



Application of Queuing Model to Determine Waiting Time of Patients at the Blood Collection Centre at the Opd of a Tertiary Care Teaching Hospital

KEYWORDS

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Introduction

In general we do not like to wait. But reduction of the waiting time usually requires extra investments. To decide whether or not to invest, it is important to know the effect of the investment on the waiting time. So we need models and techniques to analyze such situations [1]

Queuing theory deals with the study of queues which abound in practical situations and arise so long as arrival rate of any system is faster than the system can handle. Queuing theory is applicable to any situation in general life ranging from cars arriving at filling stations for fuel, customers arriving at a bank for various services, customers at a supermarket waiting to be attended to by a cashier and in healthcare settings [2].

Queuing theory is basically a mathematical approach applied to the analysis of waiting lines. "Any system in which arrivals places demands upon a finite resource, may be termed as a queuing system" (Kleinrock). In case of healthcare facilities, queue can be found wherever patients arrive or demand for the services randomly, such as emergency room, walk in patients in outpatient setting, at hospital pharmacy etc.[3] The goal of queuing analysis and its application in healthcare organizations is to "minimize costs" to the organization – both tangible and intangible. The costs that are considered are: Capacity costs, waiting costs, the cost of waiting space, cost to the society and the effects of loss of business to healthcare organization if patients refuse to wait and decide to go elsewhere [4].

The need for application of queuing theory in healthcare settings is very important because the well being and life of someone is concerned. The time spent by a patient while waiting to be attended to by a doctor is critical to the patient and to the image of the hospital before the public [5-7].

Methodology

The study was aimed to determine the waiting time of patients at blood collection center of at the civil OPD of a tertiary care teaching hospital in Pune using queuing model.

Study Design

Cross-sectional and observational study

Place

Blood Collection Centre of the OPD of a Tertiary Care Teaching Hospital in Pune.

Time period

Period of 28 days as per the following schedule:-

Data collection - 14 days

Analysis of data - 07 days

Final write up - 07 days

Data collection

Data was collected for computing mean arrival rate (average number of patients who arrive in a duration of one hour), mean service rate (average number of patients registered for blood collection at the centre in an hour).

Mean arrival rate per hour = Total no of patients registered for blood collection during the period of August / No. of working hours during the month of August 15

Mean service rate was obtained by observing the servers at variable times for one hour daily for a period of fourteen working days to cover the entire working period.

Data Analysis

Data analysis was done using QM4 Win software.

Layout	Service phase	Population	Arrival	Queue discipline	Service pattern	permissible queue length
Single channel	Single phase	Infinite	Poisson's	First in first out	Exponential	Infinite

Observation

The Tertiary Care Hospital under study is a 1082 bedded teaching and referral hospital in a metropolitan city. On an average, it has 26 OPDs everyday with super speciality OPDs on alternate days. Approximately 2000 patients visit the hospital daily for consultation. There is a single blood collection center which caters to patients from the OPDs and provides investigations free of cost to patients. The samples are transported from the collection centre for analysis and the results are provided the following day to the patients.

Blood collection centre of the hospital is open to patients from 08.00 am to 11.00 am daily. The blood collection center is closed on all Sundays and holidays. There are three Nurses which provide service to patients. Registration of the patient was done after referral from the clinical

cians for required investigations. Patients after registration in the registration counter wait in the main arena for sample collection.

Total workload of blood collection centre for the months of Aug 2015 : 2594

Total working hours during the months of Aug 2015 : 75 hours

Average number of patient registrations in an hour = $2594/75 = 36.03$ (36 registrations / hour)

Service rate was obtained by observing the registration counter for blood collection over a period of one hour on each day for fourteen working days and observations were taken on the number of patients registered during the period of observation.

Total investigation in a period of 14 hours = 300

Mean service rate / server = $(548/14) = 39.14 = 39$

Mean service time / server for registration = $60/39 = 1.53$ minutes.

