A STUDY ON DETERMINATION OF LABORATORY TAT FOR OPD AT A TERTIARY CARE HOSPITAL USING LEAN SIX SIGMA

Dissertation Submitted to

The IIHMR University, Jaipur

for the partial fulfillment for the award of the degree

ofMaster of Business Administration (MBA)

in

Hospital and Health Management

by

Sudeshna Dey

Under the Supervision and Guidance of

Dr. Susmit Jain

2021

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DECLARATION BY STUDENT

I hereby declare that this dissertation titled **"A study on determination of Laboratory TAT for OPD at a tertiary care hospital using Lean Six Sigma"** is the bonafide record of my original researchwork. I declare that it has not been submitted to any other university or institution for the award of any degree or diploma. Information derived from the published or unpublished workof others has been duly acknowledged in the text.

(Signature)

Sudeshna Dey

Date:21/06/21

THE MISSION HOSPITAL DURGAPUR | FUTURISTIC TECHNOLOGY. BRILLIANT MINDS.

Ref: TMH/HRD/OG/June -21/18

Date: 21.06.2021

To Whom It May Concern

This is to certify that **Ms. Sudeshna Dey** has done her three months dissertation on "A study on determination of Laboratory TAT for OPD at The Mission Hospital, Durgapur using Lean Six Sigma" from 22.03.2021 to 21.06.2021.

During the period of dissertation she has been found sincere.

We wish her a successful future and career ahead.

Ramesh Lall
VP – HR

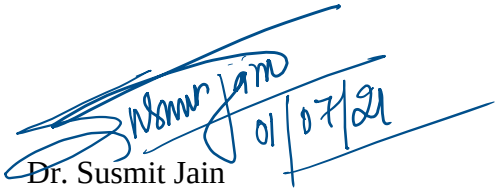
Ishani Chakraborty
GM – Operations

ISHANI CHAKRABARTY
GM-OPERATIONS
The Mission Hospital

The Mission Hospital, Durgapur | 219(P) Immon Kalyan Sarani, Sector-2C, Bidhan Nagar, Durgapur - 713212
P: 0343 2535555 | M: 9233355555 | F: 0343 2532550 | Email: hospital@themissionhospital.in | www.themissionhospital.com
Call: 9800881600 for free Ambulance within City Limits of Durgapur

CERTIFICATE

This is to certify that dissertation titled **"A study on Laboratory TAT for OPD at a tertiary care hospital using lean six sigma"** is a record of the research work undertaken by Sudeshna Dey in partial fulfillment of the requirements for the awardof the degree of MBA (Hospital and Health Management) from the IIHMR University, Jaipur under my guidance and supervision and her approach to the research study has been sincere, scientific, and analytical.



Dr. Susmit Jain
Faculty guide
IIHMR University, Jaipur

Date

Dr. Dhirendra Kumar
School Dean
IIHMR University, Jaipur

Date

ABSTRACT

This research stitled " A study on Laboratory TAT for OPD at a Tertiary care hospital using lean six sigma" was carried out at The Mission Hospital, Durgapur. This study aims to determine the current Laboratory TAT for OPD, determining the peak hour and analysing the turnaround time of Departments such as Biochemistry, Haematology, Serology. Analysing each stage of the process flow, classifying it into steps, and calculating the TAT for each step using lean six sigma. The durations on 10 different occurrences of the process gives information on the subdivided TAT, which helps us understand which phase or operation is causing the delay and can be addressed in depth to reduce the TAT. This study was a prospective study using descriptive cross-sectional method. . A total of 576 samples were analysed from the Department of Biochemistry, Haematology & Serology. Data was collected by convenient sampling techqniue through interview, observation, laboratory information system.

The morning slot had the highest overall Laboratory TAT for the OPD, with an average turnaround time of 04 hours and 50 minutes. Tin morning slot he maximum Laboratory TAT for the OPD was reported between 10:00AM and 11:00AM of 04 hours and 54 minutes. Another significant finding was that the rise in morning slot TAT was primarily attributable to increased workload during the morning shift. Haematology had the highest overall TAT of 04 hours 53 minutes, followed by Biochemistry and Serology with 04 hours 50 minutes and 04 hours 34 minutes, respectively. The pre-analysis stage contributed the most to overall TAT, accounting for 57%, followed by the analytical stage and the post-analytical phase.The contribution of ten steps to overall TAT was primarily due to result generation, sample acknowledgement, sample collection, order generation, verification. Non-value-added time contributed roughly 01 hour 50 minutes, with the majority of it occurring during sample acknowledgement, order generation, sample segregation, sample collection, and result generation. The entire TAT was delayed due to a system deficiency, lack of people during peak hours, and a lack of adequate communication. To enhance TAT policies should be developed and executed and audits should be performed on regular basis to aid in patient satisfaction.

Keywords

Laboratory, TAT, Hospital, Lean six sigma

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With due regards, I am also immensely thankful to **Dr. Susmit Jain,** Associate Professor and Faculty Guide IIHMR University, Jaipur for the guidance and support throughout the dissertation.

Last but not the least, I would like to place a profound sense of gratitude to my **parents, colleagues** for all the support always.

Sudeshna Dey
1011
MBA-HM 24rd Batch
Hospital Stream

Contents

LIST OF ABBREVIATIONS

TAT: Turnaound time

OPD: Out-patient department

IPD: In-patient department

ER: Emergency department

LIS: Laboratory Information System

SIPOC: Supplier, Input, Process, Output, Customer

VAT: Value added time

NVAT: Non value added time

GDA: General duty assistant

CHAPTER 1: INTRODUCTION

The idea of laboratory turnaround time varies depending on the type of tests performed, the analyte used, and the organisation. Timely reporting, as well as precision and reliability, are assessed as crucial aspects of the clinical laboratory's services.

Appropriate and timely clinical decisions influence patient outcomes, which are reliant on timely reporting. The total time spent in the laboratory is computed from the time the test is ordered to the time the report is generated. It comprises the time it takes for the sample to be collected, dispatched, acknowledged, centrifuged, segregated, and transported, analysed, result generated as well as the time it takes for the sample to be verified.

The fundamental goal of clinical laboratories is delivering consistent, accurate, timely interpreted test results to support clinical decision-making; the ultimate goal should be assuring desirable clinical outcomes. To reach this goal, laboratories should maintain quality in entire laboratory processes and simultaneously keeping an eye on cost effectiveness Clinical laboratories should now manage higher work volume with a wider range of indicators with the same (or less) staff while delivering accordant results with improved turnaround time & the highest standard. Despite accounting for only 5% of total healthcare spending, laboratories have a substantial impact on greater than 70% of condemnatory medical decisions, such as admitting, treating, & discharging patients. On the other side, clinical laboratories are under growing pressure to minimize costs while sustaining or even growing quality. To achieve this goal, not only the analytical phase, but also the pre- and post-analytical phases, must be simplified and "waste" eliminated. The Lean theory is a quality-improvement strategy that concentrates on providing “value” to customers and upgrading performance by removing waste, which we define as whatever that does not add value to final product or service.

TAT is often cited as one of the most important metrics of service quality. Rapid testing in the lab TATs is essential for clinicians to make timely diagnoses and treat patients. Patients arriving for OPD and laboratory testing billing at the same counter is crucial for a hospital with a high patient flow. TAT is very crucial in determining patient satisfaction. It can also be separated into pre-analytical, analytical, and post-analytical stages, depending on the level of sample processing.

The goal of this study is to use lean six-sigma to determine the current Laboratory TAT for OPD and its process flow. Identifying the peak hour, analysing the turnaround time of each stage in the process flow, further classifying into steps, and calculating the TAT for each step. To create a value-stream mapping of the Laboratory Department's process flow and utilize the mapping to identify non-value-added time in the process flow. Marking the timings ten steps to get information on the subdivided TAT, which helps us figure out which phase or process is causing the delay and can be handled more thoroughly to reduce the TAT.

