Reducing Turn Around Time (TAT) of Patients in Outpatient Department Using Six Sigma Approach

By

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Dissertation submitted for the partial fulfillment of the
MBA Hospital and Health Management

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The Internship is in fulfillment of the course requirements.

I wish him all success in all his future endeavors.

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In recognition of having successfully completed his

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In

Department of Quality

And has successfully completed his Project on the topic

"To Improve the Turn Around Time (TAT) in Out Patient Department Using Six Sigma Approach"

From 08th February 2016 to 07th May 2016

He comes across as a committed, sincere & diligent person who has a strong drive and zeal for learning

We wish him all the best for future endeavours.

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Abstract

Reducing Turn Around Time (TAT) of patients in Outpatient Department using Six Sigma approach

Col SurenderPawan Kumar, MBA Hospital& Health Management, IIHMR Jaipur, Rajasthan, India

Key words: quality, health services, Turn Around Time, India

Background

Turn Around Time for elective care have been considered a seriousproblem in many health care systems since it acts as abarriers to efficient patient flows. It is an important indicator of quality of services offered by hospitals. It is a tangible aspect of practice that patients will use to judge health personnel, even more than their knowledge and skill.

As with many tertiary healthcare centre Eternal Hospital encounters an expanding patient load, greater patient expectations and increasingly complicated patients who require services from a multitude of health providers. Such rising demands amidst limited resources cause inefficiencies and long waiting times for consultation. This results in low patient satisfaction and an unpleasant experience.

OPD is considered the shop window of the hospital and patient's impression of the hospital generally begins here.

Research Questions

1. What is the Turn Around Time (TAT) of patients in Outpatient Department?

2. How to reduce TAT of the above patients?

Aim

To reducethe TAT of patients in OPD, using Six Sigma approach.

Objectives

1. To study the process in OPD.
2. To determine TAT in OPD.
3. To assess the bottlenecks in the processes.
4. To recommend interventions to reduce the TAT.
5. To carry out Impact Study of interventions.

Methodology

1. **Study type & design:** It is a Qualitative, Analytical, Applied and Empirical type of study with *Quasi experimental*design using*Separate Sample Pretest-Posttest*.
2. **Type of data and collection method:** Primary data collected by observation.
3. **Sample size:** 10% of the total OPD patients.
4. **Sampling technique:** Systematic random sampling technique.
5. **DMAIC**

   (a) Define: Process flow of OPD patients was defined and was sub-divided for ease of study. The Upper Specification Limits were also fixed at this stage.

   (b) Measure: Waiting time was determined using Time Motion Study.

   (c) Analysis:Factors leading to delay were analysed.

   (d) Improve:Some interventions to reduce TAT were implemented.

   (e) Control: TAT was again determined to assess the impact of these interventions.

Results

- It was observed that prior to the interventions average waiting time before a patient got his billing done was 12 minutes while after interventions it was reduced to 9 minutes.
- The maximum waiting time was reduced from 50 minutes to 21 minutes after interventions.
- Before interventions 27% patients had to wait for more than 15 minutes which was the Upper Specification Limit (USL) for billing while post interventions this reduced to only 8% (Sigma level increase from 2.12 to 2.90).
- The average time between patient's first billing and second billing (billing for investigation after meeting the doctor) was reduced from 1h 10 min to 56 min (20% reduction).
- Earlier about 60% patients had to wait formore than 60 min (USL) before second billing while after interventions this section was reduced to 44%. The Sigma level increased from 1.24 before interventions to 1.65 after these.

Conclusion

This project clearly demonstrates the Six Sigma methodology as an effective tool in defining inefficiencies and improving patient flow.

As this is still one of the preliminary quality improvement project, efforts to continually track, examine, and further improve turn-around times will go a long way in improving patient's experience at Eternal Hospital.

Acknowledgement

Sometimes the greatest contribution you can make is to give regards – Brahma Kumaris

The success of any task would be incomplete without expression of gratitude. Though the words fall short to express sincere gratitude to everyone who helped me directly or indirectly in my endeavours, it is a pleasant feeling that i have an opportunity to render my gratitude to all of them.

First and foremost I would like to thank **Mr Sunil Kapoor, CEO**, Eternal Hospital, Jaipur for providing me the opportunity to work with the organization and make my internship and dissertation a valuable experience.

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I express my sincere thanks to **DrVrajesh Shah, MS,** Eternal Hospital, whose advices played extremely valuable role in accomplishment of my task.

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I am extremely grateful to my guide, **Miss KirtiHemkar, Head, Quality Department,** Eternal Hospital, who not only guided me all along but also provided all required resources and information without which completion of the project would not have been possible.Her dynamic thinking and profound knowledge assisted me greatly in achieving my objectives.

I would also like to thank the staff of Eternal Hospital for sparing their precious time and providing me full cooperation in completing my assigned task.

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List of Acronyms/Abbreviations

S. No	Acronym/ Abbreviation	Meaning
1	Cath Lab	Catheterisation Laboratory
2	DMAIC	Define Measure Analyse Improve Control
3	DPMO	Defects Per Million Opportunities
4	FMEA	Failure Mode Effect Analysis
5	GDA	General Duty Assistant
6	HEPA	High Efficiency Particulate Air
7	IPD	Inpatient Department
8	LSL	Lower Specification Limit
9	NABH	National Accreditation Board for Hospitals
10	OPD	Outpatient Department
11	PHC	Preventive Health Check up
12	PTCA	Percutaneous trans luminal coronary angioplasty
13	StdDev	Standard Deviation
14	USL	Upper Specification Limit

1.0 INTRODUCTION

1.1 Background

Public health centres are currently facing higher operating costs as treatment, diagnostics, and patient care have become more specialized. More and more patients seek care and have greater expectations from the tertiary specialist settings whilst funding, resources, and infrastructure remain limited.

Clinicians often pride themselves in delivering the best patient care but fail to acknowledge the need to improve systems and operations surrounding this administration of care. In large hospitals patients are often left waiting for long periods when they come in to see the physician. The perception of inactivity whilst waiting is largely due to the multiplicity of providers that have varying methods, training, and habits of seeing patients without recognising how such uncoordinated variability contributes to the patient experience. There is often poor handover from one provider to another with no overall coordination. Patient experience often does not take priority. Such phenomena are not uncommon and multiple improvement projects using various methods have beenreported to improve patient satisfaction both in the inpatient and ambulatory setting (1)

Patients' waiting time has been defined as "thelength of time from when the patient entered theoutpatient clinic to the time the patient actually leavesthe OPD".Whether it's a time used for registration of patient, routinedoctor's appointment, emergency room treatment, laboratory/diagnostic test, procedures, receiving the results of varioustests, waiting happens to just about everyone seekingmedical care.

Waiting times for elective care have been considered a seriousproblem in many health care systems since it acts as abarriers to efficient patient flows. It is an important indicator of quality of services offered by hospitals (2). The amount of time a patient waits to be seen is one factor which affects utilization of healthcare services. Patients perceive long waiting times as a barrier to actually obtaining services(3) Keeping patients waiting unnecessarily can be a cause of stress for both patient and doctor. Waiting time is a tangible aspect of practice that patients will use to judge health personnel, even more than their knowledge and skill.

OPD is considered as the window to hospital services and apatient's impression of the hospital begins at the OPD. Thisimpression often influences the patient's sensitivity to the

hospital and therefore it is essential to ensure that OPD servicesprovide an excellent experience for customers. It is alsowell-established that 8-10 per cent of OPD patients need hospitalization.

Six Sigma

Six Sigmais a business management strategy originallydeveloped by Motorola, USA in 1986 and wasassociated with statistical modelling of manufacturing processes.A six sigma process is one in which 99.99966% of theproducts manufactured are statistically expected to be free ofdefects (3.4 defects per million).The term "six sigma process" comes from the notion that ifone has six standard deviations between the process meanand the nearest specification limit, as shown in the figure 1.1,practically no items will fail to meet specifications (4). Thisis based on the calculation method employed in process capability studies (Figure1.1). Six Sigma seeks to improve the quality of process outputsby identifying and removing the causes of defects (errors)and minimizing variability in the work process (5). Data and statistical analysis are used to identify defects inprocesses and reduce variation. DPMO (Defects Per Millionof Opportunities) and sigma level are described in the Table 1.1.

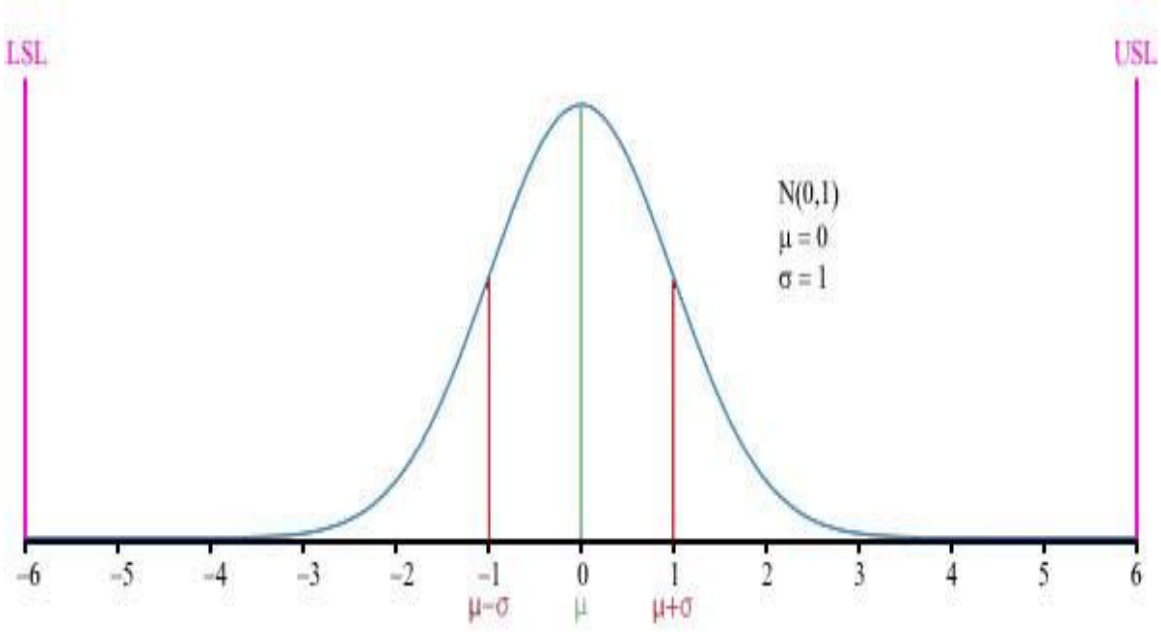


Figure1.1: Process capability

Table1.1 DPMO and sigma levels

Sigma level	DPMO	Per cent defective	Percentage yield
1.	6,91,462	69%	31%
2.	3,08538	31%	69%
3.	66,807	6.7%	93.3%
4.	6,210	0.62%	99.38%
5.	233	0.023%	99.977%
6.	3.4	0.00034%	99.99966%
7.	0.019	0.0000019%	99.9999981%

Lean Six Sigma

Figure1.2:Lean Six Sigma

Lean Six Sigma is a two staged business approach (Figure 1.2) to continual improvement which focuses on reducing waste and product variation from manufacturing, service or design processes. Lean refers to maximizing customer value and minimizing waste; creating more value for customers with less wasted resources. Six Sigma is the on-going effort to continually reduce process and product variation through a defined project approach. Combined, the two approaches drive continual

improvement, building a philosophy that is the foundation of all effective management systems and any business that wants to grow and progress for the future.

