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# IMPROVING PATIENT WAITING TIME AT A PURE WALK-IN CLINIC

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## ABSTRACT

Walk-in clinics have grown in popularity in the United States as a substitute for traditional medical care delivered in primary care clinics and emergency rooms. Walk-in clinics offer an affordable option for basic medical services when compared to a hospital emergency room or an urgent care clinic. This type of medical facility simplifies the health care process for many patients with non-life threatening conditions since no previous appointments are required to see a provider. However, the open access nature and lack of patient scheduling can lead to long wait times for patients or long periods of idle time for providers. In this paper, we derive a discrete event simulation model to study pure walk-in clinics where patients are served without appointments. A case study is discussed that considers a walk-in clinic located in central Texas. The computational study provides useful insights that are applicable to any walk-in health care facility.

## 1. INTRODUCTION

Traditional primary care clinics are led by physicians with ancillary support staff. These facilities are equipped to handle both acute and chronic medical conditions, and typically have limited hours and require advance appointment booking. In addition, physicians in primary care typically take responsibility and are a stable source of care for a large group of people over a long-term period, building a longitudinal relationship with each person over repeated office visits. In contrast, walk-in clinics are standalone physical clinics that do not require patient appointments. Walk-in clinics are outpatient medical units designed to provide acute treatment for low-risk conditions such as common coughs and colds but are generally not suited for ongoing monitoring or prevention of long-term complications (Cassel 2012; Ahmed 2010; Weinick 2010). The emphasis of walk-in care clinics is patient convenience at an affordable cost. Service is less expensive than visiting an emergency room or an urgent care clinic (Chen et al. 2015).

This research has come about as a result of the growing popularity of walk-in healthcare clinics in the United States. To the best of our knowledge, no other study has been published that considers the operation of pure walk-in clinics for primary care services. Most of the related literature has focused on the study of appointment based primary care clinics such as outpatient (Mocarzel et al. 2013; Cayirli and Gunes 2013; Sowle et al. 2014; Walker et al. 2015) and open access clinics (Kopach et al. 2007; LaGanga and Lawrence 2012; Robinson and Chen 2010).

The management and operation of walk-in clinics is difficult. Capacity planning is one of the major challenges because of the uncertainty in the patient demand. Since no appointments are provided to patients, two possible scenarios can result when planning the staff capacity for the day: 1) a patient might end up



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waiting long periods of time to see a provider and 2) providers experience long idle times. In this research paper, a discrete event simulation model is derived to assess and improve the performance of walk-in clinics. The goal of the computational study is to develop resource management policies that will increase patient satisfaction, lower patient waiting and cycle times, and improve work force utilization in walk-in clinics. The paper considers a case study for a pure walk-in clinic located in Central Texas.

The rest of the paper is organized as follows: Section 2 presents the discrete event simulation model developed for walk-in clinics. Section 3 discusses the experiments to be conducted using the model and Section 4 explains the computational results. The paper ends with some conclusions and discussion of findings in Section 5.

## 2. DISCRETE EVENT SIMULATION

In this paper, a systematic approach was taken to reduce patient wait time and improve customer satisfaction. First, to better understand the patient flow through the clinic, a process map was developed and time studies were conducted within the clinic. Time studies shed light on which areas of the process had the largest wait times. After developing a process map, a discrete event simulation was created to model the process within the clinic. Once the model was validated, a computational study was performed.

### 2.1 Description of the Walk-in Clinic

The walk-in clinic in this study has multiple issues related to patient service satisfaction. Based on patient surveys, this clinic has scored in the bottom 25% for patient overall satisfaction and in the bottom 5% for wait time satisfaction as compared with other similar facilities in their network of providers. The main problem experienced by the patients is high waiting times to finally see their provider. On average, patients wait about 40 minutes before they are called into an examination room, and have an average total visit time of about 1 hour and 20 minutes. The clinic has a total of four staff members serving patients every day. The staff group includes one front desk clerk, two medical assistants, and one provider. The clinic layout consists of one waiting room, one assessment room, and four examination rooms. Figure 1 depicts the clinic layout. The clinic operates on weekdays from 9:00AM to 7:00PM and on weekends from 10:00AM to 2:00PM.

