

# Identification and Modeling of Factors That Cause Patient Queue

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Abstract: Patient queues occur in various hospitals in the world, especially in outpatients with an average waiting time of more than 60 minutes. Long queues often occur and become a problem because of the many people who come to wait beyond the normal limit. The purpose of this study was to identify and model the factors causing the queue of patients from 5,898 patients with a sample of 260 respondents (accidental sampling). Data analysis used univariate, bivariate with chi-square test, and multivariate with multiple logistic regression at the 95% confidence level ( $\alpha = 0.05$ ) were performed. Statistical test results showed that there was an influence of patient waiting time at registration until the call, length of time the doctor's examination, human resources to the patient queue,  $p < 0.05$ . As the most influential variable, human resource (HR) availability has a 9.6 times higher chance of inadequate HR availability. Accuracy of 91% for the design of the patient queue variable model using SEM method for all test variables was achieved.

## 1 INTRODUCTION

Queuing is a common thing in daily life. Queuing is done in many ways one of which is queuing for health checks in health facilities such as health centers, clinics or hospitals (Akbar & Hirawan, 2018). Hospital queues can occur in outpatient services, inpatient services and emergency services. Outpatient service is the first service and is the gate of the hospital, and is the only part of the medical service that gives a first impression for patients as consumers (Kakiay, 2014). In outpatient services, both new patients and old patients will undergo a series of service processes that can not be separated from the queue itself, namely when waiting for a call in the administrative, polyclinic, or while making a redemption of drugs or payment in the cashier's pocket (Barnhart & Laporte, 2015).

One aspect of service quality is the fast and precise aspect. Leaving consumers waiting for no apparent reason causes negative perceptions in service quality (Sugiarto, 2014). Timeliness is the suitability of medical services provided from what is needed from time to time (Lovelock & Wright, 2012). If all services provided have not been able to satisfy patients this will end in a low level of patient satisfaction, and end in a low level of patient loyalty (Septiani, Wigati, & Fatmaasari, 2017).

In hospitals, patient queues occur as a result of high demand for health services which means that demand for health care services by residents exceeds the capacity of service facilities. Queues can be fully represented by the process of patient arrival (in) and service provision (out) which are the main components of each queuing system (Obulor & Eke, 2016; Turnip et al, 2018).

Patient queues occur in various parts of the world, the data obtained from several previous researchers. Mohebbifar et al. (2014) in several clinics and hospitals in Iran showed that the waiting time for ophthalmology clinic outpatients with an average of 245 minutes. The orthopedic clinic has a minimum average waiting time of 77 minutes per patient, the average waiting time for each patient in a teaching hospital is around 161 minutes. Musinguzi Research (2013) at the Mulago Hospital, Uganda that patients spend more than 5 hours waiting time, most of the time spent in the registration and pharmacy. There are also patients who report > 11 hours, at the beginning of the week (Monday) increasing by about 3-4 minutes for each patient who is waiting in line. Likewise what happened in China is that one of the biggest complaints voiced by the Chinese community is the amount of time needed to queue for outpatient registration at the hospital (Yu et al., 2013).

Category of distance between waiting time and check time which is estimated to be satisfactory or

unsatisfactory for patients, among others, when the patient comes from registering to the counter, queuing and waiting for a call to the general poly to be planted and examined by a doctor, nurse or midwife for more than 90 minutes (old category), 30-60 minutes (medium category) and  $\leq 30$  minutes (fast category) (Esti, 2015). Waiting times in Indonesia are determined by the Ministry of Health through minimum service standards. Every hospital must follow this minimum service standard regarding waiting time. The minimum standard of care in outpatient services based on the Ministry of Health No. 129 / Menkes / SK / II / 2008 is less or equal to 60 minutes (Kemenkes RI, 2008).

Public hospitals in major cities in Indonesia such as Jakarta, patients can queue up at 5 in the morning. Based on observations made between March and June 2017 in outpatients, patients queue from 9 am to 10 am queues at internal medicine clinics around 110 patients, queues at cardiac clinics around 104 patients and lung clinics 60 patients (Dachyar, Farizal, & Yafi, 2018). Mayasari's study (2016) in the AMC Metro RSIA clinic most of the outpatients waited for queuing for more than 60 minutes to be served by nurses and doctors so they felt dissatisfied, a small portion waited less than 60 minutes.