CHAPTER 2: REVIEW OF LITERATURE

S.No	Author	Title of the study	Source	Findings	Year & Location
1.	Wanker A.D	Study of determination of turnaround time in tertiary care hospital in India	International Journal of research in Medical sciences	There were total of 232 samples, 183 were taken for analysis. Within TAT there were 100 samples, whereas beyond TAT there were 83 samples. 57.83% of the delayed samples had a TAT between 60-90 minutes, 26.51% had 90-120 minutes, 10.84% had 120 minutes or more. There was an average delay of 15 minutes and 38 secs between sample collection & arrival to lab.	August 2014, Yashoda Hospitals, Hydrabad, Andhra Pradesh, India.
2.	Desai K.N, Shah M, Patel K, Ranapurwala M, Sapre J, Chaudhary S, Shah M	Determination of Turnaround time in NABL acredited haematology & clinical pathology laboratories.	International Research of advanced research	6989 samples fell outside of the allowed range of TAT out of 102331 samples. 59.29% occurred for first 30mins.	August 2013, Pramukhswami Medical College, Shri Krishna Hospital, Karamsad, Anand, Gujrat, India.

				Early mornings and lunch breaks were the most quintessential times for delays. Sample transport and pre-analytical processing were a usual source of delay. Corrective measures, increased manpower& regular audits played a significant role in increasing TAT from 8.02% to 5.4%	
3.	Dinesh TA, Prem Nair, Vidya Jha, Abhijath V	Analysing Turnaround time in Laboratory- A key Performance indicator	Research Advances in Pathology & Laboratory science	Total 399 samples were given by three of the OPD for analysis. On average the contribution of pre-analytical stage was higher than analytical stage	December 2018, Amrita Institute of Medical Sciences, Kochi, Kerela, India
4.	Bharat R.D, Shrestha C, Risal P	Factors affecting turnaround time in the clinical	The Journal of the Internationa l Federation of Clinical	During the research period 36,108 sample reports were	2018 September, 3 Departments of Biochemistry,

		laboratory of the Kathmandu University Hospital, Nepal	chemistry and Laboratory Medicines.	analysed from the Dept. of Clinical Biochemistry . For stat tests, 36% of reports before the implied limit of TAT. 75% report showed long TAT hor due to analytical causes.	School of Medical sciences, Kathmandu University, Nepal
5.	Tamer C. Intal, Ozlem Goruroglu, Ozuturk	Lean six sigma methodologies improve clinical laboratory efficiency and reduce turnaround time	Journal of clinical laboratory analysis	In reception area the non-value added activity was around 3 hours and 22 minutes, removal of this improved the pre-analytical process. The TAT for stat samples reduced to 59 mins from 68 minute after implementing Lean six sigma.	February 2015

CHAPTER 3: METHODOLOGY

Key Research Questions?

What is the clinical laboratory's process flow across the OPD?

What is the average turnaround time for the OPD's pre-analytical, analytical, and post-analytical laboratory testing phases?

What is the typical turnaround time for each of the three steps of OPD laboratory testing?

What is the value-added and non-value-added time?

What factors contribute to a rise in TAT?

How can the procedure be made more efficient in order to reduce delays?

Research-Design: Descriptive cross-sectional study (prospective)

Duration of the study: The research was carried out over a three-month period (22nd March 2021-21st June 2021)

S. No.	Task	22nd March-26th March	29th March-5th April	5th April-28th May	31st May- 5th June	7th June-17th June
1.	Hospital & Laboratory Dept. Orientation					
2.	Understanding the process flow					
3.	Data collection					
4.	Data analysis					
5	Root cause analysis					
6.	Report writing & presentation					

Fig.1.1 Gantt chart of the project

Study setting: The study was carried out in the Department of Laboratory Services at a tertiary care hospital, Durgapur.

Study Population-

Inclusion criteria- Requisition request for:

- The Department of Biochemistry, Haematology, Serology received from the OPD
- Laboratory tests ordered between 08:00AM to 04:00PM (Monday-Saturday)
- At Mission Hospital, Durgapur

Exclusion criteria- Requisition request for:

- The Department of Clinical Pathology, Microbiology, Histopathology
- IPD & ER reports for Laboratory test
- Laboratory tests ordered beyond 04:00PM
- At other units of Mission Hospital.

Study tools-

Information for this study was gathered using the following methods:

- Checklist
- LIS

Sample size-

A total of 576 samples were analysed from the Department of Biochemistry, Haematology & Serology.

Sampling technique-

The data analysed was selected at random from the Out-patient Department.

Data collection technique-

At each stage of the process, a total of 576 samples were analysed. The objective of the observational phase was to identify potential reasons of delays. The information was gathered through interactions with patients, laboratory and front-office workers, and through the use of a learning management system (LIS).

The study was split into two halves based on the duration of the requisition tests. Morning slots were studied from 8:00 a.m. to 11:59 a.m., and afternoon slots from 12:00 p.m. to 4:00 p.m. 08:00 a.m.-09:00 a.m., 09:01 a.m.-10:00 a.m., 10:01 a.m.-11:00 a.m. & 11:01 a.m.-11:59 a.m. were the four time slots during the morning slot.

The whole TAT was broken down into three stages: pre-analytical, analytical, and post-analytical to examine how each stage contributed, and the entire procedure was divided into ten phases to see how each step contributed to the overall laboratory TAT for OPD.

CHAPTER 4: DATA ANALYSIS & RESULTS

Sipoc Diagram

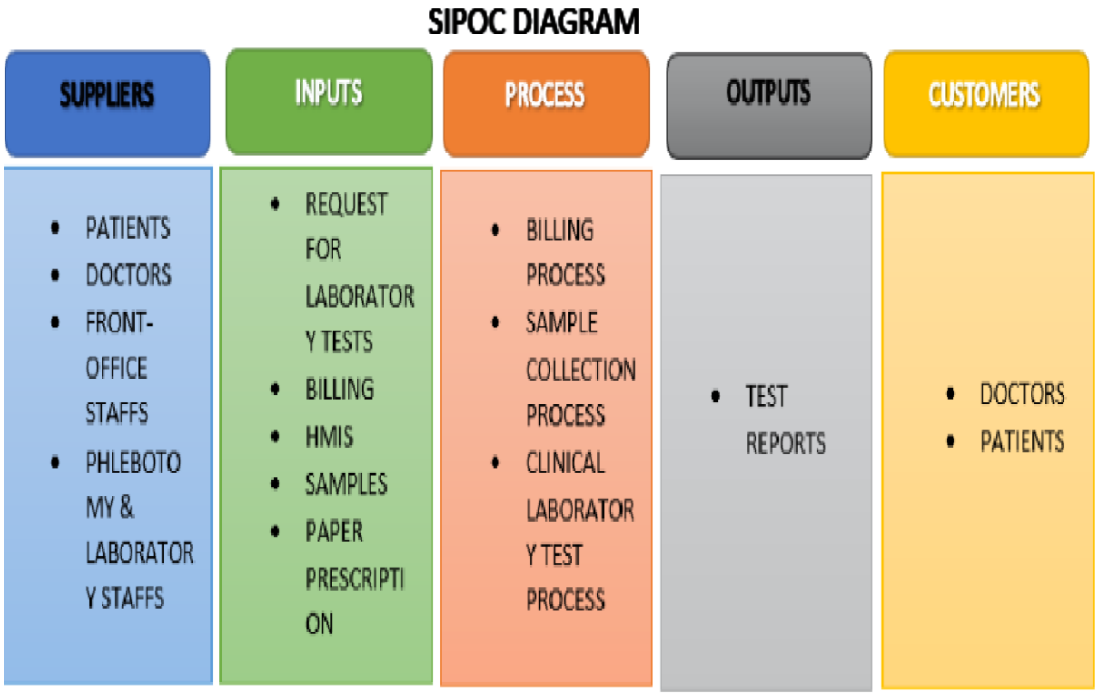


Fig.1.2 SIPOC Diagram for the OPD Laboratory process.

The SIPOC Diagram above was created to identify the key aspects of the OPD Laboratory Process Flow.

Who supplies the materials/inputs, and where do they come from?

Patients, doctors, front-office employees, and phlebotomy and laboratory staff are among the suppliers.

What resources (material/information) are required or offered by the supplier (inputs)? The inputs are request for laboratory tests, billing, HMIS, samples, paper prescription

What procedures or activities are performed to provide value to the customer?

Billing, sample collection, and laboratory testing are all part of this procedure.

What products/services are produced as a result of the process?

The output in this case is test reports.

Who are the customers, exactly?

Patients and doctors are among the clients.