Benefits of Lean Six Sigma

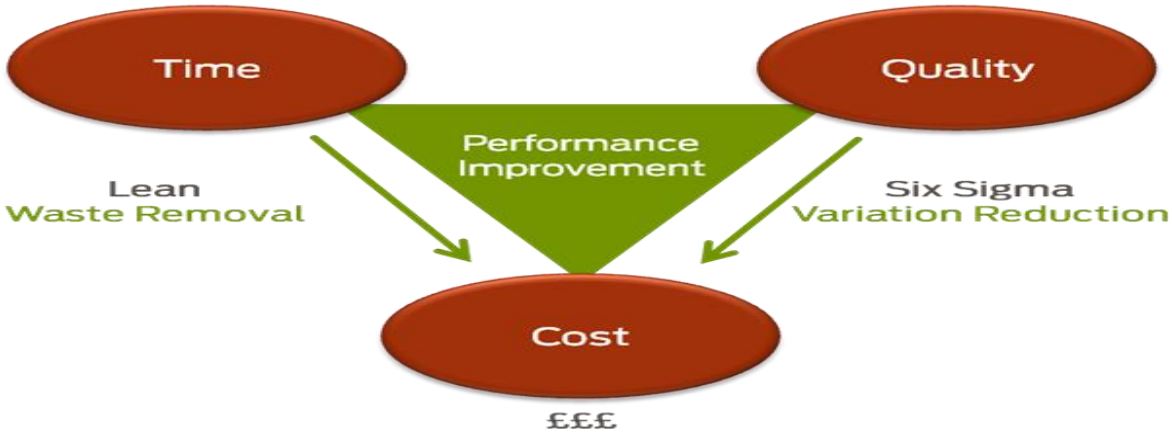


Figure1.3:Benefits of Lean Six Sigma

The most important benefits of Lean Six Sigma are(Figure 1.3):

- Removal of wastes
- Reduction of variations
- Reduction of time
- Reduction of cost
- Improvement of Quality

Besides these some other benefits to both internal and external stakeholders are:

• Increased customer and employee satisfaction

• Retained business

• Enhanced reputation

• Increased competitive advantage

• Improved staff morale

DMAIC

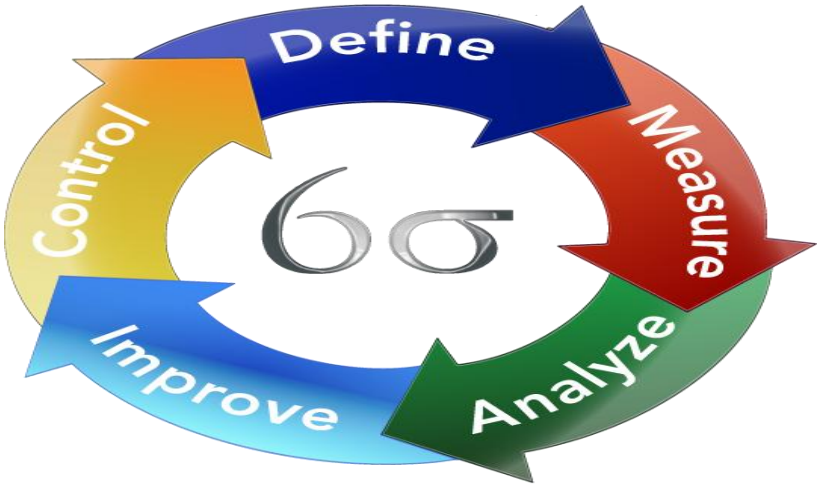


Figure 1.4:Core of Six Sigma

DMAIC is at the core of Lean Six Sigma(Figure 1.4) and stands for Define, Measure, Analyse, Improve and Control.

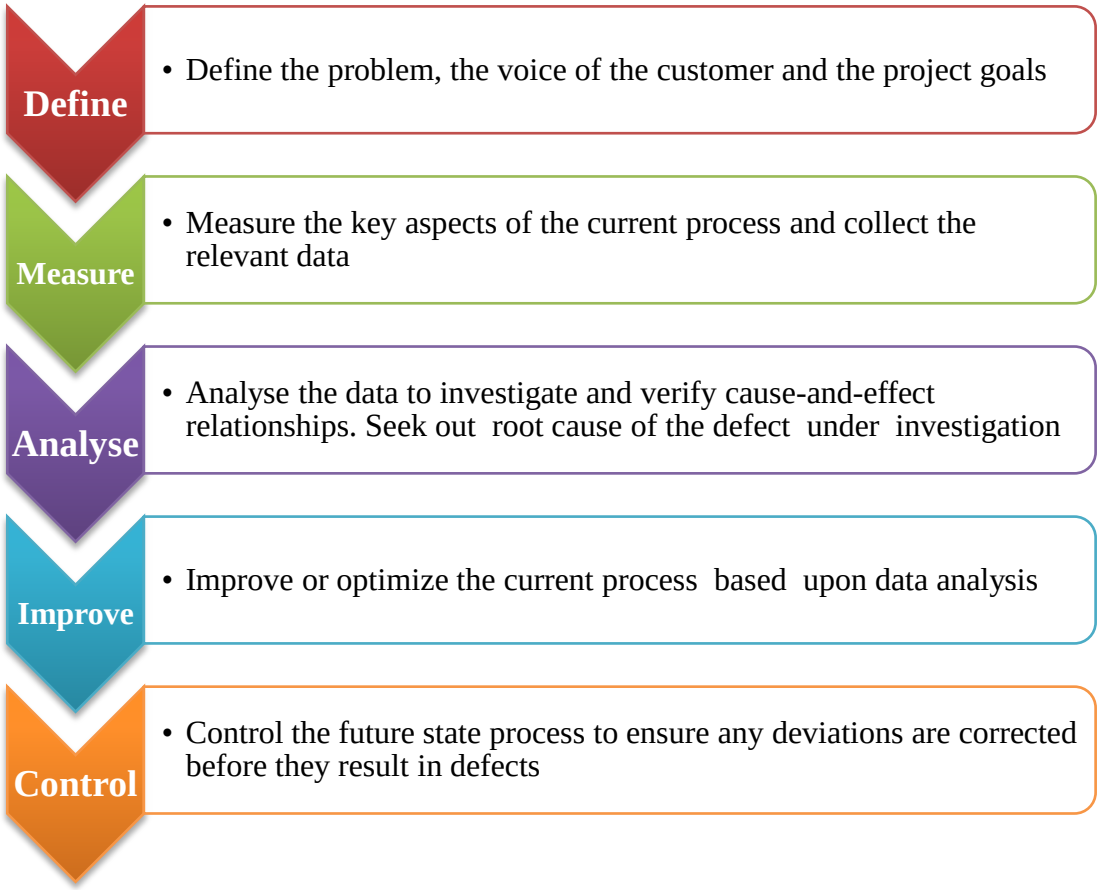


Figure 1.5:DMAIC

1.2 Justification

The Eternal Hospital, Jaipur is a multidisciplinary tertiary care hospital which aims to provide an integrated one-stop service for all health care. As with many tertiary healthcarecentre, Eternal Hospital encounters an expanding patient load, greater patient expectations and increasingly complicated patients who require services from a multitude of health providers. Such rising demands amidst limited resources cause inefficiencies and long waiting times to consultation. This result in low patient satisfaction and an unpleasant clinic experience.

Due to increasing patient loads, higher patient expectations, evolving new subspecialty services, and on-going research activities, clinic operations became complicated and inefficient. There were increasingly negative sentiments from patients, with many encountering long periods of waiting, often spending nearly a day at the centre when they came for appointments. Confusion and disorder arose when patients had multiple same day appointments, as there was a lack of coordinated workflows between care providers. Doctors, nurses, allied health, and service staff felt stressed with the increased load. Clinics often overran into lunch and after hours affecting the general morale of staff.

OPD is considered the show window of the hospital and patient's impression of the hospital generally begins here. This impression often influences patients' sensitivity to the hospital and is therefore it is essential that OPD services provide an excellent experience to the patients. It is also well established that 8-10 per cent of OPD patients need hospitalisation.

A project was thus initiated by a multidisciplinary team from Eternal Hospital to improve the TAT of patients in OPD, engage better communication and workflow between the various healthcare providers, and improve the overall hospital experience for both patient and staff.By systematically breaking down processes and identifying problem areas, targeted changes were implemented.

The primary aim of this project was to improve the patient turn-around time in OPD.

1.3 Research Questions

3. What is the Turn Around Time (TAT) of patients in Outpatient Department?

4. How to reduce TAT of the above patients?

1.4 Aim

Aim of this study was to reduce the TAT of patients in OPD.

1.5 Objectives

1. To study the process of OPD.
2. To determine the TAT of OPD patients
3. To assess the bottlenecks in the processes.
4. To recommend interventions to reduce the TAT.
5. To carry out impact study of interventions.

2.0 LITRATURE REVIEW

1.The Institute of Medicine (IOM) recommends that, at least 90% of patients should be seen within 30 min of their scheduled appointment time (6). This is, however, not the case in most developing countries, as several studies have shown that patients spend 2-4 h in the outpatient departments before seeing the doctor.(7,8,9) A source of dissatisfaction with health care reported by patients is having to wait a long period of time in the clinic and several studies have documented the negative association between increased waiting time and patient satisfaction with primary care.

2.The duration of waiting time varies from country to country, and even within country it varies from city to city. Long waiting times have been reported in both developed and developing countries.

3.In the USA, an average waiting time of about 60 min was found in Atlanta, (10) and an average of 188 min in Michigan.(11). In Nigeria, an average waiting time of about

173 min was found in Benin, (12) while in University College Hospital Ibadan, a mean waiting time of 1 h 13 min was observed. (13)

4.AkilanArunkumar.A. Delaysand waiting – a challenge for the hospital. Analysis of Out-Patient Service using Queuing Theory, Research Scholar, Tata Institute Of Social Science, Mumbai(14). The study was designed to know the arrival pattern of the patients, the time taken to utilise the services (service rate) and utilisation of ophthalmologist and other staff involved in OPD. 1413 samples were studied through this study. Response time was calculated from finding the difference between the entry and exit time. The bottleneck analysis revealed where the system fails in providing quick service. If more than 300 patients arrived at the OPD, queue starts building up at the reception centres. Reception centres were the primary bottlenecks.

5. Dr Jawahar S.K. India, A study on patient satisfaction in a super speciality hospital in India. International Journal of Medical Update 2007 (July-Dec); 2(2):13.7(15). In the study it was found that most of the patients waited for less than one hour. The enquiry time and time at Medical Record Department was less than 30 min for about 70% patients. However the time for consultation was very high; in some cases it extended even more than three hours leading to patient dissatisfaction.

6. Improving Turn Around Time for OPD. P.D. Hinduja National Hospital & Medical Research Centre [internet] 2011 [cited 2012 Apr 13]. Available from: http://www.quimpro.com/nabh/project_hinduja.php (16). In order to track waiting a study was conducted to capture end to end process for all services. It was found that the idle waiting time constituted for around 40 to 50 minutes. Theappointment patient on an average was ready to wait for 30 minutes after giving the voucher.

This study aimed at improving the patients' waiting time in the OPD of Eternal Hospital.

3.0 METHODOLOGY

3.1 **Study setting:** Outpatient Department of Eternal Hospital

3.2 St**udy type:** The studyis a Quantitative type which deals with numbers. It is Analytical as it compares pre-test and post-data. It is an Applied type of study as it aims

at finding immediate solution to the problem. The study deals with data hence it is an Empirical study.