The cause of the accumulation of queues at the outpatient reception is the human factor, which is slow service, the use of manual systems and patients who often do not carry registration requirements. Machine factor (machine), which is electricity that often dies due to inadequate power and the use of queue number machines that are used to speed up service actually experience problems in operation due to machine factors (machine error). Factor methods (methods) namely incomplete Standard Operating Procedures (SPO) or work procedures and the absence of media information or communication to patients (Sari, 2016).

The impact of long queues on hospital services will cause patients to feel bored. As a result, patients will go and look for other hospitals. This is considered a loss for the organization because patients become disloyal (Fitzsimmons & Fitzsimmons, 2014). Long waiting times at health centers can increase disease severity and cause socio-economic costs. The results of several studies on the assessment of patient satisfaction show a direct correlation between patient satisfaction and waiting time, and show the negative effect of long waiting times on total patient perception of service quality (Bahadori et al., 2014; Kusumandari et al, 2018; Turnip et al, 2018).

The best service for patients is to provide fast service to patients, so they don't wait too long to get services. However, the impact of this rapid service delivery will incur costs for organizations such as hospitals, because they have to add expensive service facilities and technology (Dachyar et al., 2018).

Stella Maris Hospital in Medan is a specialized hospital that provides services for maternal and child health. Stella Maris Medan RSIA has several integrated polyclinics that can help serve family health. By presenting the best doctors, as well as medical services provided, as a form of commitment of Stella Maris Medan Women's and Children's Hospital to reliable health services for all maternal and child health problems. Based on the performance indicators achieved by the Stella Maris Hospital in Medan in 2017, the Bed Occupancy Rate (BOR) is 80.2%, the Average Length of Stay (ALOS) is 2.7 days and the Turn Over Interval (TOI) is 1 day whereas in 2018, the number of BOR was 72.9%, ALOS was 2.8 days and TOI was 0.6 days (RSIA Stella Maris, 2019a). The ideal BOR parameter value is 60-85%, the ALOS value is between 6-9 days, the TOI value is in the range of 1-3 days (MOH RI, 2005).

The latest data that researchers obtained from the Stella Maris Mother and Child Hospital Medan that the number of recurrent outpatients during the last 8 months (the period January 2019-August 2019) was 37,294 patients. While the total number of outpatients as many as 47,179 people, namely in January 2019 as many as 6,074 people, February 2019 as many as 5,271 people, March 2019 as many as 5,828 people, April 2019 as many as 5,474 people, in May 2019 as many as 5,783 people, in June 2019 as many as 5,694 people, July 2019 as many as 6,224 people, and in August 2019 there were 6,831 people. The average number of outpatients every month is 5,898 (RSIA Stella Maris, 2019b). In statistical techniques we know what is called Structural Equation Modeling (SEM). SEM is a statistical technique that is able to analyze the pattern of relationships between latent constructs and indicators, latent constructs with one another, and direct measurement errors. SEM is a multivariate dependent statistical family. SEM allows analysis between several dependent and independent variables directly (Yamin, 2009).

Data analysis uses the Structural Equation Modeling (SEM) approach using the AMOS program. Structural Equation Modeling (SEM) equation model based on components or variants. AMOS can help researchers for predictive purposes. The formal model defines latent variables as linear aggregates of the indicators. Weight estimates for

creating the component score of latent variables are obtained based on how the outer model (measurement model is the relationship between indicators and constructs) and inner model (structural models that connect between latent variables) (Ghazali, 2013; Turnip et al, 2020; Wijaya et al, 2019).

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Preliminary survey conducted by researchers conducted observations on 20 outpatients by asking them, how long they waited for a queue in the outpatient room. A total of 12 people said to wait less than 1 hour ( $\leq 60$  minutes) while 8 others said to wait for a queue for more than 1 hour ( $> 60$  minutes). They said that they were bored and caused more time to be consumed because they had to queue and did not know when the time would be called for inspection.

## 2 METHOD

This type of research is a quantitative analytic study with a cross sectional study design. This research was conducted at Stella Maris Hospital in Medan in November 2019. The study population was all outpatients at the Polyclinic of the Stella Maris Hospital in Medan with an average number of 5,898 people per month, and samples were 260 people. The research sampling technique was accidental sampling. Univariate data analysis, bivariate using chi-square test, and multivariate using multiple logistic regression tests with a confidence level of 95% ( $\alpha = 0.05$ ).