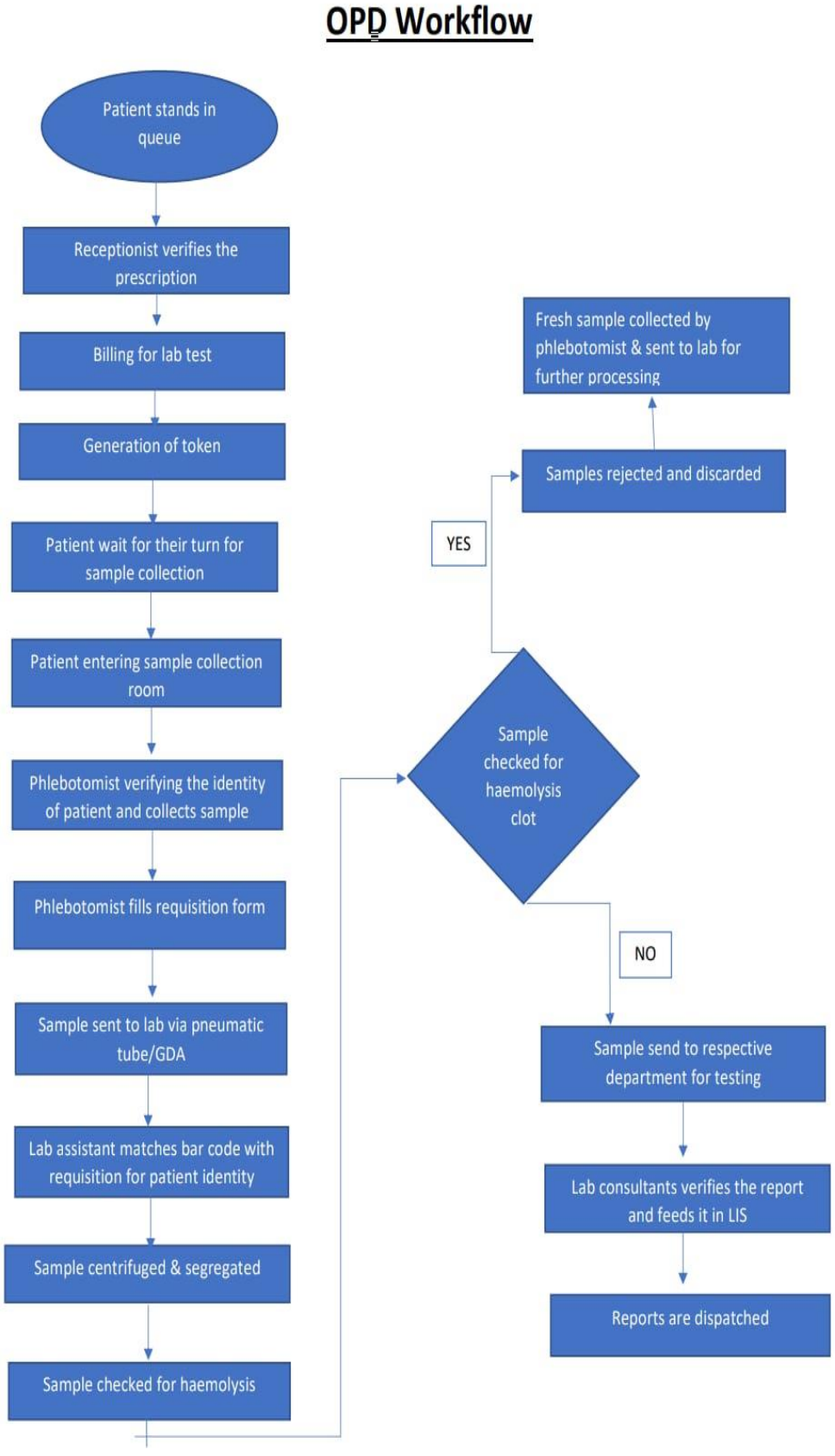


Fig.1.3 OPD workflow

TAT for Laboratory samples

A total of 576 samples were collected for analysis from the OPD for clinical laboratory routine testing, with 320 (55.5%) samples arriving within the TAT time of 4 hours & 256 (44.5%) samples arriving late.

For data analysis, primary data is obtained. Over the course of two months, each sample was followed and observed at each step.

OPD has a standard TAT of 4 hours in the laboratory

Table.1.1 Percentage of samples within & delayed TAT

TAT	No. of samples	% Of samples
Within TAT	320	55.5%
Delayed TAT	256	44.5%

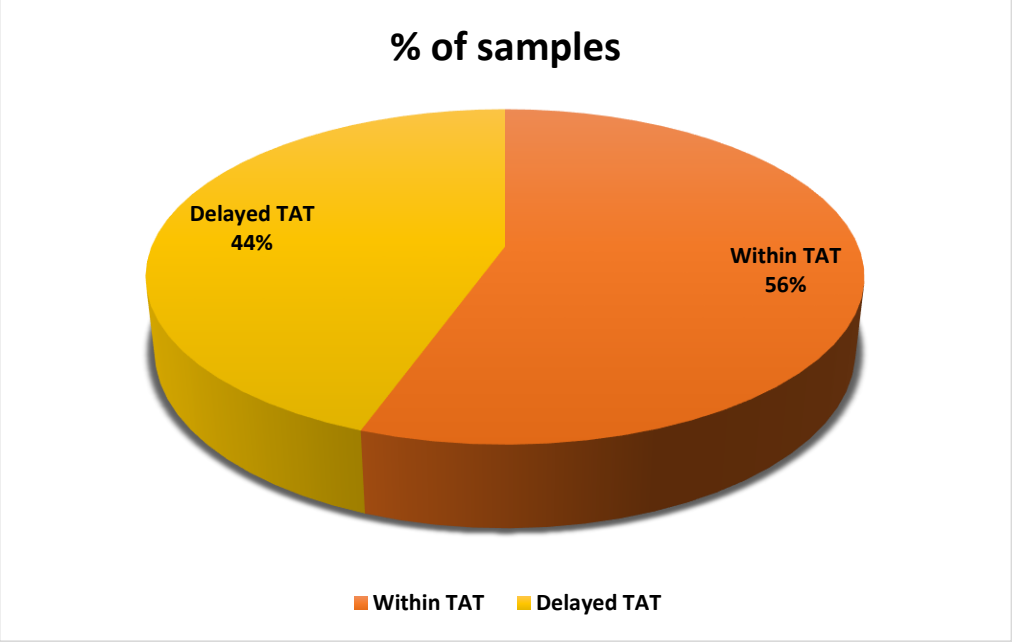


Fig.1.4 TAT for laboratory samples

256 samples from inside the delayed TAT were taken for further analysis.

Lab TAT analysis according to slot

This research was split into two sessions, one in the morning and one in the afternoon, 8:00 am to 11:59 pm & 12:00 pm to 4:00 pm, respectively**.**

Table.1.2 No. of samples & Average TAT for Morning & Afternoon slot

SLOTS	No. of samples	AVERAGE TAT (In hrs)
Morning slot (08:00AM-11:59AM)	240	04 hours 50 minutes
Afternoon slot (12:00PM-04:00-PM)	16	04 hours 20 minutes

The average TAT for morning and afternoon slots is depicted in the graph below. The greatest TAT was around 04 hours and 50 minutes in the morning slot (08:00AM-11:59AM) and around 04 hours and 20 minutes in the afternoon slot (12:00PM-04:00PM).

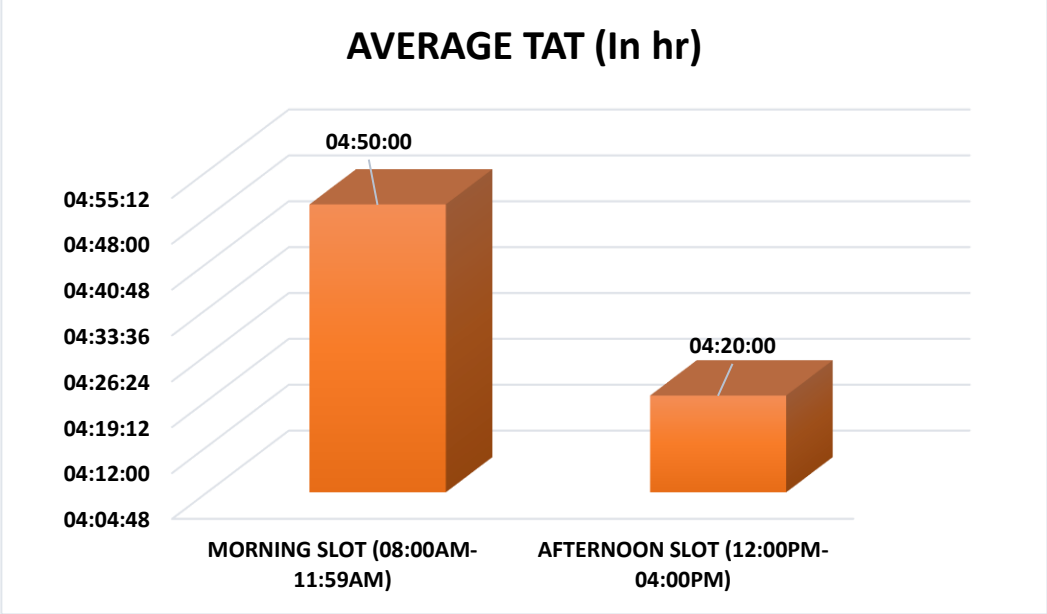


Fig.1.5. Graphical representation of Average TAT for morning and afternoon slot

Laboratory TAT analysis according to phases

In addition, the AM slot was split into four segments. The morning slot was divided into four phases: Phase I (08:30AM-09:00AM), Phase II (09:00AM-10:00AM), Phase III (10:00AM-11:00AM), and Phase IV (11:00AM-11:59M).

