

**TO ANALYZE THE TURNAROUND TIME OF PROCESSING
THE PATIENT SAMPLE AT THE CASUALTY DEPARTMENT
OF P. D. HINDUJA HOSPITAL**

Dissertation Submitted to



Institute of Health Management Research, Jaipur

for the partial fulfillment for the award of the degree of

Master of Business Administration (MBA)

in

Hospital and Health Management

By

Dr. Shaily Modi

Under the Supervision and Guidance of

Dr. Kanika Jindal

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DECLARATION

This is to declare that this dissertation titled “*To analyze the Turnaround Time of processing the patient sample at the casualty department of P. D. Hinduja Hospital*” is the genuine record of my original research work. I declare that it has never been submitted to another university or institution to confer a degree or diploma. Information derived from the published or unpublished work of others has been duly acknowledged in the text.



(Signature)

Dr. Shaily Modi

Date: 01/07/2022

**P. D. HINDUJA NATIONAL HOSPITAL
& MEDICAL RESEARCH CENTRE**

(Established and managed by the National Health & Education Society)

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June 18, 2022

TO WHOMSOEVER IT MAY CONCERN

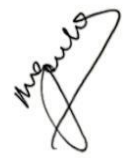
This is to certify that Dr. Shaily Modi a student of MBA- Health and Hospital Management, from IIHMR University, Jaipur did her project satisfactorily in our hospital from 21st March 2022 to 18th June 2022.

During this period her assignment was as follows:

- Emergency Patient Sample Processing Turn Around Time Analysis
- Inventory Analysis at Casualty Department
- Customer Feedback analysis at Radiation Oncology Department
- Patient waiting time analysis at Radiation Oncology Department

I wish her all the success in future endeavours.


JOY CHAKRABORTY
Chief Operating Officer


DR. PREETI GORAKSHA
Assistant Director Quality &
Clinical Administration

CERTIFICATE

This is to certify that dissertation titled “*To analyze the Turnaround Time of processing the patient sample at the casualty department of P. D. Hinduja Hospital*” is a record of the research work done by **Dr. Shaily Modi** in partial fulfillment of the requirements for the award of the degree of MBA (Hospital and Health Management) the IIHMR University, Jaipur under my guidance and supervision and her approach to the research study has been sincere, scientific, and analytical.

Dr. Kanika Jindal

Faculty Guide
IIHMR University, Jaipur

Date: 01/07/2022

Dr. (Col) Mahender Kumar

School Dean
IIHMR University, Jaipur

Date: 01/07/2022

ABSTRACT

Background: This dissertation project is carried upon Turn Around Time of Laboratory investigations at casualty department. The Emergency Department (ED) is designed for emergency patients in need of urgent and often life-saving treatment. They were not intended to treat a large number of walk-in patients. Not surprisingly, many ED patients are complaining about their care. Lab turnaround time (TAT) is one of the main reasons for long waiting hours. Test results often negatively impact patient performance. Test interpretation influences patient management decisions from admission to discharge. In fact, the quality of patient care and hospital funding can have a significant impact on the testing procedure from sample collection and the travel time for the report. In addition to these process flow issues, studies have shown that slow laboratory TAT results in negative perceptions of the healthcare facility by ED physicians. Therefore, TAT is a very important lab testing tool that is the used to evaluate the laboratory performance.

Objectives: The objective was to avoid life-threatening consequences by working on the reasons of delayed TAT of laboratory sample process and to analyze the TAT of patient sample processing at casualty by evaluating the delay reasons & suggest the measures to reduce the TAT.

Methods: This study includes both retrospective and prospective data. This study was conducted from 22nd March, 2022 to 30th April, 2022 (40 days). During this phase total 160 samples were collected, among which 30 were collected as a prospective data and 130 were collected as a retrospective data. This study was a multiphasic observational study as the data has been collected in multiple phases. And this data was collected from the patients visiting A&E department for availing medical services of P. D. Hinduja Hospital, Mumbai.

Results: To analyze the results of this study pareto chart and cause and effect diagram was used to understand the results in detail, where it was found that average TAT for sample delivery to the laboratory was 19 min and in 37.33% of cases, samples were not reaching to the laboratory within the defined timeframe, which can be considered as a 37% non-compliance. After which some reasons of delay in emergency patient sample processing were derived and was categorized in 4 phases.

Conclusion: It was determined that the reduction in TAT would allow ED to enroll more patients. Therefore, healthcare providers need to find effective ways to break down the barriers to effective laboratory TAT. At the same time, physicians need to accept and acknowledge the existing complexity of sample processing.

AKNOWLEDGEMENT

I strongly believe that the contribution and efforts of a single person would not be sufficient to complete this significant proportion of work; overall success of this work depends upon all those people who have contributed in their different way towards the fulfilment of this project on its broader aspect. This dissertation project remains incomplete without mentioning the names of whom who has given tremendous guidance & knowledge, due to which I have been polished throughout the time period of this project. I am highly indebted to the management of P. D. Hinduja Hospital, Mumbai for providing necessary support and guidance.

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I would like to express my deepest gratitude towards my respected mentor at P. D. Hinduja Hospital, Mumbai, **Mr. Vikas Tiwari (Executive- Admin & Operations)** for providing his constant support and guiding me throughout my dissertation tenure.

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Dr. Shaily Modi
Student of IIHMR University
Batch HOM-25
(2020-2022)

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ABBREVIATIONS

TAT	Turn Around Time
ED	Emergency Department
ER	Emergency Room
A & E	Accident & Emergency
HK	Housekeeping
LOS	Length Of Stay
EDC	Electronic Data Capture

PROJECT REPORT

Chapter 1: Introduction / Background

The Emergency Department (ED) is designed for the emergency patients in the need of urgency and often life-saving treatment. This department is responsible for the medical and surgical treatment of patients who need immediate treatment upon arrival at the hospital. Staff of this department can also be alerted to certain conditions within the hospital, such as Cardiac arrest reaction. It is the only place in the community where patient attention is paid day and night, all days of the year. So, it also provides services as in the regular outpatient department outside the regular working hours. This Department is responsible for 16-30% of hospital admissions.

