

Analysis of the Queue System in an Effort to Improve the Effectiveness of Gunung Pati Health Center Services in Semarang City

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Abstract

Queue is an activity where there is a group of people who have a goal, namely to get a service by waiting or queuing and having a certain order before getting a service. The services provided must be in accordance with the public service law, the community prefers the first health facility, namely the health center, so it is important to provide good service at the health center. The purpose of this study is to find out the process of the service system at the Gunung Pati Health Center and to know the service standards and quality of the Gunung Pati Health Center in order to understand how to use the queue theory at the Gunung Pati Health Center and to know and understand the effectiveness of the use of the queue theory in the quality of service at the Gunung Pati Health Center. This type of research is quantitative descriptive using data collection methods in the form of observations and interviews at the Gunung Pati Health Center. The result of this study is that the queue system at the Gunung Pati Health Center, Semarang City uses the analysis of the Multi Channel and Single Phase queue model with the number of services of three (3) registration counters, which include service fees (C_s), waiting time costs (C_w), and total service queue costs (T_c).

Keywords : Effectiveness, Service, Queue System

INTRODUCTION

The State is obliged to serve every citizen and resident to fulfill their basic rights and needs within the framework of public service which is the mandate of the 1945 Constitution of the Republic of Indonesia. In the implementation of public services, in addition to being in accordance with the public service law, it must also pay attention to the changes in the development of the times because the changes of the times greatly affect the effectiveness of the implementation of public services. In addition, the provision of public services is also required to always provide good service and prioritize customer satisfaction. Consumer satisfaction must be considered to know how good and effective the service is provided, so that development of existing services can be carried out to always create effective services and in accordance with consumer needs.

The implementation of public services is a form of national development because in its implementation it requires human resources to manage other resources and humans as the target with the aim of achieving various areas of community life optimally, one of which is the improvement of development in

Health sector. Puskesmas or Public Health Centers are a form of government efforts in the implementation of first-level health services in each region, so that people can experience health services in their respective regions, but there are still many areas that have not received

Public Health services (Puskesmas) because there are several areas that are difficult to access. As the first level of service in the community, the health center is held by emphasizing its services for the community to achieve an optimal degree of health, but there are still several health centers whose services are not in accordance with the standards, so that the service is not optimal, therefore it is necessary to have the accreditation of the health center to improve the health center that is not yet in accordance with the standards and as an effort to improve the quality of service at any time with the system that has been Determined, because there are also many health centers that have met good accredited standards but there are still many queues that accumulate in the service process.

Research Objectives

In this study, the purpose of this study is to find out the process of the service system at the Gunung Pati Health Center and to know the service standards and quality of the Gunung Pati Health Center in order to understand how to use the queue theory at the Gunung Pati Health Center and to know and understand the effectiveness of the use of the queue theory in the quality of service at the Gunung Pati Health Center.

RESEARCH METHODS

The data collection method used in this study is by observation and interview methods. Data collection was carried out on Monday, October 16, 2023 at 12.30 WIB in the Gunung Pati Health Center area, Gunung Pati District, Semarang City.

RESULTS AND DISCUSSION

1. Overview of the Research Location

The Gunungpati Health Center is a basic health service center, located in the Gunungpati District area, where there are outpatient and inpatient services for the public. Judging from the location of the Gunung Pati Health Center, it is quite strategic and the area is around 5,399,085 Km². Gunungpati Health Center has 11 (eleven) assisted villages out of 16 (sixteen) villages in Gunungpati District, namely:

1. Gunungpati Village
2. Plalangan Village
3. Pakintelan Village
4. Nongkosawit Village
5. Cepoko Village
6. Jatirejo Village
7. Sumurejo Village
8. Mangunsari Village
9. Pongangan Village
10. Kandri Village
11. Sadeng Village

The eleven assisted villages have an area of 4,321.31 ha with the following boundaries:

- a. North: Sekaran Health Center / Semarang City.
- b. South : Pustu Branjang Working Area / Semarang Regency
- c. East : Mapagan Health Center / Semarang Regency.
- d. West : Working Area of Karang Malang Health Center / Semarang City.