Table.1.3. No. of samples and average TAT at each phase

PHASES	TIME	No. of samples	Average TAT
PHASE I	08:00AM-09:00AM	24	04 hours 19 minutes
PHASE II	09:00AM- 10:00AM	68	04 hours 51 minutes
PHASE III	10:00AM-11:00AM	104	04 hours 54 minutes
PHASE IV	11:00AM-11:59AM	44	04 hours 50 minutes

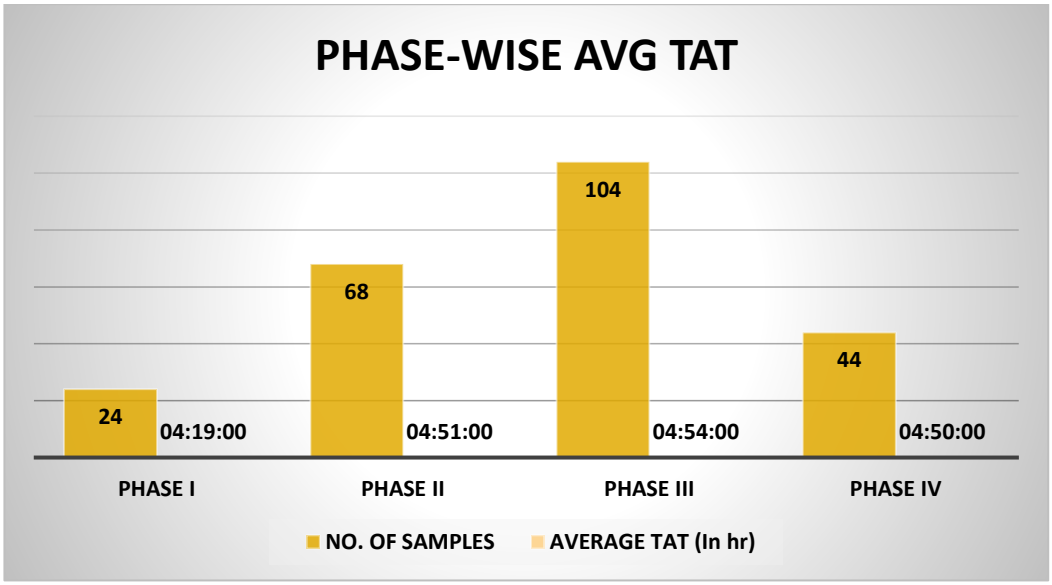


Fig.1.6 Phase-wise distribution of average TAT

The graph shows the average TAT for each morning slot period. PHASE III (10:01AM-11:00AM) had the longest TAT of roughly 04 hours and 54 minutes, followed by PHASE II (09:01AM-10:00AM), PHASE IV (11:01AM-11:59AM), and PHASE I (08:00AM-09:00AM) with TATs of around 04 hours and 51 minutes, 04 hours 50 minutes, and 04 hours 19 minutes. As can be seen, phase III has the

maximum number of samples (104), indicating that the peak hour is 10:00AM-11:00AM.

Lab TAT analysis according to departments

Table.1.4 No. of samples & Average TAT for departments

DEPARTMENTS	NO. OF SAMPLES	AVERAGE TAT
BIOCHEMISTRY	208	04 hours 50 minutes
HAEMATOLOGY	36	04 hours 53 minutes
SEROLOGY	12	04 hours 34 minutes

The graph below depicts the OPD TAT of Biochemistry, Haematology, and Serology by department. The Haematology Department had the fastest turnaround time at 04 hours and 53 minutes, followed by Biochemistry and Serology at 04 hours 50 minutes and 04 hours 34 minutes, respectively.

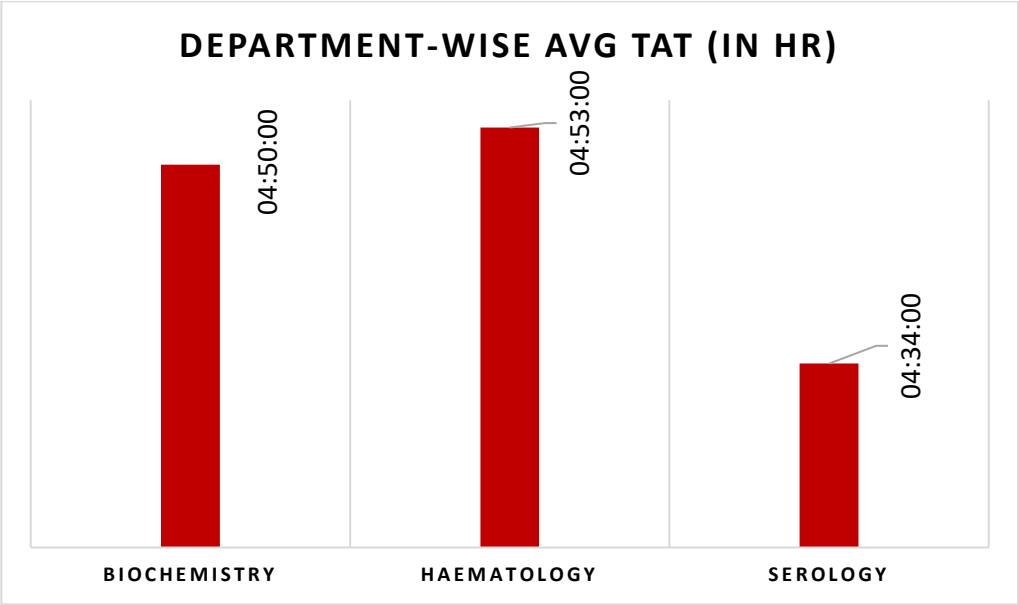


Fig.1.7. Graphical representation of Average TAT department-wise

Lab TAT analysis according to stages

Numerous TATs were calculated to better scrutinize various variances in average TAT reported at three stages, including:

Pre-Analytical stage TAT

Analytical stage TAT

Post-Analytical stage TAT

The time from when a patient came in for billing at the front desk to when the sample arrived at the appropriate department was recorded in the pre-analytical stage.

The time it took to complete the desired test was recorded in the analytical stage.

he time from the completion of the desired test till it was certified by the Laboratory HOD was recorded in the post-analytical stage..

Table.1.5 Average TAT for pre-analytical, analytical, post-analytical stages

STAGES	AVERAGE TAT
Pre-analytical Stage	02 hours 46 minutes 22 seconds
Analytical Stage	01 hour 40 minutes 40 seconds

Post-analytical Stage	23 minutes 21 seconds

The average TAT observed covering three stages of out-patient department is depicted in the next graph.

The highest turnaround time was 02 hours 46 minutes 22 seconds in the **pre-analytical stage**.

The **Analytical stage** had a turnaround time of 1 hour 40 minutes 00 seconds on average.

The turnaround time for the **post-analytical stage** was the quickest, at 23 minutes and 21 seconds.