Emergency Departments are bound to provide below services like:

- 24*7 Emergency care centre which caters to all emergencies including geriatric and pediatric patients
- Cardio-Pulmonary Resuscitation (CPR)
- Advanced cardiac Life Support (ALS)
- Pediatric Advanced Life Support (PALS) & Neonatal Resuscitation Program (NRP)
- Advanced Trauma Life Support (ATLS)
- Mechanical Ventilation
- Shock Management
- Multidisciplinary RTA and Trauma care Management
- Management of acute coronary syndrome, stroke, seizures, anaphylaxis etc.
- Airway management
- Management of Polytrauma, Head Injury, Abdominal Injury, Pelvic Injury
- Management of Toxicological Emergencies- Poisoning, Snake Bite, Drug Overdose
- 24*7 Blood Bank Support
- 24*7 ICUs & Operation Theatres to manage all critical care patients
- 24*7 Pharmacy Support
- Advanced care ambulance with monitoring equipment
- Management of Mass Casualty incidents and Disaster Preparedness
- Management of Medico-legal cases, Brought dead, Dead on arrival etc.
- The department is responsible for informing the police of cases of abuse, poisoning, suicide, murder, rape, assault, etc.
- Notice of all communicable diseases in BMC
- A&E is the center of all staff and patient policies. The protruding needle stick injury protocol for all employees is also developed here.

- The most important A&E is part of the disaster management team - inside and out.
- Referral of unstable and stable patients through appropriate Ambulance service
- The A&E Department is responsible for arranging for an ambulance service to transport or transfer patients in the event of unavailability of in-house ambulances. It also assists in arranging hearse services etc.
- First aid camps / team.
- The department provides for emergency backup for Research patients.
- Back up for the staff medical officer in Staff clinic.
- Training of the MEM and DNB PG students.

They are not meant to treat a large number of OPDs or walk-in patients. Not surprisingly, most of the ED patients complains about their care. Lab turnaround time (TAT) is one of the main reasons for long waiting hours. Test results often negatively impact patient performance. Test interpretation influences patient management decisions from admission to discharge. In fact, the quality of patient care and hospital funding can have a significant impact on the testing procedure from sample collection and the travel time for the report. In addition to these process flow issues, studies have shown that slow laboratory TAT results in negative perceptions of the healthcare facility by ED physicians.

Proper screening and patient discharge contributed to the timely return of lab test results, and the turnaround time (TAT) of lab test samples contributed significantly to the progress of ED work. The ability to quickly switch samples can be considered as an important lab performance indicator and appears to increase ED efficiency. For example, rapid troponin testing in ED patients can help identify or eliminate myocardial infarction and can have a significant impact on patient mortality. Moreover, it was reported in 2015 study that the rapid reversal of test results in patients with pulmonary disease in emergency resulted in rapid interventions and good patient results. As hospitals strive to improve the performance of ED, it is major considering the improvement of out-of-the-box features. Thus, we can enhance the effectiveness of laboratory TAT at Emergency Department.

Here, Laboratory TAT can be considered as one of the very crucial indicators of hospital efficiency. Physicians usually ask for the on-time results to produce effective clinical outcome. Specifically in ED, such reports allow doctors to hospitalize patients, evacuate them, and investigate other measures.

Therefore, TAT is a very important laboratory testing tool. Another issue is the definition of TAT include time from either the time of examination or sample collection requested by the doctor. The final point should also include the time to generate the report or contact the doctor in question to make a decision about patient management.

PURPOSE OF THE STUDY

It was observed that the laboratory sample of a patient was not reaching to the laboratory on time and because of that, those results were getting delayed, which ultimately resulted into delayed treatment of a patient at casualty department, which may lead to serious consequences. So, this study was conducted to avoid this kind of life-threatening consequences.

RESEARCH QUESTION: What are the reasons for the delay in Emergency Patient Sample processing and how to reduce that delay?

AIM: To Study the TAT of Lab samples processed from Accident & Emergency Department

OBJECTIVES:

- ✓ To analyse the TAT of patient sample processing at casualty
- ✓ To evaluate delay of TAT
- ✓ To find out reasons for delay in TAT
- ✓ To suggest measures to reduce TAT

Chapter 2: Review of Literature

Turn Around Time (TAT) as a Benchmark of Laboratory Performance (2010)

In above article, **Goswami B. S.** pointed out that doctors rely on laboratory resources to initiate and evaluate treatment options. That is why it is our right to ensure timely arrival. In this study, TAT has been calculated from the sample acceptance report. The average TAT for clinical biochemical specimens was found to be 5.5 hours in normal inpatient specimens, whereas in outpatient specimens, it was found to be 24 hours. The laboratory staff that was recruited for sample receipt makes entry regarding the time of sample reception by the lab. That was the basis for the first donation and the samples were numbered in the reception area properly. In this study, Long-term extension of TAT due to equipment failure or other unexpected problems such as a shortage of uninterruptible power supply or water supply, is not taken into account. They calculated the contribution of different stages of sample processing to the final TAT in different areas such as wards, OPDs, and emergencies. This study shows the average TAT for emergencies and PT samples of an outpatient patient, who is cared for 1 hour. In this situation, TAT is provided in both the analysis, pre-analysis and post-analysis phases.

Laboratory Turnaround Times in Emergency Departments (2009)

In above article, **Peterson A** addressed the waste and the problems in an important laboratory testing program, Sharp Chula Vista Medical Center (SCVMC) located in San Diego has expanded the implementation of Lean Six Sigma. The team recommended senior leadership that development to be made a permanent part of EDs agreements. In this study, managers recognized the importance of easy ways to reduce costs and improve patient care while using empty tools in various hospital-wide projects. This study was conducted in 5 phases. Define phase, Measure phase, Analyse phase, Improve phase, Control phase.