In this study data analysis using the Structural Equation Modeling (SEM) approach using the AMOS program. Structural Equation Modeling (SEM) equation model based on components or variants. AMOS can help researchers for predictive purposes. The underlying reason used by SEM is First, SEM has the ability to estimate relationships between variables that are multiple relationships. This relationship is formed in the structural model (the relationship between dependent and independent constructs). Second, it has the ability to describe the pattern of relationships between latent (Unobserved) and manifest variables (manifest variables or indicator variables). In its development, processing data for SEM analysis has become easy with the help of several statistical software, such as Lisrel, AMOS, and Smart PLS. The reliability test in SEM is calculated using the following formula (Puncopo, 2015).

The variables in this study consisted of queuing variables as exogenous variables. Human resources and arrival as endogenous variables. Data analysis in this study uses descriptive analysis and Structural Equation Modeling (SEM) analysis. Descriptive analysis aims to describe the characteristics of the respondents studied as well as each variable so as to give a clear picture of the patient queue. Structural Equation Modeling (SEM) analysis is used to test the models and relationships developed in this study. SEM is a statistical technique used to measure research questions that are regression or dimensional.

The data analysis technique used to discuss the problems in this study is the Structural Equation Model (SEM). Structural Equation Model (SEM) models are statistical techniques that enable the testing of a series of relatively complex relationships simultaneously (Ghozali, 2007). Complex relationships can be established between one or several dependent variables with one or several independent variables. There may also be a variable that has a dual role, that is, as an independent variable in a relationship, but becomes a dependent variable in another relationship given the tiered causal relationship. Conceptual framework or thought flow in this study can be seen in Figure 1 which shows the research flowchart model.

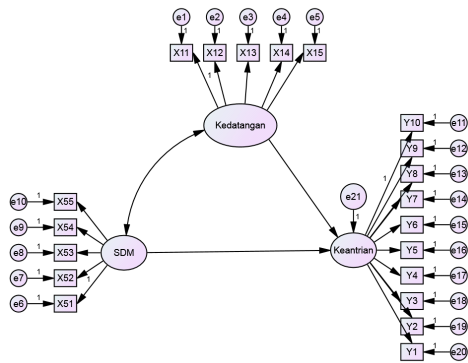


Figure 1: Model diagram of the patient queue path.

### 3 RESULTS AND DISCUSSIONS

Characteristics of respondents most of the majority of respondents aged <43 years were 54.6%. Based on gender, the majority of respondents were female as many as 52.7%. Based on education, most of the respondents had high education as much as 78.5%, the rest had secondary education as much as 21.5%. Based on work, the majority of respondents work as entrepreneurs / traders as much as 37.7%, the rest are civil servants as much as 13.0%. Based on the reason for the visit, the majority of respondents to the hospital for treatment were 50.8%, the rest were for controls (routine checks) as much as 49.2%.

Based on the results of bivariate analysis, all independent variables are significantly related to maternal satisfaction, namely physical evidence (p = 0,000), reliability (p = 0,000), responsiveness (p = 0,000), guarantee (p = 0,000), and empathy (p = 0,000) ), Full Chi-Square statistical test results can be seen in Table 1.

Table 1: Relationship of Each Independent and Dependent Variable.

Variables	Keantrian Pasien		Jumlah	p-value
	Tidak Antri	Antri		
	f	f	F	
Arrival:				
On time	121	51	172	0,027
Not on time	49	39	88	
Waiting time for registration:				
Suitable	109	46	155	0,047
Not Suitable	61	44	105	

Waiting Time for Doctor Services:				
Suitable				0,002
Not Suitable	108	38	146	
Waiting Time for Pharmaceutical Services:				
Sesuai	62	52	114	0,049
Tidak sesuai				
Human Resources:				
Adequate	105	44	149	0,000
Inadequate	65	46	111	
	150	41	191	
	20	49	69	

Multivariate analysis results with multiple logistic regression tests (Table 2) show that of the 5 variables as model candidates, 3 variables are obtained that are related to the cause of patient queue, namely waiting time for registration until the call, waiting time for doctor services and HR availability.

The variable that has the greatest relationship with output is the HR availability variable having a value of Exp (B) / OR = 9,618 meaning that patients who state that human resources (HR) are adequate are available, and the chances of patient queue being resolved are 9.6 times higher.

Table 2: Multiple Logistic Regression Test Results.

