

FMEA approach to reduce patient delay in Emergency Department

Dissertation Report

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INTRODUCTION

Emergency Department

Critical Role of EDs: Emergency departments are the safety net of the healthcare system, providing immediate care for critical illnesses and injuries.

Alarming Trend: Increased patient delays in receiving this essential care can negatively impact both patients and the healthcare system.

Consequences of Delays: Extended wait times can worsen patient outcomes, decrease patient satisfaction, and strain hospital resources.

FMEA

FMEA as a Solution: Failure Mode and Effects Analysis (FMEA) helps identify and mitigate potential causes of delays in EDs.

Benefits of FMEA: By analyzing patient care processes, FMEA allows staff to pinpoint areas for improvement, leading to smoother patient flow and reduced wait times.

AIM & OBJECTIVES

Aim

The purpose of this study is to assess the factors leading to patient delays in emergency department through failure mode and effects analysis.

Objectives

- ✓ Employing FMEA to systematically recognize potential failure modes that contribute to delays within the emergency department.
- ✓ Assessing the severity, frequency, and detectability of each identified failure mode relevant to wait times in the ED.
- ✓ Calculating a Risk Priority Number (RPN) to rank failure modes according to their potential impact on patient wait times in the ED.
- ✓ Formulating interventions and mitigation strategies to address high-risk failure modes that contribute to extended wait times in the ED.

ARTEMIS HOSPITAL

- ✓ Established in 2007, Artemis Hospital is a Gurgaon landmark for top-tier medical care.
- ✓ Accredited by Joint Commission International (JCI) and National Accreditation Board for Hospitals & Healthcare Providers (NABH), Artemis is committed to quality healthcare.
- ✓ Offering a comprehensive range of services including cardiac care, oncology, minimally invasive surgery and more.
- ✓ Emergency & Trauma Services provides 24x7, full-service emergency and trauma care with a focus on 'Life-Saving Care, Tailored to Patient Needs'.

ARTEMIS HOSPITAL

Australasian Triage Scale

Australasian Triage Scale Category	Response Time	Category Description
Category 1 (Red)	Immediate Simultaneous Assessment and Treatment	Immediate Life-Threatening
Category 2 (Orange)	Assessment and Treatment starts within 10 mins	Imminently Life-Threatening
Category 3 (Green)	Assessment and Treatment starts within 30 mins	Potentially Life-Threatening
Category 4 (Blue)	Assessment and Treatment starts within 60 mins	Potentially Serious/ Situational Serious/ Significant Complexity
Category 5 (White)	Assessment and Treatment starts within 120 mins	Less Urgent

METHODOLOGY

Research Question

Can a Failure Mode and Effects Analysis (FMEA) be employed to systematically identify and prioritize potential sources of delays within the emergency department (ED), ultimately leading to the development of interventions that can effectively reduce these delays and enhance patient care?

Study Setting

The study was conducted in Gurgaon region at Artemis Hospital- a multi-specialty hospital with nearly 550 beds. The research study was conducted under supervision of department head, taking place from March to June 2024.

Data Collection Method

The sample size of the study was 105. The sampling technique used was **Convenient Sampling**. It was collected for patients visiting the ED through:

- ✓ Time Motion Analysis
- ✓ Questionnaire Survey

METHODOLOGY

Data Analysis- Time Motion

- ✓ Shadowing each patient visiting the ED and observed the patient time spend in different departments.
- ✓ Calculated average times for different factors (triage category, day of visit, severity).
- ✓ Used these averages to assess risk factors for FMEA.

Data Analysis- Questionnaire Survey

- ✓ Collected data on delay factors, patient satisfaction, and areas for improvement.
- ✓ Analyzed responses with descriptive statistics and thematic analysis.
- ✓ Used findings to identify subjective factors for FMEA.

METHODOLOGY

Data Analysis- FMEA

The steps involved in the FMEA study are:

Pre-work for study

Path 1 development (Severity)

Path 2 development (Occurrence)

Path 3 development (Detection)

Calculation of RPN

Recommended Action and Action Priority

METHODOLOGY

Data Analysis- FMEA

Pre-work for study

- ✓ The data collated in the time motion study and questionnaire survey was utilized in determining the delay factors and RPN for these factors.
- ✓ The delays factor in the process steps/subsystems were detected and prioritized according to FMEA.
- ✓ Each delay factor was weighed based on its impact on the final product of the system.