In the define Phase, in order to start the TAT casualty lab project, top seniors chose the project sponsors, who created an interdisciplinary team of EDs and labs. At the first meeting, the charter was clarified, and the main concern as well as the business project lines were decided. The main concern was that the doctor felt that it took too long to access the test data of ED patients. Therefore, to address the delayed test outcomes, the group used Value Stream Mapping (VSM) to assess errors in procedures that provide outcomes to casualty doctors and thereby to the patients.

In the Measure phase, blood flow was being monitored from the time the patient arrives in the emergency room until the test reports are in hand. After the basic details has been gathered and analysed, the average time between patient arrival in the casualty triage counter and the 1st test outcomes were determined to be 109 minutes at peak times. In

VOC and CTQ exercises, the most important satisfactions for doctors and patients was the collection of blood samples and safe IV initiation, quick delivery for the lab analysis, and rapid recognition of outcomes.

In the Analyse phase, A causal diagram was developed to concentrate on the Group's hard work and the value of the acquisition was determined throughout the process. The largest delay happened on "arrival order" and "collection order" steps. And the group discovered that those problems are important for the patient safety.

In the Improve phase, based on a numerical flow map review and cause and effect diagram and interviews with both ED and laboratory staff using “Trystorm”, a key process development developed for “Trystorm” is included. Trystorm was a common indicator of experimental development focused on newly selected items, usually performed within a week or two.

Lastly in the Control phase, the team encouraged senior management to make a development in an integral part of the ED principles. This process has made many other significant developments revealed by projects related to the design and management of blood sample orders.

The effect of laboratory testing on emergency department length of stay: a multihospital longitudinal study applying a cross-classified random-effect modelling approach (2015)

In above article, Li L, G. A. has gathered patient details from four different hospitals over a four-year period, he used laboratory tests (including laboratory dose and duration [TAT]) and length of stay in the casualty Department. It enrolled patients who visited 1 out of 4 emergency departments in Australia, New South Wales during the two months of 2008, 2009, 2010 and 2011 (August and September). It was a retrospective multisite cohort study. Data of emergency room information system was connected to lab test details. A systematic randomized controlled trial was used to identify the characteristics that affect ED LOS, considering the association among patient placements in the same hospital or in the exact year. In which a series of test results and TAT (time of receipt for lab order for available reports) were tested. As the no of test results increases, so does the patient's ED-LOS time. For each 5 added tests ordered per test order, the central ED-LOS increase by 10 mins. Every 30 minutes of TAT increase, ED LOS increased by an average of 5.1% after adjusting other factors. Although midnight TAT was shorter than daytime symptoms, patients who visited the emergency department at night were significantly longer than those who visited during the day. Finally, they concluded that laboratory tests had a straight impact on patients' LOS in casualty department. Lab TAT, no of test results, and testing amount may affect the hospital stay span for the casualty patients.

Introduction of a stat laboratory reduces emergency department length of stay (2008)

In above article, **Singer A.J.** determined the impact of the Statistical Lab on the duration of the Emergency Department (ED) (LOS). Suppose Stat lab reduces ED LOS for inpatients by an hour. This was a pre-survey and a post-survey in the ED area and was visited by 75,000 patients yearly. All the patients who were present in ED in August and October 2006 were included. We compared ED LOS before and after the start of the Statistics Lab with the Mann-Whitney U test. The sample count of total 5,000 patients in each category had 99% ability to notice an hour change in casualty LOS. After the introduction of Stat Lab, the patient's TAT diagnostic test got improved significantly. With Stat-Lab, the median ED LOS is significantly reduced to 466 (interquartile range [IQR] = 402 minutes after the start of Stat-Lab. Stat-Lab EDLOS results are shown to be low. It will be for the ending. They concluded that the introduction of an ED statistics lab within the central lab was associated with a short laboratory TAT and short ED-LOS of approximately 1 hour for enrolled patients.

Reduction in laboratory turnaround time decreases emergency room length of stay (2018)

In above article, **Kaushik N.** has found to make a significant contribution to medical judgements in the casualty room based on lab reports. According to him, rapid switching of lab tests can improve ED across the country by shortening the total hospital span for the patients and enhancing treatment results. In this study, the revised ED analysis was taken from a major US-based unconfirmed HER website, and another ED analysis was taken from the university care center EDEHR. In addition, an effective model has been created to calculate LOS time savings and possible economic opportunities as a result of reducing TAT labs, considering the different factors triggering LOS will remain unaffected. Therefore, multivariate deterioration examination of patients through a multisite study has manifested a single minute reduction in lab TAT which had been correlated with a 0.50-minute reduction in LOS. Site analysis confirmed that the results of the multi-site analysis showed that there was a positive association among lab TAT and casualty LOS, which was present in overall casualty department subject and in the sensitivity of patients at various stages. Moreover, through the effective model calculations, a TAT reduction of 5, 10, and 15 minutes determined that a single-site ED could approve overall 127, 256, and 386 added patients, respectively. Therefore, in this study, a positive association among lab TAT and casualty department LOS was noticed with a wider patient occupants and different stages of understanding.

Chapter 3: Methodology

STUDY DESIGN: This study design was a *Multiphasic Observational Study*, as in this study, data was collected in two phases, prospective and retrospective.

SETTING: This study was conducted at *P. D. Hinduja Hospital- Accident & Emergency Department*.

STUDY POPULATION: Patients visiting A&E department for availing medical services were taken as the study population.

SAMPLE SIZE: Total *160 Samples* were collected, out of which 30 samples were collected as a prospective data and remaining 130 samples were collected as a retrospective data.

SAMPLING TECHNIQUE: The technique used in this study was a *Convenience Sampling Technique*, because here the data was collected on convenient timing.

MODE OF DATA COLLECTION: The primary data for the prospective study was collected through an *Observation Method* and the secondary data for the retrospective study was collected through *Quantitative Secondary data collection method*.

DURATION OF STUDY: The study was conducted between *22nd March, 2022 to 30th April, 2022 (40 days)*.