2. Gunung Pati Health Center Queue System

The Gunung Pati Health Center is located right in the Plangan Village area, precisely on Jl. Mr. Wuryanto No.38 Gunungpati. This health center has a queue system model, namely (Mutichannel - Singlephase). There are 3 flattening counters provided to serve every patient who comes. The Gunung Pati Health Center has a crowded queue on weekdays, namely

Monday – Friday in the morning and quiet queues during the day. The characteristics of the queue system at the registration counter of the Gunung Pati Health Center are as follows:

1. Patient Arrival

- a. Population size is a source of arrivals in a queue system that includes an unlimited population and a limited population.
 Meanwhile, the population size at the Gunung Pati Health Center is an unlimited population where the Puskesmas patients who come enter the queue system with an unlimited number of patients in patient registration services.
- b. The arrival pattern is the registration behavior of Gunung Pati Health Center patients who are different in obtaining services. The pattern of patient arrival at the Gunung Pati Health Center is that each patient arrives with a different size of time.
- c. The arrival behavior is that at first each patient comes then the patient enters the queue system to take the queue number and wait for the queue number to be called, after waiting for the patient's queue number to be called to be served at the available counter, then at the counter serves the patient data input process in accordance with the intended poly, the patient exits the queue system and goes to the intended poly.

2. Queue Discipline

Every patient who comes first takes a queue number, then the patient is first called by the 3 available counters or the arrival is served on a first in first out (FIFO) in the health services of the Gunung Pati Health Center.

3. Service Facilities

- a. The basic design of the registration counter service queue system at the Gunung Pati Health Center uses the design of a single-stage multi-channel system (Multi channel – Single phase). Where there are 3 registration counters with one service line.
- b. The pattern of service is similar to the pattern of arrival in that this pattern is divided or randomly or unequal. At the registration counter, the Gunung Pati Health Center uses a random service time pattern, namely the patient enters the queue system to take the queue number and waits for the queue number to be called, after waiting for the patient to be called according to his queue number to be served by the available counter, then at the counter serves the patient data input process, after completion the patient leaves the system and goes to the intended poly.

4. Analysis of the Queue System in Improving Service Effectiveness at the Gunung Pati Health Center

Service facilities greatly affect customers in the queue system, therefore patient registration counters must certainly be considered to increase the effectiveness of registration counter service time, especially on days with high patient arrival rates. The effectiveness of services in the queue system can be measured by taking into account the average patient arrival (λ) and the average patient service level (μ) at each registration counter.

From the results of the comparison of λ and μ , it can be known how many counters are urgently needed in the process of optimizing services and the effectiveness of service time in accordance with the time standards that have been determined from the Gunung Pati Health Center. In this study, it is necessary to calculate the cost of service, the cost of waiting time, the average arrival, and the service process at the Gunung Pati Health Center, Gunung Pati District, Semarang City.

Variables	Indicators	Size	Scale
Queue System	Average number of patients	Person	Ratio

	waiting in queues		
	Average time patients spend waiting in a queue	Minute	Ratio
	Average number of patients in the system	Person	Ratio
	Average time spent by patients in queue / being served	Minute	Ratio
Service Time Effectiveness	Waiting Fee Service Fee	Rupiah	Ratio

1. Service Fee (Cs)

The service fee is obtained from the salary of the registration counter officer and the cost of procurement of facilities, with the following details of the cost:

a. Registration counter officer salary:

IDR 2,594,000,- / month

IDR 96,081,- / day (27 days a month)

IDR 24,080,- / hour (4 working hours)

b. Computer Facility Fee:

IDR 10,000,000 with an economic life of 5 years and divided by the number of hours in a month, which is 108 hours.

= (Rp 10,000,000,- : 5) : 108

= IDR 18,519,- /hour for 1 unit

= IDR 18,519 / hour.

c. 32-inch Led TV = IDR 1,945,000 with an economic life of 10 years and divided by the number of hours in a month which is 108.

