

Multi-Channel Queue System for Outpatient Registration Services at Mitra Sejati Medan General Hospital in 2023

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ABSTRACT

Queue is a condition where a group of people, components or machines that need service must wait in a certain order before finally getting service. Data analysis of this study using quantitative analysis techniques This analysis was used to determine the efficiency of queues at Mitra Sejati Medan General Hospital. Conclusion Based on the analysis of the application of the current queuing system at Mitra Sejati Medan General Hospital, it can be drawn as follows: Registration service of Mitra Sejati Medan General Hospital, the type of queuing system applied is the type of queue model Multi Channel Single Phase or M/M/s. The service discipline applied at Mitra Sejati Medan General Hospital is the First In First Out (FIFO) service discipline. To maintain the performance of the queuing system applied to outpatient registration services at Mitra Sejati Medan General Hospital, it is necessary to consider the level of customer arrival and the level of queues that occur every day, especially during the time period of 10.00 - 11.00 at the outpatient registration counter because crowds of visitors occur at that hour.

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INTRODUCTION

Currently, public awareness of health is increasing. Along with increasing awareness, it will result in increased demands for the quality of health services. Efforts to improve the quality of health services are the most important step to increase the competitiveness of government businesses, both central and regional, in the health sector. (Tursini et al., 2022)

Queue is a condition where a group of people, components or machines that need service must wait in a certain order before finally getting service. One of the important queuing conditions to observe is the queuing system in hospitals. As a health service provider, it can be ascertained that hospitals have their own queuing systems that are used to provide optimal service to patients. The queue system in hospitals is generally used in the Outpatient Installation section, where many patients have to wait for their turn, both to register for consultation and examination with doctors and when they want to take drugs at the pharmacy. This is natural, but being in the queue line for too long will make the patient feel uncomfortable. For this reason, the hospital needs to pay attention to how the queuing system services they use can provide comfort to patients. (Pono, 2018)

Based on the results of research (Kurniati & Jaroji, 2018) entitled Web-Based Hospital Multi-Channel Queuing System, it was found that the online patient queuing system by implementing Priority Queue for Multi Channel was used as an alternative solution to the problem of the patient queuing system at Bengkalis Hospital. Based on the results of the study, it can be concluded that the use of this method is to solve the problem of priority queues and has been widely applied to cases of queues at gas stations, and queues for making driver's licenses (Driver's Licenses).

Multi-Channel Queue System for Outpatient Registration Services at Mitra Sejati Medan General Hospital in 2023. Fajar Maulana, et.al

Based on the results of the study (Tursini et al., 2022) entitled Analysis of Waiting Time and Service Time for Registration at Bandung City General Hospital in 2019, it was found that to determine the time that has the potential to cause dissatisfaction with patients and an assessment of service quality from the input / structure aspect and process aspects was carried out to analyze the factors causing the length of waiting time and / or service time at the General Hospital registration Bandung City Area.

Problems that often occur when patients come for treatment to wait for services experience large queues, resulting in a buildup of prospective patients in the outpatient registration waiting room. The buildup of queues of prospective patients also results in inadequate waiting rooms, this happens because there is no disciplinary path that can provide a form of registration services that are efficient and flexible to time.

METHODS

Queuing discipline is a concept that contains a policy where customers are selected from the queue to be served based on the order of the customer's arrival queue. Some divisions of ministry discipline are:

- a. First Come First Serve (FCFS) or First In First Out (FIFO), queue rules that are served according to the order of customers who come first.
- b. Last Come First Serve (LCFS) or Last In First Out (LIFO), the queue that comes last is the order of the queue that is served the earliest.
- c. Service In Random Order (SIRO) is a service in a random form where the service is based on random calls or does not prioritize who arrives first.
- d. Priority Service (PS), meaning that the main service is given to those who have the highest priority compared to those who have the lowest priority.

Based on the research that the author chose, the variables used in this study are

1. The number of visitor arrivals (λ) is the number of customers to be served during the observation time.
2. Average serviceable (μ) is the average person who can be served within the system.
3. The probability of not having visitors in the system (P_0) is the possibility of not having customers waiting in the system.
4. Average visitors in queue (L_q) is the average number of visitors estimated waiting in the queuing system.
5. The average waiting time for visitors in the queue (W_q) that visitors must pass while waiting in the queue.
6. Average estimated time in the system (W_s) time visitors are served in the system.
7. The average number of visitors in the system (L_s) is an approximate number based on the average number of visitors present in the system.

Multi channel - single phase or double track one stage service is a system where there is only one queue line with two or more service facilities.

RESULTS AND DISCUSSION

The following is the arrival data of visitors who visit Mitra Sejati Medan General Hospital through the registration queue for 3 days during working hours. Here is the data on the average visitor arrival rate:

Multi-Channel Queue System for Outpatient Registration Services at Mitra Sejati Medan General Hospital in 2023. Fajar Maulana, et. al

Table 1. Average Hourly Patient Arrivals at the Outpatient Registration Counter at Mitra Sejati Medan General Hospital

Time Period (Hours)	Average Visitor Arrivals		Total
	BPJS patients	General Patient/Insurance	
09.00 – 10.00	21.6	8.6	30.2
10.00 – 11.00	16.3	6	22.3
11.00 – 12.00	13.3	7	20.3
Amount	51.2	21.6	72.8

It is known in table 1 that the visitor arrival rate with the highest number of arrival rates is at the BPJS registration counter with an average of 51.2 patients, while the least number of patient arrival rates is at the general registration/insurance counter with an average of 21.6. In addition, the high arrival rate occurs at 09.00-10.00 with an average of 30.2 and the low occurs at 11.00-12.00 with an average of 20.3

The level of ability (average) to serve the needs of visitors upon each arrival is referred to as service capability. The level of ability (average) of this service is required to be able to meet the needs of visitors, but the ability to serve the needs of visitors on each arrival is not the same even though the type of service desired by visitors is the same. This is because the conditions of service activities are always different but the time difference is not much. Service level (μ) per hour.