STUDY TOOLS: Different study tools were used to analyze the data, like *Pareto chart, Fishbone diagram* (Cause & Effect diagram)

- **Inclusion criteria:**

- The patient sample processed from 9.30 am to 1 pm and 2 pm to 5.30 pm will be included.
- All the lab sample tests conducted and advised by consultants.

- **Exclusion criteria:**

- The patient sample processed between 1 pm to 2 pm (Lunch Time) will be excluded.
- Recollected sample will be excluded.

ANALYSIS METHOD FOR RETROSPECTIVE DATA:

Gathered the data from the register maintained in the casualty and then analyzed the data in excel sheet and calculated the difference between sent time and receive time of all the samples collected within the timeline, after that calculated average, minimum and

maximum time difference for sample transport time, then calculated the compliance rate based on defined timeframe, which is 0:15 min. And lastly, calculated the frequency of lab tests being ordered in the casualty on a daily basis.

ANALYSIS METHOD FOR PROSPECTIVE DATA:

Collected the data through constant observation and divided it into different phases of a sample collection procedure:

- Order given time
- Sample taken time
- Time of Lab receipt given to pt. relative
- Time of Voucher copy received by ER staff from pt. relative
- Time of Information passed to HK for sample transfer
- Time of Sample taken from ER to state lab

Plotted all the data into an excel sheet and then calculated the difference between all the procedures and derived average, minimum and maximum timings out of each procedure.

Chapter 4: Results

Retrospective Data:

The data was collected from the register maintained by the casualty department as well as from the chargesheets maintained by the casualty department (shown in **Figure 7**) and was noted in a table prepared for the data collection (shown in **Figure 8**). After which TAT was calculated for each sample.

Average TAT of Lab sample processed from ER was found to be 19 min, where in some emergency cases it has gone down upto 5 min and in some stable cases, it has been increased upto 1 hr 32 min (shown in **Figure 1**).

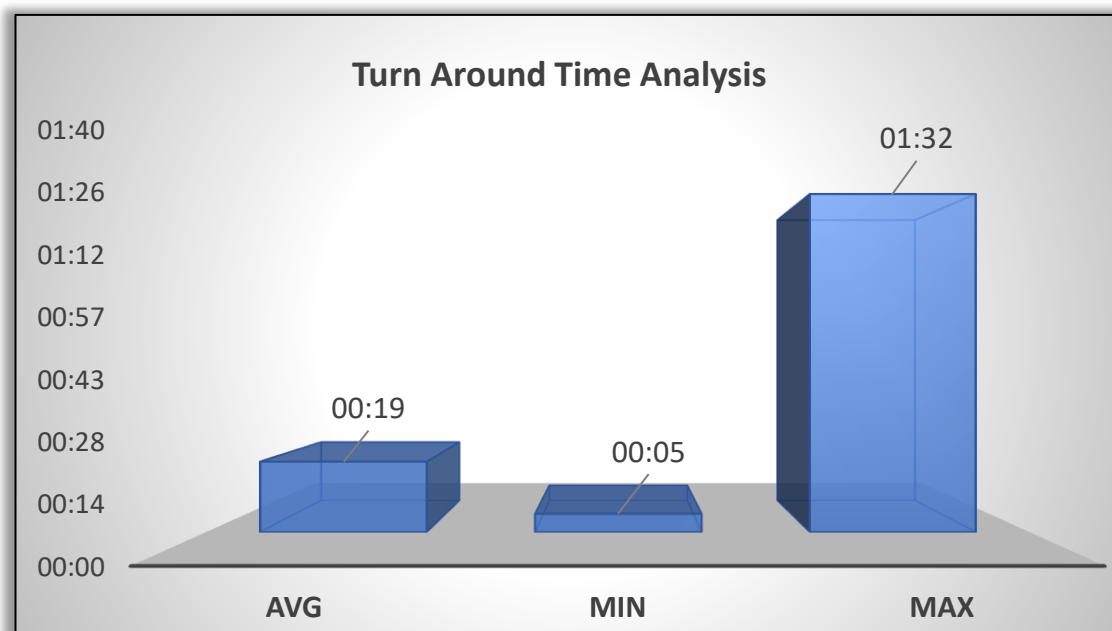


Figure 1

Here the defined turnaround time was 15 min, so even average TAT result was not falling into the defined timeframe. After getting this result, we calculated the compliance rate, that was found to be 62.67%. Here samples were reaching to the laboratory within 15 min in 63% of the cases and in the remaining 37% of the cases, either samples were not reaching to the laboratory within the defined timeframe or sent time or receive time or both were not mentioned in the register, which can also be considered as a noncompliance (shown in **Figure 2**). In 55 samples, it was found either sent time or receive time or both were not mentioned in the register.

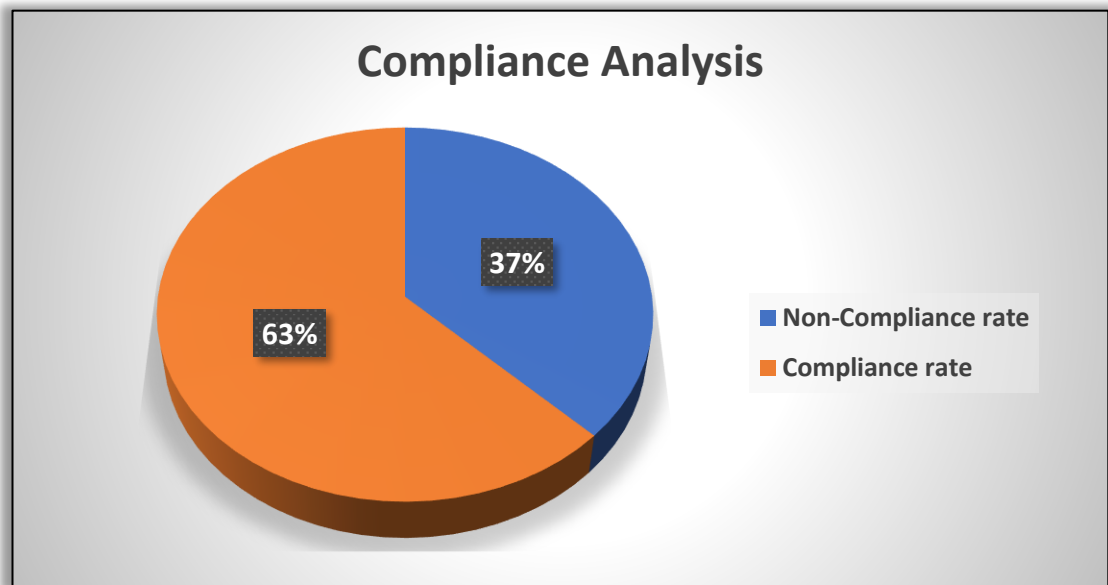


Figure 2

Here, even though compliance rate is higher, average TAT is not falling under defined timeframe, because of some outliers, so maximum TAT can be considered as an outlier.