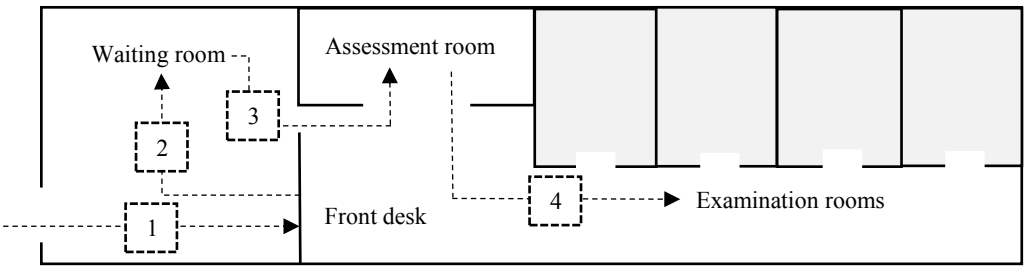


Figure 1: Walk-in clinic layout.

### 2.2 Model Abstraction

The abstraction of the model was performed by breaking the process down into phases and then evaluating the key inputs for each of the phases. As shown in Figure 1, the first phase identified was the patient check-in. In this phase, the patient speaks to the receptionist and provides him/her with the required information to begin the check-in process. In a second phase, the receptionist provides the patient with paperwork which the patient fills out in the patient waiting area. The patients must wait until they are called back by the medical assistant. In phase 3, the patient is called back by the medical assistant and moves to the assessment

room for the initial assessment. In this phase, the medical assistant takes the patient's height, weight and vitals. While collecting this information, the medical assistant simultaneously asks the patient questions about their medical history as well as the reason for their visit. After the patient's initial assessment has been completed, the patient is taken to the examination room to wait for the physician/hospitalist (phase 5). Once a physician is available, the examination and testing phase begins. In this phase, the physician examines the patient and determines additional tests, if any, required to provide the patient with a prognosis. If no tests are required, the patient receives a prognosis and care instructions and proceeds to checkout. If tests are required, the patient moves into the testing phase in which the medical assistant performs all required tests. Tests such as X-rays, blood tests and urinalysis are usually the most common ones performed in this clinic. Once tests are completed, the patient may be re-evaluated by the physician or proceed to checkout. If re-evaluation is required, the patient spends additional time in the examination room waiting for the physician and the prognosis and then can check out. A more detailed representation of the process flow is presented in Figure 2.