This weight was called risk priority number (RPN) and calculated through the following formula:

$$\text{RPN} = \text{Severity} \times \text{Delay Probability} \times \text{Delay Degree}$$

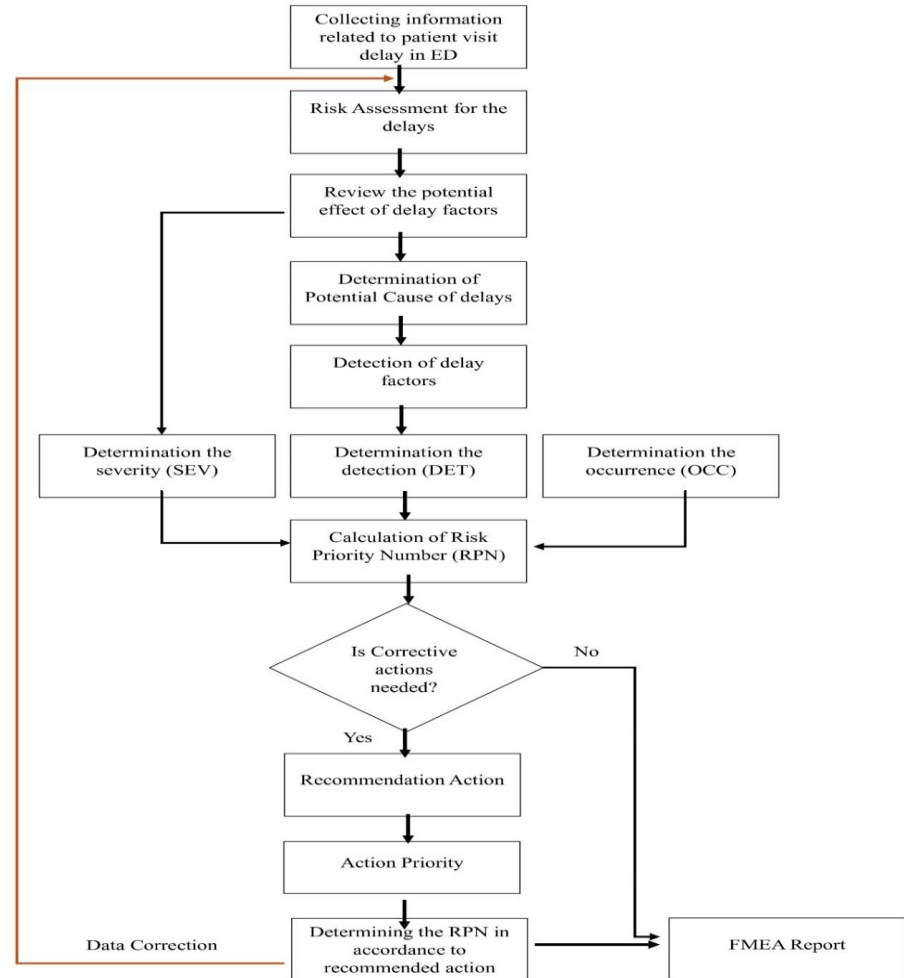
METHODOLOGY

Data Analysis- FMEA

Pre-work for study

Process flow diagram for FMEA:

It explains the methodology and process followed in the study to obtain RPN for FMEA study and further steps.



METHODOLOGY

Data Analysis- FMEA

Path 1 development (Severity)

Path 1 involves determining the severity of delay factors. The data collected in the TMA and Questionnaire survey helps in the risk assessment of delay factors, potential effects of the determined delay factors.

Severity Impact	Criteria Severity of Delay on Patient	Rank
Catastrophic Event	Potential failure mode causes death of the patient or major loss of physiological function	4
Major Event	Potential failure mode leads to potential worsening of condition, exposed to increased risk of complications	3
Moderate Event	Patient experiences prolonged pain or discomfort, delayed treatment, medication errors or missed diagnoses	2
Minor Event	Patients need to have increased length of stay, ED have reduced capacity for new patients	1

Path 2 development (Occurrence)

Path 2 involves determining the occurrence of delay factors. The data collected in the TMA provides the frequency of occurrence of different delay factors and potential cause of the delay factors are determined.

Likelihood of Occurrence	Criteria Occurrence of cause	Rank
High	Potential failure mode have frequency of occurrence more than 12	4
Moderate	Potential failure mode have frequency of occurrence ranges between 8 to 10	3
Low	Potential failure mode have frequency of occurrence between 6 to 8	2
Very Low	Potential failure mode have frequency of occurrence less than 6	1

METHODOLOGY

Data Analysis- FMEA

Path 3 development (Detection)

Path 3 involves determining the detection of delay factors. The data collected in the TMA and Questionnaire survey provides the detection controls of different delay factors during patient visit of ED.

Opportunity for Detection	Criteria Likelihood of detection of delays	Rank
No detection	The potential failure mode is not detection in process	4
Low	Low possibility of detecting the delay factor during patient visit	3
Moderate	Moderate possibility of detecting the delay factor during patient visit	2
High	High possibility of detecting the delay factor during patient visit	1

Calculation of RPN

Risk Priority Number is calculated by multiplying severity rank, occurrence rank and detection rank for each of the delay factors.