3.3 **Study design:** The study is a *Quasi experimental* studywhich used *Separate Sample Pretest-Posttest Design*.

(a) Observational study was carried to understand the process which a patient undergoes after entering the OPD till he leaves the department. The bottlenecks and possible solutions were noted down.

(b) Time motion study was carried out to note time taken for each activity.

3.4 **Type of data:** Primary data was collected by following the patients or their attendants.

3.5 **Data collection method:** By observation

3.6 **Sample size:** 10% of the total OPD patients were taken as sample (131 and 103 before intervention and 149 and 120 after intervention)

3.7 **Sampling technique:** Systematic random sampling technique was used where every individual had equal chance of getting selected.

3.8 **Study tools used:**

(a) Observational study was used to understand processes in OPD.

(b) Time motion study was used to collect data on time taken for each activity in the process.

(c) Fish Bone diagram was used to analyse the causes of delay.

(d) Modified FMEA was used to prioritise the causes.

(d) Brainstorming session wereundertaken to work out possible solutions.

(e) MS Excel was used for statistical analysis.

3.9 Project team

A multidisciplinary team was constituted by the hospital to undertake this study. The team consisted of following:

1. Dr Vrajesh Shah - Medical Superintendent
2. Mrs Monika Saxena - Deputy MedicalSuperintendent
3. Mr Subratha Das - General Manager, HR
4. Miss Kirti Hemkar - Quality Head
5. Mr Shailender Singh - PHC Head
6. Col S Pawan Kumar - Observer

3.10 Time frame

Table 3.1: Time frame of the study (in weeks)

Activity	Feb			Mar				Apr				May
	2	3	4	1	2	3	4	1	2	3	4	1
Understanding the working of hospital, getting acquainted with various departments, discuss project with the MS and noting the process flow in OPD **(Define stage)**												
Time motion study and collecting data**(Measure stage)**												
Transfer of data to MS Excel, creating tables and charts, analysing bottlenecks **(Analysis stage)**												
Brainstorming for possible measures to reduce TAT and implementation of interventions **(Improve stage)**												
Time motion study, collecting data and analysing impact of interventions **(Control stage)**												

4.0 RESULTS AND DISCUSSION

4.1 Define

This is the first step that refers to defining the goals ofthe project. The hospital had been receiving constant feedback about the long waiting time during their OPD visits. However there was data available on this issue. During this stage, the team first developed a high-level process map to help understand the larger process and to gain consensus for the overall scope of the project (Figure 4.1). To understand the actual processes and problems faced on the ground, an actual state analysis was performed.

The process starts when the patient enters the OPD and ends when the patient checks out at the end of the OPD visit.On entry in OPD every patient is expected to take a token for his turn. The entire process was further divided into three parts for better analysis. Part 1 included steps from the time patient takes token till he gets his receipt of billing. Part 2 was from the time patient leaves the billing counter till he/she comes back for billing for investigations if any. Part 3 covers time after billing for investigations till the patient receives the report.

As the hospital earlier was a single specialty hospital and got upgraded to multispecialty hospital just about 2 months ago, the teamdecided to undertake the project in phased manner and hence worked on Part1 and Part 2 only for this study. TheUpper Specification Limit (USL) decided for Part 1 was 15 minutes and for Part 2 was 60 minutes.

To identify high level process map and the stakeholders the SIPOC (Table 4.1) has been done.

Table 4.1: SIPOC

Supplier	**Input**	**Process**	**Output**	**Customer**
Patient	Patient information	Patient registration	UHID No	Billing staff
Billing staff	UHID No & cash	Billing	File& Receipt	Attendant
Doctor's Attendant	File and Receipt	Encountering	Wait list No	Doctor
Doctor	File & wait list No	Consultation	Prescription	Patient

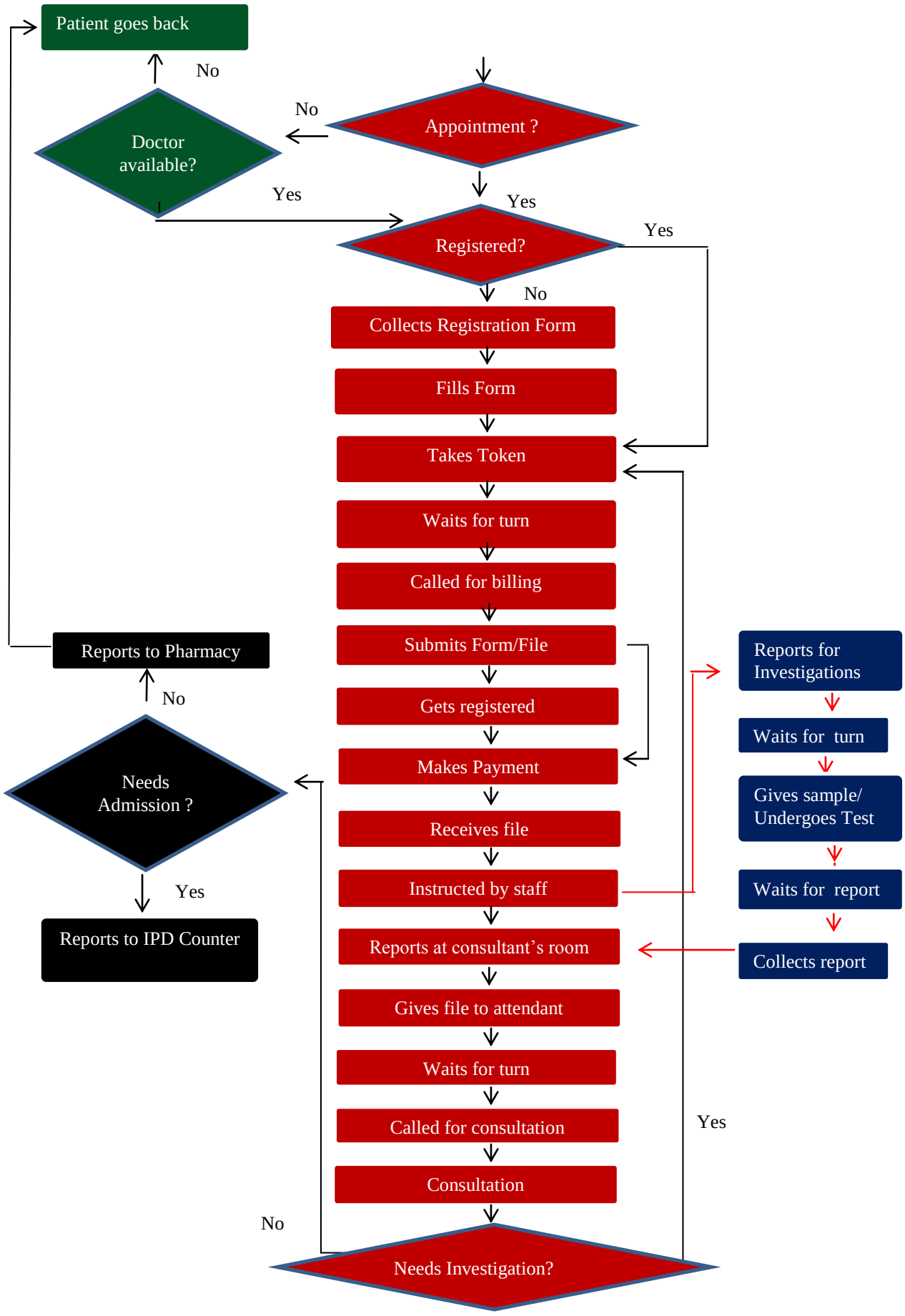


Figure 4.1: Process Flow OPD

4.2 Measure

The goal in the Measure phase was to determine a baseline metric of the identified overall (TAT) from start to finish. The process map was used to identify each step, and a data collection tool was created to capture a metric for the designated incremental steps within the hospital. The team decided to measure the time required to complete the following process increments:

1. Waiting time after collecting token and being called for registration and/or billing for consultation.
2. Time taken for registration and/or billing.
3. Time taken between patient leaving the billing counter and coming back after consultation for billing of investigations.

The process in OPD was divided in 3 parts as under:

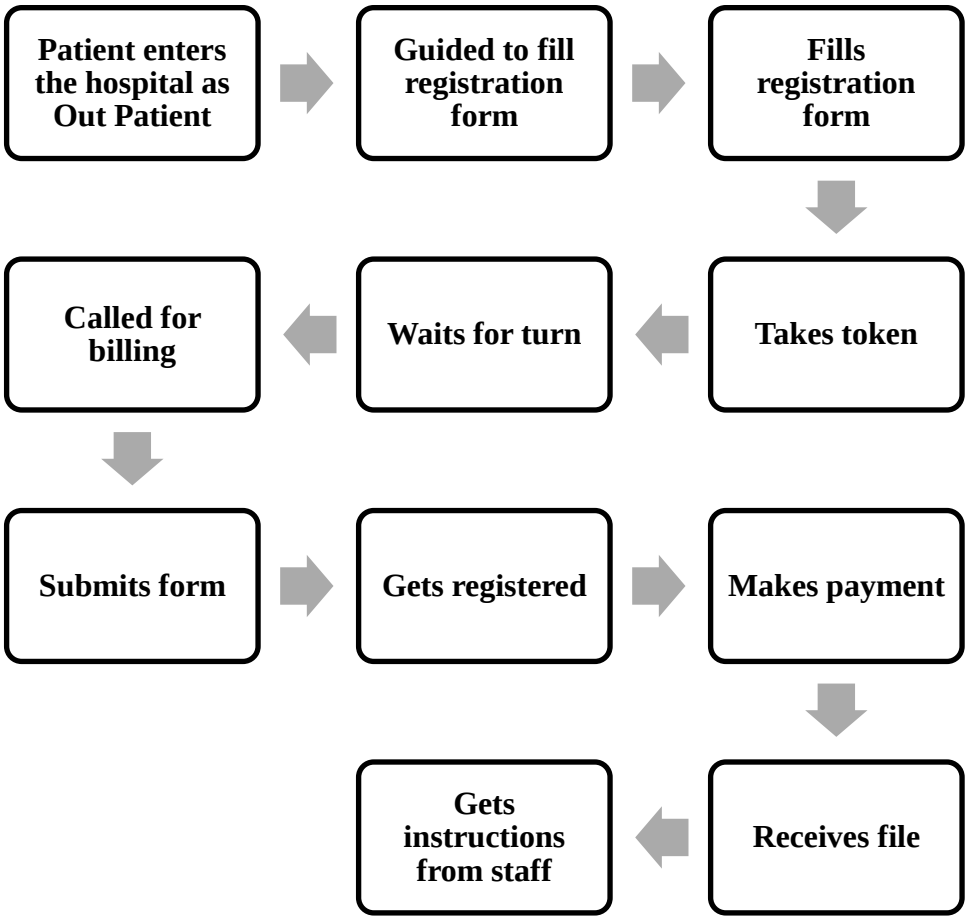


Figure 4.2: Part 1 of Process flow at OPD

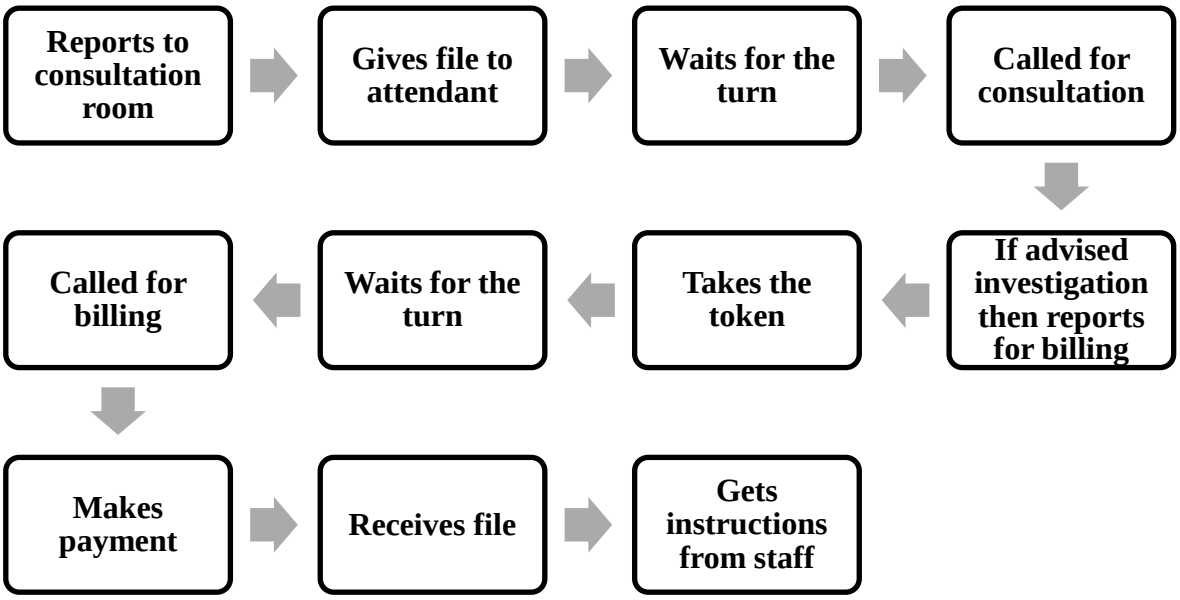


Figure 4.3: Part 2 of Process flow at OPD

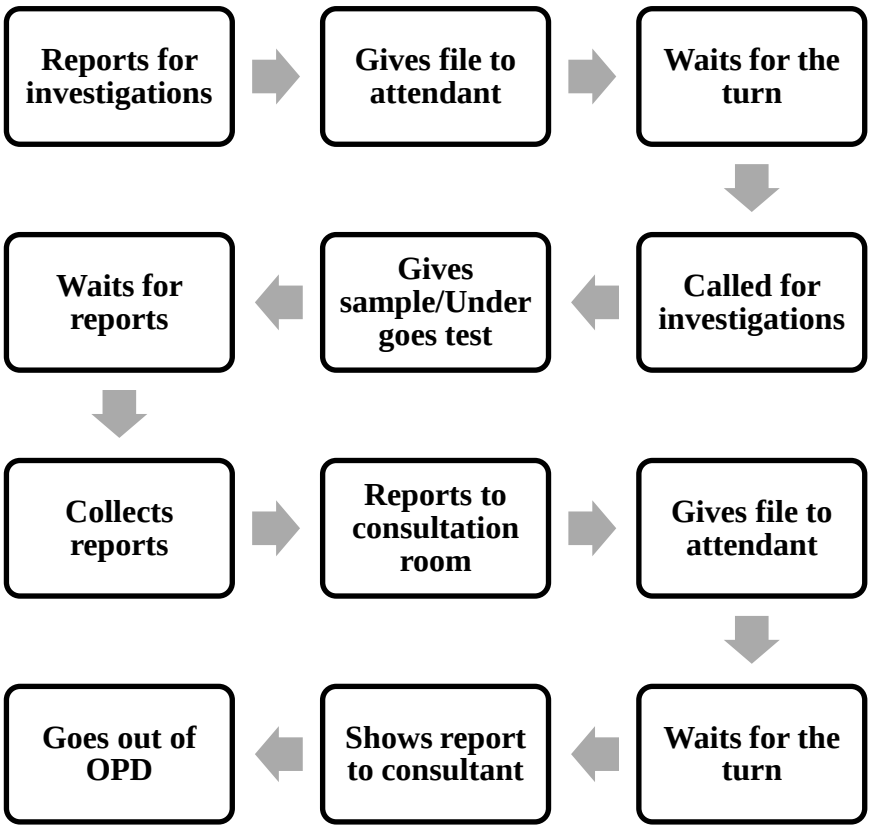


Figure 4.4: Part 3 of Process flow at OPD

A check sheet was designed and data was collected by carrying out a time motion study. The check sheets for Part 1 and Part 2 are given as Appendix A and Brespectively.

4.2.1 Inclusions

Part 1: Data was collected for as many patients as possible in the OPD. Thereafter 10% of the total patients for that day were included in the study. The selection of sample was done based on systematic random samplingmethod where everyone had equal chance of getting selected.

Part 2: Only those patients whose consultation and investigations were done on the same day were included. Following patients were not included in the study:

1. Patients who came for investigations only.
2. Patients who were not advised any investigations.
3. Patients who utilised various health packages.
4. The Inpatient Department(IPD) patients.

The details of sampling method and sample size for Part 1 and 2 before the interventions are given as Appendix Cand after the interventions as Appendix D.

The results are depicted below:

Part 1

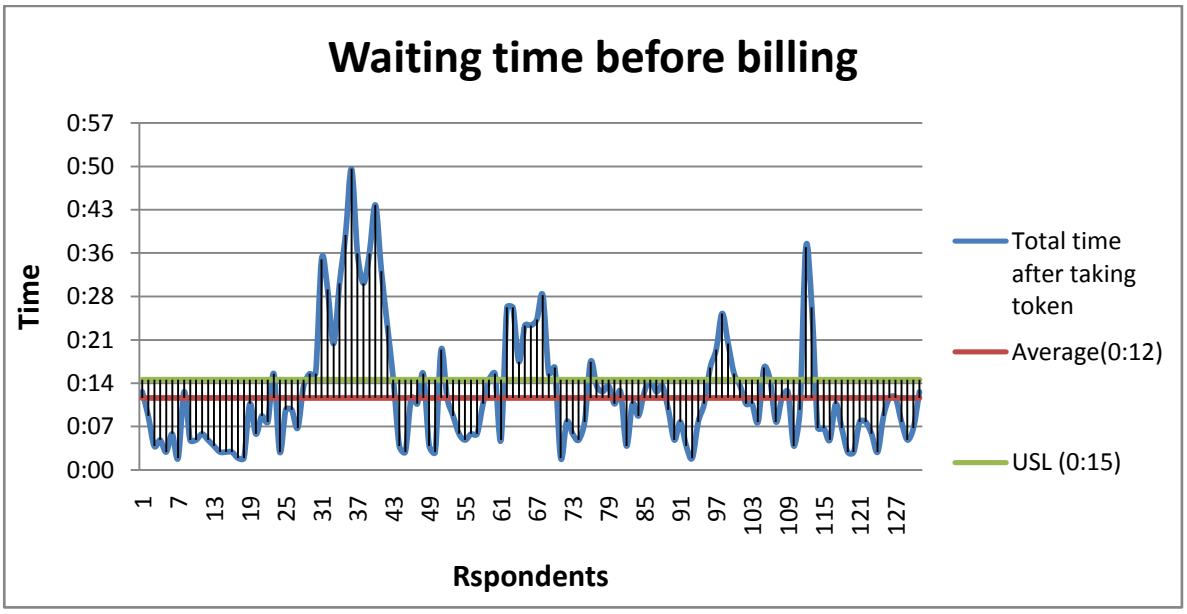


Figure 4.5: Waiting time before billing

On an average, total time that the patients had to wait till they got their receipt was 0:12 minutes which was quiet close to the USL of 0:15 minutes. The distribution(Figure 4.5)showed that there were specific periods when the waiting time had exceeded the USL. On further analysis it was found that these were particular days in a week.

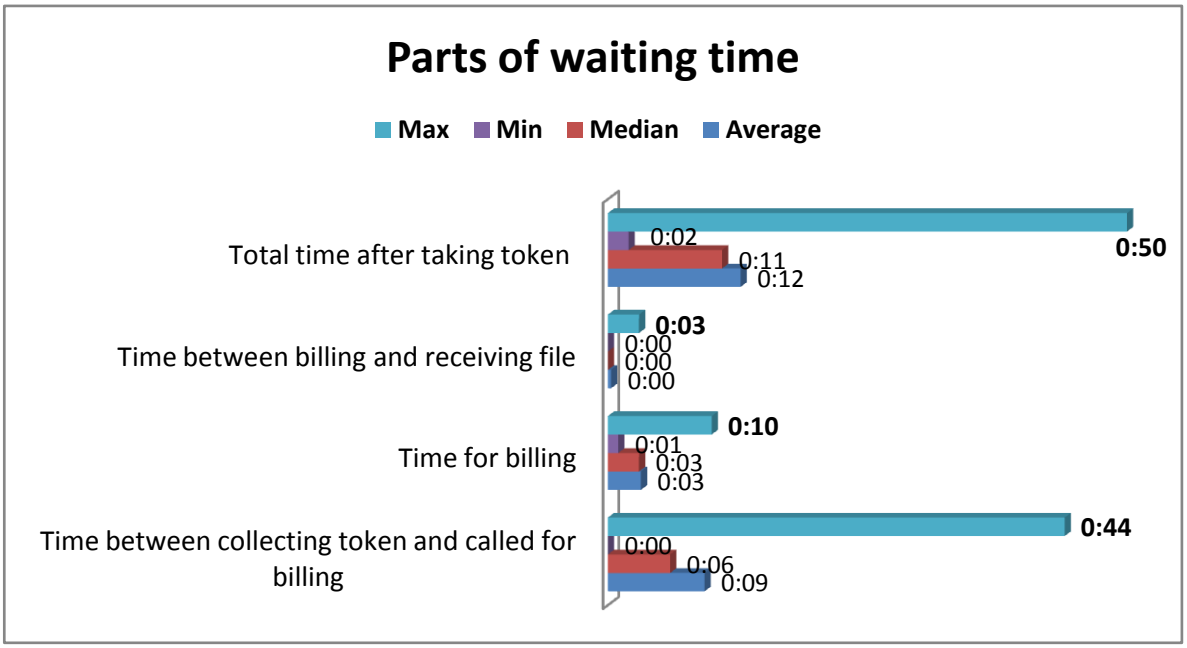
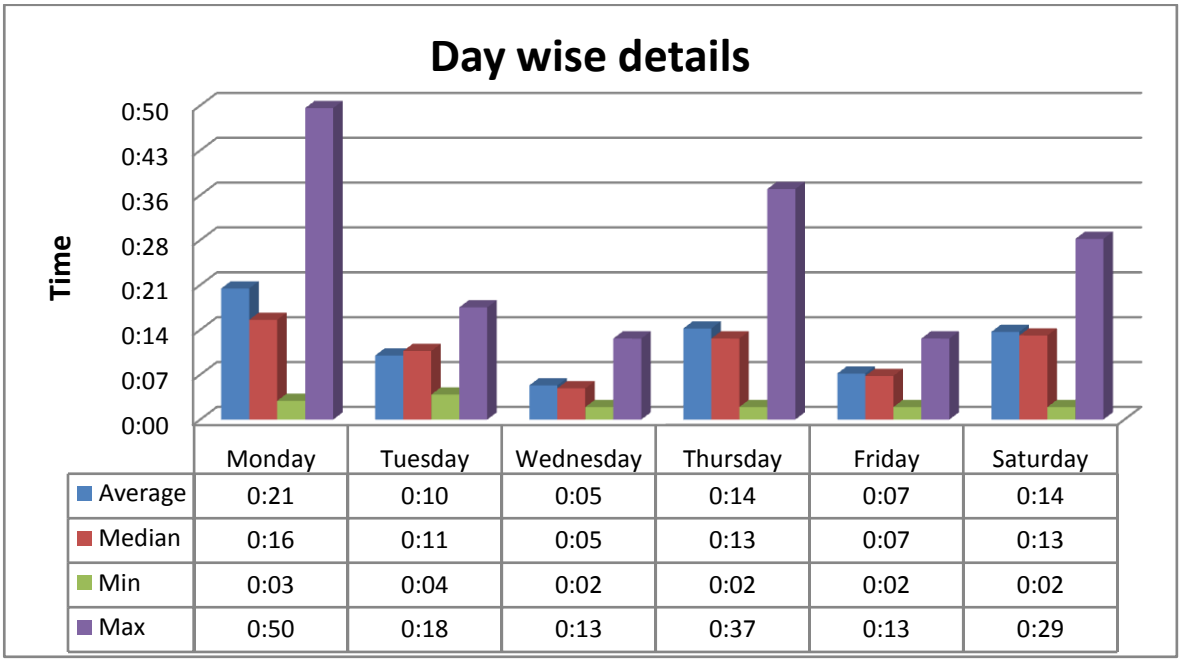