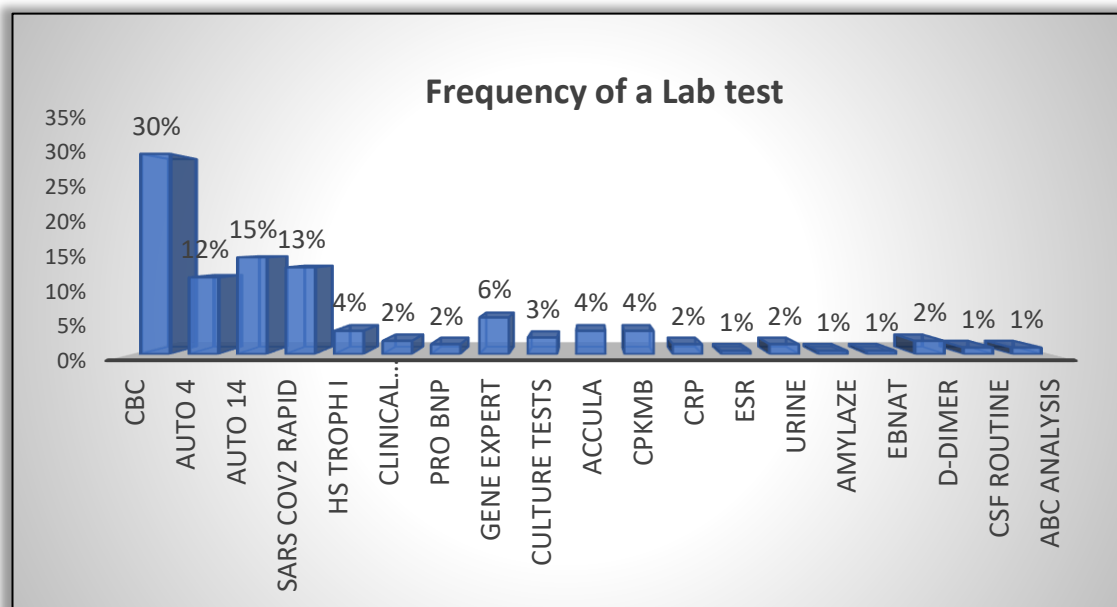


Figure 3

In 30% of the cases, CBC sample collection was prescribed, and in 15%, 13% and 12%, Auto 14, RTPCR, Auto 4 were prescribed respectively, these were major tests prescribed from the casualty department (shown in **Figure 3**). Based on that, we can predict TAT for these specific tests. So, based on that patient treatment can be done accordingly.

Prospective Data:

The data was collected through the constant observation of different processes at casualty department. Those processes were categorized under different phases:

- Order given time
- ❖ Sample taken time
- ❖ Time of Lab receipt given to pt. relative
- ❖ Time of Voucher copy received by ER staff from pt. relative
- ❖ Time of Information passed to HK for sample transfer
- ❖ Time of Sample taken from ER to state lab

These phases were observed carefully, and time was noted in all the phases from sample collection to sample delivered to HK staff for each sample.

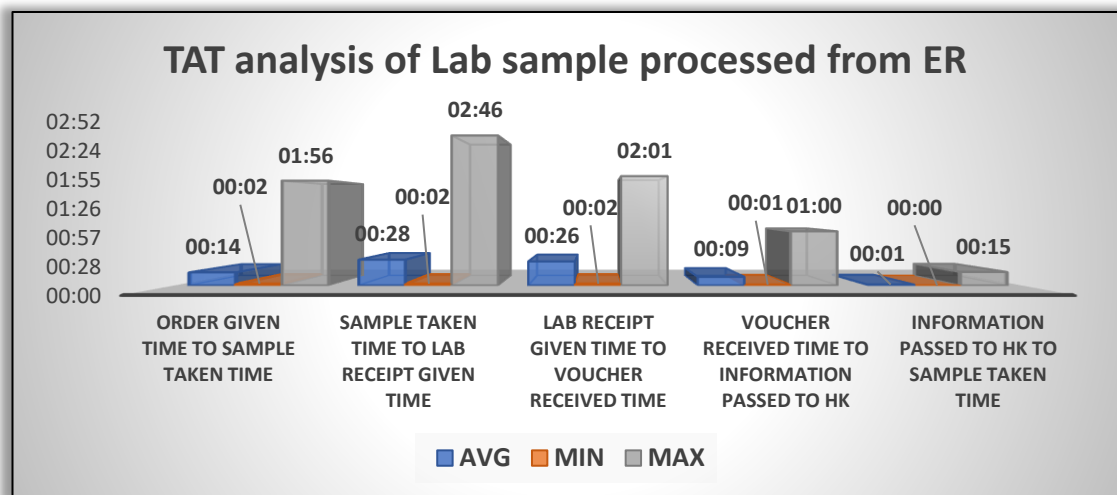


Figure 4

Average TAT between order given time to sample taken time was found to be 14 min, for sample taken time to lab receipt given time it has found to be 28 min, for Lab receipt given time to voucher received time it has found to be 26 min, for Voucher received time to information passed to HK it has found to be 9 min and lastly for Information passed to HK to sample taken time it has found to be 1 min (shown in **Figure 4**). So, total average time for dispatching laboratory sample from casualty department was found to be 1 hour 20 min, which also includes outliers.