Variabel	B	Sig.	Exp(B)	95% CI for Exp(B)
Waiting time	0,867	0,007	2,380	1,272-4,452
Service time	1,081	0,001	2,946	1,584-5,480
Availability SDM	2,264	0,000	9,618	4,965-18,630
Constants	-2,024	0,000		

#### 3.1 Waiting Time Factors

Based on the results of the study showed that there was a relationship between the time of registration and call with the cause of the patient queue, p = 0.007 <0.05. Variable length of time of registration until the summon has a value Exp (B) / OR = 2.380 means that patients who state the length of time of registration until the summon was appropriate, the patient queuing chance was resolved by 2.3 times higher than that which was not appropriate.

Patients or customers come to a health facility with random, irregular time and cannot be served immediately so they have to wait long enough. The queue process starts when customers who need service start coming (registration) to get health care facilities according to their needs. They come from a

population that is referred to as an input source. The input source of a queuing system consists of a population of people, goods, paperwork components that come to the service system.

The results of this study prove that the queue or waiting time of patients from registration to the call is the cause of the patient queue. The average time required by patients in the registration section is 10.57 minutes, with the fastest time (minimum) of 5.08 minutes, and the longest time is 14.59 minutes. It was also found that the majority of patient waiting times were appropriate ie below the average time even though there were still 40% of respondents with waiting times above the average time. This is due to the large number of patient visits so they have to queue and wait for the examination of patients who have come first. The Hospital must strive for the waiting time (queuing) of patients in the registration until the calling is increased again, so that more patients are waiting in line below the average waiting time.

### 3.2 Service Time

Based on the results of the study showed that there is a relationship between the length of time the doctor's service and the cause of the patient queue,  $p = 0.001 < 0.05$ . The length of time the doctor's service variable has the value  $\text{Exp (B) / OR} = 2,946$  means that patients who state the length of time the doctor's service is appropriate, the patient queuing chance is resolved by 2.9 times higher than that which is not appropriate.

The results of this study prove that the length of time a patient's health examination by a doctor is one of the causes of patient queue. If seen from the waiting time or the average doctor's service time the patient is 16.58 minutes exceeding the standard average waiting time which is 15 minutes. The shortest service time is 8.59 minutes while the longest service time is 29.54 minutes. As many as 56.2% of patients get appropriate services in the sense that less than 15 minutes get doctor's services, while the other 43.8% get services more than 15 minutes.

Doctor's examination in outpatients also depends on the patient's condition at the time of the examination, whether the patient has a disease in the category of mild, moderate or severe. A quick and thorough examination requires a longer time, especially for patients who come with moderate and severe disease, whereas patients with mild illness conditions, the examination is carried out with a faster time.

### 3.3 Availability

Based on the results of the study showed that there is a relationship between the availability of human resources (HR) with the cause of the queue of patients at Stella Maris Hospital in 2019,  $p = 0,000 < 0.05$ . Variable availability of human resources has a value of  $\text{Exp (B) / OR} = 9,618$  meaning that patients who claim the availability of adequate human resources have a chance of queuing for patients to be 9.6 times higher than patients who claim the availability of human resources is inadequate.

The results of this study prove that human resources were related to the patient queue. The sufficient number of employees in the registration section has an impact on reducing the number of queues in the registration section. Human resources or officers who work skillfully and skillfully will be able to make the queue not pile up. Likewise friendly and communicative officers make it easy for patients to understand the stages of service. As many as 73.5% of respondents stated that human resources in the registration section were sufficient. Respondents who said that HR was inadequate because they had to wait longer, especially in the registration until the summons. For this reason, the hospital must innovate by providing free wifi for all visitors, especially outpatients so that when waiting in line, they can spend time surfing the internet. In addition, the Hospital must provide regular training to each employee in the registration section so that the ability and competency of employees increases.

### 3.4 Modeling using SEM

Figure 2 showing the model after analysis and modification, the chi-square value of 196,714 with a p-value greater than the specified criteria ( $0.0477 < 0.05$ ), so that the overall fit size of the model based on the chi-square value has a good matching level. RMSEA value of 0.028 (close fit 0.05 good fit 0.08 bad fit) with a p-value of  $.0477 < 0.05$  and the RMSEA value is within 90 percent confidence interval for RMSEA of 0.020; 0.083, so the RMSEA is in good precision. Differentiate the results of the RMSEA match size to have a good fit.