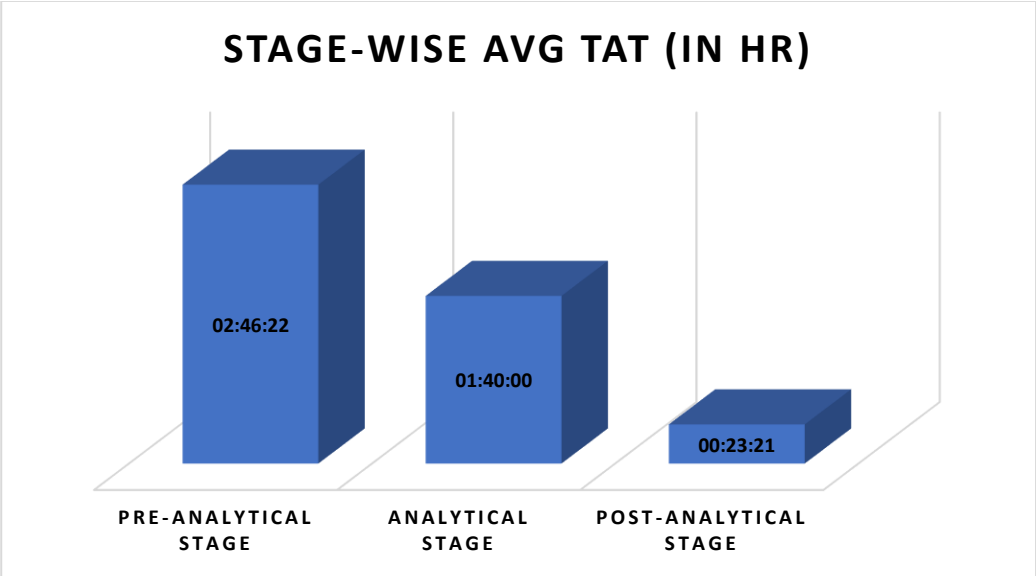


Fig.1.8 Graphical representation of average TAT at each stage

The pie graphic shows how much of the total TAT generated by OPD was accounted for (in percent). The pre-analytical phase accounted for 57% of the total, while the analytical and post-analytical stages each contributed 35% and 8% of the total.

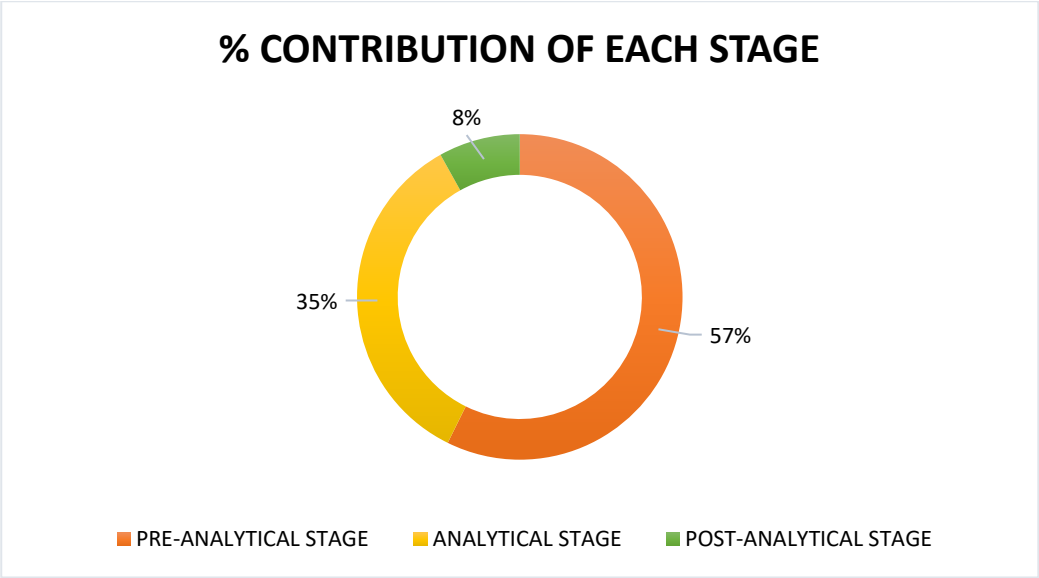


Fig.1.9 Pie-chart representation of percentage contribution of each stage

Lab TAT analysis according to steps

The study was further subdivided into ten steps for a more in-depth examination of each process that occurs from the ordering of the sample to the verification of the results.

STEP 1:

ORDER GENERATION

From the time a patient queues for billing of referred laboratory tests until the order is placed by the receptionist at the billing counter or reception, this is the process.

STEP 2:

TOKEN-GENERATION

It entails the entire process from the time the billing is completed to the time a token is generated for him or her to enter the phlebotomy/sample collection area.

STEP 3:

SAMPLE COLLECTION

The time between when the token is produced and when the sample is collected by phlebotomists in a vacutainer blood collection tube is included in this process.

STEP 4:

SAMPLE DISPATCH

This includes the time it takes for a phlebotomist to collect a sample and fill up a requisition form, as well as the time it takes for the sample to be transported to a clinical laboratory via pneumatic tube system.

STEP 5:

SAMPLE ACCEPTANCE

The period between when the requisition slip and sample are delivered and when the sample is acknowledged at the central laboratory is included in this process.

STEP 6:

SAMPLE CENTRIFUGATION

The time it takes for laboratory assistants to acknowledge a sample to the centrifugation process to be completed is included in this process..

STEP 7:

SAMPLE SEGGREGATION

From the time the samples are centrifuged until they are separated by laboratory assistants according to the separation of request forms matching vacutainer blood tubes for different departments, this process takes time.

STEP 8:

SAMPLE AT WORKSTATION

This procedure entails the time it takes for samples to be separated into departments and placed in a tray by laboratory assistants until they arrive at the appropriate department.

STEP 9:

RESULT GENERATION

The time it takes to analyse a sample for various tests is included in this process.

STEP 10:

VERIFICATION

The period between when the result is put into the LIS and when the reports are checked by laboratory experts is included in this procedure.

Table.1.6. Average TAT and target average TAT of each step

STEPS	AVG TAT	TARGET AVG TAT
Order generation TAT 1	**25 minutes 01 seconds**	15 minutes
Token generation TAT 2	46 seconds	1 minute
Sample collection TAT 3	**30 minutes 26 seconds**	15 minutes
Sample Dispatch TAT 4	04 minutes 32 seconds	05 minutes
Sample Acknowledgement TAT 5	**01 hour 20 minutes**	20 minutes
Centrifugation TAT 6	**13 minutes 29 seconds**	10 minutes
Segregation TAT 7	**08 minutes 15 seconds**	05 minutes
Sample at workstation TAT 8	03 minutes 52 seconds	05 minutes
Result generation TAT 9	**01 hour 40 minutes**	01 hour 30 minutes
Verification TAT 10	**23 minutes**	20 minutes

Source: As per discussion with Clinical Laboratory HOD (target average TAT)

The average TAT at each phase of the OP Laboratory procedure is given in the graph below. The longest TAT for result generating is 01 hour 40 minutes, followed by Sample Acceptance. TAT is 1 hour and 20 minutes, Sample Collection is 30 minutes and 26 seconds, and Order Generation is 25 minutes and 21 seconds, a verification time of 23 minutes 21 seconds, a centrifugation time of 13 minutes 29

seconds, a sample dispatch time of 4 minutes 32 seconds, a sample at the workstation time of 3 minutes 52 seconds, and a token creation time of 46 seconds.

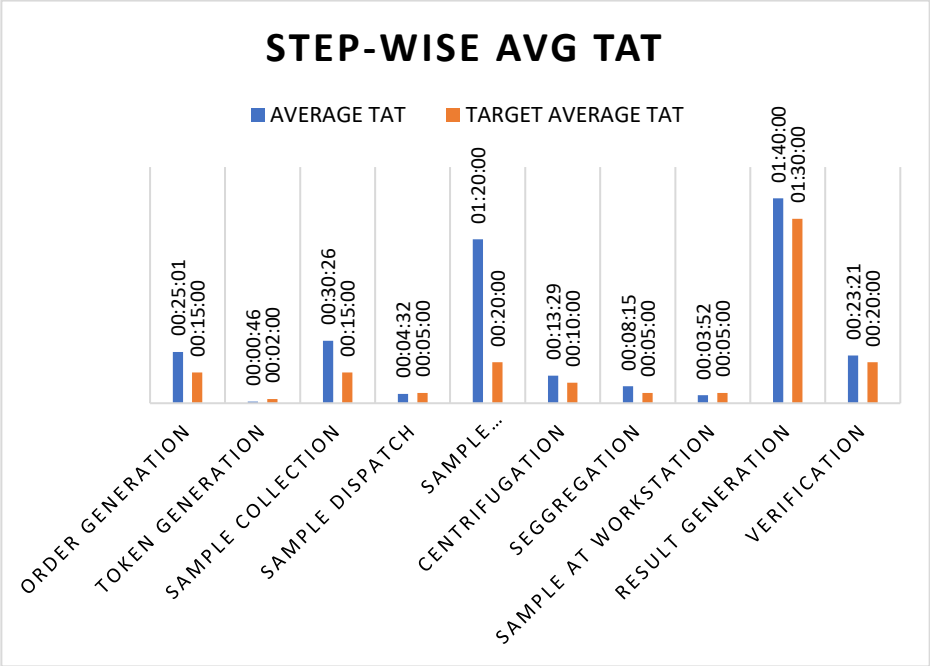


Fig.2.1 Graphical representation of the steps within target average TAT and above target average TAT

The below pie-chart depicts the overall contribution made by each step in the overall laboratory TAT for OPD.

