

Bottlenecks Detection for Improvement of The Emergency Department Process Flow in a Healthcare Facility

Nur Farhaniz

Arshad Ayub Graduate Business School,
Universiti Teknologi MARA, Shah Alam, Malaysia

Nor Azlina

Arshad Ayub Graduate Business School,
Universiti Teknologi MARA, Shah Alam, Malaysia

Shahrul Reza

Arshad Ayub Graduate Business School,
Universiti Teknologi MARA, Shah Alam, Malaysia

Siti Rohaya

Arshad Ayub Graduate Business School,
Universiti Teknologi MARA, Shah Alam, Malaysia

Azilah Anis

Corresponding Author

azilahanis@uitm.edu.my

Faculty of Business and Management, Universiti Teknologi MARA,
Cawangan Selangor, Kampus Puncak Alam, Selangor, Malaysia

ABSTRACT

The emergency room of a healthcare facility is one of the most complicated and challenging service production processes. People often talk about overcrowding, long waiting times for treatment, lower quality and safety of care, as well as ineffective use of resources. It was discovered that delays between diagnosis and treatment are patients' biggest complaints. Nevertheless, limited studies were found to investigate the causes of delays in the emergency department of a healthcare facility. This study thus aims to investigate how procedures are carried out in the emergency department of a healthcare facility in Klang Valley, particularly to identify the root causes of long waiting times between diagnosis and treatment, as well as to provide some solutions to address the causes. The qualitative method is applied in the present study. Observation and semi-structured interviews with five important internal resource persons/respondents were used to gather the data. The results show that bottlenecks in the Triage Stage, caused by 1) incorrectly classifying a patient's need, 2) lengthy consultation by a Medical Officer, and 3) a longer time to get the review result of a patient's admission, cause delays in the emergency department of the Healthcare Facility. The findings discovered that the Healthcare Facility should improve staff-patient communication, establish a more effective Queue Management System (QMS), and

reassign duties to improve emergency department process efficiency as well as increase patient satisfaction. The findings from this study, specifically focusing on the comprehensive root-cause analysis, offer the healthcare facility a significant opportunity to drive transformative improvements in patient care and operational efficiency. By leveraging the insights gained through the study, the management can implement the proposed solutions to reduce delays and proactively address emergency department bottlenecks.

Keywords: Bottleneck, Waiting time, Process flow, Cause-effect Analysis, Emergency Department, Lean application

INTRODUCTION

The Emergency Department, or ED, is the busiest and most important department in any healthcare facility. *Ali Alowad et al. (2020)* state that the procedure in the emergency department is one of the most complex and dynamic procedures in a service production process. The emergency department in most hospitals in Malaysia, normally operating 24 hours a day with limited resources, perpetuates a chaotic situation. For example, according to an article in *The Straits Times* written in 2023, a shortage of intensive care unit (ICU) beds increases the number of patients receiving adequate medical care in the emergency department and delays transfers to the ICU. This might be seen as a reason why patients are often unsatisfied with the services provided by hospitals, especially regarding the waiting times between diagnosis and treatment.

Among the challenges in complex operations of emergency departments are overcrowding, treatment delays, reductions in both quality and safety of care as well as inefficient use of available resources. However, the most common complaint from the patients is treatment delays/ long waiting times, as reported by previous researchers, for instance, by *Moreira (2017)*.

In determining the root cause of the delays/ long waiting time at the emergency department, problem analysis was conducted by analyzing the number of complaints and understanding the patient process flow of the emergency department of the Healthcare Facility in Klang Valley. Problem analysis is used in the present study to examine an existing situation by identifying the issues impeding the organization's progress and generating a list of potential improvement opportunities.

According to a Healthcare Customer Complaint Report for 2022 (*Customer Service Department, 2022*), the emergency department received 83 complaints from January to December 2022. The Pareto chart in Figure 1 below depicts 83 complaints received for the emergency department, with 26 or 31% of them related to waiting time. The complaints demonstrate that the healthcare facility must identify flaws to avoid being the cause of future declines in customer rating experience, particularly those related to services provided at its emergency department.