Figure 4.6: Parts of waiting time

It was observed that the average time of waiting before a patient is called for billing was 0:9 minutes while the maximum time taken was 0:44 minutes(Figure4.6). The average time for billing was 0:3 minutes and in some cases it was as high as 0:10 minutes. The maximum time that patients had to wait was 0:50 till they completed their billing.



	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Average	0:21	0:10	0:05	0:14	0:07	0:14
Median	0:16	0:11	0:05	0:13	0:07	0:13
Min	0:03	0:04	0:02	0:02	0:02	0:02
Max	0:50	0:18	0:13	0:37	0:13	0:29

Figure 4.7: Day wise details of waiting time

The day wise analysis of data(Figure 4.7)revealed that the average waiting time on Monday (0:21 minutes) was above the USL (0:15 minutes), and on Thursday and Saturday it was above overall average of 0:12 minutes. The maximum time of waiting (0:50 minutes) was also noted on Monday.

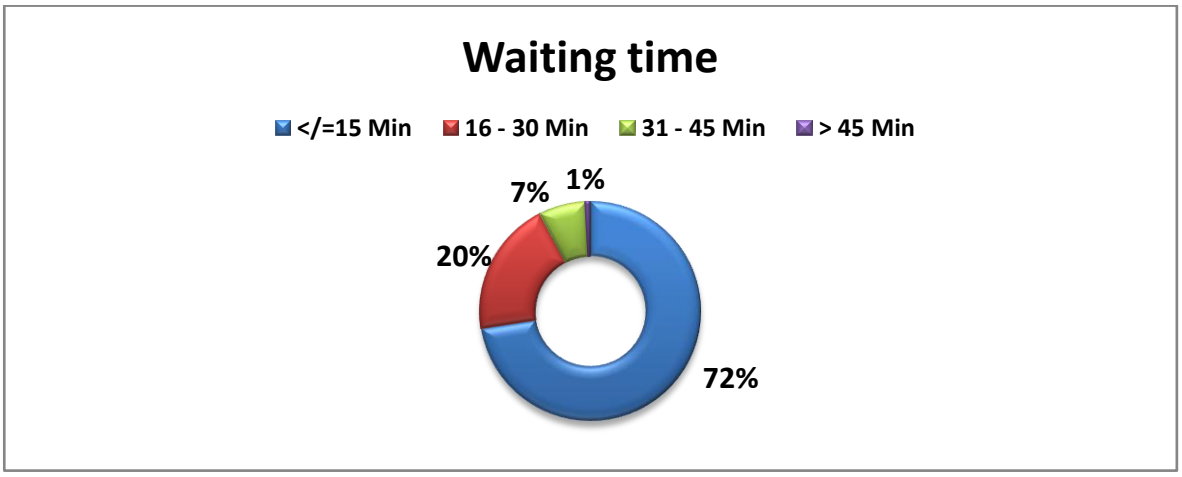


Figure4.8: Overall distribution of waiting time (Part 1)

It was observed that 72% patients were seen within 15 minutes(Figure4.8). However there were still about 8% patients who had to wait for more than 30 minutes just to get their billing done.

Part 2

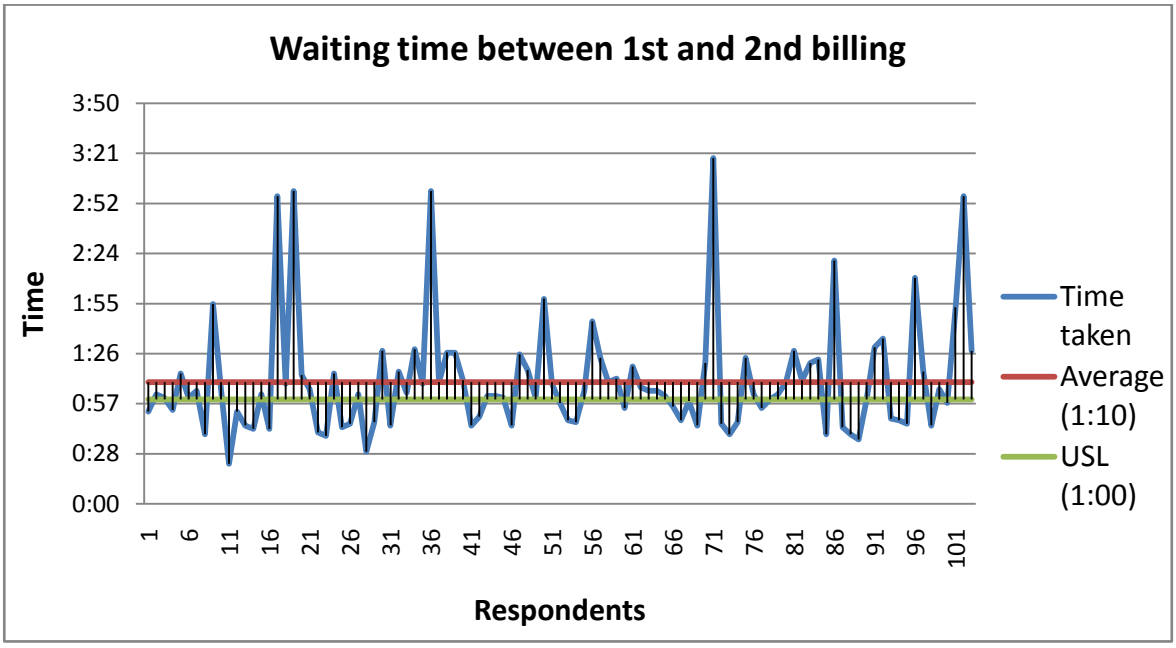


Figure 4.9: Waiting time between 1st and 2nd billing

In this part of the process it was observed (Figure 4.9) that most of the patients had to wait for more than 1:00 hour. The average waiting time was 1hour 10 minutes which was above the USL of 1 hour.The maximum time was about 3:20 minutes.

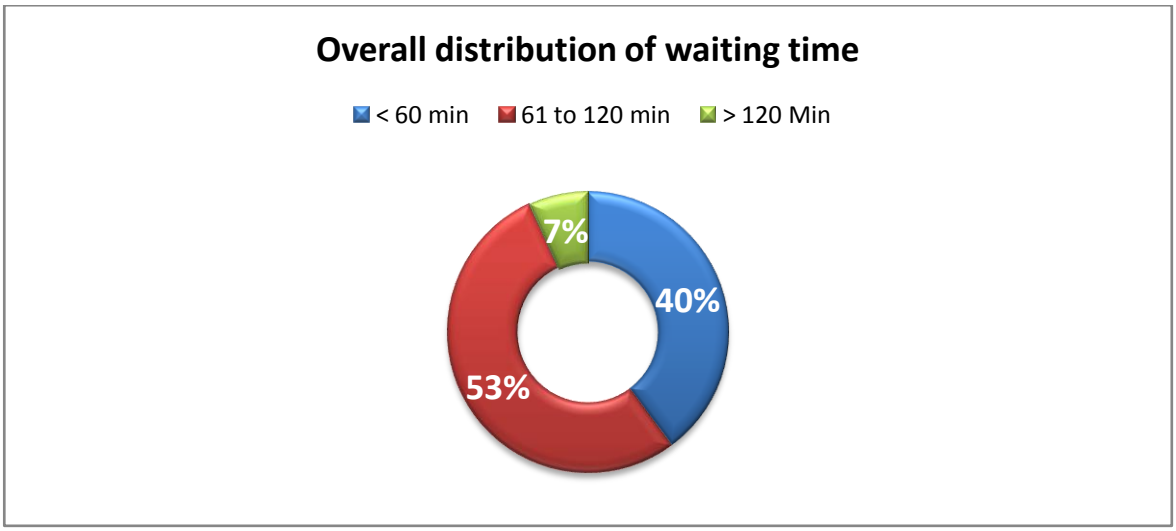


Figure 4.10: Overall distribution of waiting time (Part 2)

Only 40% patients waited for </= 1hour and there were about 7% patients who had to spend more than 2 hours before going for their investigations. Bulk of the patients (53%) had to wait for 1 to 2 hours(Figure4.10).

Table 4.6: Current Process Capability

Current Process capability						
Process	**Max**	**Min**	**Range**	**Median**	**Average**	**Std Dev**
Part 1						
Waiting time after taking token till called for billing	0:44	0:00	0:44	0:06	0:09	0:09
Time for billing	0:10	0:01	0:09	0:03	0:03	0:01
Total time	**0:50**	**0:02**	**0:48**	**0:11**	**0:12**	**0:09**
Part 2						
Time between 1st and 2nd billing	3:19	0:23	2:56	1:03	1:10	0:32

4.3 Analysis

The goal in this phase was to identify causes of delays in patient TATand to determine any disparity that may exist in the goals set and the currentperformance levelsachieved.The understanding of therelationship between cause and effect was necessary to bringabout any improvements, if needed.

In keeping with Six Sigma strategy, the team held a brainstorming session with frontline employees to delineate the perceived causes of delay and to get a broad employee prospective of alleged problems in the patient flow process. The Fish Bone Diagram of all the perceived causes was prepared(Figure 4.11).