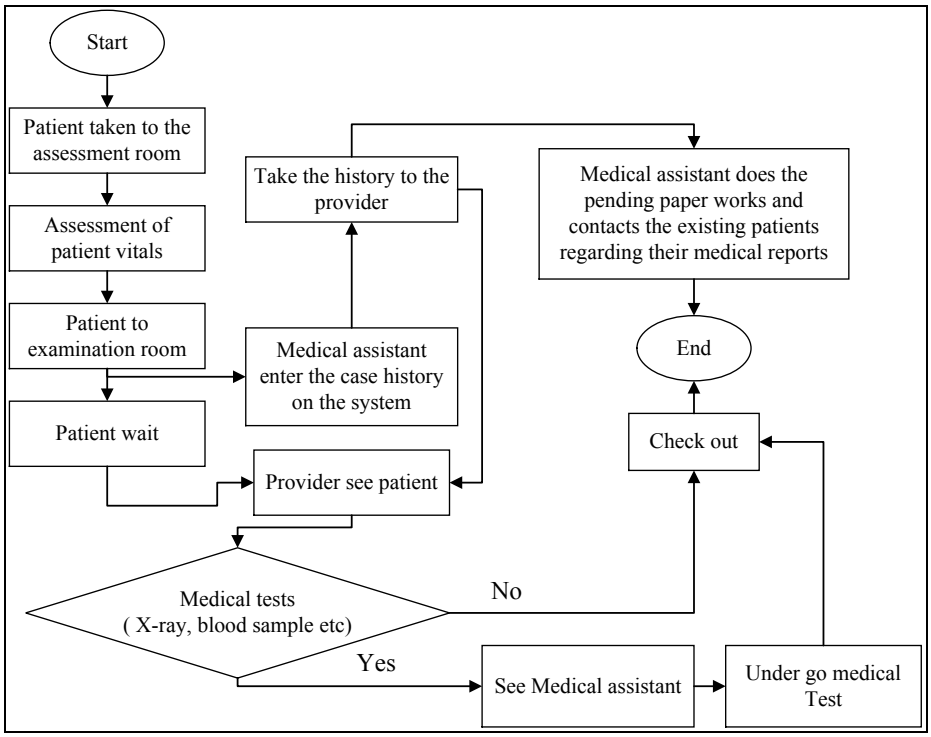


Figure 2: Patient sequence flow chart.

**Physician/Provider**

The physician behavior can be modeled by a three-step systematic process which involves receiving the patient information, examining the patient and inputting the results of the exam into the electronic system. The physician can receive the patient's file either electronically or physically. If the patients file is sent electronically, the physician will receive a notification on the clinic's patient data logging software. The file will contain the patients past pertinent medical history, the reason for their visit and the symptoms the patient is currently exhibiting. This is the most common way of delivering patient information to the physician because all patient data must be logged electronically., However, in special cases the medical

assistant will deliver the physical patient file to the physician. This is common only when there is a special case with the patient or special instructions for the provider.

After the provider examines the patient's file, the second step is examining the patient. In this step the physician will use the information from the patient's file, and will ask the patient additional questions to learn more about the patient's condition. The physician will provide the patient with an initial prognosis or recommend further testing. If testing is required, the physician will leave the examination room and alert the medical assistant what tests are required. Some test, such as X-rays, will return results quickly and will require the physician to wait until the test has been conducted to provide a final prognosis. If the test requires longer to return a result, such as blood tests, the physician will allow the patient to leave once the test has been conducted and provide a prognosis at a later date over the phone.

Regardless of whether a final prognosis is able to be rendered, the physician must return to their office to complete the third step of the patient treatment process, data entry. Once the provider has finished with a patient, he/she must enter all of the pertinent patient information into the electronic software before treating the next patient. The physician will systematically follow this process with every patient that arrives and is treated until the clinic closes.

**Medical Assistants**

As previously stated there are two medical assistants on staff while the clinic is open. The medial assistants' behavior can be modeled as a two-step process that is repeated for each patient. Similar to the physician, the medical assistants must follow a systematic approach to patient treatment but unlike the physician they may also be required to stop to conduct tests as needed.

The first step is the initial assessment of the patient. Once the patient has completed the required paperwork at the front desk. his/her file will be put into a wall tray by the receptionist giving a visual signal to the medical assistant that the patient is ready to be taken back into the examination room. Once the medical assistant is available, he/she will take the file and call back the patient provided that there is an open examination room. The first step once the patient has been called back is the initial assessment. In this step, the medical assistant will first take the patient height, weight and vitals. After this has been done the medical assistant will ask the patient about their medical history, their symptoms as well as reason for their visit. After the medical assistant collects this information, the patient can move into an open examination room to wait for the next step of the process. The second step for the medical assistant is to return to their computer workstation and input all of the patient's information into the electronic software. In special cases, the medical assistant may also talk to the physician about the patient's condition.

The medical assistant will continue to systematically perform the two steps described above until all the patients have been seen or all of the examination rooms have been filled, unless they are instructed by the physician to perform a special test. If a test is required, the medical assistant will go into the examination room with the patient. Some tests, such as blood and strep throat tests, may be able to be performed in the exam room, but tests such as X-rays and urinalysis will require the medical assistant to move the patient into a separate testing space until the test is finished. Once the test has been conducted and the patient is back in their examination room, the medical assistant will report their results back to the physician.

