Simulation: Patient Accommodation of Vitas Health Center

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***Abstract*—The healthcare industry is heavily regulated due to the sensitive nature of the services the industry offers. Today, the provision of healthcare and the research that occurs within laboratory facilities is under a lot of constraints driven by regulations and the need to offer excellent patient care. Simulation modeling provides the perfect virtual environment to evaluate the effects of these constraints without risks. This Patient Accommodation of Vitas Health Center has 95% accuracy.**

Keywords—modeling, simulation, M&S, patient accommodation, Vitas Health Center, health center

I. Introduction

Modeling and Simulation (M&S) is the use of logical or physical representation of a given system to generate data and help decide decisions or produce predictions about the system. It is widely used in social and physical sciences, engineering, manufacturing and product development, among many other areas [1]. This paper will discuss the simulation of health care accommodation .

The Philippines has licensed emergency clinics and thoroughly prepared clinical suppliers. In many urban communities, medical services in the Philippines will be comparable, while possibly worse, than in your nation of origin.

Notwithstanding, the Philippines comprises in excess of 7,500 islands, and the nation has in excess of 20,000 miles of shore. There are numerous far off regions inside this geology. Far off areas might not have forward-thinking gear or satisfactory staffing levels, however the nature of wellbeing administrations will change by office and locale.

Barangay (town) health stations and neighborhood wellbeing focuses on meeting a significant part of the country's essential needs. Public medical clinics have once in a while battled with staffing levels, as care suppliers can frequently secure better-paying positions in the confidential area or by moving abroad. Because of the issues with staffing and the way that more patients look for care at these offices, treatment delays are normal at public clinics. The individuals who can manage the cost of it frequently go to private settings. [2].

II. Review of Related Literature

In this study, the authors present discrete-event simulation models of primary health centers' (PHCs') activities in the context of India. The PHC simulation models include four different patient types who are seeking medical attention: antenatal patients, inpatients, childbirth cases, and outpatients. For the creation of simulation models of PHC operations, a general modeling approach was used. This involved creating a simulation of an archetypal PHC that was later modified to represent two other PHC configurations, each with a different set of resources and services offered during PHC visits. A model that represents a benchmark configuration that complies with legally required operational guidelines and whose demand is estimated using disease burden data and whose service times are more in line with international estimates (higher than observed) was also created. At observed patient demand estimates, simulation results for the three observed configurations show negligible patient waiting times and low resource utilization values. However, simulation results for the benchmark configuration showed significantly higher resource utilization. For the benchmark case, simulation experiments were conducted to assess the impact of potential changes in operational patterns on lowering the utilisation of stressed resources. The analysis served as inspiration for the creation of straightforward analytical approximations of a server's typical server utilization in a queueing system that shared features with the PHC doctor/patient system [3].

The authors of this study stated that the average life expectancies have increased for the general population as a result of the quick advancements in medical technology, the economy, and average incomes. As a result, people in their mid-life are giving preventive healthcare and health screenings more thought. The developed model for the waiting areas of the examination stations was simulated in this study using FIFO and based on three major improvement strategies and six improvement plans. According to the findings, adding human resources to bottleneck stations was the most effective, followed by adjusting patient arrival times. The time of arrival was discovered to be important. Triaging causes patient waiting times to be shorter for those with higher acuity classes of patients, but longer for those with lower priority classes, who don't need immediate attention and aren't subject to FIFO and first-come-first-served scheduling (FCFS) [4].

A detailed simulation of patient care provided in healthcare units necessitates an examination of the process from multiple perspectives. The process involves numerous departments, various activity types, various actors playing specific roles, varying levels of expertise and knowledge, and so forth. The suggested method aims to expand on simulated solutions by combining in-depth data analysis for the detection of critical points with additional patient flow simulation. To find and evaluate diversity in patient flow, structure, classes of CPs, and others, a variety of data, text, and process mining techniques are used. Therefore, using this method makes it possible to perform simulations that are more accurate and to obtain macro-level characteristics like departmental load, queueing parameters, patient experiences, etc. An application of the suggested method to enhance the discrete-event simulation of ACS patient flow using the automatic identification and classification of CPs is shown in the study's demonstrated example [5].

