Improving The Effectiveness Of The Drug Queuing System: Case Study Of Citra Husada Hospital

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Abstract: Queuing system is a set of customers, servants, and a rule that regulates the arrival of customers and their services. This study aims to determine the right number of counters in order to provide effective service at the drug collection counter at Citra Husada Hospital, Jember Regency. The queuing system method used is the multiple path method (Multi Channel- Single Phase) to determine the number of effective counters in order to provide service time less than the standard time set at the drug collection counter at Citra Husada Hospital, Jember Regency. By using secondary data, the number of samples used was 189 patients seen from the maximum and minimum arrival and service levels. The results of the study using queuing theory analysis through the calculation of multiple line queuing models, show that the queuing system applied with 2 drug taking counters at peak times is still less effective with a percentage of service time effectiveness of 61%. The alternative to adding counters by considering the average waiting time is to increase the service station to 3 drug-taking counters with a percentage of the effectiveness of service time of 180% so that the services provided are less than the standard time of the drug-taking counter applied of 15 minutes.

Keywords: Queuing System, Service Effectiveness, and Multi Channel- Single Phase.

INTRODUCTION

Currently, the population increase is so extraordinary that it requires all people to build the habit of queuing wherever and wherever they are, including queues at health centres, for example, queues in taking medicine at a hospital. In everyday life, queuing is one example of an activity that cannot be avoided anymore, such as queuing at a hospital, especially queuing at the drug collection counter. This is to accommodate population growth in Indonesia. In Permenkes No.58 of 2014 concerning Pharmaceutical Service Standards in Hospitals, it is stipulated that the waiting time for drugs is a maximum of 15 minutes for non-recombinant drugs and 30 minutes for concocted drugs, regardless of the number of drug items based on research results Menkes RI [1].

According to Khaskeheli [2] overcrowding of patients at the hospitals is the highlighted issue. Recently, it has been the teething concern for healthcare providers. She revealed that a hospital is an organisation carried out by a well-organised professional medical workforce in terms of permanent medical facilities and infra-structure, medical services, continuous nursing care, diagnosis and treatment of diseases provided to patients. To fulfil and realise the rights of every community in getting good services, especially effective services, hospitals are required to provide optimal service facilities as well as service facilities engaged in services.

According to Rahmiati [3], queuing is one of the activities where a customer must wait to get service. Queuing is a process related to the arrival of a customer (patient) at a service facility, then waiting in the queue

time and finally leaving the service facility. At present, long queues are often found in good service provider facilities. The density of the population results in people having to respect and cultivate queuing. Long queues occur in health services which result in some patients feeling bored. This will cause dissatisfaction for a patient, therefore the need for the right decision in improving the quality of service to patients so that the queuing system implemented is effective.

According to Pratami [4], says that effectiveness is a description of a situation that shows the extent to which the plan can be achieved. Fast service is a sign of high service quality because it makes patients not have to wait too long. The goal in providing good service is to implement the right queuing system. To determine the balance between waiting time and service time, queue analysis is needed. Queue analysis is directed at knowing the queue conditions and the level of service provided in helping to determine whether the service facility is running well.

In providing services, the drug collection counter is one of the important formations in a hospital. However, there is often a build-up of prescription drugs that results in a long wait for patients at the drug collection counter. This happens every day in the process of services provided by the hospital both in dense arrival rates to small-scale arrival rates. This requires effective and optimal solutions so that patients who come with the aim of seeking treatment or obtaining services from the hospital can feel satisfied with the services that have been provided [5].

To determine the ideal number of counters, agencies must also establish a system of operating drug-taking counters or a certain queuing system. The flow of the queuing system for patient services at the drug collection counter at Citra Husada Hospital, Jember Regency, starts with the collection of prescriptions from the patient to the drug collection counter and then the patient obtains a queue receipt for drug collection. Then the patient waits to be called his turn according to the queue number on the receipt he obtained. The queuing situation that occurs at the drug collection counter is the last process in outpatient services at Citra Husada Hospital, Jember Regency.