= (IDR 1,945,000,- : 10) : 108

= IDR 1,801,- / hour.

d. Total service fee : (Registration Counter Officer Salary + computer facility fee + 32 inch Led Tv)

= IDR 24,080,- + IDR 18,519,- + IDR 1,801

= IDR 44,400 / hour

2. Waiting Time Fee (Cs)

Waiting time costs are costs related to the cost of patient losses because they spend time waiting for a service call. Semarang City's UMR revenue in 2023 is IDR 2,791,015,-. It is assumed to be per month 30 days, or 720 hours. So (IDR 2,791,015,- : 720) = IDR 3,876,-.

Table 2.1 Average arrival rate (λ) on Monday

It	Day	Arrival Rate (λ)	Service Level (μ)
	Monday	60	25

After knowing the level of arrival and service as well as the cost of procurement of facilities and the cost of waiting time are the highest in one month, namely on Tuesday and Thursday. So an analysis of the queue system can be carried out to find out how long the service time at the Gunung Pati Health Center is. The analysis of the queue system and service effectiveness was carried out by simulating service facilities starting from 3 service stations to 5 service stations. The analysis was carried out using the queue formula of the multi-channel - single phase model with the following queue costs:

1. Monday

a. Number of Service Facilities 3 Counters

$M = 3$ counters

$\lambda = 60$

$\mu = 25$

P_0 = Probability of having 0 patients in the system (absence of patients in the system).

$$P_0 = \frac{1}{M-1 \frac{1}{n!} \left(\frac{\lambda}{\mu}\right)^n + \frac{1}{m} \left(\frac{\lambda}{\mu}\right)^M \frac{M \mu}{M \mu - \lambda}} \quad \text{for } \mu > \lambda$$

$n = 0$

$$= \frac{1}{M-1 \frac{1}{0!} \left(\frac{60}{25}\right)^0 + \frac{1}{1!} \left(\frac{60}{25}\right)^1 + \frac{1}{2!} \left(\frac{60}{25}\right)^2 + \frac{1}{3!} \left(\frac{60}{25}\right)^3 \frac{3 \times 25}{3 \times 25 - 60}}$$

$n = 0$

$= 0.141$

$= 14.1\%$ (probability of 14.1% of patients in the system)

L_s = Average number of patients in the system at the outpatient registration counter of the Gunung Pati Health Center.

$$L_s = \frac{\lambda \mu (\lambda / \mu)^M}{M-1 ! (M \mu - \lambda)^2} P_0 + \frac{\lambda}{\mu}$$

$$L_s = \frac{60 \times 25 (60 / 25)^3}{3-1 ! (3 \times 60 - 25)^2} \times 0,141 + \frac{60}{25}$$

$= 8$ patients

W_s = Average number of patients in the system (queue to get services) at the outpatient registration counter of the Gunung Pati Health Center.

$$L_s = \frac{\lambda \mu (\lambda / \mu)^M}{M-1 ! (M \mu - \lambda)^2} P_0 + \frac{\lambda}{\mu}$$

$$L_s = \frac{60 \times 25 (60 / 25)^3}{3-1 ! (3 \times 60 - 25)^2} \times 0,141 + \frac{60}{25}$$

$= 8$ patients

L_q = Average number of patients in the queue at the outpatient registration counter of the Gunung Pati Health Center.

$$L_q = L_s - \frac{\lambda}{\mu}$$

$$= 8 - \frac{60}{25}$$

$$= 6 \text{ pasien}$$

Wq = Average time spent by patients in the queue at the outpatient registration counter of the Gunung Pati Health Center.

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

$$= 0,133 - \frac{1}{25}$$

$$= 0,093 \text{ jam} = 5,58 \text{ menit.}$$

It is known that the service time is effective by increasing the service cost. The service fee includes waiting costs and facility fees, which are as follows:

1) **Patient waiting fee (Cw)**

$$E(Cw) = nt \text{ Cw} \times$$

$$= 8 \times Rp \text{ 3.876,-}$$

$$= \text{IDR 31,008}$$

Patient waiting fee = the number of patient waiting in the patient waiting fee queue. \times

2) **Registration counter facility fee (Cs)**

$$E(Cs) = sCs \times$$

$$= 3 \text{ IDR 44,400} \times$$

$$= \text{IDR 133,200}$$

Registration counter facility fee = total service status service facility fee. \times