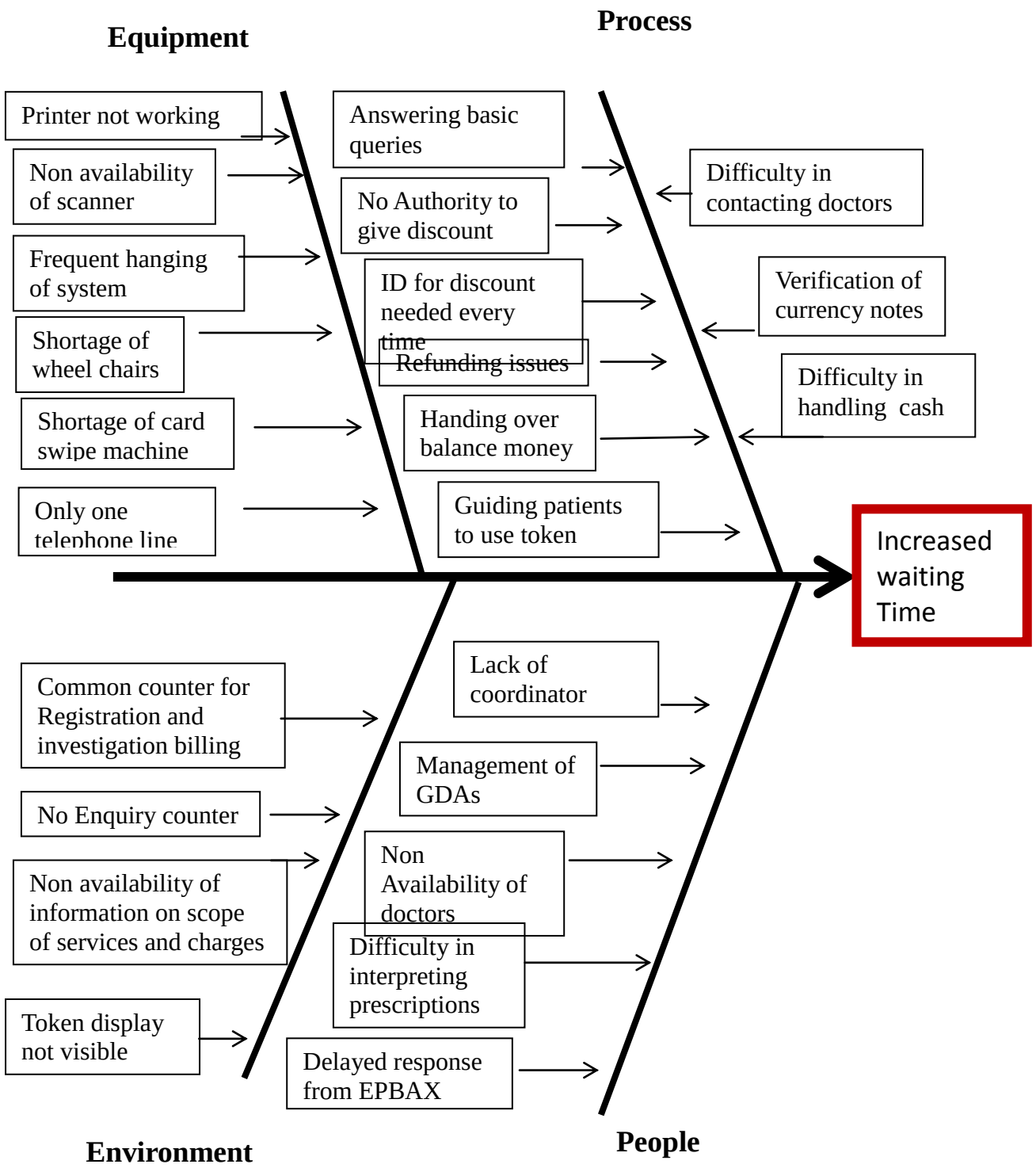


Figure 4.11:Fish Bone diagram for causes of delay

A modified Failure Mode and Effect Analysis (FMEA) was carried out where the causes were ranked on the basis of occurrence and severity of their impacton waiting time(Table4.8) as per criteria given in Table 4.7.

Table 4.7: Rank weightage

Occurrence	Rank	Severity	Rank
Once a Month	1	Mild	1
Once a Week	5	Moderate	5
Every day	9	Severe	9

Table 4.8: FMEA of causes of delay

Cause	Occurrence	Severity	RPN	Rank
Guiding patients to use token	9	1	9	15
Handing over balance money	9	5	45	4.5
Refunding issues	1	9	9	15
ID for discount needed every time	9	5	45	4.5
Answering basic queries	5	5	25	9.5
No Authority to give discount	9	9	81	2
Verification of currency notes	9	1	9	15
Difficulty in handling Cash	9	1	9	15
Difficulty in contacting doctors	5	5	25	9.5
Delayed response from EPBAX	5	1	5	19
Difficulty in interpreting prescriptions	5	1	5	19
Lack of coordinator	9	1	9	15
Management of GDAs	5	1	5	19
Common counter for Registration and investigation billing	9	9	81	2
No Enquiry counter	9	1	9	15
Non availability of information on scope of services and charges	9	5	45	4.5
Token display not visible	5	1	5	19
Printer not working	5	1	5	19
Non availability of scanner	9	5	45	4.5
Frequent hanging of system	9	1	9	15
Shortage of wheel chairs	5	5	25	9.5
Shortage of card swipe machine	5	5	25	9.5
Non availability of doctors	9	9	81	2

4.4 Improve

Improvements in existing systems are necessary to bring the organizationtowards achievement of the organization goals. Creative development of processes and tools brings about a new lease on life for the organization's processes and takes them nearer to organizational objectives.

The team performed another brainstorming session with representatives from each area where inefficiencies occurred to find solutions that could have a positive impact on patient flow. The causes along with possible solutions are given in Table 4.9.

Table 4.9: Causes & Possible solutions

Cause	Possible solutions
Common counter for registration and investigation billing	• Dedicated counter for investigation billing. • Additional counters specially on high foot fall days.
Discount cases handling ➢ Copy of ID being asked every time. ➢ Non availability of scanner/photocopier. ➢ Person authorised to give discount not avail at billing counter.	• Information can be captured in the software once patient has been registered. • Provide scanner. • Billing counter staff can be given rights to authorise discount.
Return of balance money(lose money not available)	• Bulk provision of lose money in denominations of Rs 1, 2 ,5,10 and 50 every morning. • Availability of in lieu items like candies.
Delay in communication with doctors ➢ Delayed response from EPBAX ➢ Only one phone available	• Direct calling facilities to be available to counter staff. • Provide one more phone.
Frequent hanging of the system	• Upgrade the system
Sharing of card swipe machine with other counters	• Provide additional machine
Frequent enquiry by patients about OPD days, OPD charges and other tests charges.	• Setting up of separate MAY I HELP YOU desk. • Static display of OPD Schedule and the Charges

Difficulty in handling of cash	• Provision of Cash trays • Provision of partition in the drawer
Guiding customers on use of token machine	• Providing visual instructions on use of token machine
Non availability of doctors due to : ➢ Doctor not arrived in hospital. ➢ Doctor on round in wards ➢ Doctor in OT ➢ Doctor gone for lunch ➢ Doctor attending emergency patients	• Doctor's schedule can be displayed prominently in Hindi and English • Fixed schedule for the rounds can be displayed and followed. • Appointment system should be encouraged • OT and OPD days can be different
Wheel Chair Management: The GDA is sent to get wheel from other departments hampering functioning of billing counter.	• Wheel chairs earmarked for OPD could be placed at waiting area. Movement of these can be easily tracked.
Verification of currency notes done manually	• Currency counting and verification machine can be provided.
Answering basic queries of outside customers on telephone like types of facilities available, names and schedule of doctors etc.	• Basic details could be available with the EPBAX operator who can satisfy the caller. Availability of doctors can be checked from the OPD.

Keeping in mind the availability of time and other resources the team decided to undertake following immediate interventions/corrective actions:

1. Set up a separate counter for Investigation billing.
2. Providing lose money to the counter every morning.
3. Sensitising EPBAX operator for a faster response.
4. Provision of dedicated wheel chairs for OPD.
5. Rounding of the discounted amount to nearest Rs 10 in the system.
6. Person authorised to allow discount is made available at the counter always.
7. Provide GDAs for guiding patients to collect token.

4.5 Control

Control phase is the last step in the DMAIC method. Time motion study was once again conducted to note down the data and analyse the impact of the interventions implemented.

Based on the data from the measure phase the followingNull hypotheses were formulated:

1. Ho = There is no reduction in waiting time in Part 1 of the process before andafter the interventions.

2. Ho = There is no reduction in waiting time for Part 2 of the process before and after the interventions.

3. Ho = There is no significant increase in patients who were cleared in less than 0:15 minutes in Part 1 of the process, before and after the interventions.

4. Ho = There is no significant increase in patients who were cleared in less than 0:60 minutes in Part 2 of the process before and after the interventions.

1. .Ho = There is no reduction in waiting time in Part 1 of the process before and after the interventions.

Table 4.10: Test Statistics for Ho 1

	Before	After
η	131	149
Xbar	0:12	0:09
SD	0:09	0:04
t value	4.62	

Analysis of waiting time after and before the interventions is given in Table4.10. It was suspected that there is no reduction in waiting timebefore and interventions. 2 t Testwas conducted to ascertain this.

Null hypothesis was rejected as the *t*-Value was calculated to be 4.62 which is greater than 1.96 at 95% confidence level.

2. *Ho = There is no reduction in waiting time for Part 2 of the process before and after the interventions.*

Table 4.11: Test Statistics for Ho 2

	Before	**After**
η	131	149
Xbar	0:12	0:09
SD	0:09	0:04
t value	10.85	

The analysis is given in Table 4.11. After *t- test* the null hypothesis was rejected as the t-Value was calculated to be 10.85 which issignificantly greater than even 3.39 at 99.9% confidence interval.

3. Ho = There is no significant increase in patients who were cleared in less than 0:15 minutes in Part 1 of the process, before and after the interventions.

Table 4.12: Test Statistics for Ho 3

	Before	After
η	131	149
P	72.52	91.95
p	82.86	
q	17.14	
Z value	4.31	

The test analysis showed that the calculated *z-Value* of 4.31 was greater than 1.96 at 95% and hence null hypothesis was rejected. The analysis is given in Table4.12.

4. Ho = There is no significant increase in patients who were cleared in less than 0:60 minutes in Part 2 of the process before and after the interventions.

Table 4.13: Test Statistics for Ho 4

	Before	After
η	103	120
P	40	56
p	48.87	
q	51.13	
Z value	2.51	

Analysis is given in Table4.13. The Null hypothesis was rejected as the *z-Values* calculated was 2.51 which is more than 1.96 at 95% confidence interval. However for confidence intervals of 99% and above the hypothesis could not rejected.

The results are given below:

Table 4.14: Process capability after intervention

Process capability after interventions						
Process	**Max**	**Min**	**Range**	**Median**	**Average**	**Std Dev**
Part 1						
Waiting time after taking token till called for billing	0:19	0:01	0:18	0:07	0:07	0:01
Time for billing	0:06	0:00	0:06	0:02	0:02	0:01
Total time	**0:21**	**0:02**	0:19	**0:09**	**0:09**	**0:04**
Part 2						
Time between 1st and 2nd billing	2:19	0:09	2:10	0:54	0:56	0:25

The Process Capability Chart (Table 4.14) depicts that the maximum time for Part 2 of the study has decreased from 3 hours19 minutes to 2 hours19 minutes i.e there has been a reduction of about 30%. The reduction in maximum time in Part 1 has been 58%.. The average and median values are same. This indicates that the procedures have got streamlined and the non- random events in the system have been reduced. The data is evenly distributed.