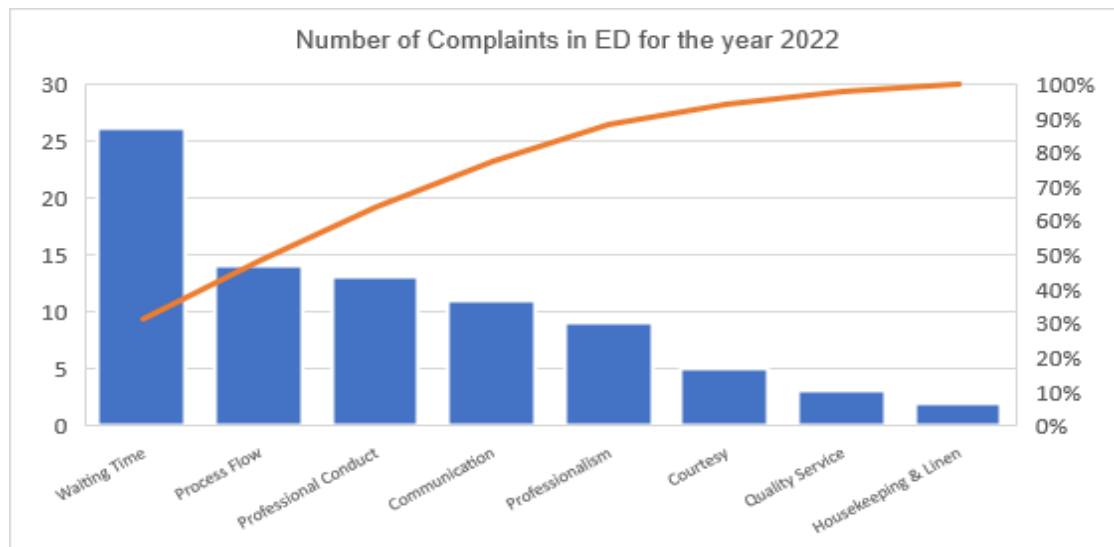


Figure 1: Pareto Chart for the Number of Customer Complaints in the Emergency Department for 2022

Source: Customer Service Department (Healthcare's Customer Complaint Report for The Year 2022)

Considering the scenario mentioned above, this study thus aims to investigate the current process of a Healthcare emergency department's facilities in an attempt to identify operational difficulty factors or bottlenecks based on elements contained in the theory of the Cause-and-Effect Diagram. In addition, the most pertinent internal resource individuals of the Healthcare Facility are consulted to validate the focal points that the Healthcare Facility must take seriously to address patient complaints regarding wait times at the emergency department, which can affect future demand of the Healthcare Facility.

LITERATURE REVIEW

Waiting Time and Bottleneck

Nowadays, issues of overcrowding due to long waiting hours in the emergency departments have been a common issue raised by almost every healthcare facility globally. According to *Durand et al. (2012)* as well as *Andrews and Kass (2018)*, excessive waiting periods, unit overcrowding, non-urgent patients attending emergency departments, and personnel shortages are the main obstacles limiting prompt healthcare delivery. In order to have a clear view of the waiting time issue at the emergency department of a healthcare facility, it is essential to understand the overall process flow of the patients who seek medical treatment at the emergency department. Emergency department waiting time is an important criterion for evaluating the emergency department's performance (*Khalifa and Khalid, 2015*). The emergency department is organized into three areas: Major medical/trauma, Minor Medical/trauma, and emergency department walk-in. Each has a separate physical area and serves a different set of patients. When patients enter the emergency department, they first see a triage nurse, who determines the severity of their condition. Immediately afterward, the Patient Flow System (PFS) assigns a Unique Health Identification Number (UHIN) if the patient is new to the healthcare. With the help of the patient's name, date of birth, and mother's maiden name, PFS checks the information system for previous medical records for the patients to proceed to the further stages (*Anil & Meenal, 2017*).