Process Step /Subsystems	PATH 1		PATH 2		PATH 3		Recommended Action	Action Priority	S E V	O C C	D E T	R P N
	Potential Failure Mode	Potential Effect of failure	S E V	Potential Cause/Mechanism of Failure	O C C	Detection of Failure Mode						

Sample FMEA Worksheet

METHODOLOGY

Data Analysis- FMEA

Recommended Action and Action Priority

- ✓ Recommended action is provided to each of the delay factors along with action priority based on the RPN.
- ✓ The FMEA actions are closed when actions are taken towards the delay factor with most priority and reassessment of the failure modes are done

RPN Action Priority

1st Priority = RPN > 24

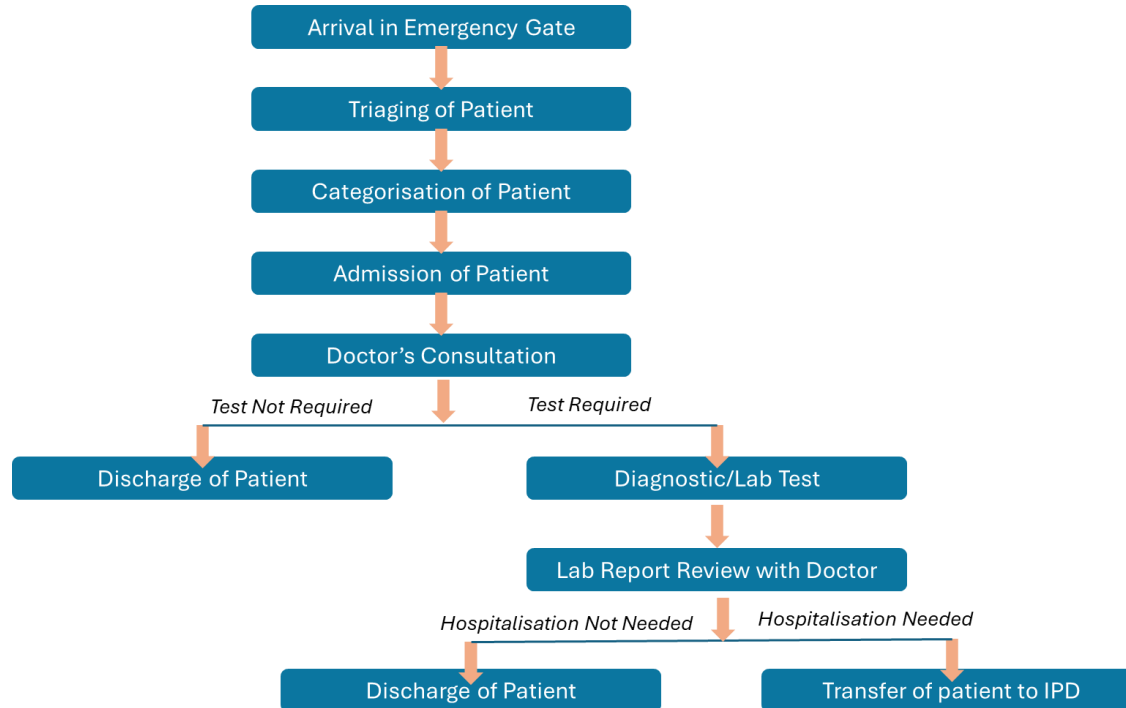
2nd Priority = RPN between 14 and 24

3rd Priority = RPN between 8 and 14

4th Priority = RPN < 8

METHODOLOGY

Process Flow in ED



RESULT

FMEA STUDY

The list of delay factors impacting patient visit in ED, identified during the study were:

Delay in admission due to Insurance

Admission process took time

Beds not available

Time taken to diagnosis problem

Delay during treatment

Rush in emergency

Partial Documentation

Delay due to Insurance clearance

Late sending of the files to the discharge unit

Patient took time to leave

Patient attendant unavailable

Delay in providing test report

Delay in conducting tests

Lack of specific identifying code for the patients' files moving from the ED to any other department

RESULT

FMEA STUDY

Process Step /Subsystems	PATH 1		S E V	PATH 2		PATH 3		D E T	R E P N	Recommended Action	Action Priority	S E V	O C C	D E T	R P N
	Potential Failure Mode	Potential Effect of failure		Potential Cause/Mechanism of Failure	O C C	Detection of Failure Mode	D E T								
Admission	Delay in admission due to Insurance	Increased wait time, anxiety, Potential worsening of condition	4	Complex insurance verification procedures, Lack of trained staff for insurance verification	4	Moderate	2	32		Collaborate with insurance companies to streamline pre-authorization processes.	1st Priority Category	4	3	2	24
Admission	Admission process took time	Frustration for patient, Perception of inefficiency	2	Lengthy intake forms Inadequate staffing	2	Moderate	2	8		Optimize paperwork by reducing unnecessary steps and duplications.	3rd Priority Category	2	2	2	8
Admission	Beds not available	Extended wait time in ED, Potential need for care in non-ideal setting	1	Lack of effective bed management system	1	High	1	1		Implement a real-time bed tracking system to improve visibility of bed availability across departments. Establish better communication between the ED and inpatient wards to coordinate bed allocation.	4th Priority Category	1	1	1	1
Consultation	Time taken to diagnosis problem	Delayed treatment, Potential for complications	2	Complex medical conditions Difficulty obtaining a complete medical history	3	Low	3	18		Implement clinical decision support systems to aid in diagnosis by providing clinicians with quick access to patient data and treatment guidelines.	2nd Priority Category	2	2	3	12
Consultation	Delay during treatment	Prolonged pain or discomfort, Increased risk of complications	2	Waiting for test results Complex treatment procedures	2	Moderate	2	8		Streamlining processes for medication access within the ED can minimize delays in administering necessary medications.	3rd Priority Category	2	2	1	4