Maximum time taken in these processes was between sample taken time to laboratory receipt given time to the patient's relative for the payment to be done, because this time period also includes the sample collection time, in which multiple samples were collected at a time, that leads to increase the TAT. This has been derived by just measuring time period between different processes.

It was also found that HK staff are instructed to collect multiple samples at a time whenever they visit a laboratory for a sample transfer. So, if in a case, some samples are ready to dispatch and some are about to get ready, then they are instructed to wait and collect those samples before leaving for the laboratory.

Various reasons of delay in emergency patient sample processing were found while collecting the data, those were categorized into 4 phases:

- Order Processing
- Sample Drawing
- Sample Dispatch
- Sample Processing and Reporting

Reasons of delay are shown below in the fishbone diagram:

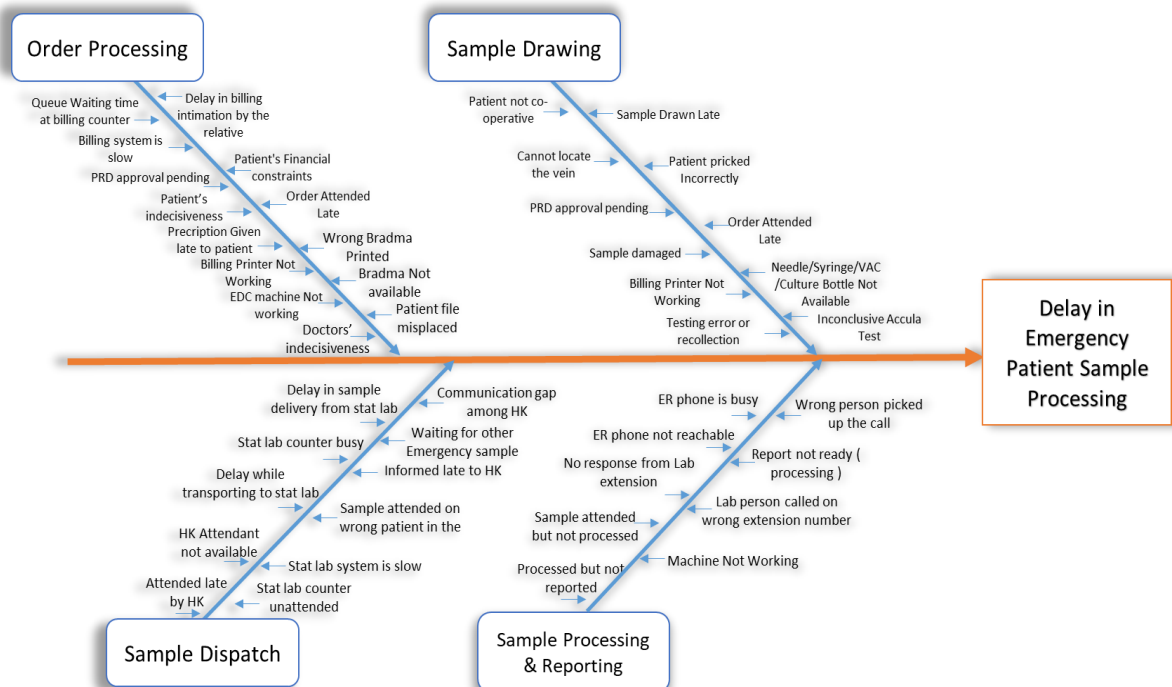


Figure 5
Fishbone Diagram

After categorizing these reasons into 4 phases, ratings were calculated as per their impact and likelihood, based on which percentage was calculated (shown in **Table 1**).

Delay in Emergency Patient Sample processing					
Type	Delay Cause	Impact	Likelihood/ Occurrence	Rating	Percentage
Order Processing	Queue Waiting time at billing counter	5	5	25	4.14%
Order Processing	Delay in billing intimation by the relative	5	5	25	4.14%
Order Processing	Billing system is slow	5	5	25	4.14%
Sample Dispatch	Attended late by HK	5	5	25	4.14%
Sample Processing & Reporting	ER phone is busy	5	5	25	4.14%
Sample Processing & Reporting	ER phone not reachable	5	5	25	4.14%
Order Processing	Patient's Financial constraints	5	4	20	3.31%
Sample Dispatch	HK Attendant not available (busy attending patients)	5	4	20	3.31%
Sample Dispatch	Delay while transporting to stat lab	5	4	20	3.31%
Sample Dispatch	Stat lab counter busy	5	4	20	3.31%
Sample Dispatch	Delay in sample delivery from stat lab to Lab section	5	4	20	3.31%
Sample Processing & Reporting	Wrong person picked up the call	4	5	20	3.31%
Sample Processing & Reporting	Report not ready (processing)	5	4	20	3.31%
Sample Processing & Reporting	No response from Lab extension	5	4	20	3.31%
Order Processing	PRD Approval pending	4	4	16	2.65%
Sample Dispatch	Waiting for other Emergency sample	4	4	16	2.65%
Sample Processing & Reporting	Lab person called on wrong extension number	4	4	16	2.65%

DISSERTATION REPORT (2020-2022)

Sample Drawing	Patient not co-operative	5	3	15	2.48%
Order Processing	Order Attended Late	5	3	15	2.48%
Order Processing	Prescription Given late to patient	5	3	15	2.48%
Sample Drawing	Sample Drawn Late	5	3	15	2.48%
Sample Dispatch	Informed late to HK	4	3	12	1.99%
Sample Drawing	Cannot locate the vein	4	3	12	1.99%
Sample Drawing	Testing error or recollection	4	3	12	1.99%
Order Processing	Wrong Bradma Printed	5	2	10	1.66%
Sample Dispatch	Sample attended on wrong patient in the system	5	2	10	1.66%
Sample Dispatch	Stat lab system is slow	3	3	9	1.49%
Order Processing	Billing Printer Not Working	3	3	9	1.49%
Sample Drawing	Less Sample collected	3	3	9	1.49%
Order Processing	Patient's indecisiveness	3	3	9	1.49%
Sample Dispatch	Stat lab counter unattended	4	2	8	1.32%
Order Processing	Bradma Not available	4	2	8	1.32%
Order Processing	Bradma Printer Not Working	4	2	8	1.32%
Sample Drawing	Patient pricked Incorrectly	4	2	8	1.32%
Sample Drawing	Sample damaged	4	2	8	1.32%
Order Processing	Doctors' indecisiveness	4	2	8	1.32%
Sample Dispatch	Communication gap among HK	4	2	8	1.32%

