Abstract—Mental health polyclinic has a very different treatment for patient than other polyclinics. In the mental health polyclinic, patients are given more treatment in the form of consultations than medical measures as in surgical or other polyclinics. It caused to the time required to provide treatment to patients will vary and affecting queue time that cannot be calculated appropriately. This study aims to evaluate queue management at a mental health polyclinic in one of the hospitals in Bandung, which is the object of research, and compare it with hospital's standard operating procedure whether it is in accordance with the standard or not. This research uses POM-QM software tool with multi-channel single phase queuing model to process queue data. The results showed that mental health polyclinic utility was 88.76% and the probability of 0 patients in the system was 0.59%. Each patient takes an average of 91.71 minutes to complete treatment at a mental health clinic and the average waiting time to be served is 62.13 minutes. Compared with the hospital’s SOP of 15 minutes, the average service time has a difference of 76.71 minutes. This indicates a need for a renewal of standard operating procedures in the mental health clinic at the hospital, due to different handling of each patient compared to other polyclinics and the need to add more mental health clinics and facilities in the system to decrease queue time and utilization in order to keep the facility optimal.

Keywords—management; queue analysis; hospital

I. INTRODUCTION

The hospital is one of the public facilities that is used as a place for treatment for people who are experiencing illness or suffering from illness. However, along with the increase in the number of people and the variety of diseases not accompanied by the addition of the number of hospitals. This causes a queue to get service, even though the queue is something that is very avoided in a hospital because it will delay the services that will be given especially the patient may not be able to wait for treatment from a doctor. The queue in hospital should be managed, company’s queuing management can indirectly reduce customers’ perceived waiting time by improving the waiting environment [1].

Type of hospital treatment is divided into 2 types, there are inpatient and outpatient care. The hospital which is the object of research has a total of 13 polyclinics that serve outpatient services for general patients or insurance guarantees. Outpatient services are important activities of a hospital, which provide diagnostic, curative, preventive and rehabilitative services [2].

Fig. 1. Patient flow in hospital’s outpatient services.

In Figure 1, the process of patient flow in hospital outpatient services. The first stage, the patient must register at the Outpatient Installation registration counter. The patient will be asked for personal data to make a patient’s identity card and medical record data, then the nurse will inform the overall cost and make payment. After that, the patient waits for his turn in the waiting room. When it comes to turn, the nurse calls the patient to the examination room, observation room, or medical rehabilitation room. Then an examination is conducted by the referred doctor and if necessary, assisted by the nurse. After the examination is complete, the patient will be given a doctor’s prescription to be exchanged for medication at the pharmacy or hospital pharmacy.

The hospital’s mental health clinic which is the subject of the study is one of the 13 polyclinics available in the hospital under study. In mental health polyclinic provide various types of services such as mental health examination, psychiatric free examination, psychiatric and psychological counseling, general psychiatry: anxiety, depression, insomnia, psychotherapy, psychosomatic, psychosis, drug dependency clinic, youth and family consultation clinic, clinic learning difficulties, hyperactivity and autism in children, IQ test, talent test, sociology test, and MMPI: Multiphasic Minnesota Personality Inventor.

Based on previous observations, mental health polyclinics have different treatment characteristics from other polyclinics, where patients get more counseling, discussion, consultation
and a variety of mental health tests unlike medical treatment on other polyclinic where length of time can be measured and can meet hospital operational standards. Effective waiting list management enables healthcare providers to reduce lost capacity and to help patients receive the right examination at the right time [3].

This study aims to observe the queues that occur in mental health polyclinics, measure the average time spent by patients in the queue and inside the system, the utilization of the clinic and to analyze and review the operational standard procedures that are currently applied for 15 minutes whether it is in accordance with the condition of the polyclinic or not because patient satisfaction and quality care are important indicators for the success of any health care enterprise [4].

II. LITERATURE REVIEW

Waiting line models make use of queueing theory fundamentals to analyze the impact of alternative operational measures such as queue length, waiting time, and utilization of resources. It can be interpreted that the queuing model makes the queuing theory basis can be used to analyze the impact of alternative capacity options on important operational steps on the operating system such as queue length, waiting time, and resource utilization [5]. There are three components in a queue [6] and queue system concept can be seen on Figure 2.

- Arrival or Input System: Arrival has characteristics such as population size, behavior, and a statistical distribution.
- Queuing or queuing disciplines: The queue characteristics include whether the queue is limited or unlimited in length and the material or the people in it.
- Service Facility: Characteristics include design and distribution of service time statistics.