In another study conducted by *Ali Alowad et al. (2020)*, the overall steps involved in the patient journey in the emergency department are arrival, registration/reception, triage, critical care unit, intermediate care unit, screening room, diagnostic testing, follow-up treatment, patient discharge from the emergency department to home or admit into in-patient ward. Commonly, this would be the standard set up of the emergency departments of Healthcare Facilities globally and the structure of the emergency department of the Healthcare Facility for the present study. *Kriegel et al. (2015)* highlighted that an efficient patient flow is crucial for ensuring patients are present and prepared at every point of care they require. Moreover, the patient flow in the hospital setting is highly complex, influenced by various factors such as the timing of patient inflow, individual patient needs, treatment response, and current medical knowledge (*Bohmer, 2005*).

From the process flow, a bottleneck is expected to occur in either one or more stages of the emergency department. Due to the bottleneck, the emergency department of the healthcare facility experience delays or setbacks because they are burdened with more than one task, even when operating at a maximum capacity. This leads to delays within the emergency department and disrupts workflow throughout the production stages. *Mihalj et al. (2022)* mention that bottlenecks represent a location of congestion that frequently results in delays, a backlog of patients, or administrative processes, which results in increased expenditures and degraded service. A study by *Urban and Rogowska (2018)* highlights that bottlenecks limit the capacity and throughput of the production system; thus, identifying and eliminating bottlenecks is the most effective approach for a company to increase its production and economic performance.

Lean Application in Healthcare Facility

Various studies have proven that deliberately adapting lean applications will improve the patient process flow in the Healthcare Emergency Department. This is because lean application brings all stakeholders together as a multidisciplinary team with the goal of continuous improvement (*Vinodh et al., 2011*).

There are several obvious advantages of implementing lean in the healthcare facility. For instance, implementing lean facilitates waste reduction in broader healthcare settings. Furthermore, as *Diego Tlapa et al. (2020)* highlighted, implementing lean in the healthcare industry helped reduce waiting time as well as identify and minimize non-value added (NVA) activities.

Anil & Meenal (2017) recommend that one of the solutions for the emergency department that could provide a huge impact is by investing in a good Patient Tracking System and ID. Many computerized patient tracking systems, such as those the hospital is considering, are electronic tracking. Operational data related to patient flow requires a clear, consistent, and efficient patient identification system. Various alternatives, such as bar codes and radio frequency IDs, are available, which can directly save operating costs and offer valuable data on patient flows. Another study from *Tsui & Fong (2018)* emphasizes that the commonly discussed suggestion to reduce the waiting time is to consider the continuous improvement of their manpower, including the medical personnel, nurses, and administration staff. The manpower of the health care facility should be frequently trained to alert them on providing the best services to the patient. This is because their action and response will, directly and indirectly, impact the patient's life and death.

RESEARCH METHODOLOGY

A qualitative research approach was adopted to investigate the causes that affect the patient waiting time at the emergency department of a healthcare facility in Klang Valley, Malaysia, as well as to provide some recommendations to address the problem.

Two different approaches were implemented for collecting the data for the present study. The first approach is observing and self-experiencing the process flow of the emergency department. Throughout the process, personal notes were taken and data was compiled accordingly. The second approach is by conducting a semi-structured interview with the five (5) most relevant internal resource persons of the Healthcare Facility. The resource persons were selected due to their position and experience with the process flow in the emergency department of the healthcare facility. The list of the five selected resource persons (RP) is displayed in Table 1:

Table 1: List of Resource Persons

No	Position	Year of experience
RP1	CEO of the Healthcare Facility & Ex-Medical Officer in the Emergency Department	15
RP2	Group Head Facilities Support Services – Operations	10
RP3	Nurse Manager, Accident & Emergency Services	16
RP4	Head of Department, Patient Safety & Quality Assurance	1
RP5	Assistant Manager, Patient Safety & Quality Assurance	16