According to Aziati and Hamdan (2018), the main issue that the public clinic faces is long lines at the outpatient counter. In comparison to the other units, the outpatient department at the public health clinic faced the biggest queuing issue. Patients have frequently expressed their dissatisfaction with this situation. As a result, the goal of this research is to identify the waiting arrival time and service time of patients at the outpatient counter, as well as to model a suited queuing system using simulation. To develop an appropriate model, this study used descriptive analytical and simulation methods. The outpatient counter's patient arrival and service rates were used to calculate the waiting time for this study. Microsoft Excel was used to calculate and analyze the data. Using ARENA software, a model and simulation of the patient's current queuing system was created based on the data analysis. According to the simulation model's output, the average wait time for patients in the queue is 54.295 minutes, and the average number of people leaving the queue at once is 327. As a result, the average service time is 13.481 minutes. This study demonstrated that the clinic met the Ministry of Health patient charter's target of having patients wait no longer than 60 minutes to see a doctor. The study also addressed a few issues that were noticed during observation, and appropriate solutions, such as scheduling resource changes, were developed to reduce waiting times and increase utilization rates [6].

In an effort to boost patient satisfaction, hospitals make every effort to offer a wide range of medical services. With the help of queueing theory, the authors were able to determine the waiting time while excluding distorted values from the digital data and distortion factors, such as arriving before the hospital opens, which frequently happens in the beginning of a queueing system. Using the methodology outlined in this paper, the authors of this study compared the variations in the wait times for outpatients before and after the implementation of EMR and discovered that the wait times for outpatients decreased after the implementation of EMR. Outpatient waiting times in the target public hospitals, in particular, have decreased by rates ranging from 44% to 78%. Utilizing digital data and the queueing theory allows for the analysis of waiting times while minimizing input errors and constraints affecting consultation processes. The findings show that implementing EMR improves patient services by reducing outpatient wait times or increasing efficiency. Additionally, it is anticipated that the methodology, or its development, will aid in the detection and elimination of bottlenecks in the outpatient consultation process, thereby enhancing hospital services [7].

III. Methodology

A. Stations, Patient Types, and Patient Routing Sequence

There were eight stations or offices that accommodated the people or patients that visit the Vitas Health Center. The Health Center stations or offices are the following: (1) Registration, (2) Laboratory, (3) Triage, (4) Treatment, (5) X-Ray, (6) MRI, (7) ECG, and (8) Accounting. And these are the following patient types: (1) Walk-in patients, (2) Lab patients, (3) X-ray patients, (4) MRI patients, and (5) ECG patients.

The table below shows the stations or offices' patient routing sequence.

TABLE I. Patient Routing Sequence

	Patient Routing Sequence							
	Reg.	**Triage**	**Treat**	**Lab**	**XRay**	**MRI**	**ECG**	**Acct**
Walk-in	1	2	3					4
Lab	1	2		3				4
XRay	1	2			3			4
MRI	1					2		3
ECG	1						2	3

The table 1 showed the logic of each entity which indicated that all types of patients must undergo the registration first. The walk-in patient will go to Triage after they're registered, Triage is where preliminary assessment of patients takes place. Then from Triage the patient will go to Treatment and then go to the accounting. The Lab patient will also need to go to Triage after they're registered. Then the patient will go to the lab and next to the accounting station. Same goes with the XRay patients, they register first and then go to Triage. And then examine at the Xray station then go to accounting. The MRI patients only need to register then they can go straight to the MRI station then accounting. Same goes with the ECG patients, after the registration, they can go to the ECG station. After that, they can go to the accounting station.

B. Service Distribution

TABLE II. SERVICE DISTRIBUTION

Station/Office	Service (in minute)	Initial Capacity
Registration	Exponential, mean 6 mins	1
Triage	Exponential, mean 3 mins	5
Treatment	Exponential, mean 3 mins	5
Laboratory	Exponential, mean 3 mins	4
X-Ray	Exponential, mean 12 mins	3
MRI	Exponential, mean 10 mins	2
ECG	Exponential, mean 30 mins	5
Accounting	Exponential, mean 5 mins	3

The table 2 indicates the station/office, service (in minute), and initial capacity. For each station they allocated estimated time of service and the capacity of patient can accommodate in each station. Registration with the exponential mean of 6 mins and capacity of 1. Triage with the exponential mean of 3 mins and capacity of 5. Treatment with the exponential mean of 3 mins and capacity of 5. Laboratory with the exponential mean of 3 mins and capacity of 4. Xray with the exponential mean of 12 mins and capacity of 3. MRI with the exponential mean of 10 mins and capacity of 2. ECG with the exponential mean of 30 mins and capacity of 5. Accounting with the exponential mean of 5 mins and capacity of 3.