**Patients**

The patient treatment process can be marked by four active steps and two waiting steps. The first active step of the patient process is the check-in. In this step, the patient provides identification and insurance information to the receptionist who provides the patient with the required forms patients must fill out. Some patients may not have insurance. Once the patient has completed the preliminary paperwork, its first *waiting*

*step starts*. The patient must sit in the waiting area until there is both a room available and a medical assistant who can begin their initial assessment.

Once there is both a room and a medical assistant available, the patient enters the second active step of the process, the initial assessment. In this step the patient gets their height, weight and vitals recorded and tells the medical assistant the reason for their visit. Once this information has been gathered by the medical assistant, the patient is moved to an examination room and enters the *second waiting step* of the process. The patient must wait in the examination room until the provider has seen all patients who arrived previously.

Once there is a physician is available, the patient enters the third active step of the process, the exam by the physician. During this exam, the patient is either given a prognosis based on the current symptoms or is recommended for further testing. If no further testing is required, the patient enters the last step, checkout, returning to the receptionist's desk to finalize paperwork. A patient may obtain a note for their employer if one is needed. However, if testing is required the patient will undergo additional steps. The first step is a secondary wait for a medical assistant to become available to perform the tests. Once a medical assistant is available, the required tests are performed, and if no additional provider care is required, the patient may proceed to the checkout. If the physician would like to discuss test results with a patient, the patient must enter another waiting step until a provider becomes available. Once the provider is available, he/she may provide final care for the patient and discuss tests results. Once final care has been rendered, the patient can proceed to checkout.

### 2.3 Data

The data used in this project was collected at the clinic by the first two authors of this paper. A random sampling methodology was used to assure independence among the data collected. The data accounts for low and high demand period of times. The flow charts discussed in Section 2.2 aided in the data collection process by identifying those activities important for the operations of the walk-in clinic. A data collection form was developed using the insight gained developing the flow charts. Probability models were developed for each important activity occurring at the walk-in clinic using the data collected and the Arena Input Analyzer.

### 2.4 Model Implementation, Verification, and Validation

After analyzing the process flow of the clinic, a discrete event simulation model was derived. Figure 3 provides a snapshot of the model implementation using Rockwell Software Arena. The simulation model has six major components represented as sub-models. The six major components are: patient check-in, patient check-out, waiting room, assessment room, examination room, and X-ray room. Each simulation sub-model was created using a flowchart similar to the one discussed in Section 2.2.

A number of techniques were used to verify and validate the simulation model. The animation of the simulation model combined with dynamic statistics provided a general view of the system behavior. Verification was performed by closely examining whether the animation imitates the real system. Validation was done by comparing data obtained at the clinic with the simulated output data for some system performance measures. Table 1 displays the average of some of the performance measure values obtained from the simulation against the real clinic average values. The validation was performed for three different scenarios morning, evening, and weekends. The results obtained from the simulation, shown in Table 1, indicates that the model provides realistic predictions for the system behavior under various experimental scenarios. Data was collected over 20 days over the course of 7 weeks in three different time windows, weekday mornings, weekday afternoons, and weekends.

Table1: Simulation validation results.

| | | Patients served | | Cycle Time (average) | |
|---|---|---|---|---|---|
| | | Average | Std Dev | Average (mins) | Std Dev (mins) |
| Morning | Simulation | 16.13 | 3.30 | 68.69 | 25.97 |
| | CTMC | 16.33 | 4.94 | 59.96 | 26.20 |
| Evening | Simulation | 18.51 | 1.44 | 65.14 | 23.40 |
| | CTMC | 19.56 | 6.09 | 60.45 | 27.06 |
| Weekends | Simulation | 11.19 | 2.22 | 63.00 | 20.22 |
| | CTMC | 12.41 | 4.11 | 63.02 | 27.59 |