The contribution of each step to overall TAT for result generation was 34.6%, sample acknowledgement 27.6%, sample collection 10.44%, order generation 8.66%, verification 8.02%, centrifugation 4.58%, segregation 2.8%, sample dispatch 1.49%, sample at workstation 1.21% & token generation 0.1%.

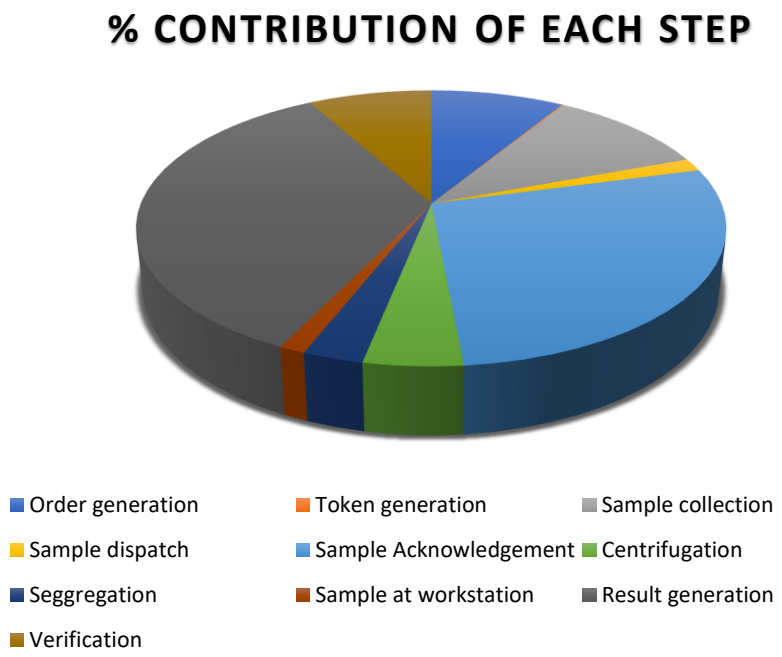


Fig.2.2 Pie-chart representing percentage contribution of each step

It was noticed that the major steps that did not met the target average TAT lied in pre-analytical stage.

Table.1.7 Percentage of samples above target TAT at each step

Steps	No. of samples within target TAT	No. of samples above target TAT	% Above target TAT
Order generation	44	**212**	**82.8%**
Token generation	256	0	0%
Sample collection	88	**168**	**65.6%**
Sample dispatch	184	72	28.12%
Sample acknowledgement	24	**232**	**90.6%**
Centrifugation	224	32	12.5%
Segregation	64	**192**	**75%**
Sample at workstation	236	20	7.8%
Result generation	124	**132**	**51.5%**

Verification	148	108	42.18%

The above table represents percentage of samples that falls within the target average TAT at each step for OPD. It was noticed that among the ten steps involved in the process flow four steps had higher percentage above target average TAT for sample acknowledgement, order generation, sample segregation, sample collection, result generation was found to be 90.60%, 83%, 75%, 65.60%, 51.5% respectively.

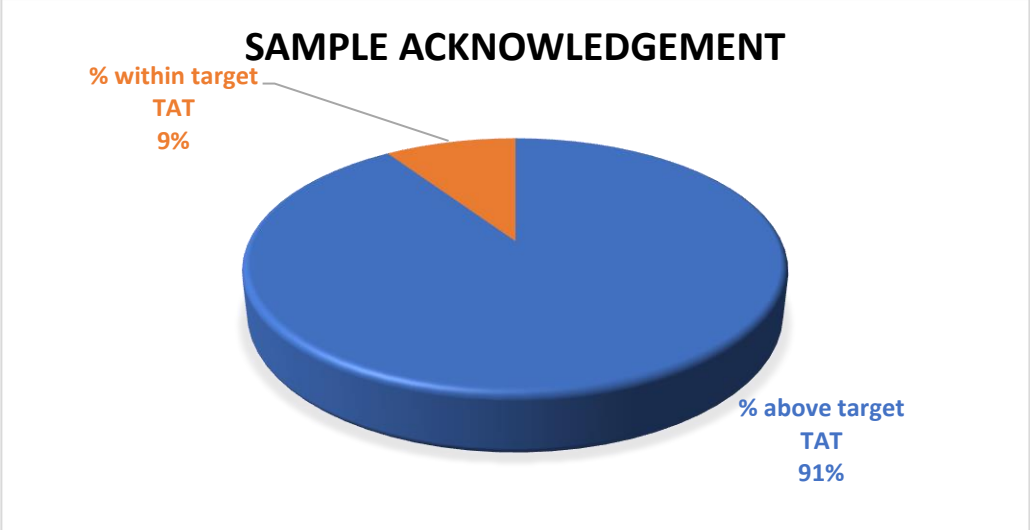


Fig.2.3 Percentage of samples above & within target sample acknowledgement TAT

This graph represents the sample acceptance TAT where the percentage of samples above target average TAT (>20 minutes) was 91%.

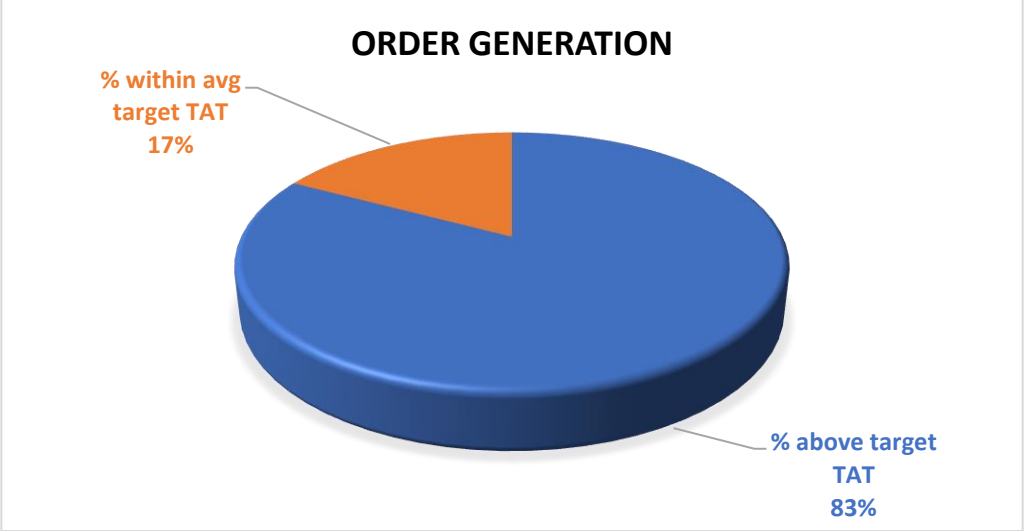


Fig.2.4. Percentage of samples above & within target order generation TAT

The above graph represents the order generation step where the percentage of samples above target average TAT (>15 minutes) was 83%