Table 1. 1 Arrival Rate and Patient Service of Drug Collection Counter at Citra Husada Hospital, Jember Regency in 2023

March			
Day/Date	Patient arrives	Patient served	Difference
Tuesday, March 21, 2023	177	145	32
Saturday, March 18, 2023	12	11	1

Source: Citra Husada Hospital, Jember Regency

Table 1. 2 Service Time At The Drug Collection Counter At Citra Husada Hospital, Jember Regency

	Maret		
Day/Date	Waiting Time	Total Number Of Patients	Percentage
Tuesday, March 21, 2023	0 - 15 minute	45	31.0%
	> 15 minute	100	69.0%
	Total patient	145	100%
Saturday, March 18, 2023	0 - 15 minute	9	81.8%
	> 15 minute	2	18.2%
	Total patient	11	100%

Source: Citra Husada Hospital, Jember Regency

Citra Husada Hospital of Jember Regency sets the standard time for pharmaceutical services based on Permenkes No.58 of 2014 concerning Pharmaceutical Service Standards in Hospitals, which is 15 minutes for non-recipe drugs. Table 1.2 shows that there are still patients who get services that are not in accordance with the standard time determined by Citra Husada Hospital, Jember Regency, which is 15 minutes. The queuing system at the drug collection counter at Citra Husada Hospital, Jember Regency still has many patients with a waiting time of more than 15 minutes, even because of the long waiting time of patients which causes patients to prefer to leave the service facility.

For prescriptions that have been submitted to the pharmaceutical staff and then the patient gets a queue number on that day, sometimes there are some patients who have urgent matters that make it impossible to wait for drug services at the collection counter. This results in the queue number obtained that day, will be forfeited and replaced with a new queue number without giving a repeat prescription the following day. So, this is included in the unserved queue. Therefore, it is necessary to analyse the queuing model again so that this research can help the Citra Husada Hospital, Jember Regency in designing a service operational system so that the service process can run effectively, namely by providing good service and according to established standards.

METHOD

Research design

The research design used in this study is using quantitative methods. Quantitative research method is a research method based on the philosophy of positivism used in research to examine certain populations or samples, data collection with research instruments, quantitative data analysis with the aim of knowing a predetermined problem formulation.

Population, Sample, Sampling

In this study, the population was outpatients at the non-drug dispensing counter at Citra Husada Hospital, Jember Regency in March 2023 as many as 2638 patients with a sample obtained of 189 patients, where the maximum arrival and service level data were 177 patients and a minimum of 12 patients. In this study the sampling technique used was purposive sampling which was carried out based on the criteria set by the researcher, namely 1) Hospitals that have data on arrival rates and services at drug collection counters in March 2023, 2) Data on the level of arrival and services used specifically for non-packaged drugs at the drug collection counter, 3) Maximum and minimum arrival and service level data in March 2023.

Instrument

In this study the data used is quantitative data which is defined as data or information from Citra Husada Hospital, Jember Regency which can be processed using mathematical formulas or can also be analysed with a statistical system. Data sources in this study were obtained through intermediary media in the form of evidence, records, historical reports arranged in published and unpublished archives or documentary data. Secondary data in the form of the number of arrivals of outpatients at the drug collection counter at Citra Husada Hospital, Jember Regency in March 2023.

Data Collection Techniques

Data collection techniques are at least carried out in various ways in order to obtain perfect data and in accordance with what is desired so that research takes place easily. According to Sugiyono [6] data collection is flight

research field research conducted in conducting direct reviews at the agency that is the object to obtain secondary data. The data collection technique used in this research is secondary data collection. Secondary data collection carried out by researchers is by downloading or downloading data on patient arrival rates at drug collection counters provided by the head of administration and staff at Citra Husada Hospital, Jember Regency.

Data Analysis Technique

The research technique used in this study is to use a multi-channel multi-phase line queuing model. Where the queue used in this study is a multiple line queue. Quantitative analysis is the queuing formulas for Multi Channel Single Phase (M/M/S). By using the calculation of the Model B: M/M/S (Multiple Channel Query System) method, it will produce information related to the level of service intensity in the queue in development and planning in improving service and effectiveness. To clarify the problem in data analysis, the data that has been collected will be processed first using the following method:

1. Calculate costs which include service costs (Cs) and waiting time costs (Cw). This cost calculation is needed to determine the costs that need to be incurred in servicing service facilities.

