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Review Article

The Impact of Hospital Queue Management Systems

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Abstract
Hospital patients' experiences have an impact on their contentment. The current study set out to determine how using a queue management system might impact patient satisfaction in emergency hospital waiting areas. Process engineering or simple queue management techniques like demand control, queue prioritization, or staffing the emergency department are frequently used to address the problem of overcrowding in an emergency department (ED). In daily life, waiting in lines is inevitable and cannot be avoided. The time lost in lines can be converted into useful and pleasurable time, though. E-queue seeks to reinvent the experience of standing in line by offering a practical, all-encompassing, and pleasurable alternative. Designing a comprehensive queuing management system that will be used to register people in lineups and offer real-time information on the waiting time for patients to see their doctors or nurses is one way to address this issue. Therefore, e-Queue enables patients to make better use of the time they would otherwise squander waiting in lines. Numerous queuing factors were taken into account, and research was done on existing queuing systems. To give patients pertinent queuing information, E-Queue combines the usage of a smartphone application, a cloud-based database, and information sharing over the internet. In addition, it offers hospitals the chance to effectively manage their line-ups.

Keywords: Queue, Hospitals, Patients, Emergency Department, Management.

INTRODUCTION

Due to the research of Erlang, queueing theory began in Denmark around 100 years ago. However, despite the lengthy period of time since the first mathematical formulation, queueing mathematics has not altered significantly [1]. Since "frequently the psychology of queueing is more important than the statistics of the delay itself," queueing psychology has taken precedence [2]. In addition to the length of the wait, queues are a frustrating everyday experience because of how one feels throughout that time. For instance, research suggests that when we have a general idea of how long the wait will be, we are far more patient [3]. Furthermore, the time spent is actually regarded as passing more quickly than the time spent passively waiting [2]. Many people are becoming increasingly concerned about long wait times in hospital emergency rooms due to their numerous negative effects, including crowding, patients leaving out of frustration without receiving care, patients' and their relatives' irrational behavior, as well as stress on both staff and patients [17]. A hospital's clinical and non-clinical operations are often served by a series of unified modules that make up hospital management information systems (HMIS). Patient registration counters, bill payment counters, laboratory test requisitions, sample or report collection counters, pharmacy counters, as well as patient waiting areas for out-patient visits and appointments, are just a few examples of the service areas that make up the interfaces for transaction management in HMIS. In these settings, managing high patient loads is difficult, and effective methods are required, particularly in tertiary care centers. A smart and efficient queue management system (QMS) is now essential for improving patient experience and optimizing performance metrics for hospitals for efficient healthcare service delivery

as a result of the growing accessibility of mobile devices and ubiquitous technologies [4]. Although many aspects of public service, especially in a growing nation like Nigeria, have seen technological and efficiency advancements, queuing has historically remained constant. In the past, one had to wait in line while moving forward one at a time. Although numerous solutions, including queue priority and numbered tickets, have been implemented in developed nations over the years, the reality is that people must wait in line for as long as they require the services, regardless of whether the issue is a lack of staff or facilities or a hospital's capacity that is insufficient for the population it serves. Long lines are a needless and undesirable strain for both patients and medical workers, especially in an emergency room. Patients receive lower-quality care, suffer from worse health outcomes, and express lower levels of satisfaction when the availability of resources cannot keep up with the demand for services. They are linked to a poor perception of the hospital stay. In my home nation of Nigeria, a mechanism has been put in place to deal with and resolve these problems.