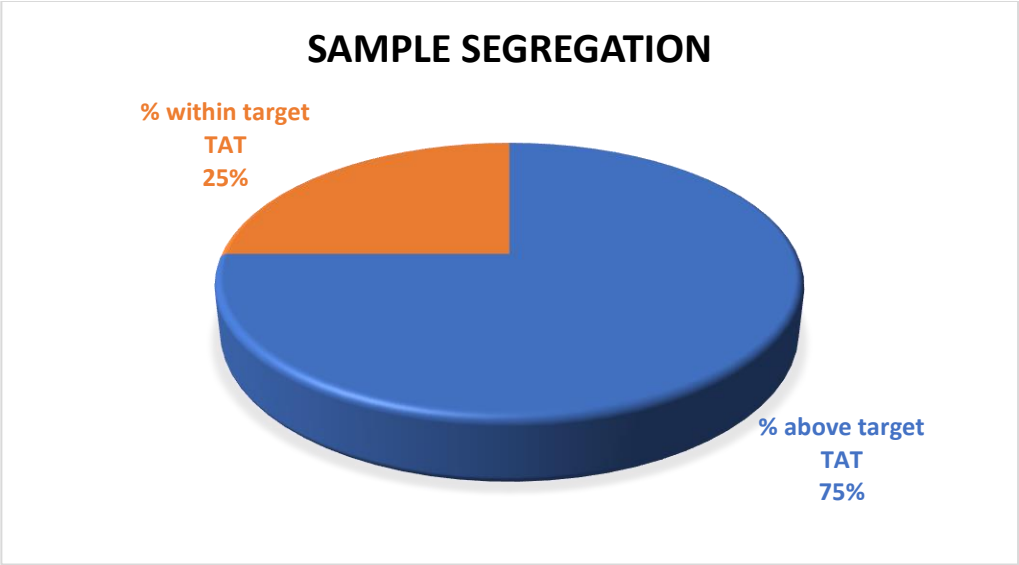


Fig.2.5. Percentage of samples above & within target sample segregation TAT

This graph represents the segregation step where the percentage of samples above target TAT (>5 minutes) was 75%.

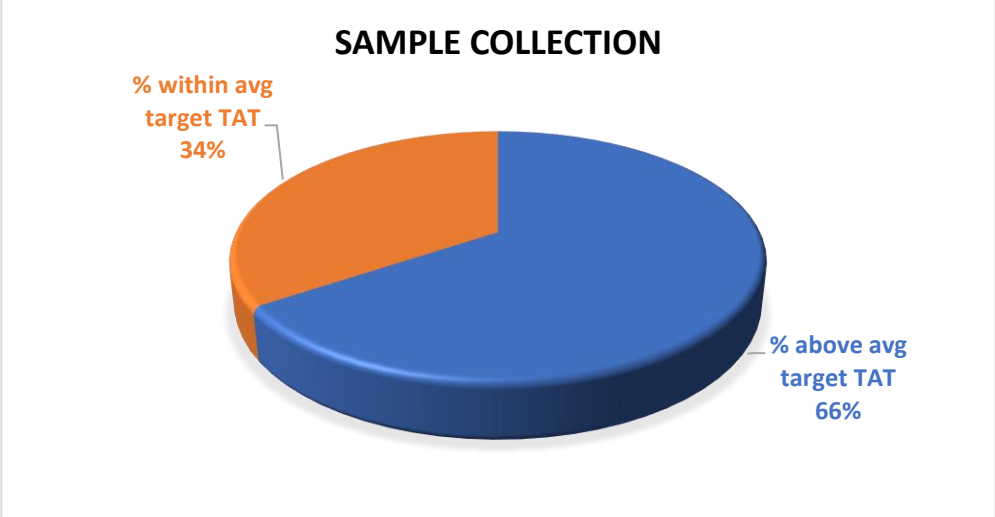


Fig.2.6 Percentage of samples above & within target sample collection TAT

This graph represents the sample collection step where the percentage of samples above target average TAT (>15 minutes) was 66%.

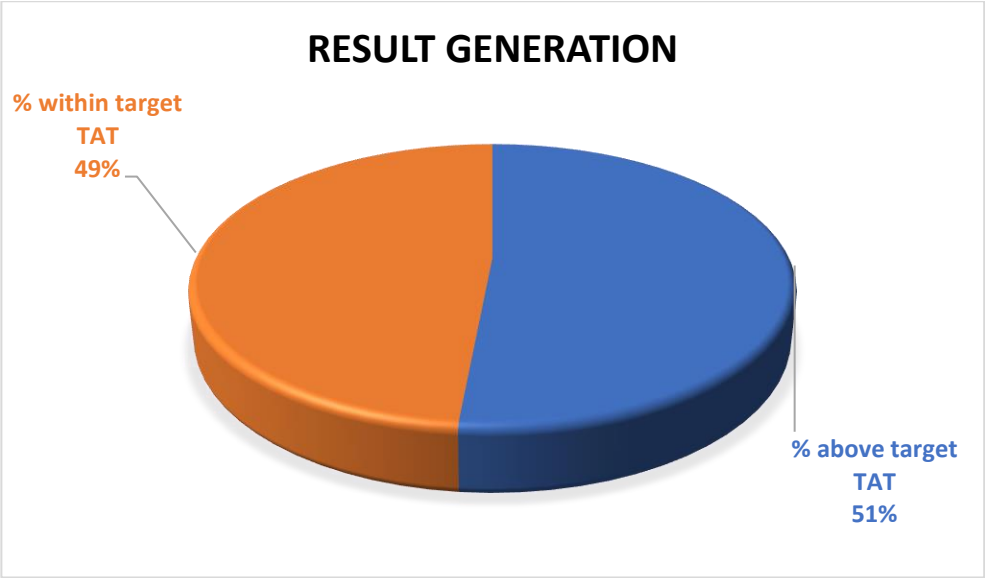
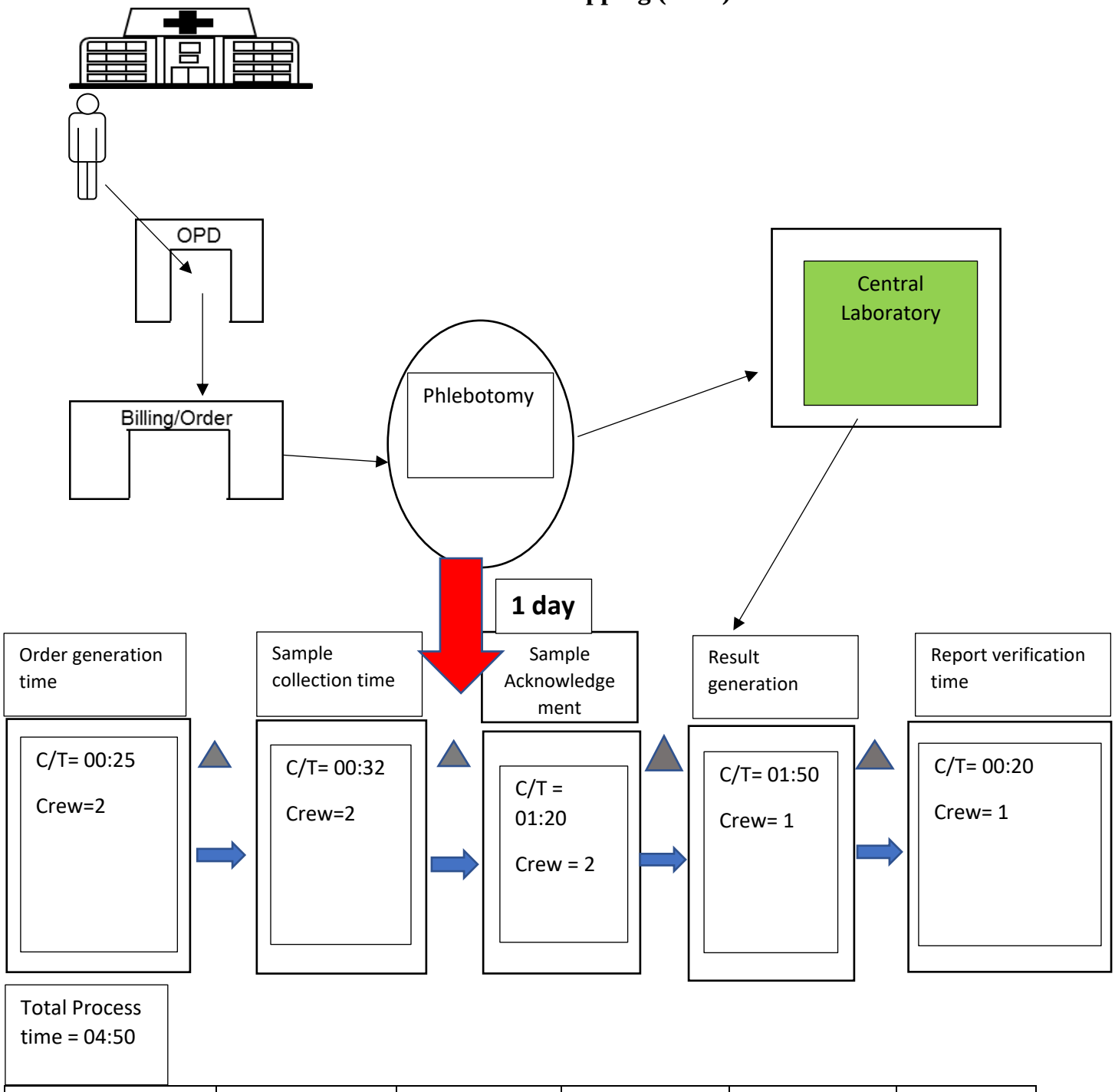


Fig.2.7. Percentage of samples above & within target result generation TAT

This graph represents the result generation step where the percentage of samples above target TAT (>1 hour 30 minutes) was 51%.

