIAN HEALTHCARE

In Indian healthcare organizations, several methods are employed to manage outpatient department (OPD) queues effectively. These include:

1. First In, First Out (FIFO): This method prioritizes patients based on their arrival time. Those who arrive first are seen first, with hospitals typically issuing tokens to manage this queue efficiently.
2. Priority Selection: Certain patients may be given priority based on specific circumstances, such as medical urgency or other critical factors. This allows for flexibility in the queue, enabling those in greater need to consult with the doctor sooner.
3. Token System: Under this system, patients receive a token number when they schedule an appointment. Unlike the FIFO method, this system is not solely based on arrival time but rather on pre-scheduled appointments, allowing patients to see doctors at their convenience.
4. Tatkal System: Designed for situations where doctors' schedules are fully booked, the Tatkal system allows patients to book last-minute appointments if slots become available due to cancellations. This method is particularly useful for those seeking urgent consultations with highly sought-after physicians.

These strategies aim to streamline patient flow and enhance service efficiency in OPDs across healthcare facilities in India.

5. Types of Patients Visiting Health Care Organizations

1. Regular Patients: These individuals require ongoing medical attention and routinely visit health care facilities to monitor their health status. They follow a systematic schedule for check-ups, typically due to chronic conditions or age-related issues. Regular patients prioritize consistent follow-up care to manage and maintain their overall health. This group often includes elderly patients or those needing long-term, close medical supervision.
2. Walk-in Patients: Walk-in patients seek medical care for minor or temporary ailments, usually without the need for an appointment. Their conditions are generally not urgent, and they visit healthcare providers at their convenience. These patients may not require regular follow-ups and are often treated for seasonal or temporary health concerns.
3. VIP Patients: Patients from high-profile backgrounds, such as celebrities, politicians, or religious leaders, fall into this category. Due to their public standing and potential security concerns, they may need special appointment arrangements outside of regular office hours to avoid public attention. These individuals are often given flexible scheduling to maintain privacy and avoid disruption.

4. Referral Patients: These are individuals referred to specialized hospitals or clinics for advanced investigations or treatments. Referral patients typically come from primary care centers or general practitioners who identify the need for more specialized medical expertise.

5. Critical Patients: Patients in critical condition require immediate medical attention due to life-threatening situations. They are treated as high-priority cases, and their care cannot be delayed. Immediate relief and stabilization are the primary focus for these patients.

6. Preferred Patients: These patients visit health care facilities based on personal connections or recommendations from doctors, family members, or acquaintances. Often, they have a preferred physician or receive special attention due to their relationships with medical professionals or the healthcare facility's management.

6. CHALLENGES

Healthcare organizations face numerous challenges in managing patient care, especially when it comes to ensuring quality in addressing patient wait times. Reducing wait times requires improvements in three critical areas: appointment scheduling systems, patient flow management, and the organization's capacity to handle patient load. A well-thought-out plan for distributing limited resources across the organization's various departments, without compromising efficiency in any one area, is essential. This is especially important for optimizing resource allocation in patient management, which remains the core focus of healthcare organizations. The challenge of how to best allocate scarce resources, particularly in relation to staffing (doctors, nurses, and other personnel), demands clear, precise solutions.

Minimizing patient wait times is crucial for two key reasons. First, excessive crowding during peak consultation hours can hinder the organization's overall operations. Employees responsible for answering queries, guiding patients to the correct medical procedures, and providing instructions can become overwhelmed if there are too many patients at once. Additionally, unexpected absences of doctors due to unforeseen circumstances can further complicate matters. Effective allocation of infrastructure, such as examination rooms and sanitation facilities, is only possible when patient volumes remain within manageable limits. These limits are relative to the organization's size, with larger organizations being better equipped to handle higher patient volumes compared to smaller ones.

Determining the average consultation time for doctors is a complex task, as it varies depending on the type of healthcare provider (physicians, surgeons, etc.) and the medical condition of each patient. Different medical specialties—such as ophthalmology, psychiatry, orthopedics, and gynecology—also require varying amounts of consultation time. As a result, estimating the total time a patient will spend at a clinic is challenging.

In response to these challenges, healthcare organizations need to implement measures that optimize resource allocation, improve patient flow, and reduce wait times, while maintaining quality care across all departments.

7. FACILITIES

Facilities Provided by Health Care Organizations to Minimize Patient Stress During Waiting Periods

Appointment scheduling is generally divided into two main types:

1. Static scheduling: This approach involves making all appointment-related decisions before the clinic session begins, which is the most commonly used system in healthcare settings.
2. Dynamic scheduling: In this approach, appointment times are continuously adjusted throughout the day based on the system's current state. This method is particularly suitable for situations where patient arrivals can be dynamically managed, such as in hospital settings with already-admitted patients (Mardiah & Basri, 2013).