3) **Total cost of queue services at Gunung Pati Health Center (Tc)**

$$E(Tc) = E(Cw) + E(Cs)$$

$$= (31.008,-) + (133.200,-)$$

$$= \text{IDR 164,208,-}$$

b. Number of service facilities 4 counters

$$M = 4 \text{ Counters}$$

$$\lambda = 60$$

$$\mu = 25$$

P_0 = Probability that there are no patients in the system at the outpatient registration counter of the Gunung Pati Health Center.

$$P_0 = \frac{1}{\sum_{n=0}^{M-1} \frac{1}{n!} \left(\frac{\lambda}{\mu}\right)^n + \frac{1}{M!} \left(\frac{\lambda}{\mu}\right)^M \frac{M\mu}{M\mu - \lambda}} \text{ untuk } \mu > \lambda$$

$$= \frac{1}{\sum_{n=0}^{M-1} \frac{1}{n!} \left(\frac{60}{25}\right)^n + \frac{1}{4!} \left(\frac{60}{25}\right)^4 \times \frac{4 \times 25}{4 \times 25 - 60}}$$

$$= 0,130$$

$$= 13\% \text{ (Probabilitas 13\% pasien dalam sistem)}$$

- L_s = The average number of patients in the system at the outpatient registration counter of the Gunung Pati Health Center.

$$L_s = \frac{\lambda \mu (\lambda / \mu)^M}{M - 1! (M\mu - \lambda)^2} P_0 + \frac{\lambda}{\mu}$$

$$L_s = \frac{60 \times 25(60 \times 25)^4}{4 - 1!(4 \times 25 - 60)^2} \times 0,148 + \frac{60}{25}$$

$$= 3$$

W_s = Average number of patients in the system (queue or receiving services) at the outpatient registration counter of the Gunung Pati Health Center

$$W_s = \frac{L_s}{\lambda}$$

$$W_s = \frac{3}{62}$$

$$W_s = 0,051 \text{ jam}$$

$$W_s = 3 \text{ menit}$$

L_q = Average number of patients in the queue at the outpatient registration counter of the Gunung Pati Health Center.

$$L_q = L_s - \frac{\lambda}{\mu}$$

$$L_q = 2 - \frac{60}{25}$$

$$L_q = 1 \text{ pasien}$$

W_q = Average time spent by patients in the queue at the outpatient registration counter of the Gunung Pati Health Center.

$$W_q = W_s - \frac{1}{\mu}$$

$$= 0,051 - \frac{1}{59} = 0,0112 \text{ hours}$$

$$= 0,67 \text{ minutes}$$

It is known that the service time is effective by increasing the service cost. The service fee includes waiting costs and facility fees, which are as follows:

1) Patient waiting fee (C_w)

$$W(C_w) = nt \times C_w$$

$$= 3 \times Rp 3.876,-$$

$$= IDR 11,628,-$$

Waiting for patients = the number of patients waiting in the waiting fee queue \times

2) Registration counter facility fee (C_s)

$$E(C_s) = nt \times C$$

$$= 4 \times Rp 44.400$$

$$= IDR 177,600$$

Registration counter facility fee = number of service stations service facility fee \times

3) Total cost of queue services at Gunung Pati Health Center

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

$$= (11.628,-) + (177.600,-)$$

$$= IDR 189,228,-$$

c. Number of service facilities 5 counters

$$M = 5 \text{ Counters}$$

$$\lambda = 60$$

$$\mu = 25$$

P_0 = Probability that there are no patients in the system at the outpatient registration counter of the Gunung Pati Health Center.

$$P_0 = \frac{1}{\sum_{n=0}^{M-1} \frac{1}{n!} \left(\frac{\lambda}{\mu}\right)^n + \frac{1}{M!} \left(\frac{\lambda}{\mu}\right)^M \frac{M\mu}{M\mu - \lambda}}$$

$$= \frac{1}{N = 0 \frac{1}{0!} \left(\frac{60}{25}\right)^0 + \frac{1}{1!} \left(\frac{60}{25}\right)^1 + \frac{1}{2!} \left(\frac{60}{25}\right)^2 + \frac{1}{3!} \left(\frac{60}{25}\right)^3 + \frac{1}{4!} \left(\frac{60}{25}\right)^4 + \frac{1}{5!} \left(\frac{60}{25}\right)^5 \times \frac{5 \times 25}{5 \times 25 - 60}}$$

$$= 0,089$$

Ls = Average number of patients in the system at the outpatient registration counter of the Gunung Pati Health Center.