Value stream mapping (OPD)



Value added	00:15	00:15	00:20	01:30	00:20
Non value added	00:10	00:17	01:00	00:20	00:03

Fig.2.8 Representation of the Value Stream Mapping for OPD Laboratory Process

As a result, the total OPD procedure time is 04 hours and 50 minutes. The procedure that adds value to the customer and for which the consumer is ready to pay is known as value added time. The waiting time, move time, and inspection time are included in the non-value-added times. The amount of time it takes to conduct an action is referred to as value added time, which is the amount of time it takes to complete the task.

For OPD,

The VAT = 3 hours

The NVAT = 1 hour 50 min.

From the time the patient enters the department until the reports are generated, time is taken into account.

As previously stated, the maximum time spent is during sample acknowledgement, which increases the time spent waiting for reports and so increases the activity's non-value-added time.

Root cause analysis

The following were recognised as contributing factors to the delay in laboratory TAT for OPD and were categorised into the following categories:

Machine

System shortages in the basement and first floor.

Breakdown of the server

Breakdown of the pneumatic system

Breakdown of barcode generator

Man

During peak hours, there is a shortage of phlebotomists and laboratory assistants.

Patients, receptionists, phlebotomists, and laboratory workers do not communicate effectively.

Negligence by the staff

When personnel working at the billing counter are unable to read a doctor's handwriting, the registration process takes longer.

Workload has increased.

Process

Waiting time for test billing registration

The time it takes to collect and transport samples in the OPD causes a pneumatic shoot delay.

Environment

Insufficient space in the phlebotomy room and the central laboratory.

For laboratory tests, there is no separate billing counter.

Policies

Lack of regular audits.

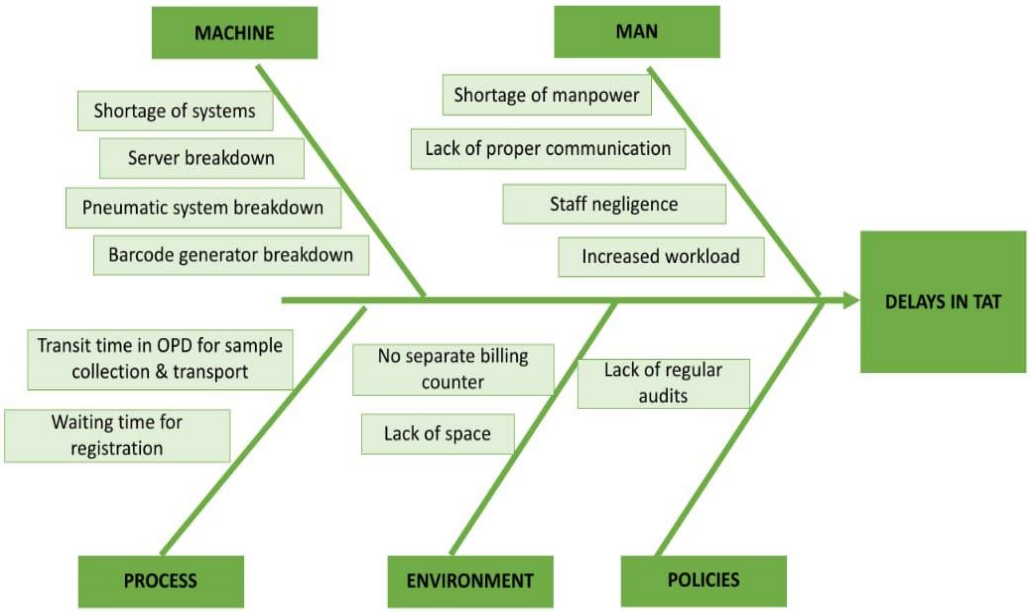


Fig.2.9. Ishikawa diagram for increase in Laboratory TAT for OPD

CHAPTER 5: DISCUSSION

Due to a system shortage, the higher turn-around time for the OPD laboratory was caused by an increase in billing time at reception. As a result, introducing a dedicated billing counter for Laboratory would aid with queue management and reduce turn-around time.

There must be three active phlebotomists in the sample collection room/phlebotomy to speed up the blood collection procedure, one phlebotomist for barcode production, and one for filling out the requisition form at a time during peak hour.

Request maintenance as quickly as feasible if the pneumatic tube system fails, and keep a GDA for the transport of cylindrical containers to the central laboratory. When travelling to the lab and returning to the collection centre, OP sample assembling room conveyance staff with sample acquitting boxes should be competent to use the elevator without constraint..Creating appropriate space at the central laboratory and allocating specific duties to the laboratory assistant would reduce the chaos and workload as a result of the increased turn-around time for sample acknowledgement. Samples from the IPD and ER departments are also received in the central laboratory, which adds to the burden of the laboratory assistants on duty.

For IPD, OPD, and ER departments, dedicated laboratory assistants must be given. To speed up the sample separation procedure, two laboratory assistants must be present at the same time. Tables and chairs should be set up in such a way that laboratory technicians may move around freely.

CHAPTER 6: RECOMMENDATIONS

(a) Having a separate billing counter for laboratory tests will reduce delays during peak hours, reducing wait times for both patients seeking OPD consultation and those registering for laboratory testing. This would allow for efficient queue management.

(b) Working together with health IT vendors to migrate doctors' manual prescriptions to electronic prescription printing.

(c) Establishing a monthly feedback system to address any technical difficulties that arise.

(d) Improving communication between employees by focusing on an assessment of present communication methods, streamlining communication routes, and giving every employee a voice and respecting their input.

(e) A thorough rooster should be built, with a greater presence of employees accessible at our disposal throughout the hospital's peak hours. Because of the early morning hours, this is largely directed towards them. The unit has noticed an increase in workload.

(f) Creating a ancillary Phlebotomist Bay for the out-patient department and including guidance on the OPD token, building it more convenient for patients gathering samples.

(g) A monthly pneumatic system maintenance schedule would boost efficiency while reducing system malfunctions.

(h) Adoption of effective quality control processes in the laboratory, including the use of a checklist.

(i) Creating an overall laboratory turnaround time benchmarking system.

(j) Implementation of a quarterly audit plan throughout all three phases to ensure that the outcomes achieved are in line with established benchmarks.

(k) Open laboratory design must be taken into account.

(l) Priority should be given to receiving OP samples over ward samples.

CHAPTER 7: CONCLUSION

Increased workload, untrained workers, inefficient communication among staff, bad space management, unorganised workstation, extra transportation, and excessive mobility were all factors that contributed to the delay of laboratory reports. With the use of lean management technologies, these causes were discovered.

There are numerous outliers that affect the laboratory's TAT, and in order to minimise the TAT, one must exert at each and every step, included in all the three stages that is pre-analytical, analytical, and post-analytical, as these are all associated, and keeping an eye on these will not only help enhance the TAT altogether but also ensure quality control.

The main cause of TAT was delayed sample acknowledgement due to increased workload, which was followed by frequent equipment malfunction and manpower shortage during the pre-analytical stage, which exacerbated the TAT of the OPD Laboratory process flow.

To enhance TAT, policies should be developed and executed, and audits should be performed on a regular basis to aid in patient satisfaction.

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ANNEXURE

S. No.	UHID No.	Type of test	Patient in queue	Order generation time	Order generation TAT 1	Token generation time	Token generation TAT 2	Sample collection time

Sample collection TAT 3	Sample dispatch time	Sample dispatch TAT 4	Sample acknowledgement time	Sample acknowledgement TAT 5	Centrifugation time	Centrifugation TAT 6	Segregation time	Segregation TAT 7

Sample at workstation time	Sample at workstation TAT 8	Result generation time	Result generation TAT 9	Verification time	Verification TAT 10