![Queue system concept](image)

**Fig. 2.** Queue system concept.

The source of input that presents the arrival of customers for a service system has three main characteristics [5]:

**A. Arrival Population Size**

Source of arrival in a queuing system consisting of:

- Unlimited population: the number of arrivals or customers at a certain time is only a small part of all potential arrivals. Examples of an unlimited population are cars that come in a car wash, visitors arriving at a supermarket, and students who come to enroll in a large university.
- Limited population: a queue when there are only potential service users with limited junks. An example is found in a printing shop that has eight printing presses. Each printing press is a potential "customer" that may be damaged and requires maintenance.

**B. Arrival Behavior**

The population to be served has different behaviors in forming a queue, there are three types of behavior [5].

- Patient Customer: machines or people waiting in the queue until they are served and do not move the queue line.
- Customers who refuse: those who will not want to join the queue because they feel that it takes too long to meet their needs.
- Customers who defected: those who enter the queue but are impatient and leave the queue without completing their transactions.

Customer arrival behavior also consists of three types of behavior, namely:

- Reneging: a behavior leaves the queue before it is served.
- Balking: behavior of people who do not enter the queue and leave the queue immediately
- Jockeying: the behavior of people who move from one queue to another.

**C. Arrival Pattern (Statistical Distribution)**

Arrival is considered a random arrival if the arrival is not bound to each other and the arrival event cannot be predicted correctly. Often in queue problems, the number of arrivals at each time unit can be estimated by a probability distribution known as a Poisson distribution. For each time of arrival, a discrete Poisson distribution can be specified using the formula:

\[ P(x) = \frac{e^{-x}x^x}{x!} \]

where,

- \( P(x) \) = the probability of the arrival of \( x \)
- \( x \) = number of arrivals per unit time
- \( e \) = average arrival rate

\[ e = 2.7183 \]

In this research, the research object applied multi-channel single phase queueing system. Multi-channel single phase is a system where customer receive service from only one station and then leave system [5], as seen in Figure 3.

![Multi-channel single phase](image)

**Fig. 3.** Multi-channel single phase.
In the multiple pathway model, there are two or more lanes or service stations available to handle incoming customers. Assuming that the customer who waited for the service came from one line and will be served at the service station that was first available at that time. The multiple-track queue model assumes that the arrival pattern follows the Poisson distribution and the service time follows a negative Exponential distribution. Service is done first-come, first-served, and all service stations are assumed to have the same level of service.

### III. RESEARCH METHODOLOGY

Analysis of queuing system for Multiple Channel Query System model or multiple path queuing model is as follows:

- **Utility Counter Rate** as seen on Equation (1)
  \[ \rho = \frac{\lambda}{m \mu} \]  
  \[ (1) \]

- **Probability of 0 people in the system if** \( M_\mu > \lambda \) as seen on Equation (2)
  \[ P_0 = \frac{1}{\left[ \sum_{n=0}^{\infty} \frac{1}{n! \mu^n} \right] + \frac{\lambda}{M\mu} \frac{M_\mu}{\mu - \lambda}} \]  
  \[ (2) \]

- **The average number of customers in the system as seen on Equation (3)**
  \[ L_s = \frac{\lambda \mu (\lambda/\mu)^M}{(M-1)! (M-\lambda)^2} P_0 + \frac{\lambda}{\mu} \]  
  \[ (3) \]

- **The average time a customer spends in the queue or is being served in the system as seen on Equation (4)**
  \[ W_s = \frac{L_s}{\lambda} \]  
  \[ (4) \]

- **The number of people or average units waiting in the queue as seen on Equation (5)**
  \[ L_q = L_s - \frac{\lambda}{\mu} \]  
  \[ (5) \]

- **Average time spent by a customer or unit to wait in queue as seen on Equation (6)**
  \[ W_q = \frac{L_q}{\lambda} \]  
  \[ (6) \]

Note:
- \( M \) = Number of open lines
- \( \lambda \) = Average arrival amount per time unit
- \( \mu \) = The average number served per unit of time on each path

The population in this study were patients queuing up at the Mental Health Clinic at the hospital which became the object of the study and the sample taken was a queue of patients queuing at the Mental Health Clinic at the hospital for 1 month in May 2018 (27 working day) from Monday to Saturday every week. Every day polyclinic serving patients of 8 hours and the observation is done from 07.30-16.30. Analysis of queue system performance will be assisted with POM QM software to facilitate the authors processing the data.

### IV. FINDINGS

Queues occur because the demand for services is greater than the existing service facilities in the queue system. Thus, there needs to be a queuing system analysis to find out how effective the service facility is. In order to improve the services of the poly, the Outpatient Mental Health Clinic has set the standard operating procedures at the Mental Health Clinic for 15 minutes. If service is not in accordance with the standard operating procedures, then will cause long waiting time before get service. Therefore, a queue system analysis is needed to determine the queue system performance in the poly by comparing the predefined standard operating procedures to perform the services of hospital. Measures for service quality in hospitals should be determined by customer expectations, who along with service provider may participate in setting specifications for hospital service delivery [7].