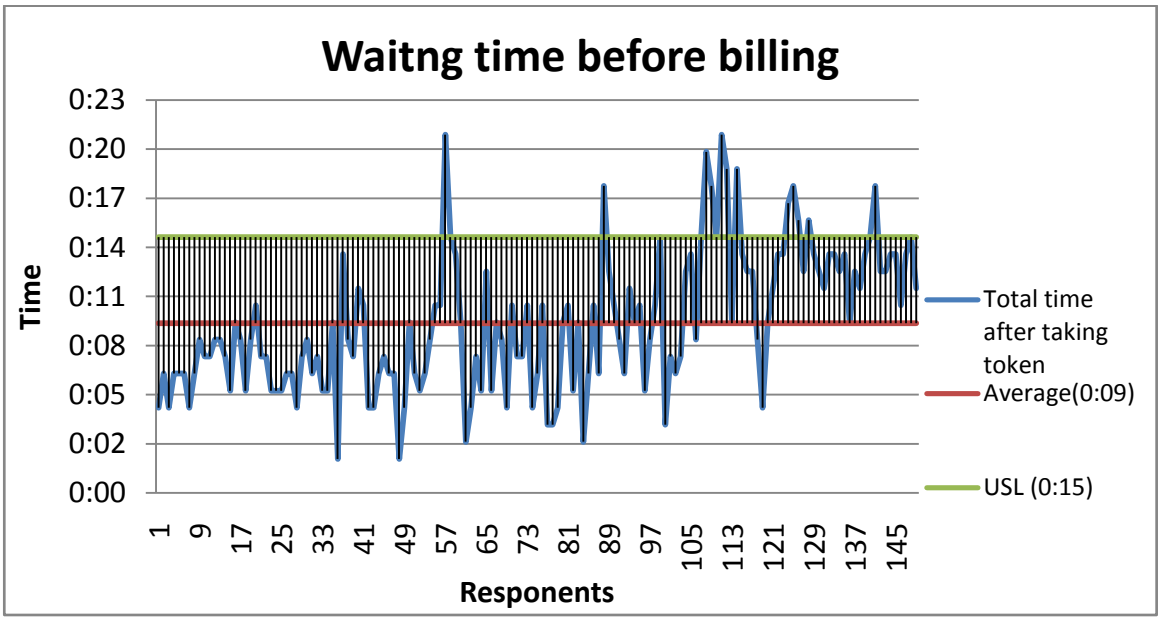


Figure4.12: Waiting time before billing post interventions

The average waiting time had reduced from 0:12 minutes to 0:09 minutes (Figure4.12). Almost all patients got their billing done within 0:15 minutes. It was once again noted that most of the patients who had waited for more than the average time were grouped in the last part of the graph i.e. corresponded to some particular days. Once again the data showed that thesedays were Mondays and Saturdays.

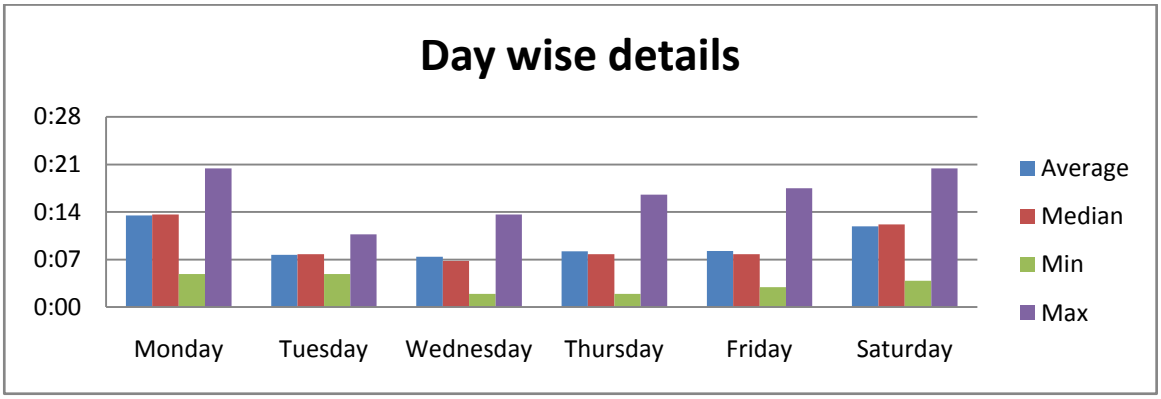
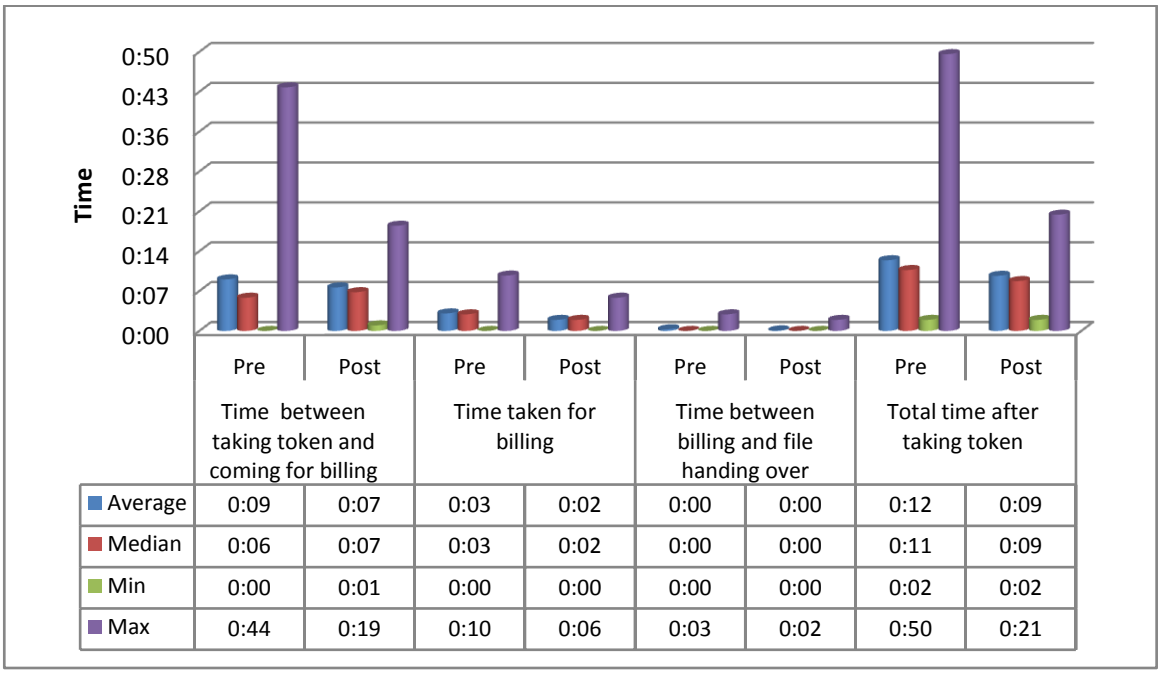


Figure4.13: Day wise details, post interventions

On analysing the day wise details (Figures 4.13)it was noticed that the daily average waiting time on Mondays and Saturdays was above 0:09 minutes while on all other days it was less. The maximum waiting time was also on Mondays and Saturdays



	Pre	Post	Pre	Post	Pre	Post	Pre	Post
	Time between taking token and coming for billing		Time taken for billing		Time between billing and file handing over		Total time after taking token	
Average	0:09	0:07	0:03	0:02	0:00	0:00	0:12	0:09
Median	0:06	0:07	0:03	0:02	0:00	0:00	0:11	0:09
Min	0:00	0:01	0:00	0:00	0:00	0:00	0:02	0:02
Max	0:44	0:19	0:10	0:06	0:03	0:02	0:50	0:21

Figure4.14: Comparison of waiting time pre and post interventions

There was a sharp drop in maximum idle waiting time (time between taking token coming for billing) from 0:44 minutes before interventions to 0:19 minutes after interventions(Figure 4.14).The maximum time for registration and/or billing also reduced to 0:06 minutes from previous figure of 0:10 minutes. Thus the overall maximum time reduced from 0:50 minutesto 0:21 minutes.

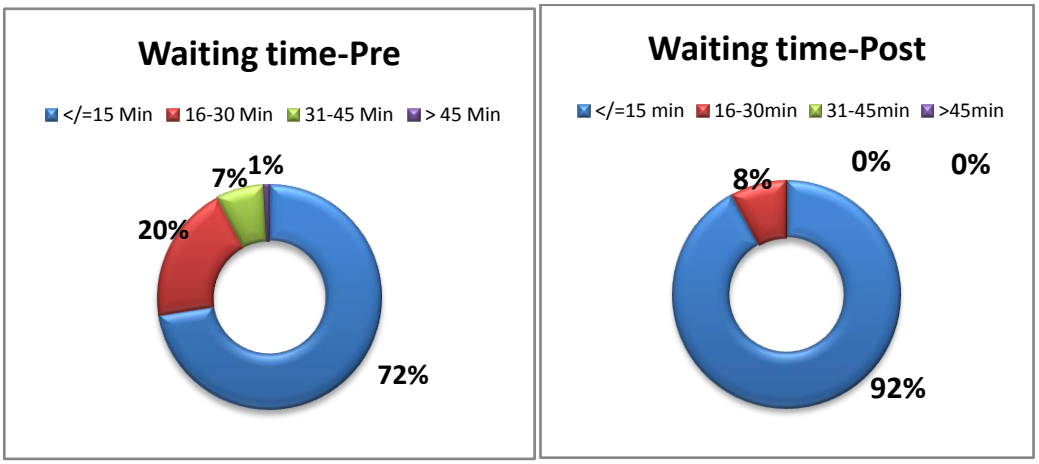


Figure4.15: Comparison of waiting time of Part 1

The patients who waited for less than 0:15 minutes before billing significantly increased to 92% (Figure4.15). No patient had to wait for more than 0:30 minutes.

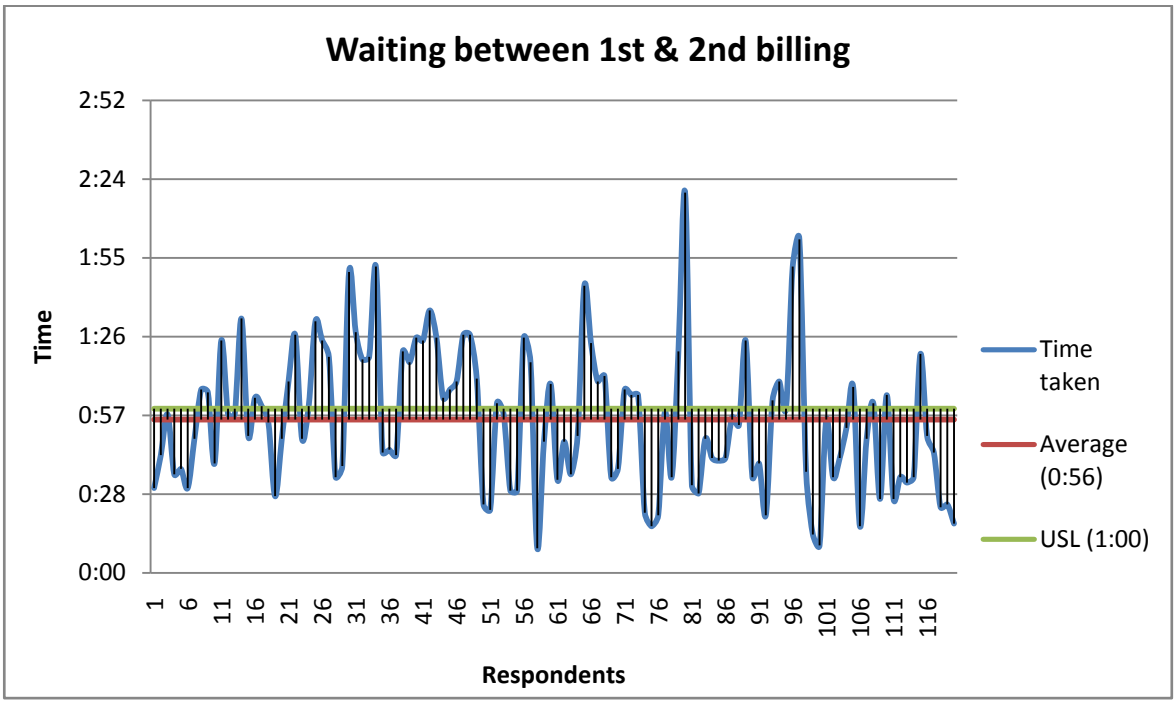


Figure4.16: Waiting time of Part 2 post interventions

The average waiting time for this part came down below USL to 0:56 minutes(Figure4.16). The data was fairly evenly distributed on either side of average indicating that the processes had got more or less streamlined.