RESULT

FMEA STUDY

Process Step /Subsystems	PATH 1		PATH 2		PATH 3		Recommended Action	Action Priority	S E V	O C C	D E T	R P N
	Potential Failure Mode	Potential Effect of failure	S E V	Potential Cause/Mechanism of Failure	O C C	Detection of Failure Mode	D E T					
Consultation	Rush in emergency	Increased wait time for non-critical cases, Potential for errors	2	Seasonal variations in patient volume (e.g., flu season) Major accidents or disasters	1	Low	3 6	Increase operational efficiency by converting underutilised areas of hospital as temporary emergency area and transfer of less prior cases (as per the Triage Categorisation) to these areas of hospital	1st Priority Category	2	1	3 6
Discharge	Partial Documentation	Incomplete medical record, potential for medication errors or missed diagnoses	2	Lack of timely communication from insurance companies Errors or missing information in insurance requests	2	Moderate	2 8	Implement standardized templates for documentation to ensure all necessary information is captured during the initial assessment.	2nd Priority Category	2	2	1 4
Discharge	Delay due to Insurance clearance	Anxiety about cost, Delayed access to necessary care	4	Complex pre-approval process for certain procedures by some insurance companies Lack of timely communication from insurance companies	2	High	1 8	Implement a dedicated insurance liaison within the ED to handle insurance issues and expedite clearances.	2nd Priority Category	4	2	1 8
Discharge	Late sending of the files to the discharge unit	Delayed discharge of patient	1	Inefficient communication between departments (ED and discharge planning) Incomplete discharge paperwork	2	High	1 2	Implement a dedicated discharge coordinator to oversee the discharge process and ensure timely file transfer.	4th Priority Category	1	2	1 2

RESULT

FMEA STUDY

Process Step /Subsystems	PATH 1		PATH 2		PATH 3				Recommended Action	Action Priority				
	Potential Failure Mode	Potential Effect of failure	S E V	Potential Cause/Mechanism of Failure	O C C	Detection of Failure Mode	D E T	R P N			S E V	O C C	D E T	R P N
Discharge	Lack of specific identifying code for the patients files moving from the ED to any other department	Increased risk of lost or misplaced files, Delays in patient care	1	Manual filing system with potential for human error	1	High	1	1	Generate an error check when identifying codes are not entered while transferring files to other departments	4th Priority Category	1	1	1	1
Patient	Patient took time to leave	Reduced bed availability for new patients	2	Waiting for medications or prescriptions	3	Moderate	2	12	Ensure timely completion of necessary paperwork by streamlining processes.	3rd Priority Category	2	2	2	8
Patient	Patient attendant unavailable	Delays in decision-making, Potential for missed information	2	Elderly patients without readily available family Patients with mental health conditions who may not have reliable support	2	Low	3	12	Assist patients in coordinating transportation if needed to facilitate a smooth discharge process.	3rd Priority Category	2	2	3	12
Diagnosis	Delay to provide test report	Delayed diagnosis and treatment, anxiety	3	High volume of tests in the laboratory Equipment malfunction	4	Moderate	2	24	Prioritize turnaround times for critical tests to ensure timely results. Ensure adequate staffing levels in the laboratory departments to avoid delays in processing tests.	1st Priority Category	3	3	1	9
Diagnosis	Delay to conduct tests	Potential worsening of condition, Delayed treatment	4	Need for specialized tests requiring referral to another facility Limited availability of testing equipment	2	Moderate	2	16	Explore the use of rapid diagnostic tests for specific conditions where appropriate.	2nd Priority Category	4	2	1	8

RESULT

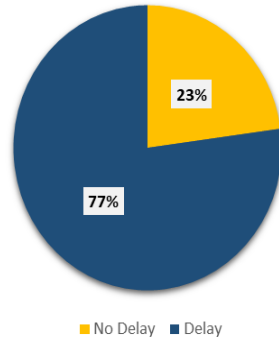
FMEA STUDY

Subsystem	Delay Factor	RPN	Frequency
Admission	Delay in admission due to Insurance	32	13 (12%)
	Admission process took time	8	6 (6%)
	Beds not available	1	2 (2%)
Consulation	Time taken to diagnosis problem	18	9 (9%)
	Delay during treatment	8	7 (7%)
	Rush in emergency	6	5 (5%)
Discharge	Partial Documentation	8	8 (8%)
	Delay due to Insurance clearance	8	6 (6%)
	Late sending of the files to the discharge unit	2	7 (7%)
	Lack of specific identifying code for the patients files moving from	1	2 (2%)
Patient	Patient took time to leave	18	10 (10%)
	Patient attendant unavailable	18	7 (7%)
Diagnosis	Delay to provide test report	12	15 (14%)
	Delay to conduct tests	8	8 (8%)