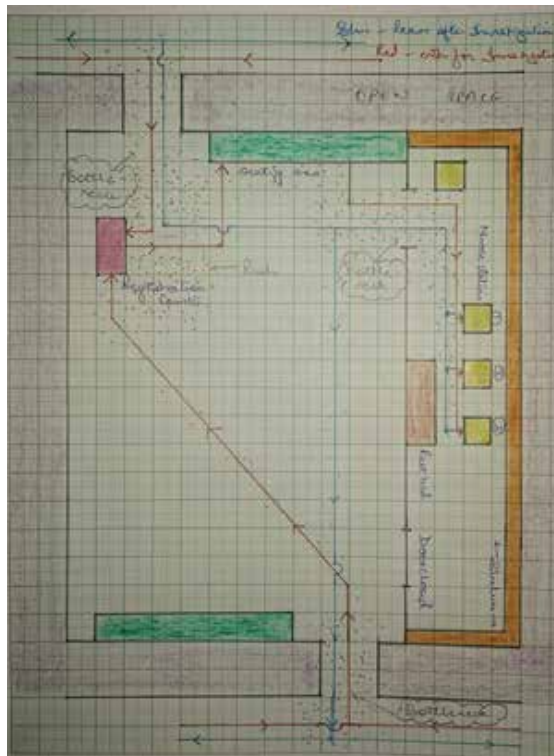
The data obtained was analyzed with Queue Calculator and following results obtained as given

Data	Value	Results	Value
Arrival rate (l)	36	Queue length in queue	11.07
Service rate (m)	39	Queue length in system	12.00
Number of servers(s)	1	Delay in queue	0.308
Queue Intensity	0.923	Delay in system	0.333
Queuing Utilization	92.308%	Probability of idle server	7.692%

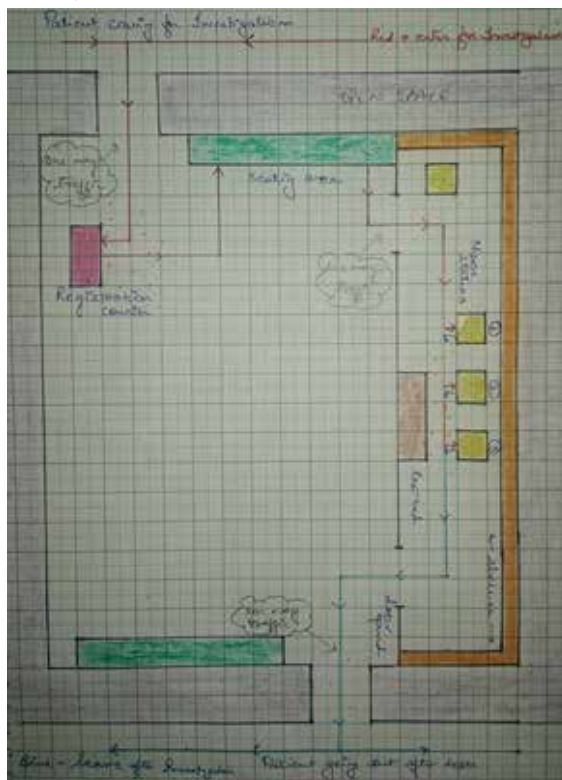
Recommendation

- Since waiting time is a predictor of patient satisfaction, efforts should be made to reduce the waiting time by providing extra manpower at the blood collection center of Tertiary Care Hospital under study.
- The time spent by the patient while waiting to be served at the collection center can be made bearable at the by providing various amenities. These may include the following:-
 - Waiting area with provision of seating space
 - Token system and patient call system to prevent crowding of patients at the service counter.
 - Drinking water facility
 - Cafeteria
 - Provision of television / piped music
 - News paper / Magazines
- Counseling of patients on various investigation such as fasting blood sugar, Post prandial as a part of information process which will help in reducing confusion among the patients.
- Preference may be given to pregnant ladies and elderly patients who may not be able to wait in a queue.
- Patients who come back after 2 hours of giving their fasting blood glucose sample to give their post prandial sample should be attended first and a separate queue can be made to draw their samples as quickly as possible, since they have already stood in a queue before and should not be asked to wait again.

- A change in the flow of patients to improve the crowd management is proposed as follows:



Old Layout



New Layout

Conclusion

This study was carried out to determine the waiting time of patients at the blood collection center of tertiary care

hospital under study as a patient's experience of waiting can radically influence his/her perceptions of service quality through application of queuing theory.

Mean arrival rate of patients at main blood collection centre was obtained by calculating the number of patients that were registered for investigations at the blood collection centre one hour from the record of investigation register that were taken during previous six month from the blood collection centre. Mean service rate was obtained through observation of servers at blood collection centre at various times of the day covering the entire working period. The data was analysed by using a queue calculator to obtain results.

By better understanding of queuing theory, service managers and healthcare providers can make decisions that increase the satisfaction of all relevant groups — customers, employees, and management.

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