During the interview sessions, responses from the respondents were recorded using a voice recorder which was later analyzed. Data obtained from both methods, i.e., the observation and semi-structured interview, were then analyzed using content analysis. The approaches of prolonged involvement, member checking, and audit trail were applied to enhance the validity of the research. Prolonged involvement is adopted by spending sufficient time in the field to develop a deep understanding of the overall context of the study. This is followed by a member checking whereby the interpretations of data obtained from both methods were shared with the participants for validation. Finally, a record of all the activities involved in the research process, including personal notes and voice recordings, was kept as an audit trail to ensure the transparency of the research. Subsequently, the interview session's output was summarized using the Ishikawa or Cause and Effect diagram.

FINDINGS

This section will be divided into two sections according to the aims/ purposes of the present study; firstly, to identify the root causes of the waiting times between diagnosis and treatment of the patients at the emergency department, and secondly, to provide some solutions to address the identified causes.

To identify the root cause of the waiting time between diagnosis and treatment of the patient at the ED

To determine the root causes for the waiting time, the present study's findings are explained through the approaches used: observations and semi-structured interviews.

Observation:

Patients in the emergency department are classified into Green Zone, Yellow Zone, and Red Zone. These zones are divided according to the severity of the patient's health conditions. The Green Zone treats patients with minor, non-critical conditions, including cuts, sprains, and minor head injuries. In contrast, the Yellow Zone treats patients with semi-critical conditions like abdominal pain or mild breathing problems. Meanwhile, the Red Zone treats patients with complex and very severe conditions like heart attacks or accidents that cause significant external bleeding. At the Red Zone, patients will be treated immediately, resulting in no waiting time in the Red Zone. The present study focused on the Green and Yellow Zone, which requires patients to wait longer.