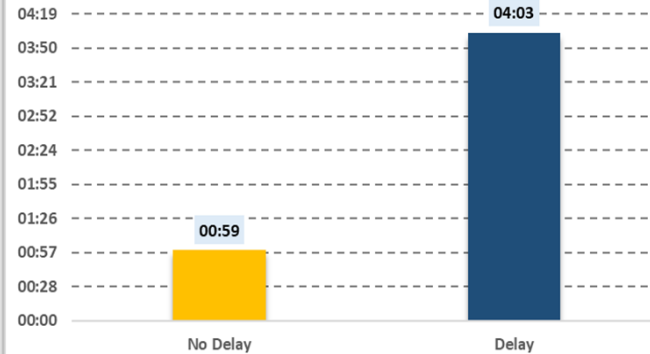
RESULT

TIME MOTION ANALYSIS

Total Cases Observed in ED



Average Patient Time in ED

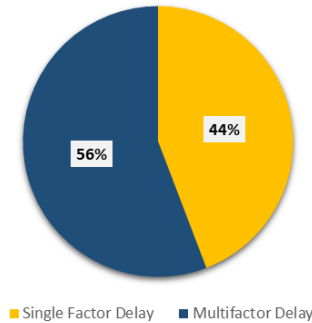


- ✓ 77% of cases observed in ED (81 cases) have observed some of form of delays during the period of study.
- ✓ The average time duration for which 24 respondents have considered as “No delay” is 59 minutes whereas 81 respondents have considered as “Delay” with average patient time in ED is 4 hours 3 minutes

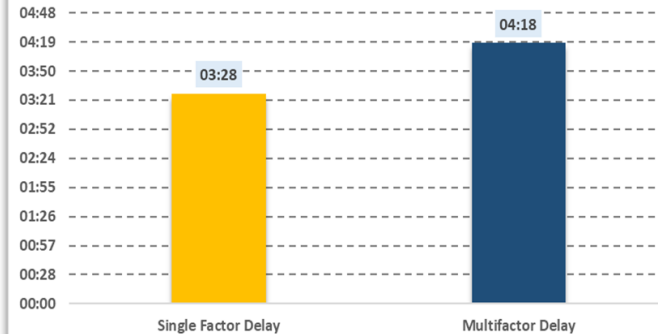
RESULT

TIME MOTION ANALYSIS

Count of Patient Delay Cases



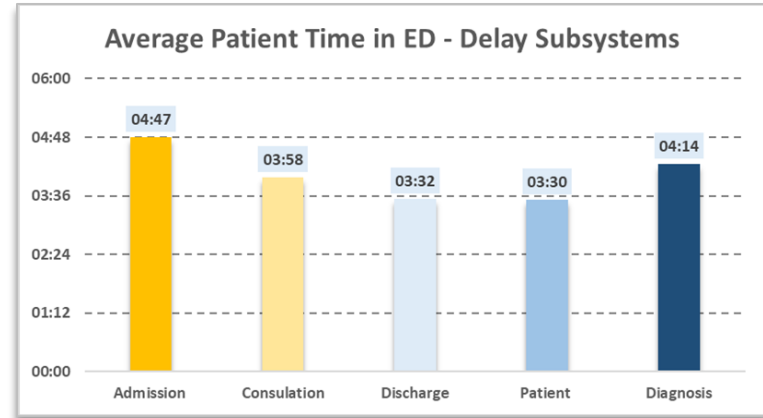
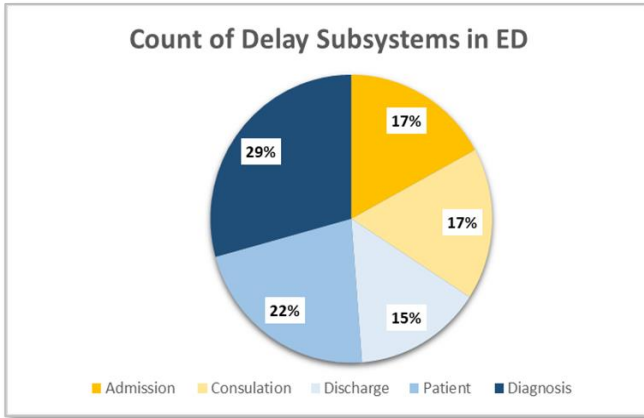
Average Patient Time in ED- Delays Cases



- ✓ Out of the patients experiencing delays, 56% linked these delays to one delay factor whereas 44% have considered more than 1 factors leading to the delays..
- ✓ For single factor delay time is 3 hours 28 minutes whereas for multiple factors delay it is 4 hours 18 minutes.