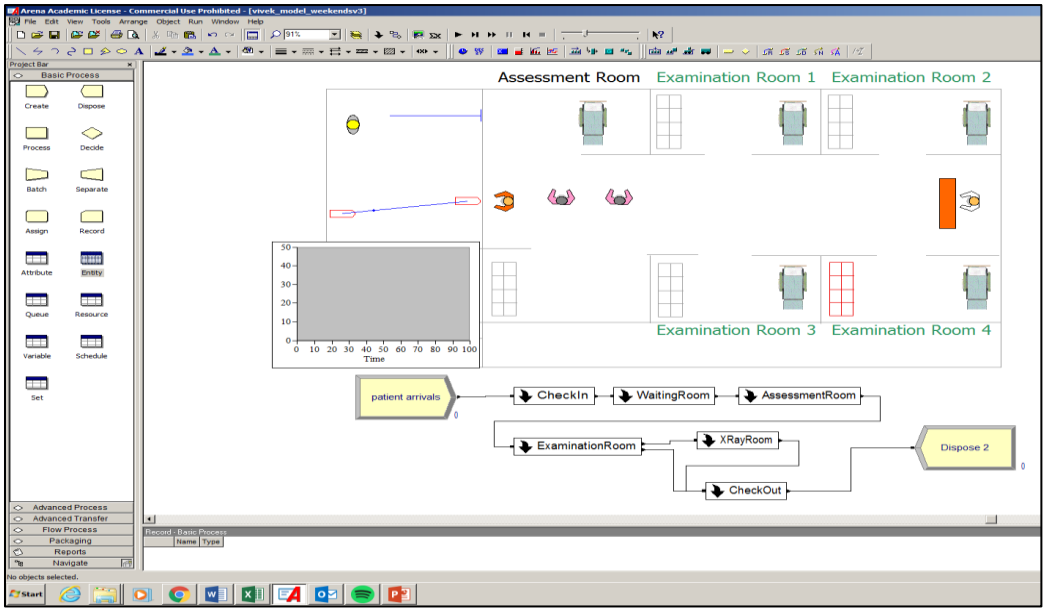


Figure 3: Discrete-event simulation model.

## 3. EXPERIMENTATION

As stated earlier, the goal of this research is to develop resource management policies that will increase patient satisfaction, lower patient waiting and cycle times, and improve work force utilization in walk-in clinics. After analyzing historical data and data collected from the time studies, four key factors were identified that impacted patient wait times. The key factors are: days of the week with the highest demand, patient demand peak times, providers service times, and staff capacity.

### 3.1 Data Analysis

The data analysis in terms of patient demand showed that Mondays, Tuesdays and Fridays were the days of the week when a higher number of patients will visit the clinic. Based on this finding, the team decided to analyze the data by time of day to identify demand peaks. The data analysis considered time periods of one hour. The results showed that during the morning (9:00AM to 12:00PM) a high number of patients is expected compared to the rest of the day. Figure 4 shows the expected number of patients per hour on weekdays. The data shows that about one third of all patients seen each day arrived within the first two

hours the clinic is open. After the first two hours, the demand reaches a steady state. However, as a result of the high quantity of patients arriving in the early hours, wait times remained high throughout the day. Therefore, more staff capacity is required during the first hours of operation to mitigate these high wait times.