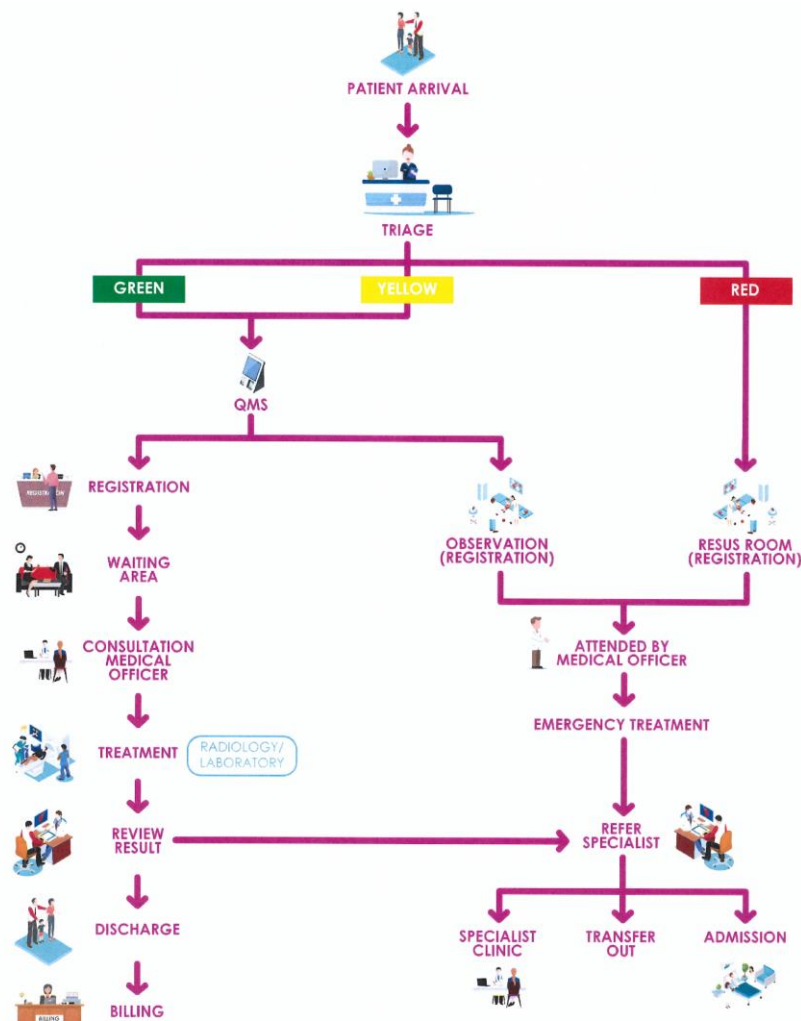


Figure 2: Process flow of Emergency Department

Source: Healthcare's Emergency Department (Process Flow SOP of Emergency Department)

The Healthcare Facility employs Patient Monitoring System (PMS), which is sent digitally to all patients after treatment. The system is accessible by an online link via mobile or a digital gadget provided by the hospital.

Referring to Figure 2, patients will encounter six steps in the emergency department before discharge. The steps are triage, registration, waiting area, consultation with medical officer,

treatment, and review results. The flow starts with the patient's arrival. Upon arrival, patients will be given a triage number and must wait for a triage assessment. During triage assessment, the patient will be categorized as Green, Yellow or Red. Patients will get a new number depending on their category and they will register themselves at the registration counter. After registration, patients will wait in the waiting area for their consultation with the medical officer. After waiting some time, patients will be consulted by a medical officer and receive the necessary treatment depending on their conditions. Occasionally, some patients need to undergo radiology and laboratory treatment including blood tests, X-Ray, CT scans, etc. Each treatment will require the patient to take a new number accordingly. The final step is the result review session based on each patient's treatment. After completing all these six steps, finally, the patient can be discharged. However, there are conditions where patients need to refer to a specialist if necessary.

According to the process flow in Figure 2, it is identified that there will be three stages that will require patients to wait. The stages are triage, consultation with the medical officer, and review of results. Hence, data for these stages is essential for further understanding the present study. Nevertheless, due to some limitations, data on waiting time can only be obtained at triage and consultation with the medical officer. The data for triage and consultation for three consecutive months: November 2022, December 2022, and January 2023, are tabulated in Table 2.

Table 2: Waiting Time for Triage and Consultation Medical Officer

No	Item	November 2022	December 2022	January 2022
1	Total patients received	3176	3544	2332
2	Standard waiting time for Triage (Set by management)	≤ 15 minutes		
3	Average waiting time for Triage	4 min 14 sec	4 min 58 sec	4 min 10 sec
4	No. of patients wait more than 15 minutes	209	206	230
5	Standard waiting time for Consultation Medical Officer (Set by management)	≤ 45 min		
6	Average waiting time for Consultation Medical Officer	16 min 25 sec	16 min 20 sec	16 min 29 sec
7	No patients wait more than 45 minutes	122	92	57

As shown in Table 2, it is known that the Healthcare Facility has set the standard waiting time for both stages. The standard waiting time for triage (line no. 2) must be less or equal to 15 minutes, whereas the standard waiting time for consultation medical officers (line no. 5) must be less or equal to 45 minutes.

Waiting Time for Triage:

As observed in Table 2, the average waiting time (line no. 3) to be called for triage assessment was approximately 4 minutes plus. Although it appears to comply with management standard waiting times, more than 200 patients (line no 4) still have to wait more than 15 minutes each month.

Waiting Time for Consultation Medical Officer:

As for the waiting time for Consultation Medical Officer, it is revealed that the average waiting time (line no. 6) to be consulted by a medical officer is approximately 16 minutes plus. Again, although it meets the health facility standard waiting time for consultation, some patients have waited more than 45 minutes. The number of patients who have waited more than 45 minutes in November, December, and January 2023 are 122, 92, and 57 respectively (line no 7).