RESULT

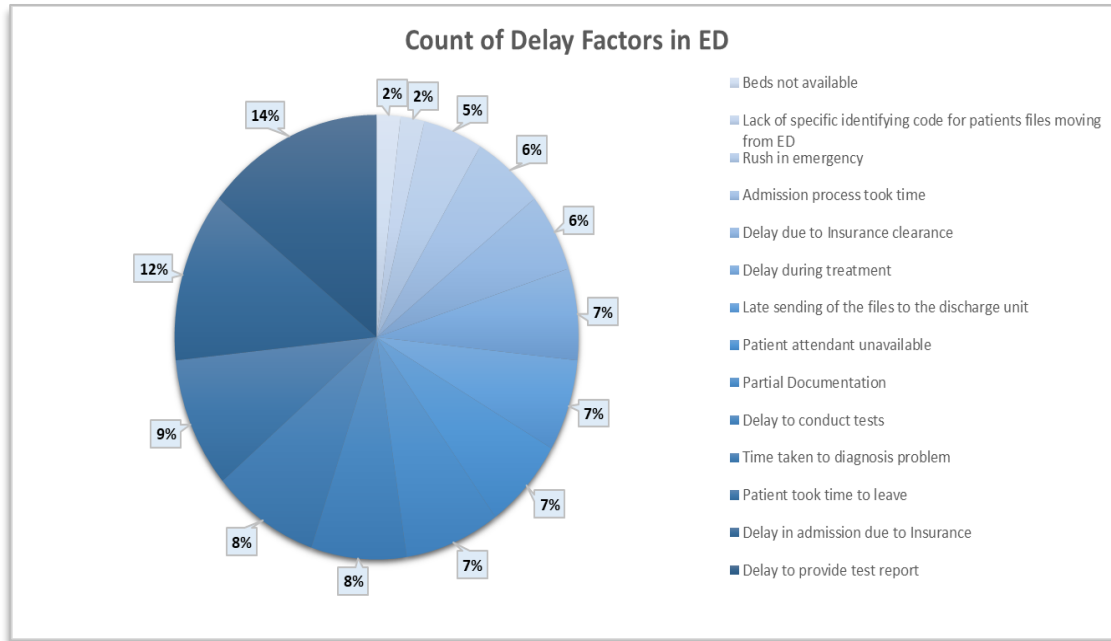
TIME MOTION ANALYSIS



- ✓ In the FMEA study, 5 subsystems for the delays in patient visits were considered. Diagnosis subsystem has the highest percentage of delay being contributed to, as 29%.
- ✓ The highest time taken is for Admission (4 hours 47 minutes) followed by Diagnosis (4 hours 14 minutes).

RESULT

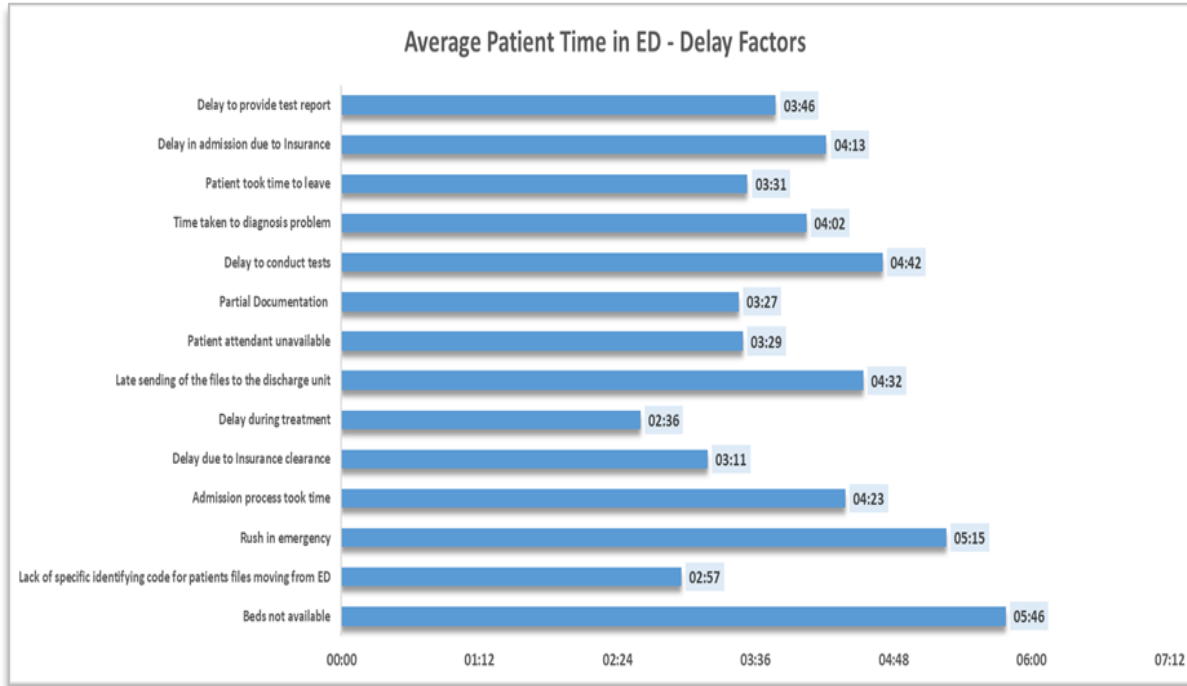
TIME MOTION ANALYSIS



- ✓ In the FMEA study, the delay factors in ED is categorized into 14 categories.
- ✓ The graph depicts the counts percentage contributing to these 14 delay factors.
- ✓ It can be observed that 14% of delay cases is due to delay in providing test reports and 12% due to delay in admission due to insurance.