2. Alculating the maximum and minimum amount of patient arrival and service data.

3. Calculate the number of Probability there are 0 patients in the system (P_0), the average patient in the system (L_s), the average time taken by patients in the system (W_s), the average number of patients or units spent by patients or units to wait in the queue (W_q). According to Heizer dan Render [7] in his book, to calculate this can be done by formula:

(a) Probability that there are 0 people in the system or idle system (P_0)

$$Po = \frac{1}{\left[\sum_{n=0}^{M-1} \frac{1}{n!}\left(\frac{\lambda}{\mu}\right)^n\right] + \frac{1}{M}\left(\frac{\lambda}{\mu}\right) M \frac{M\mu}{M\mu - \lambda}}$$

(b) Average demand amount in the system (L_s)

$$Ls = \frac{\lambda\mu\left(\frac{\lambda}{\mu}\right)^M}{(M-1)! \ (M\mu - \lambda)^2} \ Po + \frac{\lambda}{\mu}$$

(c) The average time spent by a customer in the queue or being served in the system. (W_s)

$$Ws = \frac{Ls}{\lambda}$$

(d) The average number of people or units waiting in the queue (Lq)

$$Lq = Ls - \frac{\lambda}{\mu}$$

(e) Average time spent by a customer or unit waiting in the queue. Average time spent by a customer or unit waiting in the queue. (W_q)

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

4. Perform effectiveness calculations with calculation results ≥100% and actual time < standard time. According to Supranto [8], the formula for measuring the effectiveness of service time is as follows:

$$Effectiveness \ Of \ service \ Time = \frac{standard \ time}{actual \ time} \ x \ 100\%$$

Then the effective service time will be known by adding several service stations at Citra Husada Hospital, Jember Regency.

5. Effective service time will increase service costs. Service costs include waiting costs and facility costs the two costs can be calculated by the formula:

(a) Service Costs at Citra Husada Hospital, Jember Regency

Service Cost $E(C_s) = s \ x \ C_s$

(b) Waiting Costs at Citra Husada Hospital, Jember Regency

Waiting Cost $E(C_w) = n_t \ . \ C_w$

(c) Total Cost of Queuing Services at Citra Husada Hospital, Jember Rege

From the two costs above, the total expected cost per time period is:

$E(C_t) = E(C_s) + E(C_w)$

After being seen by comparing and simulating using the multi-channel multi-phase method, it will be seen the highest effectiveness of the analysis results, which service facilities with faster (minimum) time and the cost of adding facilities. After doing all the calculations, the queue system and time effectiveness will be optimal.

RESULTS AND DISCUSSION

Citra Husada Jember Hospital has a multi channel single phase system. Where there are two drug collection counters that have been provided to serve each stack of prescription drugs for patients who come. Citra Husada Hospital Jember Regency has a busy queue on Tuesday and a quiet queue on Saturday with an arrival rate greater than the service level contained in table and table 1.1. With the available two-counter queuing system there are still patients who are served more than the standard time for drug collection counters at Rosada Hospital Jember Regency that has been set. From the results of research that has been conducted at the drug collection counter at Citra Husada Hospital, Jember Regency, the following conclusions can be drawn:

1. The results of the calculation of costs carried out at the drug collection counter are as follows:

Service Costs (Cs)

Service costs are obtained from the salaries of pharmacy counter officers and facility procurement costs, with the following cost details:

a.	Salary of drug collection counter staff	:	Rp. 2.500.000/ month
			Rp. 96.154/ days (26 days a month)
			Rp. 13.736/ hours (7 working hours)
b.	Computer facility costs	:	Rp. 5,000,000/ with an economic life of 10 years divided by 130 hours
			Rp. 2.747/ hours (182 working hours in a month)
c.	Electricity and internet costs	:	Rp. 450.000/ month
			Rp. 17.308/ days
			Rp. 2.473/ hours
d.	Total service cost	:	Rp. 13.736.26 + Rp. 2.747,25 + Rp. 2.472,53
			Rp. 18.956/ hours

Cost of waiting time (Cw)

The cost of waiting time is a cost associated with the cost of losing patients. This is due to a system that has insufficient service resources. The minimum wage income for the city of Jember in 2023 is Rp. 2,555,662.