Sample Drawing	Inconclusive Accula Test	4	2	8	1.32%
Order Processing	EDC machine Not working	3	2	6	0.99%
Sample Drawing	Needle/Syringe/VAC /Culture Bottle Not Available	5	1	5	0.83%
Sample Processing & Reporting	Sample attended but not processed	5	1	5	0.83%
Sample Processing & Reporting	Machine Not Working	5	1	5	0.83%
Sample Processing & Reporting	Processed but not reported	5	1	5	0.83%
Order Processing	Patient file misplaced	4	1	4	0.66%

Table 1

After which top 80% reasons were derived to prepare a Pareto chart (shown in **Figure 6**). It was found that below reasons were having low impact and are having a low occurrence rate:

- Billing Printer not working
- Less samples collected by HK staff
- Patient's indecisiveness
- Stat laboratory counter unattended for any queries
- Bradma not available
- Bradma Printer not working
- Staff pricked incorrectly for sample collection
- Sample damaged
- Doctor's indecisiveness
- Communication gap among HK
- Inconclusive Accula Test
- EDC machine not working
- Needle/Syringe/VAC /Culture Bottle Not Available
- Sample attended but not processed
- Machine Not Working
- Processed but not reported
- Patient file misplaced

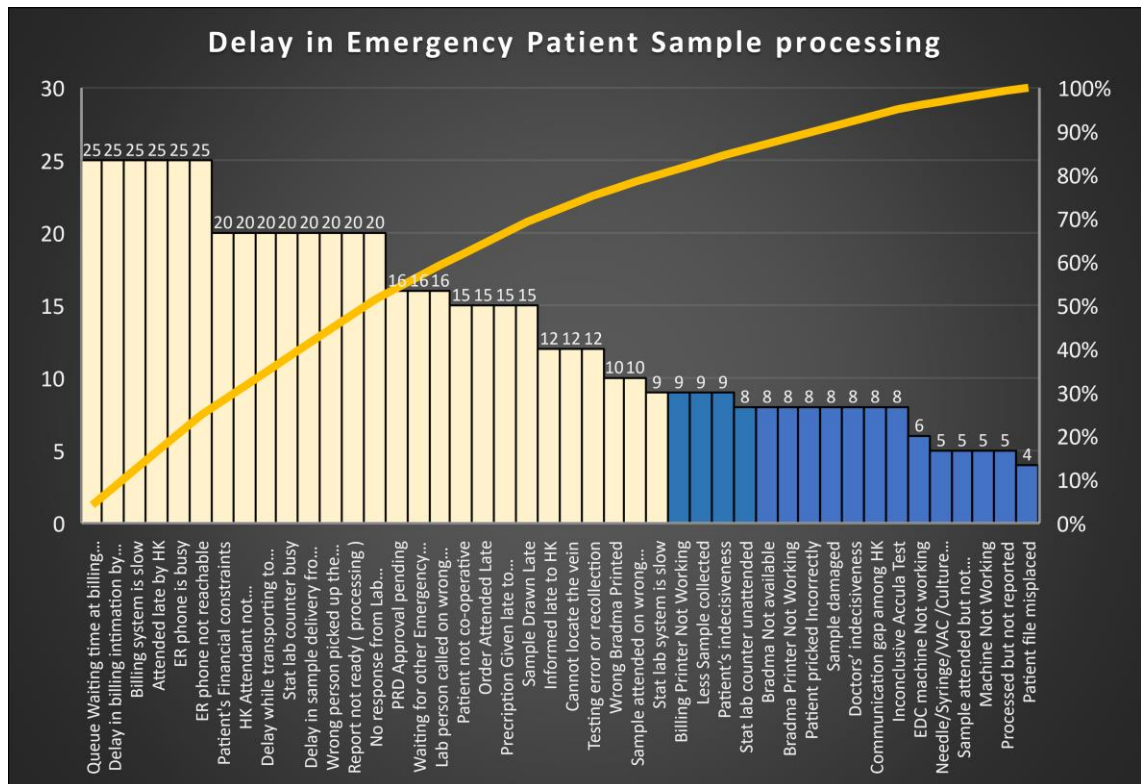


Figure 6
Pareto Chart

After considering all the reasons of delay, we can say that there is not a single factor we have to look upon, there are multiple factors that plays a role in delaying the TAT of laboratory sample transfer process. For which we should work upon major reasons individually.

Limitations of the study:

- ❖ In this study, we have not included cases for which the TAT has been extended due to unexpected problems such as breakdowns and uninterrupted power and water supply shortages.
- ❖ We have not taken those samples into considerations, which were having any testing errors.
- ❖ Samples were collected during specific time-period only.

Chapter 5: Discussions

In our study we have aimed to find out the delay reasons of TAT in patient sample processing at casualty department. Patients who are having more laboratory tests are used to be in a complex condition with insufficient data to manage statistically. Therefore, to accurately understand the reason for the delay, the analysis is having only casualty results containing only one lab test order result.

In our study we have not linked patient LOS with the laboratory sample TAT, whereas in couple of other studies it has linked LOS with the laboratory TAT. Like, in the study named *“Reduction in laboratory turnaround time decreases emergency room length of stay”* (2018) Kaushik N has seen a constructive association among laboratory TAT and ED LOS at a wide patient population and at various levels. Even Li L, G. A. has showed direct effects of laboratory testing on patients' LOS in ED in his article *“The effect of laboratory testing on emergency department length of stay: a multihospital longitudinal study applying a cross-classified random-effect modeling approach”* (2015).