The queuing model used by the Mental Health Polyclinic today is Multi Channel-Single Phase (M / M / S) with the arrival distribution of Poisson and exponential service distribution. In Table 1 can be seen calculation results with existing condition and under standard operating procedures simulation:

<table>
<thead>
<tr>
<th>Parameter Comparison of Existing and SOP</th>
<th>Existing</th>
<th>SOP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability 0 number in system</td>
<td>0.0059</td>
<td>0.7539</td>
</tr>
<tr>
<td>Average server utilization</td>
<td>0.8876</td>
<td>0.1354</td>
</tr>
<tr>
<td>Average number in the queue (Lq)</td>
<td>0.1322</td>
<td>0.0078</td>
</tr>
<tr>
<td>Average number in the system(Ls)</td>
<td>1.932</td>
<td>0.9653</td>
</tr>
<tr>
<td>Average time in the queue (Wq)</td>
<td>0.0034</td>
<td>0.0002</td>
</tr>
<tr>
<td>Average time in the system (Ws)</td>
<td>91.71</td>
<td></td>
</tr>
</tbody>
</table>

#### A. Level of Polyclinic Busyness (\( \rho \))

The average level of poly activity or average server utilization during 27 days of research that is 0.8876 or 88.76% means that the service provider facilities work within 7.1 hours per day of the overall 8 hours of operation. While with the average service time according to operational standards that is 0.1354 or 13.54% means service provider facilities work within 1.08 hours per day of the overall 8 hours of operation. SOP determination is not based on the length of service time in the field, especially in the mental heal pole that requires more time for observation and patient studies. So, Hospital should review and adjust SOP with length of service time in field and add service room and polyclinic facility.

#### B. Probability of 0 Patients in the System (Po)

The probability of 0 patients in the system for 27 days is 0.0059 or 0.59%. This means the opportunity for unemployed service facilities is 2.8 minutes. While the average service time according to operational standards is 0.7539 or 75.39%.
indicates that the opportunities for unemployed service facilities increased to 361 minutes.

C. Average Number of Patient in Queue (Lq)

The average number of patients waiting in the queue for 27 days of research is 0.1322 people. While the average service time according to operational standards reduced to 0.0078 people. This proves that the faster service provided by Mental Health Polyclinic of Outpatient Installation of Hospital X Bandung, it will further reduce the length of the queue.

D. Average Number of Patient in System (Ls)

The average number of patients waiting in the system or being served for 27 days of research is as many as 323 people. While the average service time according to operational standards reduced to 983 people.

E. Average Waiting Time in Queue (Wq)

The average time spent by patients to wait in the queue for 27 days of research is 0.204 minutes and with the average service time according to operational standards is 0.01 minutes. This can prove that the average waiting for the patient to be reduced by 0.194 if the service in accordance with SOP.

F. Average Waiting Time in System (Ws)

The average time spent by patients to wait in the system or being served for 27 days of research is 91.71 minutes while based on SOP established by the hospital Mental Health Polyclinic is 15 minutes. There was an average difference of time spent by patients (Ws) during the study 27 days (existing) and SOP that is equal to 76.71 minutes, with the discovery of a difference of 76.71 minutes in the implementation of mental health examinations, it is necessary to update the operational standard procedures applied to the mental health polyclinic, due to different handling of each patient compared to other polyclinics and the need to add more mental health clinics and facilities in the system to decrease queue time and utilization in order to keep the facility optimal. A system can work with efficient coordination and control of the flow of all operations – including patients, personnel, and other resources [8].

V. CONCLUSION

The average level of poly activity or average utilization during 27 days of research that is 0.8876 or 88.76% means that the service provider facilities work within 7.1 hours per day of the overall 8 hours of operation. The probability of 0 patients in the system for 27 days is 0.0059 or 0.59%. This means the opportunity for unemployed service facilities is 2.8 minutes from overall 8 hours of operation. The average time spent by patients to wait in the queue for 27 days of research is 0.204 minutes and with the average service time according to operational standards is 0.01 minutes. The average time spent by patients to wait in the system or being served for 27 days of research is 91.71 minutes while based on SOP established by the hospital Mental Health Polyclinic is 15 minutes. There was an average difference of time spent by patients (Ws) during the study 27 days (existing) and SOP that is equal to 76.71 minutes, with the discovery of a difference of 76.71 minutes in the implementation of mental health examinations, it is necessary to update the operational standard procedures applied to the mental health polyclinic, due to different handling of each patient compared to other polyclinics and the need to add more mental health clinics and facilities in the system to decrease queue time and utilization in order to keep the facility optimal. A system can work with efficient coordination and control of the flow of all operations – including patients, personnel, and other resources [8].

REFERENCES