This income is assumed to be 30 days per month, or 720 hours. So (Rp. 2,555,662 : 720) = Rp 3,550. Therefore the cost of waiting time for patients is Rp. 3,550.

2. The results of the calculation of arrival and service level data serve to determine the number of \lambda and μ to perform calculations on the queuing system improvement system.

   Calculation of data on the arrival rate of drug collection counters at Citra Husada Hospital, Jember Regency on Tuesday and Saturday obtained the results:

   Tuesday, March 21, 2023 patients who came as many as 177 patients with a time interval of 13, then the arrival rate can be calculated as follows:

$$\lambda = \frac{arrival}{interval\ time} \quad = \quad \lambda = \frac{177}{13} = 14$$

   Saturday, March 18, 2023 patients who came as many as 30 patients with a time interval of 4, then the arrival rate can be calculated as follows:

$$\lambda = \frac{arrival}{interval\ time} \quad = \quad \lambda = \frac{30}{4} = 8$$

   Calculation of data on the level of service of drug collection counters at Citra Husada Hospital, Jember Regency on Tuesday and Saturday obtained the results:

   Tuesday, March 21, 2023 as many as 145 patients with working hours can be calculated the level of service as follows:

$$\mu = \frac{of\ services}{working\ hours} \quad = \quad \mu = \frac{145}{13} = 11$$

   Tuesday, March 18, 2023 as many as 24 patients with working hours can be calculated the level of service as follows:

$$\mu = \frac{of\ services}{working\ hours} \quad = \quad \mu = \frac{24}{4} = 6$$

   After knowing the arrival rate and service level as well as the cost of waiting time and the cost of procuring facilities on Tuesdays and Saturdays, a queuing system analysis can be carried out to find out how long the service time at the drug collection counter at Husada Hospital, Jember Regency. Queuing system analysis and service effectiveness are carried out by simulating service facilities starting from 2 service stations to 3 service stations. The analysis was carried out using the queuing formula of the multiple path model (Multi Channel - Single Phase) and queuing costs.

3. The results of the calculation of the improvement of the queuing system carried out can be seen that the number of effective service facilities to improve the performance of the queuing system so as not to exceed the standard time set by the drug collection counter at Citra Husada Hospital, Jember Regency as follows:

Table 4. 5 Calculation Results of Queuing System Improvements and Total Costs on Tuesday

Description	2 counter	3 counter
Po	0.173	0.185
Ls	6 patient	2 patient
Ws	25 minute	8 minute
Lq	4 patient	1 patient
Wq	19,30 minute	2,95 minute

Source: Data processed 2023

Table 4. 6 Calculation Results of Queuing System Improvements and Total Costs on Saturday

Description	2 counter	3 counter
Po	0.158	0.251
Ls	1 patient	0 patient
Ws	17 minute	3 minute
Lq	0 patient	-1 patient
Wq	0.101 minute	-0.3 minute

Source: Data processed 2023

Based on data analysis of queuing system improvements at the drug collection counter at Cit-ra Husada Jember Hospital with 2 counters, the current waiting time in the system that a patient must take is 25 minutes for Tuesday and 17 minutes for Saturday. This shows that service facilities with 2 counters are still not effective because they exceed the standardized service time set.

4. The results of the effectiveness calculation by calculating the standard time with the actual time show that:

Tuesday:

Service effectiveness 2 drug collection counters

$$Service\ Time\ Effectiveness = \frac{15\ minutes}{25\ minutes}\ x\ 100\% = 61\%$$

Service effectiveness 3 drug collection counters

$$Service\ Time\ Effectiveness = \frac{15\ minutes}{8\ minutes}\ x\ 100\% = 180\%$$

From the above calculations it can be concluded that the effective service time on Tuesday is at the number of 3 counters with an effective service time of 180%.

Saturday:

Service effectiveness 2 drug collection counters

$$Service\ Time\ Effectiveness = \frac{15\ minutes}{17\ minutes}\ x\ 100\% = 90\ \%$$

Service effectiveness 3 drug collection counters

$$Service\ Time\ Effectiveness = \frac{15\ minutes}{3\ minutes}\ x\ 100\% = 481\%$$

From the above calculations it can be concluded that the effective service time on Saturday is at the number of 3 counters with the effectiveness of service time of 481%. So, when viewed from the results of calculations carried out on the effectiveness of services, it shows that the need for additional counters to increase the effectiveness of services at the drug collection counter at Citra Husada Hospital, Jember Regency to 3 counters.