RESULT

TIME MOTION ANALYSIS

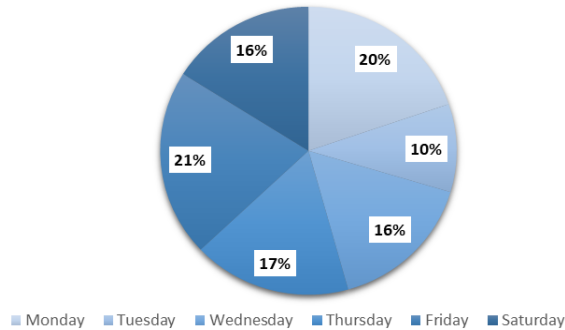


- ✓ According to data from the TMA study, highest delay experienced by the patients was due to bed not being available.
- ✓ The count percentage of these delay factor was only 2% but the average time taken was 5 hours and 46 minutes

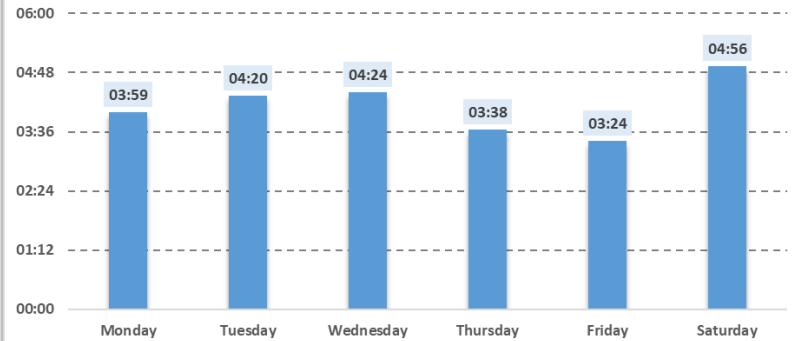
RESULT

TIME MOTION ANALYSIS

Count of Delay in ED - Day Wise



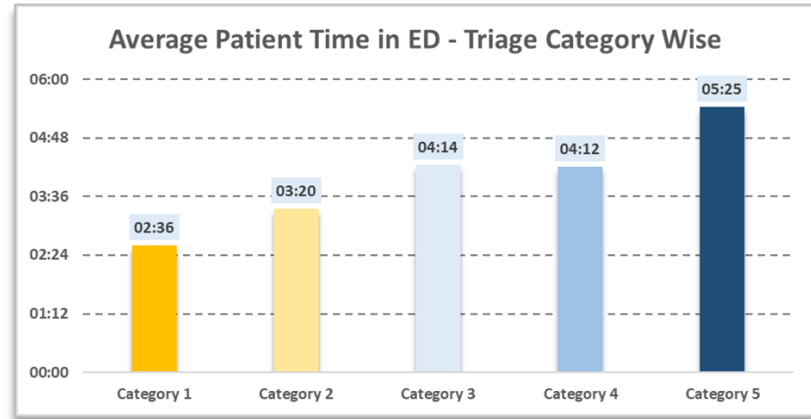
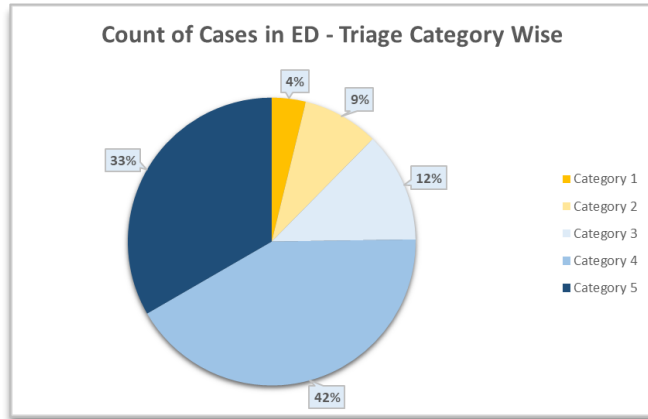
Average Patient Time in ED - Day Wise analysis



- ✓ Different days of the week observed different proportion of patient visit time. Highest was observed on Friday (21%)
- ✓ The highest patient visit time was observed on Saturday i.e., 4 hours and 56 minutes