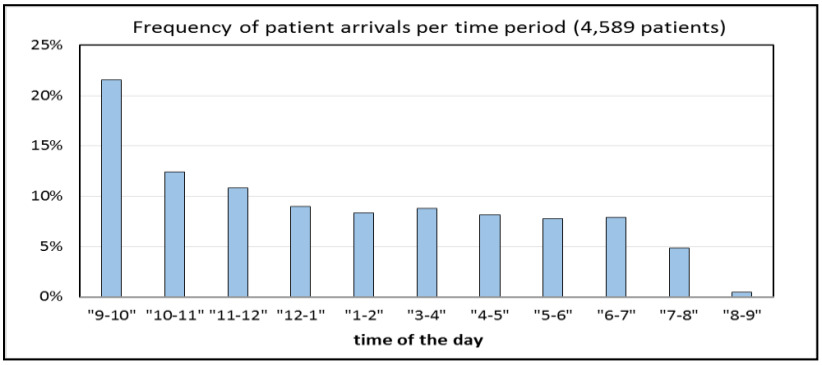


Figure 4: Patient demand per hour during weekdays operation

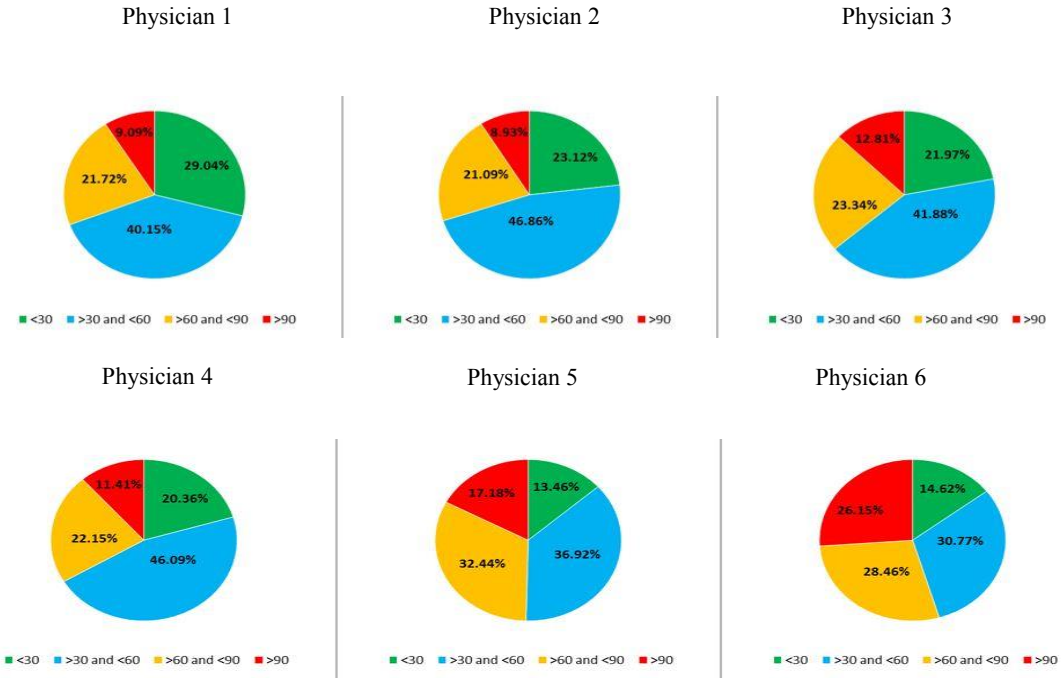


Figure 5: Service time ratios per provider.

Only one provider is staffed per day at the walk-in clinic. However, there are six providers but only one works each day. The data analysis included also a comparison of the average service times for each provider serving at the clinic. Figure 5 shows the service time ratios for each provider. The green color represents the percent of patients that were served in less than 30 minutes; the blue one the percent of patients that were served in 30 to 60 minutes, the yellow one the percent of patients that were served in 60 to 90 minutes, and the red one the percent of patients that took more than 90 minutes to be served. The results show that some providers, such as physicians 1 and 2, have over 70% of patients being treated in an hour or less.

Other physicians, like physicians 5 and 6, have less than half of their patients treated within an hour of arrival. It is important to find out the causes of these differences and why there is such a wind range of treatment times between the six physicians. If we can understand the cause of this gap, we can get the average patient treatment time closer to our goal.