Thus, by referring to the data presented in Table 2, it is verified that the waiting time has been an issue for the emergency department in the healthcare facility, particularly at the triage and consultation with the medical officer. Although the number of patients who have stayed longer than it should be for both stages seems small, the standard that has been set still needs to be met. Furthermore, this was supported by the fact that the highest complaint received in the emergency department for 2022 was waiting time (refer to Figure 1).

Semi-Structured Interview

All respondents (refer to Table 1) do not deny the number of complaints depicted in Figure 1 and agree that waiting time is currently the most significant impediment the management should overcome. Most respondents state that the waiting period is subjective based on the type of treatment the patient requires or the desire to seek a consultation from their preferred Medical Officer as service quality preferences. This is also acknowledged by *Johnson et al. (2016)*, who discovered that some critical aspects of service quality contribute to long-term patient satisfaction.

According to the Malaysian Society for Quality in Health (MSQH) standards for Performance Indicators of Emergency Department Service Standards, the maximum waiting time for yellow cases is 30 minutes, while the maximum waiting time for green cases is an hour. However, the Healthcare Facility has established a standard waiting period of 15 minutes for yellow cases and 45 minutes for green cases. Based on the interview, the average patient waiting time is approximately 16 minutes (day or night). The waiting time might be extended if the patient is required to undergo an extra assessment such as a laboratory test or x-ray examination.

As depicted in Figure 1, most respondents acknowledged that certain steps of the Emergency Department's Process Flow have contributed to patient waiting times. This may be influenced by the clinical and soft skills of personnel, particularly nurses, or by the level of interaction between the Emergency Department Team and patients, which might increase their work efficiency.

Bottleneck Analysis:

Based on Figure 3 below, it is identified that the bottleneck in the Emergency Department process flow is at the Triage stage, from the Waiting Area to the Consultation of Medical Officer stage and Reviewing Result stage. Based on the interview feedback by Patient Safety, Quality and Assurance Department (PSQA Department), it is clarified that the bottleneck occurring in the Triage stage is mainly because of a wrong decision made by Triage staff, affecting the waiting time. For example, if they inappropriately classified the yellow cases as green cases, it might cause significant delays to the next process and danger to the patients.

In addition, from the feedback from the interview, the prolonged consultation by Medical Officer may also have contributed to the long patient waiting time. This problem will only improve if sufficient labor exists, especially during certain shifts and peak hours