RESULT

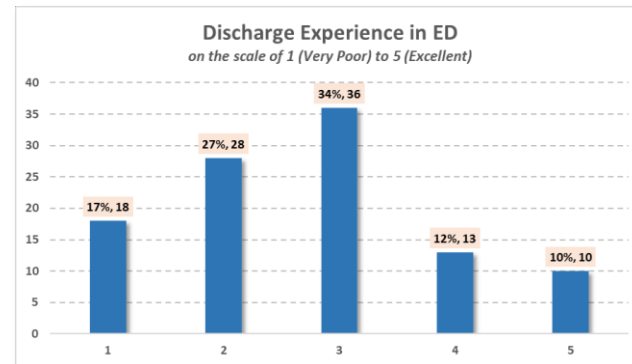
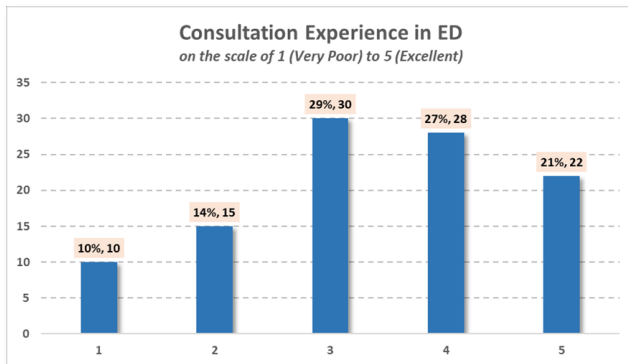
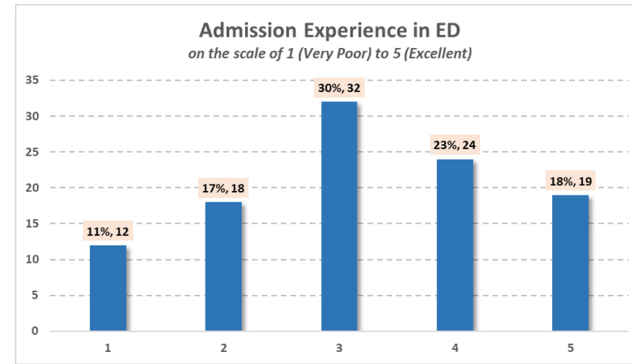
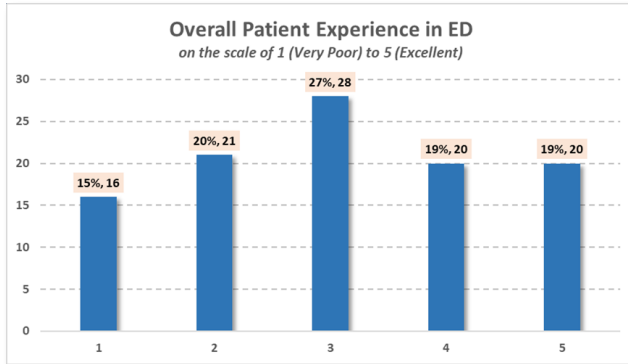
TIME MOTION ANALYSIS



- ✓ Maximum cases of delays were observed in Category 4 i.e., 42% of overall delay cases.
- ✓ According to the data, the highest time taken by patient was in category 5, which was coherent with the definition of category. The patient visit time for category 5 was 5 hours 25 minutes.

RESULT

PATIENT SATISFACTION ASSESSMENT



RECOMMENDATION

1st Priority Delay Factors

1. Delay in admission due to Insurance
2. Delay in providing test report

2nd Priority Delay Factors

1. Time taken to diagnosis problem
2. Delay in conducting tests

3rd Priority Delay Factors

1. Admission process took time
2. Delay during treatment
3. Partial Documentation
4. Delay due to Insurance clearance
5. Patient took time to leave
6. Patient attendant unavailable

4th Priority Delay Factors

1. Beds not available
2. Rush in emergency
3. Late sending of files to discharge unit
4. Lack of specific identifying code for patients' files

RECOMMENDATION

Subsystem	Delay Factor	Recommendation
Admission	Delay in admission due to Insurance	Collaborate with insurance companies to streamline pre-authorization processes.
	Admission process took time	Optimize paperwork by reducing unnecessary steps and duplications. Leverage technology to automate tasks where possible, such as electronic health records. Ensure adequate staffing levels to handle admissions efficiently.
	Beds not available	Implement a real-time bed tracking system to improve visibility of bed availability across departments. Establish better communication between the ED and inpatient wards to coordinate bed allocation.
Consultation	Time taken to diagnosis problem	Implement clinical decision support systems to aid in diagnosis by providing clinicians with quick access to patient data and treatment guidelines.
	Delay during treatment	Streamlining processes for medication access within the ED can minimize delays in administering necessary medications.
	Rush in emergency	Increase operational efficiency by converting underutilised areas of hospital as temporary emergency area and transfer of less prior cases (as per the Triage Categorisation) to these areas of hospital

RECOMMENDATION

Subsystem	Delay Factor	Recommendation
Discharge	Partial Documentation	Implement standardized templates for documentation to ensure all necessary information is captured during the initial assessment. Provide training to staff on the importance of complete and accurate documentation.
	Delay due to Insurance clearance	Implement a dedicated insurance liaison within the ED to handle insurance issues and expedite clearances.
	Late sending of the files to the discharge unit	Implement a dedicated discharge coordinator to oversee the discharge process and ensure timely file transfer. Utilize a digital system for transferring patient information electronically to improve efficiency.
	Lack of specific identifying code for the patients files moving from the ED to any other department	Generate an error check when identifying codes are not entered while transferring files to other departments
Patient	Patient took time to leave	Provide clear and concise discharge instructions to patients. Ensure timely completion of necessary paperwork by streamlining processes.
	Patient attendant unavailable	Ensure that patient's attendant is available during the entire discharge procedure. Assist patients in coordinating transportation if needed to facilitate a smooth discharge process.
Diagnosis	Delay to provide test report	Prioritize turnaround times for critical tests to ensure timely results. Ensure adequate staffing levels in the laboratory departments to avoid delays in processing tests.
	Delay to conduct tests	Explore the use of rapid diagnostic tests for specific conditions where appropriate.

Thank You