IV. RESULT AND DISCUSSION

The data was collected and observed from July 1, 2022, 8:00am to 5:00pm

TABLE III. DATA COLLECTION

	Number of Patients per hour				
	Walkin Patients	*Laboratory Patients*	*X-Ray Patients*	*MRI Patients*	*ECG Patients*
8AM - 9AM	8	6	4	6	4
9AM-10AM	5	7	5	8	3
10AM-11AM	5	1	1	6	1
11AM-12PM	11	5	6	6	2
12PM-1PM	10	7	6	2	1
1PM-2PM	7	6	7	8	1
2PM-3PM	7	5	10	7	2
3PM-4PM	9	5	6	3	0
4PM-5PM	0	0	0	0	0
TOTAL	62	42	45	46	14

Table 3 showed the number of patients that were entering per hour. Number of Patients per station was also monitored. Total number of patients entered the center was 209. Less than 15 were hesitated, and less than 40 of them were revoked.

TABLE IV. VALIDATION

Seed (Randomness)	Number of Patients				
	Walkin Patients	*Laboratory Patients*	*X-Ray Patients*	*MRI Patients*	*ECG Patients*
1	62	35	54	40	17
2	47	46	43	42	20
3	62	36	64	38	14
4	52	42	52	29	17
5	73	36	44	43	11
6	64	30	60	54	17
7	63	48	44	46	20
8	70	42	36	57	16
9	67	47	32	57	10
10	68	56	47	46	15

Table 4 showed the result of the Simulation based on the seed number or randomness of the entity. Seed number 1 was the result of the simulation. It resulted in 208 patients accommodated by the center.

TABLE V. RESULT OF THE SIMULATION

Seed (Randomness)	Number in System			
	Served	*Balked*	*Reneged*	*Total*
1	169	9	30	208
2	168	6	30	204
3	183	7	24	214
4	168	8	16	192
5	170	8	29	207
6	176	14	35	225
7	182	9	30	221
8	173	16	30	219
9	170	13	30	213
10	186	13	32	231

Table 5 presents the number of patients that were served, balked, and reneged. Balk are the patients that hesitate and decide to not to continue their registration because of the queueing system. They hesitate when the queue has a capacity of 5. Renege patients are those who are undecided whether going to, but at another time or not. It will take 5 minutes for them to decide and probabilistic, which is 50%.

V. Conclusion

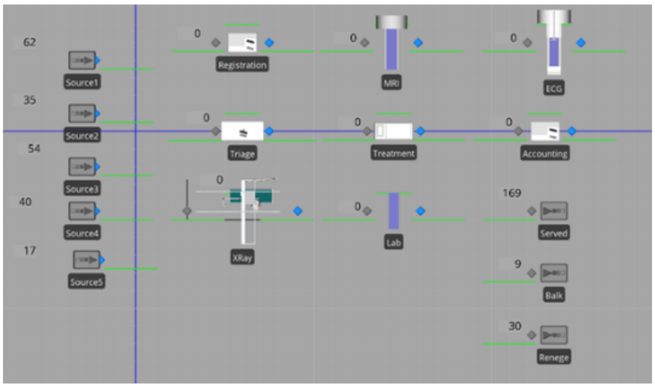

Figure 1

Total of 208 patients under figure 1 went to the center but only 169 patients were served. Some of them were balked or reneged. Balk are the patients that hesitate and decide to not to continue their registration because of the queueing system. They hesitate when the queue has a capacity of 5. Renege patients are those who are undecided in visiting the center. It will take 5 minutes for them to decide and the probability of it is 50%.

Some of the health centers are having trouble tracking patients visiting everyday. The purpose of this simulation is to effectively accommodate patients and the researchers were able to simulate it in terms of its different stations or offices.

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