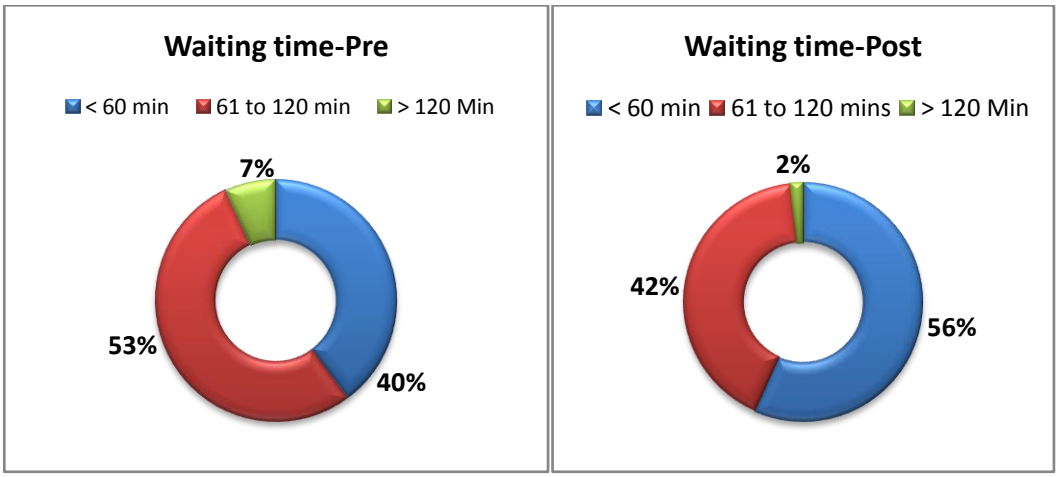


Figure4.17: Comparison of waiting time of Part 2

After the interventions 56% of patients were cleared within 1 hour as compared to 40% before interventions (Figure 4.17) and only 2% had to wait for more than 2 hours. The sigma level increasedto 1.65 after intervention ascompared to 1.24 before that.

5.0 LIMITATIONS

It should be noted that the Eternal Hospital had started its super speciality operations just about 2 months before the commencement of the project. A lot many consultants have recently joined and as result there has been surge in number of patients in the OPD. The hospital has been constantly adapting to demands of the patients.

It should be noted that the baseline data was collected during the time the hospital was functioning optimally. The initial data was collected in Feb, while the improvement phase and the post-solution measurement phase occurred during the most hectic time of March and April when the hospital was preparing for its NABH accreditation.

Besides this some other limitations of the study are as follows:

1. Even though the clocks of token machine, computers at billing counter and that of the investigator were calibrated, the time was rounded off to nearest one minute. Hence all times are plus minus one minute.

2. Some of the doctors asked their patients to come and meet them before billing. Such patients have not been included in the study.

3. The study would have given better insight of waiting time in Part 2 if the waiting time for each consultant could be calculated. However due to time and resource constraints the same could not be done.

6.0 CONCLUSION

This project clearly demonstrates the Six Sigma methodology as an effective tool in defining inefficiencies and improving patient flow in a hospital outpatient department. Six Sigma uses hard data to drive changes rather than notions based on individual perceptions, assumptions and agendas.

Significant reduction in waiting time wasachieved in the outpatient services of theEternal Hospital by using the six sigma approach(Table 6.1). As an off shoot of the study a separate registration counter was started, the person authorised to give discount was placed permanently at billing counter, dedicated wheel chairs were placed for OPD, the billing staff was provided with lose money every morning, the discounted rates were rounded off to nearest Rs 10, the EPBAX operators were sensitised to the

importance of prompt response, andGDAs were appointedto guide patients for collecting token.

Table 6.1: Summary of statistics

	Part 1		**Part 2**	
	Before	After	Before	After
Maximum	0:50	0:21	3:19	2:19
Minimum	0:02	0:02	0:23	0:09
Range	0:48	0:19	2:56	2:10
Average	0:12	0:09	1:10	0:56
Median	0:11	0:09	1:03	0:54
Std Deviation	0:09	0:04	0:32	0:25
Count	131	149	103	120
Confidence level 95%	4.62		10.85	
DPMO	267.176	80.537	601,942	441.667
Sigma	**2.12**	**2.90**	**1.24**	**1.65**

Eternal Hospital is encountering an expanding patient load, greater patient expectations and increasingly complicated patients who require services from a multitude of health providers.

Such rising demands amidst limited resources can cause inefficiencies and long waiting times to consultation. This would result in low patient satisfaction and an unpleasant clinic experience.

As this is still one of the preliminary quality improvement project, efforts to continually track, examine, and further improve turn-around times will go a long way in improving patient’s experience at Eternal Hospital.

Future initiatives could be directed at more time-efficient appointment scheduling, a real-time patient tracking system which can facilitate hand over of patients with same day multiple appointment system and reinforcing the billing counters to provide a more seamless patient flow.

Appendices

Appendix A(Sample of Check sheet for Part 1 data)

Monday - Total OPD 254								
Ser No	**Token Time (A)**	**Time called for billing (B)**	**Time taken (B-A)**	**Billing time (C)**	**Time taken (C-B)**	**File Hand over Time (D)**	**Time taken (D-C)**	**Total time (D-A)**
1	10:03	10:07	**0:04**	10:08	**0:01**	10:09	**0:01**	**0:06**
2	10:08	10:12	**0:04**	10:16	**0:04**	10:17	**0:01**	**0:09**
3	10:18	10:20	**0:02**	10:25	**0:05**	10:26	**0:01**	**0:08**
4	10:19	10:26	**0:07**	10:32	**0:06**	10:35	**0:03**	**0:16**
5	10:33	10:35	**0:02**	10:36	**0:01**	10:36	**0:00**	**0:03**
6	10:35	10:37	**0:02**	10:42	**0:05**	10:45	**0:03**	**0:10**
7	10:39	10:45	**0:06**	10:49	**0:04**	10:49	**0:00**	**0:10**
8	10:45	10:50	**0:05**	10:52	**0:02**	10:52	**0:00**	**0:07**
9	10:48	10:58	**0:10**	11:02	**0:04**	11:02	**0:00**	**0:14**
10	11:13	11:24	**0:11**	11:28	**0:04**	11:29	**0:01**	**0:16**
11	11:16	11:27	**0:11**	11:30	**0:03**	11:32	**0:02**	**0:16**
12	11:15	11:45	**0:30**	11:49	**0:04**	11:50	**0:01**	**0:35**
13	11:24	11:50	**0:26**	11:54	**0:04**	11:54	**0:00**	**0:30**
14	11:38	11:55	**0:17**	11:58	**0:03**	11:59	**0:01**	**0:21**
15	11:41	12:07	**0:26**	12:11	**0:04**	12:12	**0:01**	**0:31**
16	11:44	12:19	**0:35**	12:23	**0:04**	12:23	**0:00**	**0:39**
17	11:51	12:35	**0:44**	12:40	**0:05**	12:41	**0:01**	**0:50**
18	12:14	12:42	**0:28**	12:49	**0:07**	12:50	**0:01**	**0:36**
19	12:31	12:55	**0:24**	13:02	**0:07**	13:02	**0:00**	**0:31**
20	12:39	13:12	**0:33**	13:15	**0:03**	13:15	**0:00**	**0:36**
21	12:54	13:35	**0:41**	13:38	**0:03**	13:38	**0:00**	**0:44**
22	13:11	13:40	**0:29**	13:44	**0:04**	13:44	**0:00**	**0:33**
23	13:21	13:40	**0:19**	13:45	**0:05**	13:45	**0:00**	**0:24**
24	13:44	13:58	**0:14**	13:59	**0:01**	13:59	**0:00**	**0:15**
25	13:58	13:59	**0:01**	14:02	**0:03**	14:02	**0:00**	**0:04**
26	14:00	14:01	**0:01**	14:03	**0:02**	14:03	**0:00**	**0:03**
		Average	**0:16**		**0:03**		**0:00**	**0:21**
		Median	**0:12**		**0:04**		**0:00**	**0:16**
		Min	**0:01**		**0:01**		**0:00**	**0:03**
		Max	**0:44**		**0:07**		**0:02**	**0:50**

Appendix B (Sample of Check sheet for Part 2 data)

Monday - Total OPD = 196				
Ser No	**UHID**	**1st Billing time (A)**	**2nd Billing time (B)**	**Time taken (B-A)**
1	27306	8:42	9:35	**0:53**
2	26216	9:15	9:43	**0:28**
3	26072	8:56	9:45	**0:49**
4	26250	8:57	10:11	**1:14**
5	34356	8:45	10:00	**1:15**
6	32229	10:04	10:45	**0:41**
7	29322	10:17	11:19	**1:02**
8	20963	11:30	12:10	**0:40**
9	34407	10:42	12:50	**2:08**
10	34463	12:46	13:47	**1:01**
11	33233	12:40	13:45	**1:05**
12	24170	12:12	13:45	**1:33**
13	31325	12:26	13:11	**0:45**
14	16493	12:32	13:25	**0:53**
15	34465	13:00	13:55	**0:55**
16	34483	14:05	15:15	**1:10**
17	34428	12:21	14:18	**1:57**
18	33673	14:57	15:27	**0:30**
19	32474	12:50	14:50	**2:00**
20	29967	13:15	15:08	**1:53**
			Average	**1:08**
			Median	**1:01**
			Min	**0:28**
			Max	**2:08**

Appendix C (Sampling before interventions)

Part 1 sample

	Mon	**Tues**	**Wed**	**Thu**	**Fri**	**Sat**	**Total**
OPD	254	203	188	207	172	252	1276
10%	25.4	20.3	18.8	20.7	17.2	25.2	127.6
Sample	26	21	19	21	18	26	**131**

Part 2 sample

	Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**	**Total**
OPD	242	200	215	218	197	237	1309
NA	35	32	39	34	29	44	213
Packages	13	16	10	13	18	31	101
Balance	194	152	166	171	150	162	995
10%	**20**	**16**	**17**	**18**	**15**	**17**	**103**
NA %	14.46	16.00	18.14	15.60	14.72	18.57	16.27
Package %	5.37	8.00	4.65	5.96	9.14	13.08	7.72

Appendix D (Sampling after interventions)

Part 1 sample

	Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**	**Total**
OPD	312	231	215	216	229	255	1458
10%	31.2	23.1	21.5	21.6	22.9	25.5	145.8
Sample	32	24	22	22	23	26	**149**

Part 2 sample

	Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**	**Total**
OPD	312	231	215	216	229	255	1458
NA	27	29	36	29	28	27	176
Packages	21	23	13	11	13	23	104
Balance	264	179	166	176	188	205	1178
10%	**27**	**18**	**17**	**18**	**19**	**21**	**120**
NA %	8.65	12.55	16.74	13.43	12.23	10.59	12.07
Pkg %	6.73	9.96	6.05	5.09	5.68	9.02	7.13

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