To alleviate patient stress during waiting periods, healthcare facilities can focus on enhancing the environment of the waiting areas. Comfortable, well-furnished spaces can contribute to a relaxing atmosphere. Ensuring regular cleaning and sanitization of these areas and restrooms is crucial. Providing reading materials that may comfort anxious or depressed patients is beneficial. Additionally, televisions in the waiting area can serve as a source of distraction, helping patients to pass the time more easily. Clear and informative signboards, especially ones that cater to illiterate patients, can also be helpful in reducing confusion and stress.

8. CONCLUSION

Effectively managing the outpatient department (OPD) queue is vital for the sustainability and success of healthcare organizations. Ensuring patients receive excellent services and maintaining their satisfaction is a core responsibility of healthcare administration. Quality assurance in healthcare relies heavily on management's ability to address patient waiting time. Reducing these delays requires improvements across three key areas: the appointment system, patient flow, and the organization's overall capacity.

REFERENCES

- [1] Elalouf, A., Wachtel, G. Queueing Problems in Emergency Departments: A Review of Practical Approaches and Research Methodologies. *Oper. Res. Forum* 3, 2 (2022). <https://doi.org/10.1007/s43069-021-00114-8>
- [2] Rema, V., Sikdar, K. Optimizing Patient Waiting Time in the Outpatient Department of a Multi-specialty Indian Hospital: The Role of Technology Adoption and Queue-Based Monte Carlo Simulation. *SN COMPUT. SCI.* 2, 200 (2021). <https://doi.org/10.1007/s42979-021-00595-8>
- [3] Ajibike, O. Iteboje, Yekini N. Asafe. A Systematic Review of Queue Management System: A Case of Prolonged Wait Times in Hospital Emergency Rooms. Volume-1, Issue-1, Jun-Jul -2019, *South Asian Res J Eng Tech*
- [4] K. Hedau, N. Dhakare, S. Bhongle, S. Hedau, V. Gadigone, and N. Titarmare, "Patient queue management system," 2018.
- [5] A. L. Aizan, A. Z. Mukhtar, K. A. A. Bashah, N. L. Ahmad, and M. K. A. M. Ali, "„walk-away „queue management system using MySQL and secure mobile application," *Journal of Electrical Power and Electronic Systems*, vol. 1, no. 1, 2019.
- [6] U. N. Bhat, "An Introduction to Queueing Theory", Birkhauser Boston, DOI:10.1007/978-0-8176-4725-4, ISBN: 978-0-8176-4724-7, [Online] Available at: <https://link.springer.com/content/pdf/bfm%3A978-0-8176-4725-4%2F1>, [Accessed 12 Mar. 2016], 2008.
- [7] A. Stone, "Why Waiting in Line Is Torture", [online] *Nytimes.com*, Available at <http://www.nytimes.com/2012/08/19/opinion/sunday/why-waiting-in-line-is-torture.html>. [Accessed 12 Mar. 2016], 2012.
- [8] D. Maister, "The Psychology of Waiting Lines", [online] *Davidmaister.com*, Available at: <http://davidmaister.com/articles/the-psychology-of-waiting-lines/>, [Accessed 12 Mar. 2016], 1985.
- [9] S. Soman, S. Rai, P. Ranjan, A. S. Cheema, P. K. Srivastava, "Mobile-Augmented Smart Queue Management
- [10] System for Hospitals", 2020 IEEE 33rd International Symposium on Computer-Based Medical Systems (CBMS), pp. 421-426, 2020.

- [11] R. Sahney, "Smart opd framework–new era in the digital healthcare initiative of sir ganga ram hospital," *Current Medicine Research and Practice*, vol. 6, no. 5, pp. 204–207, 2016.
- [12] C. C. Batbagon, O. B. Jayme Jr, and J. P. Pradilla, "I-queue: A centralized queue management system," 1 Semester Of 2018, p. 24, 2018.
- [13] R. Arun and P. Priyesh, "Smart queue management system using GSM technology," *Advanced in Electronic and Electric Engineering*, vol. 3, no. 8, pp. 941–950, 2013.
- [14] M. Ngorsed and P. Suesaowaluk, "Hospital service queue management system with wireless approach," in *Frontier Computing*. Springer, 2016, pp. 627–637.
- [15] M. Ghazal, R. Hamouda, and S. Ali, "An IoT smart queue management system with real-time queue tracking," in *2015 Fifth International Conference on e-Learning (econf)*. IEEE, 2015, pp. 257–262.