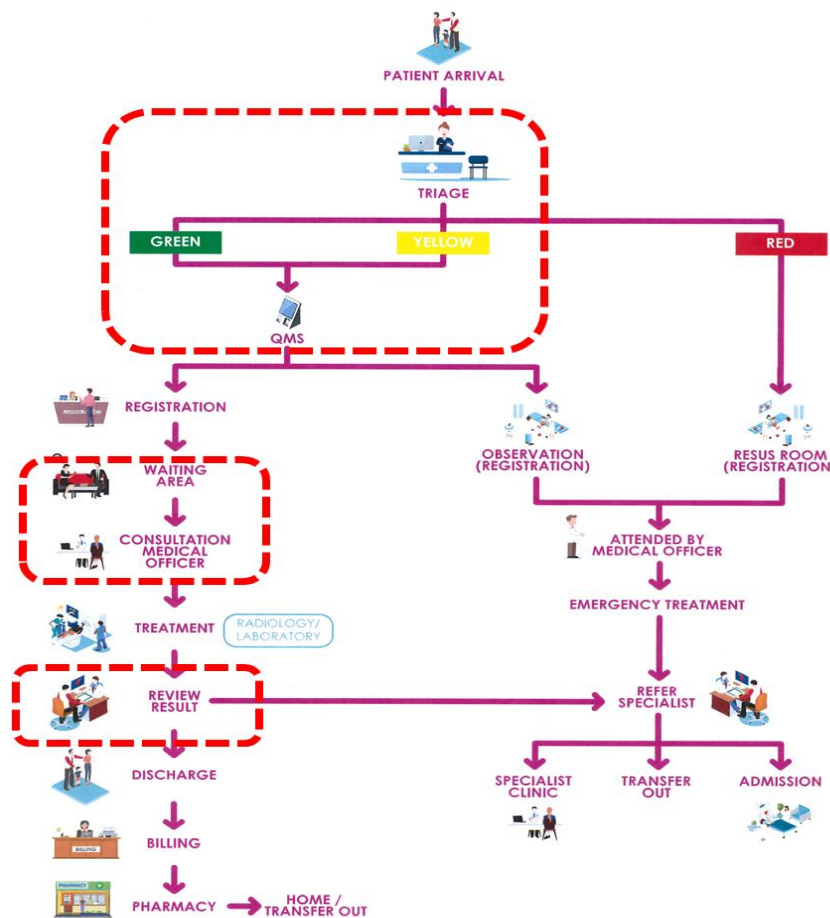


Figure 4: Bottlenecks identified in the process flow of the Emergency Department

Lastly, the waiting time to get to the review result of the assessment with the Medical Officer is another bottleneck identified in the process flow. This is because certain staff members were unaware of checking the result, which was eventually ready to be reviewed. This leads to longer waiting times for the patient and in some situations, patients have to take the initiative to ask the clinical staff to check their results. In overall, the root causes of these bottlenecks and outputs of the interview are shown in the Cause-and-Effect diagram in Figure 5.

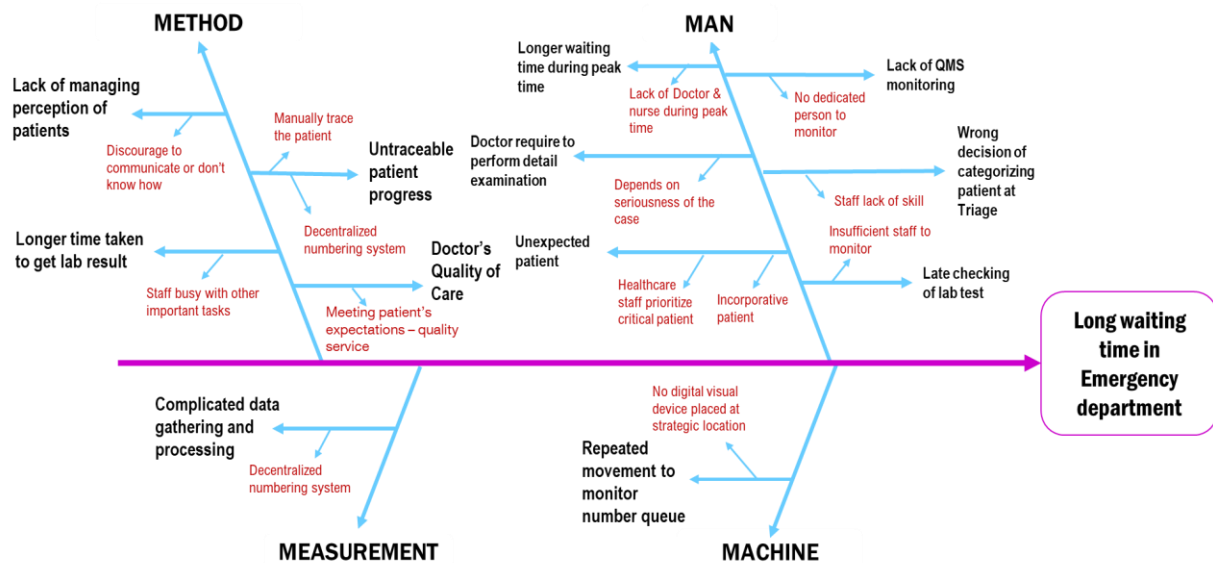


Figure 5: The Cause-and-Effect Diagram of the causes for waiting time at the Emergency Department

Source: Heizer et. al. (2017)