5. The results of the service fee calculation show that :

Tabel 4. 1 Results of Total Cost Calculation on Tuesday

Description	2 Counter	3 Counter
E(Cw)	Rp. 19.877 / hours	Rp 14.198 / hours
E(Cs)	Rp. 37.912 / hours	Rp. 56.868 / hours
E(Tc)	Rp 57.789 / hours	Rp. 71.066 / hours
Difference In Service Fee	-	Rp. 13.277 / hours

Source: Data processed 2023

Tabel 4. 2 Results of Total Cost Calculation on Saturday

Description	2 Counter	3 Counter
E(Cw)	Rp 2,960 / hours	Rp 554 / hours
E(Cs)	Rp 37,912 / hours	Rp 56,868 / hours
E(Tc)	Rp 40,872 / hours	Rp 57,422 / hours
Difference In Service Fee	-	Rp 16,549 / hours

Source: Data processed 2023

Table 4.5 means that the cost of procuring service facilities for 2 counters is Rp. 57,789 / hour and for the cost of procuring service facilities for 3 counters is Rp. 71,066 / hour. While in table 4.6 for the cost of procuring service facilities 2 counters Rp. 40,872 / hour and for the cost of procuring service facilities 3 counters Rp. 57,422 / hour. Then for the difference in additional service costs from existing service facilities on Tuesdays of Rp. 13,277 / hour and the difference in costs on Saturdays is Rp. 16,549.

Therefore, in the addition of service facilities carried out must consider the amount of costs that must be taken into account so that when the addition of services in increasing the effectiveness of drug collection counters at the Husada Image Hospital of Jember Regency does not make losses due to additional costs in adding counters. Increasing the effectiveness of services with the addition of counters must be balanced, so that there are no losses in efforts to increase effectiveness.

RESEARCH LIMITATION

Based on the direct experience of researchers in this research process, there are several limitations experienced and can be several factors that can be considered in the future for researchers who will perfect their research because this research itself certainly has shortcomings and needs to be improved in the future. The limitations that exist in this study are that the company prioritizes data confidentiality, so not all data can be obtained and the company severely limits the interaction of researchers with patients due to a code of ethics that must be obeyed. In addition, there is a lack of supporting literature related to the queuing system variables used in this study.

CONCLUSION

Based on the results of data analysis and discussion that has been carried out at the drug-taking counter at Citra Husada Hospital, Jember Regency, it can be concluded that the queuing system applied to the drug-taking counter at Citra Husada Hospital, Jember Regency uses a double line queuing model (Multi Channel - Single Phase) with the B model: M/M/S. The current number of stations at the drug collection counter at Citra Husada Hospital, Jember Regency is 2 counters that operate to provide services. The service used in the drug collection counter at Citra Husada Hospital, Jember Regency is FIFO (First In Firs Out). The level of service provided at the drug collection counter at Citra Husada Hospital, Jember Regency still exceeds the predetermined time standard of 15 minutes for non-prescription drugs. Then the effectiveness of the queuing system at the drug collection counter at Citra Husada Hospital, Jember Regency for the 2 service stations currently provided on Tuesdays and Saturdays or busy patient days and quiet patients is declared less effective. Because the calculation obtained is <100%.

Suggestions that researchers suggest to the Citra Husada Hospital of Jember Regency, namely that the management of the Citra Husada Hospital of Jember Regency can make the results of the study as input in improving the queuing system in improving service effectiveness by adding counters that aim to reduce the time waiting for patients in the queue to be effective in accordance with the standard service time set by the Citra Husada Hospital of Jember Regency. To maintain the performance of the queuing system applied to the drug collection counter at Citra Husada Hospital, Jember Regency in improving service effectiveness, the Citra Husada Hospital, Jember Regency needs to pay attention to the level of patient arrival with patient queues that occur every day, so that the performance of the queuing system runs effectively so as not to make patients wait too long in obtaining services.

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