Indicators on the arrival variable are X1.1, X1.2, X1.3, X1.4, and X1.5. Shows the results of the biggest value loading factor of 1.47 indicated by the value of X1.5 to the arrival variable. this shows that the X1.5 variable has a greater influence than the other variables on the arrival variable. It can also be concluded that to find out the patient's flow in the hospital, X1.5 is a very important factor.

Indicators on the HR variable are X5.1, X5.2, X5.3, X5.4, and X5.5. Shows the results of the biggest value loading factor of 8.34 indicated by the value of X5.3 to the HR variable. this shows that the X5.3 variable has a greater influence than the other variables on the arrival variable. It can also be concluded that to find out the patient's flow in the hospital, X5.3 is a very important factor.

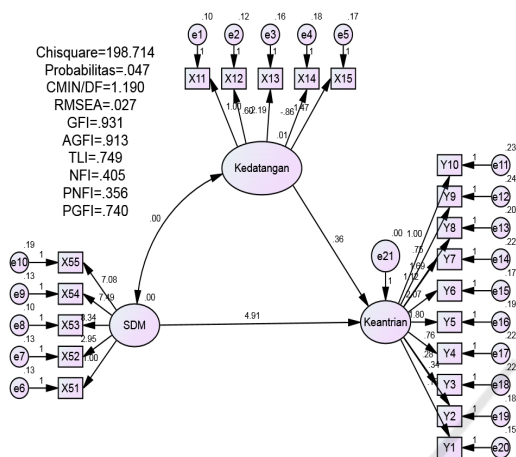


Figure 2. Patient Queue Model

Evaluation of the model is done through suitability and statistical tests, and reliability testing. In the suitability and statistical tests carried out by using several Fit Indexes to measure the truth of the proposed model. The results of the evaluation of each of the modified models are compared with the statistical limits set in the SEM procedure. The results of the Goodness Of Fit Indexes test in this study are as follows:

Table3: Recapitulation of Goodness Evaluation (Fit)

Criteria	Fit Cut of Value	Results	Evaluation
Chi Square	$\cong 0$	198,71	Fit
Probability	$< 0,05$	0,047	Fit
CMIN/DF	$< 2,00$	1,190	Fit
GFI	$\cong 1$	0,931	Fit
RMSEA	$< 0,08$	0,027	Fit
NFI	$\cong 1$	0.845	Fit

Based on the Table 3 it is known that the Goodness of Fit Indexes values of this research model of all the criteria have been fulfilled well, so it can be

concluded that the created model was in accordance with the observation data.

This hypothesis test was conducted to determine whether or not exogenous variables affect endogenous variables. This hypothesis can be accepted if the probability value is  $P > 0.05$  and the Critical Ratio (CR) value  $< 1.96$ .

Table 3: Regression Weights Estimates Software AMOS.

			C.R.	P
Queue	<---	HR	.688	.492
Queue	<---	Arrival	.937	.349

Basis of Decision: If the Probability value (P)  $> 0.05$  then the hypothesis can be accepted, If the Probability value (P)  $< 0.05$  then the hypothesis can be accepted. Based on the table above obtained information from the results of hypothesis testing from HR and arrival to queue has a value of  $P > 0.05$ , then the hypothesis can be accepted. So it can be said that there is a positive and significant effect between HR and the arrival of the patient queue at the hospital.

#### 4 CONCLUSIONS

Physical evidence, reliability, responsiveness, and empathy influence on maternal satisfaction while guarantee variables have no effect. The most influential variable in this study is the responsiveness variable which has a value of  $\text{Exp}(B) / \text{OR} = 7,985$  meaning that the mother who states the responsiveness of the hospital is good, have a 7.9 times higher chance of being satisfied with pregnancy and childbirth services.

The results of the SEM study show that there is a relationship between the length of time the doctor's service and the cause of the patient's queue. The hospital is seen from the value of  $p = 0.349 > 0.05$ . If seen from the average patient waiting time or doctor's service time which is 16.58 minutes exceeding the standard average waiting time which is 15 minutes, a fast and thorough examination is needed by the hospital for the efficiency of doctor's service time so as to reduce the patient queue length in the hospital .

There is a relationship between the availability of human resources (HR) and the causes of queues in hospital patients with a value of  $p = 0.492 > 0.05$ . This proves that human resources at the hospital are related to the occurrence of patient queues. In this case a

sufficient number of employees can affect the speed of the patient registration process. In addition, the hospital must make innovations by providing convenient facilities for all visitors, especially outpatients so that when waiting in line patients still feel relaxed.

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