From the diagram, it is shown that both Man and Method are the key contributors to the long waiting time of patients in the Emergency process flow. The 'Man' factor is mostly emphasized during the interview session with the respondents. The insufficient number of staff attending to the patients contributes the most to the delay of the processes. On certain occasions, it is based on the situational condition of the patients, which potentially causes longer waiting times for other patients to seek treatment in the Emergency Department. On the other hand, despite the availability of digital technology systems in the market, some of the 'Method' applied within the process still utilizes a manual approach which develops non-value-added activities or wastes. From the same 'Method' branch, managing the expectations of patients was highlighted by the respondents as essential due to the release of unwanted situations that may lead to interruptions and severe delays of process flows at the Emergency Department. Nevertheless, although both 'Machine' and 'Measurement' exhibit not as many root cause branches as the 'Man' and 'Method,' both causes are still important to address as they affect the patient's process flow for getting treatment. Overall, these key visual findings are further elaborated on in the next section.

Findings of the Interview:

The output of the interview session was analyzed and consolidated according to the most significant causes emphasized by each respondent. The findings were grouped into several categories, which are communication, system and manpower that can potentially improve patients' waiting time in the emergency department, as presented in Table 4 below.

Table 4: Key findings and recommendations of the causes

Communication	System	Manpower
Key Findings		
PSQA department highlighted that communication between staff and the patient is essential to ensure the smoothness of the Emergency Department flow.	The most significant cause for the Emergency department's whole process flow is the Queue System's decentralization. This issue affects: • Current Queue system is working fine to notify if any maximum time is reached for a patient. However, regarding the visual check, the staff could not be triggered since there is only one personal computer (PC) for the staff to check. This caused too much motion (waste) and hassle for the staff to check back from the same PC. • Due to multiple numbers being issued at different stages of the flow (over-processing), it caused the patient to be untraceable and staff had to check manually through the documentation. • Current Queue system is also not comprehensive as it does not indicate which stage of the emergency department is taking longer to serve. PSQA department has difficulty understanding the data and is unsure which part of the process needs improvement.	Insufficient staff was highlighted by the operations head due to multi tasks which needed to be attended to. Some important tasks, such as acquiring the laboratory test result and checking the next person to be served were neglected or forgotten. They were causing delays in the progress of the service.
Recommendations		
The head of operations suggested that the communication issue could be improved by assigning a dedicated person to focus on customer service to	• All respondents recommended centralizing the number queue system. This will also improve the data reading process and immediately trigger which	• Nurse Manager recommends that current staff perform well if the assigned job tasks are distributed accordingly to match the demand.

manage each patient's perception. However, at the moment, the company should train current staff to develop the courage to communicate with patients. This is mainly to control the situation in the Emergency Department throughout the process.	part must be rectified immediately. • Digital visual board to be placed strategically to understand patient progress clearly. • In addition, creating a service blueprint and conducting time studies on each step of the emergency department procedure will benefit the Healthcare Facility in streamlining its process flow in the future to reduce waiting times. • The CEO also recommends that digitalizing the Queue system will significantly improve the patient's waiting time in the emergency department.	• Additional manpower in the line-up would also help the process flow and provide more eyes to check or monitor.
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CONCLUSION

Delay or long waiting time is the most common complaint received by the emergency department of a Healthcare Facility in Klang Valley. Due to that scenario, the present study is conducted to identify the root causes of the delay using an observation technique and a semi-structured interview to collect the data. Five internal resource persons or respondents were selected. The findings reveal that the delays/ long waiting time is due to the bottlenecks that occurred at the three identified points which are 1) the Triage Stage, resulting from incorrect decisions made to classify a patient's need; 2) lengthy consultation by a Medical Officer and 3) lengthier time to get the review result of a patient's admission. To resolve the issue, the management of the Healthcare Facility should focus on enhancing communication between staff and patients, improvising a Queue Management System (QMS) and realigning job tasks to the appropriate manpower. The management of the Healthcare Facility can use the study's findings, particularly from the root cause analysis, to develop a plan for reducing long waiting times or eliminating the identified bottlenecks in its emergency department.

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