$$Ls = \frac{\lambda \mu (\lambda \mu)^M}{M-1!(M\mu-\lambda)^2} P_0 + \frac{\lambda}{\mu}$$

$$Ls = \frac{6 \times 25 (60/25)^5}{5-1!(5 \times 25 - 60)^2} \times 0,089 + \frac{60}{25} = 2$$

Ws = Average number of patients in the system (queue or receive services) at the outpatient registration counter of the Gunung Pati Health Center.

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

$$= \frac{2}{60}$$

$$= 0.033 \text{ hours}$$

$$= 2 \text{ minutes}$$

Lq = Average number of patients in the queue at the outpatient registration counter of the Gunung Pati Health Center.

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

$$= 2 - \frac{60}{25}$$

$$= 1 \text{ patient}$$

Wq = Average time spent by patients in the queue at the outpatient registration counter of the Gunung Pati Health Center.

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

$$= 0.032 - = 0.033 \text{ hours } \frac{1}{25}$$

$$= 0.006 \text{ minutes}$$

It is known that the service time is effective by increasing the service cost. The service fee includes waiting costs and facility fees, which are as follows:

1) **Patient waiting fee (Cw)**

$$W(Cw) = nt \times Cw$$

$$= 2 \times Rp 3.876,-$$

$$= IDR 7,752,-$$

Waiting for patients = the number of patients waiting in the waiting fee queue. ×

2) **Registration counter facility fee (Cs)**

$$E(Cs) = nt \times Cw$$

$$= ,5 \times Rp 44.400$$

$$= IDR 222,000,-$$

Registration counter facility fee = number of service stations service facility fee ×

3) **Total cost of queue services at Gunung Pati Health Center**

$$E(Tc) = E(Cw) + E(Cs)$$

$$= (\text{IDR } 7,752) + (222,000)$$

$$= \text{IDR } 229,752,-$$

Service System

According to Schroeder, in 1989 there are five elements that need to be considered in the service system:

1. Technology: degree of automation, equipment, degree of vertical integration.
2. Process Flow: the sequence of events used to produce services.
3. Process Type: Number of contacts involved (high or low), degree of service and integration.
4. Location and Size: the place where the service process is located, the size of each place where the service is implemented.
5. Workforce: Skills, type of organization, reward system, degree of participation.

Queue Method

According to Heizer and Render (2005: 426), there are 4 queue models used in the service process, namely:

1. Model A: M/M/1 (Single Channel Query System) or single path queue model)
The application of this model is distributed arrival poisson and exponential service time. In this situation, arrivals form a single line to be served by a single station.
2. Model B : M/M/S (Multiple Channel Query System or multiple path queue model)
On the model there are two or more service lines or stations available to serve incoming customers. The model assumes that the arrival pattern follows a negative exponential distribution.
3. Model C : M/D/1 (constant service or constant service time)

In this model, the things that are considered are as follows:

- 1) Average queue length
- 2) Average queue wait time
- 3) Average number of customers in the system
- 4) Average waiting time in the system
4. Model D (limited population)

In this model, the things that are considered are as follows:

1. Service Factor
2. Average queue count
3. Average wait time
4. Average number of services
5. Average number of services
6. Number of population

Effectiveness

Effectiveness can be interpreted as the use of a certain amount of resources, facilities and infrastructure that are consciously determined in advance to produce a number of goods for the services of the activities carried out (Sondang P. Siagian, 2001: 24).

CONCLUSION

Based on the results of research conducted at the Gunung Pati Health Center, Semarang City, it can be concluded that the queue system of the Gunung Pati Health Center, Semarang City uses a *Multi Channel - Single Phase queue model* with a total of 3 registration counters. The service process begins when the patient takes the queue at the counter which then the patient is welcome to wait to be called based on the queue sequence number.

After being called, the patient registers according to the intended poly. Then the patient goes to the doctor's waiting room.

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