RELATED WORKS

In order to shorten wait times at the OPD/doctor visiting area, Hedau et al. [5] present the design and construction of a queue management system for patients where an Android app offers interfaces to schedule appointments with doctors and notifications are given to the patient. Additionally, their app offers hospital navigation instructions. Aizan et al. [6] offer a "walk-away" queue management system in which Android devices take the place of traditional token dispensers and token calling hardware at counters and a service-based paradigm is presented for the creation and management of tokens. As a result of collecting the user's mobile number at the time of token generation, notifications are sent to users at a predetermined time limit prior to the anticipated calling of the token. The advantages and use cases of a smart queue management system at a well-known hospital in Delhi, India, are listed by Sahney [7]. Batbagon et al[8] .'s I Queue system uses a web-based QMS application augmented by Android apps, along with supplemental services like report production and data analytics for optimizing queue generation at service locations, to achieve comparable goals and functionality. A GSM-based queue management system that merges a PC-based system with a microcontroller has been presented by Arun et al. [9]. Internet of Things [10, 11] and wireless technology-based strategies have also been put forth. The advantages of using a queue management system in improving hospital performance metrics such patient length of stay [12], waiting time for in-patient surgeries [13], triaging in emergency departments [14, 15], and decision support [16] have also been described in literature. This study describes an operational hospital management information system that can be simply equipped with a mobile-augmented smart queue management system (HMIS). It uses clever algorithms for token generation and allocation and offers a variety of interfaces for token generation and consumption on mobile devices integrated with hospital service counters. A single patient token can be used for efficient queue management across numerous hospital service areas, which enhance the patient experience and aids in tracking and optimizing important performance metrics for the hospital administration. We outline the system's architectural and functional design along with an example of how it was used to monitor the productivity of service counter employees during a pilot project [4]. The hospital is in conformity with Electronic Health Record (EHR) standards and has a functioning HMIS [18, 19] with several modules [20, 21, 22, 23]. In order to organize queuing systems, this research aims to create an automated queue management system that can assess the queue's status and decide which client to service first. This study focuses primarily on the bank's queuing system, various methods to queuing algorithms that banks employ to service customers, and the typical wait time. By utilizing two distinct queue control systems that have evolved, this queuing architecture model can transition between various scheduling algorithms based on the testing result, which is the average waiting time. The Intel Galileo Microcontroller, which is software compatible with the Arduino software development environment, regulates a number of processes. In order to assess the systems' performance, many testing scenarios have been used [24]. The current study's goal was to determine how using a queue management system in emergency care waiting areas affected patient satisfaction [25]. A comprehensive framework for managing queues dynamically from both the supply and demand perspectives is provided by this work. To be more precise, we present dynamic resource adjustment policies and intelligent dynamic patient prioritizing algorithms to control supply and demand. Using our paradigm, decision-makers can choose supply- and demand-side tactics to meet the demands of their ED. Through simulation, we can demonstrate that such a framework reduces patients' length of stay in the ED without limiting demand [26]. A centralized queue control system that can be applied to many hospital departments was developed in this study. The system makes use of Little's Law, the Haversine Model, the Poisson distribution, and the Kendall Notation. It is a web-based system that was created to function on the Internet since it concentrates on outpatients and takes into account the fact that different departments in the majority of non-tertiary hospitals may be located in various structures or locations. The system was developed using Microsoft SQL and ASP.NET. Data gathered from non-tertiary hospitals in Benue State, Nigeria, was used to evaluate it. As a result, there were fewer patients in the hospital at any given moment, and there was some difference between some patients' actual arrival times and their estimated arrival times. The technique avoids crowds, improves hospital organization, and saves time for the patients. At the same time, there is also a major reduction in the burden on the hospital infrastructure. Both patients and medical staff benefit from enhanced service delivery and a safer atmosphere [27]. The purpose of this study is to create a queue assessment model to assess the flow of walk-in outpatients in a busy public hospital in a developing economy in the absence of appointment systems and to build a dynamic framework devoted to the practical application of the proposed model for continuous monitoring of the queue system [28]. The nurse caller device is used as a special communication device between the patients and the

doctor or nurse within the hospital area as a means of speeding the doctor or nurse's time response in providing immediate care to the patients. The use of the wireless-based nurse caller device makes communication easier and neater between the two parties. The Bluetooth module MH-10 is connected to the microcontroller ATMega8 as the sender and receiver. The information is processed using a microcontroller ATMega8 that produces characters on the LCD, turns on the LED, and activates the buzzer to call the doctor or nurse [29].

THE VARIOUS TYPES OF QUEUE

1. Structured queues: People stand in a predictable stance, and they are organized. The most frequent locations for these lines to form are at grocery store checkouts and airport security.
2. Unstructured queues: People stand in various angles and positions, and they are typically unpredictable.
3. Mobile queue: People use their mobile devices to queue up for services by making appointments online and arriving at the service facility just when they are scheduled to be served.
4. Kiosk-based queues: Customers fill out their contact information and the reason for their visit at this self-service kiosk. In banking and medical facilities, these lines are typical.

THE VARIOUS FORMS OF LINE DISCIPLINE

1. Priority selection — Customers are served here based on how quickly they require your services. For instance, in a hospital setting, the care of patients who have suffered serious injuries is given first.
2. Service in random order (SIRO) — This order of service involves a random selection of customers.
3. Last in, first-out (LIFO) — The last-arrived consumers at your establishment receive service first.
4. First in, first-out (FIFO) — First-come, first-served policy is followed when serving customers.

THE IMPACT OF HOSPITAL QUEUE MANAGEMENT SYSTEMS

The reality is that managing long, never-ending lines may be stressful, and this is especially true when several services are available. Queue management is useful in this situation. Virtual lines can be used in medical facilities to:

1. Easily guide clients through the touch points. Without physically standing in line for each of these services, a consumer can go quickly through the arrival process to registration, admitting, imaging, blood work, etc.
2. Access patient information including their basic details, medical history, blood pressure, gender, age, and the doctor they like to be treated should be made available to doctors, nurses, and staff. This improves operational efficiency by automating some of the labor-intensive operations.
3. Customers should be able to check their queue number and wait in line from anywhere. This might be done in the waiting room, the café, or even the comfort of their car, which would ultimately relieve congestion.
4. Inform them of their anticipated wait time, the number of individuals in front of them, and the time their doctor will be available [30].

CONCLUSION

Both the hospital management information system and the queue management system have been extensively studied in this research. They have made contributions to hospitals as well as to business sectors. Their different forms and effects have also been covered.

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