We have worked on the root causes which are affecting the delay in laboratory sample testing, rather than looking on its impact. Even we have categorized these delay reasons into 4 phases, as shown into couple of other studies, in which they have worked upon the application of lean methodologies to reduce the Laboratory sample TAT, like in the study named *“21 Applying Lean Methodologies Reduces Emergency Department Laboratory Turnaround Times”* (2014), the author B. A. investigated the idea that a lean-based structure of the lab process is going to enhance laboratory TAT, especially mean sampling. In their mono-centric interpretation study, a plain redesign of the lab process flow has decreased laboratory TAT in casualty patients. Therefore, in general we can say that the multidisciplinary application of system engineering science may improve the efficiency of parallel testing, as well as the overall output of ED. In that study, a lean-based structure of the lab's process has remarkably improved the efficiency of a process. And after the intervention, the median laboratory TAT dropped in all multiple tests. Significant reductions were made in the “reflex test” performed after the first test. That was a potential study in the environment, where pre- and post-analysis laboratory development analysis in the emergency department of an educational hospital (ED) took place.

In our study, we have analyzed the delay reasons through fishbone diagram and pareto chart, yet our collected data was having a time constraint.

None of the above study includes the compliance analysis, which we have covered in our study. Even we have worked upon both the type of data: Retrospective and Prospective. Based on which we have derived different kind of results.

Chapter 6: Recommendations

Reasons of delay	Recommendations
Long queue waiting time at billing counter/ Billing system is slow	To avoid the long queuing time for patients/relatives, we can start self-payment machine to make the process easier and quicker, for which we can align the lab test name with the name in self-payment machine to avoid the confusion for the patients.
ER phone is busy/not reachable	We can allot one dedicated intercom for lab queries.
Testing error or recollection	
Wrong Bradma Printed	Staff training on regular interval
Sample attended on wrong patient in the system	
Cannot locate the vein	For those difficult patients, we can choose alternate limb or use Infrared Vein Finder, which can be a lifesaver for them.
Prescription given late to patient	
Sample Drawn Late	We can implement Standalone Emergency management system
Informed late to HK	
HK Attendant not available (busy attending patients)	We can implement pneumatic tube system. We can also develop one automated system, which will notify at laboratory once the sample is dispatched from the emergency. And likewise, once sample is received by lab, it will notify at emergency. And it will also send/update reports directly at emergency through the system once testing procedure is completed.

Table 2

Chapter 7: Conclusion

Indian hospitals continue to be pressured to cure maximum patients having less casualty wards and less beds. ED has bit complex workflow as compared to other clinical wards, overcrowding of ER can have impacts on patients depending on the severity of the disease, and laboratory tests have a direct effect on LOS in patients.

Also, the observations indicate that reducing TAT allows ED to serve more patients, and the benefits of developing processes/technologies can be seen in increasing the efficiency of ED and reducing TAT. Implementing a stand-alone emergency management system can be an effective result in reducing the TAT of laboratory samples.

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[illegible]

Sr No.	Date	HH No.	Investigation	Sent Time	Receive Time	TAT (Difference)
1	22/3/22	876069	Pro BNP	11:00 pm	11:45 pm	45 m
2	22/3/22	1473884	Accula	11:10 pm	11:45 pm	35 m
3	23/3/22	1407781	CBC, Auto	1:00 am	1:10 am	10 m
4	22/3/22	1187187	Gene Expect	2:37 pm	2:00 pm	23 m
5	23/3/22	1673260	CBC Renal profile	4:40 am	4:50 am	10 m
6	23/3/22	1537506	CBC electrolytes	5:10 am	5:15 am	5 m
7	23/3/22	1537506	SARS Cov2 Rapid	7:10 pm	7:20 pm	10 m
8	23/3/22	1403142	CBC A-4 CPKMB	3:45 pm	-	-
9	23/3/22	1831597	CBC Auto 14 PT/INR	-	-	-
10	23/3/22	1818000	CB MAT Chemical Gluco	4:40 pm	-	-
11	23/3/22	1310044	HS Troph I	5:40 pm	-	-
12	23/3/22	1821033	CBC A4	5:50 am	6:00 am	10 m
13	23/3/22	1543513	CRP, CBC, D-Dymer	5:57 pm	-	-
14	"	1831597	SARS Cov2 Rapid	8:15 pm	-	-
15	"	1820434	CBC A-14 (CRS)	8:30 pm	-	-
16	"	1831597	CBC Auto 14	8:47 pm	-	-
17	"	1288695	Culture bacter	7 pm	7:40 pm	40 m
18	"	1293156	CBC Auto 4	7:20 pm	7:40 pm	20 m
19	"	1543513	Blood culture	7:40 pm	7:50 pm	10 m
20	"	1310044	SARS Cov2 rapid	7:39 pm	7:50 pm	11 m
21	"	1820434	CPKMB, Troph I	7:40 pm	7:50 pm	10 m
22	"	1543513	SARS Cov2	9:15 pm	10:10 pm	55 m
23	"	23446	CBC Renal profile	9:58 pm	10:10 pm	12 m
24	"	1831589	CBC A14 Gene	10:30 pm	10:30 pm	0 m
25	"	1831549	HS Troponin T	11:11 pm	12:10 pm	59 m
26	"	1456506	CBC Auto 4	11:52 pm	12:10 pm	18 m
27	"	848296	Gene Expect	12:05 pm	12:40 pm	35 m
28	"	1673260	Accula	12:05 pm	12:40 pm	35 m
29	"	1456506	FB NAT SARS Cov2	1:45 am	2 am	15 m
30	24/3/22	772308	CBC Auto 4	1:16 am	1:30 am	14 m
31	"	CBC A4	⇒ 479707	8:50 am	8:50 am	0 m
32	"	CPKMB AS Troph I	⇒ 479707	9:10 am	-	-

Figure 8
Retrospective Data Collection

[illegible]

Figure 9
Prospective Data Collection