### 3.2 Computational Study

The discrete-event simulation model was used to study the effect of changes in the staff capacity in walk-in clinic performance. Four performance measurements were considered, namely number of patients served, patient cycle time, waiting time type 1, and waiting time type 2. Waiting time type 1 considers the time the patient waits in the waiting room after the check-in process. Waiting time type 2 considers the waiting time for the patient in the examination room. Based on the initial assessment of the staff utilization, it was evident that the resource bottleneck was the provider. The physician utilization ranged from 90% to 95% in most of the experiments.

The computational study then focused on answering the following questions: 1) what is the impact of adding an extra provider in the performance of the walk-in clinic? and 2) does the clinic need to schedule the extra provider for the whole day or just for certain hours? Since the demand peaks per day occurs early in the morning (see Figure 4), the computational study considered the impact of an additional provider under three scenarios. In scenario 1, a second provider is available from 9:00AM to 10:00AM. In scenario 2, the second provider is available for two hours at the beginning of the day (9:00AM to 11:00AM). In scenario 3, the second provider is available for the first three hours of the day (9:00AM to 12:00PM). The results of the computational study are presented in Section 4.

## 4. RESULTS

Table 2 shows the results of the computational study for the three scenarios discussed in the previous section and how do they compare with the current system (benchmark). Based on our conversation with the clinic, their target waiting time type 1 was less than 30 minutes and their target patient cycle time was less than 60 minutes. The results show that adding one additional physician for the first two hours of the day satisfies the clinic benchmarks. In the current system, the average time each patient spends in the waiting room is nearly 40 minutes and the total cycle time is about 1 hour and 20 minutes. With one additional provider for the first two hours of the clinic operation the time spent in the waiting room drops from nearly 40 minutes to just over 20 minutes and the total cycle time becomes less than 1 hour. These numbers represent a 50% drop in patient wait times and just over a 25% drop in total cycle times.

**Table 2** Simulation study results

| Performance Measures | Benchmark | Simulation Scenario 1 | **Simulation Scenario 2** | Simulation Scenario 3 |
|---|---|---|---|---|
| Avg. waiting time type 1 (minutes) | 38.21 ± 5.2 | 32.23 ± 4.7 | **20.85 ± 3.3** | 20.05± 2.4 |
| Avg. waiting time type 2 (minutes) | 18.45 ± 3.1 | 18.20 ± 3.2 | **15.12 ± 2.5** | 12.13± 3.3 |
| Avg. number of patients served per day | 38.90 ± 7.6 | 40.20 ± 6.6 | **42.60 ± 6.1** | 42.90± 6.3 |
| Avg. number patient cycle time (minutes) | 81.07 ± 8.4 | 72.01 ± 5.1 | **59.70 ± 6.9** | 57.11± 7.1 |

## 5. CONCLUSION AND DISCUSSION

In this paper, a simulation model was developed in order to analyze the operation of walk-in clinics. Factors affecting these services were identified as days of the week with the highest demand, patient demand peak

times, providers service times, and staff capacity. Data analysis and a computational study were conducted and analyzed in order to evaluate how these factors and the factor interactions impact average waiting time type 1, waiting time type 2, patient cycle times, and the number of patient served at the clinic. Several suggestions and implications result from this simulation study:

- Discuss strategies for improvement among providers. Interview providers that are performing according to the clinic benchmark in terms of patient cycle times. Identify techniques that can help to better serve patients. Develop a training program to help underperforming providers to improve their average patient cycle times.
- Add an additional provider for the first two hours of the day, 9AM to 11AM. By implementing it, the system can normalize their operation sooner (take care of large number of patients waiting at the time of opening the clinic) and the performance of the clinic improves dramatically.
- Simulation modeling and analysis enables quantitative decision making for managing health care clinics.

With walk-in clinics growing in popularity in the United States, it is important for these health care providers to deliver quality health care quickly and effectively. Future research should focus on developing real time tools that will allow patients to be informed about the current status of walk-in clinics so they can make informed decisions on when to visit.

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