Analysis of the queuing system with *the Multi Channel Single Phase multiple server model* is as follows:

λ = Number of average arrivals of time unions.

μ = Number of patients served union time

1. 09.00-10.00

With known $S = 3$, $\lambda = 30.2$ $\mu = 24.3$

a) The level of intensity of service facilities

$$\rho = \frac{\lambda}{S\mu}$$

$$\rho = \frac{30.2}{3(24.3)}$$

$$\rho = 0.414266118$$

So the level of service facility intensity is 41.42%

b) The probability that there are 0 people in the system

$$P_0 = 1 - \rho \times 60 \text{ minutes}$$

$$= (1 - 0.414266118) \times 60$$

$$= 0.585733882 \times 60$$

$$= 35.14403292$$

So the server intrusion rate is 35.14%

c) Average number of patients in queue

$$Lq = \frac{P_0 \left(\frac{\lambda}{\mu}\right)^S \cdot P}{S! (1-P)^2}$$

$$Lq = 35.14403292 \left(\frac{30.2}{24.3}\right)^3 \cdot 0.414266118$$

$$Lq = 7.9520924915$$

So the average visitor waiting in the queue is 7.9520924915 or if rounded up to 8 visitors.

d) The time the patient is in the queue

$$Wq = \frac{Lq}{\lambda}$$

$$Wq = \frac{7.9520924915}{30.2}$$

$$Wq = 0.2633143209$$

So the average time visitors spend is 0.2633143209 hours or 947.932 seconds.

e) The time the patient is in the system

$$Ws = Wq + \frac{1}{\mu}$$

$$Ws = 0.2633143209 + \frac{1}{24.3}$$

$$Ws = 0.3044665843$$

So the average time a visitor spends is 0.3044665843 hours or 1096.08 seconds.

f) The average number of patients in the system

$$Ls = \lambda \times W$$

$$= 30.2 \times 0.3044665843$$

$$= 9.1948908459$$

So the average number of visitors in the system is 9.1948908459 or if rounded up to 9 people.

Discussion

From the results of the calculation above, the M/M/S model queue at Mitra Sejati Medan General Hospital was obtained in a certain period:

Table 2. Queuing System performance results

Clock Time	Queuing System Performance					
	ρ	P0	Lq	Wq	Ws	Ls
09.00 - 10.00	0,4142	35,14	7,9520	0,2633	0,3044	9,1948
10.00 - 11.00	0,3058	41,64	2,3641	0,1060	2,5761	24,8761
11.00 - 12.00	0,2784	43,29	1,6234	0,0799	0,1211	2,4588

In table 2 above it can be seen that:

1. Service server activity rate (ρ)

The peak working hours of the service server at 09.00-10.00 are clearly visible at that hour the level of service server activity amounted to 41.42%.

2. Average number of visitors in queue (Lq)

The average number of visitors in the longest queue occurred at 09.00-10.00 WIB where the average number of visitors queuing was 7.9520 visitors or rounded up to 8 visitors. While the shortest average queue is at 11.00-12.00 WIB where visitors queue as many as 1.6234 visitors or rounded up to 2 visitors.

3. Average time spent by a customer waiting in a queue (W_q)

The longest time needed by visitors in queuing 0.2633 seconds occurs at 09.00-10.000 WIB and the shortest time is for 0.0799 seconds this occurs at 11.00-12.00 WIB.

4. Average time a customer spends in the system (W_s)

The longest time a person spends in the system is for 2.5761 seconds, this occurs in the time period 10.00-11.00 WIB, and the shortest time is for 0.1211 seconds, this occurs in the time period 11.00-12.00 WIB.

5. Average number of subscribers in the system (L_s)

The average number of customers queuing in the longest system with a time period of 10.00-11.00 WIB where the average number of customers was 24.8761 visitors or rounded up to 25 visitors. While the average number of customers queuing in the shortest system occurs with a time period of 11.00-12.00 which is 2.4588 visitors or rounded up to 2 visitors.

CONCLUSION

The queuing system applied to the registration service of Mitra Sejati Medan General Hospital is a queuing system with a Multi Channel Single Phase or *M/M/s model*. The service discipline applied at Mitra Sejati Medan General Hospital is the First In First Out (FIFO) service discipline. Where visitors who come first queue at Mitra Sejati Medan General Hospital which will be served for the first time. Analysis of the queuing system model applied at Mitra Sejati Medan General Hospital expressed in the notation model (M/M/s) where all calculations of the performance results of the queuing system on Monday, Tuesday, and Wednesday can be concluded: At 09.00 - 10.00 known $s = 3$, $\lambda = 30.2$, $\mu = 24.3$ obtained $\rho = 41.42\%$, $P_0 = 35.14\%$, $L_q = 8$ visitors, $W_q = 947.932$ seconds, $W_s = 1096.08$ seconds and $L_s = 9$ people. At 10.00 - 11.00 known $s = 3$, $\lambda = 22.3$, $\mu = 24.3$ obtained $\rho = 30.58\%$, $P_0 = 41.64\%$, $L_q = 2$ visitors, $W_q = 381.655$ seconds, $W_s = 9274.212$ seconds and $L_s = 25$ visitors. At 11.00 - 12.00 known $s = 3$, $\lambda = 20.3$, $\mu = 24.3$ obtained $\rho = 27.84\%$, $P_0 = 43.29\%$, $L_q = 2$ visitors, $W_q = 287.902$ seconds $W_s = 436.05$ seconds and $L_s = 2$ visitors.

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