

Time and Motion Study to Reduce Waiting Time Using
DMAIC Approach of Six- Sigma at Registration, Refraction
and Retina Department of Sankara Eye Hospital, Coimbatore

By

Anukriti Kamal

*Dissertation submitted in partial fulfillment of the requirements of the degree
MBA Hospital and Health Management*

Academic year, 2018-2020



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The certificate is awarded to

ANUKRITI KAMAL

In recognition of having successfully completed her
Internship in the department of

OPERATIONS

and has successfully completed her Project on

**TIME MOTION STUDY OF OUTPATIENT DEPARTMENT AT
SANKARA EYE HOSPITAL, COIMBATORE**

3RD FEBRUARY 2020 to 2ND MAY 2020

Organization: SANKARA EYE HOSPITAL, COIMBATORE

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

We wish her all the best for future endeavours


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Abstract

Title- Time Motion study to reduce patient waiting time by using DMAIC approach of Six- sigma at Registration, Refraction and Retina department of Sankara Eye Hospital, Coimbatore

Author- Dr. Anukriti Kamal

Objective- The goal of the study is to delineate the current procedure and to discover the reason behind increasing patient waiting time in Registration, Refraction, and Retina department of the medical clinic recommending the implementable suggestions for the same.

Method- A descriptive analysis of the secondary data, gathered from the registration, refraction, and retina department, by time and movement study, was done which included observation of the current procedure. A subjective exploration approach was utilized to decide the normal waiting time by various parameters. Normal and unique causes were set apart with the assistance of the control chart and, the Ishikawa diagram was used to portray it. The examination was done for 3 months i.e., from ^{3rd} February 2020 to ^{2nd} May 2020. Patients visiting during hospital time were observed from three departments (Registration, Refraction, and Retina).

Result- Average waiting time details of the hospital when compared to that of the genuine waiting time reported difference at the registration counter and different steps of the retina department. Causes were recognized and appropriate suggestions were provided for the same.

Conclusion- Observing the three departments, it was discovered that the procedure was unpredictable and unstable which was depicted through the control chart of the individual department. There were few uncommon causes which when managed can decrease waiting time and increase the quality of healthcare service delivered.

Acknowledgment

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Anukriti Kamal

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Abbreviations

DFSS	Design for Six- sigma
DMAIC	Define, Measure, Analyze, Improve and Control
HIS	Hospital Information System
LSS	Lean Six- sigma
OPD	Outpatient Department
SIPOC	Supplier, Input, Process, Output, and Customer
VCT	Vision Care Technician
TMS	Time- motion Study
TAT	Turnaround Time

Time Motion study to reduce patient waiting time by using DMAIC approach of Six- sigma at Registration, Refraction and Retina department of Sankara Eye Hospital, Coimbatore

Introduction

With an increasing burden of ailment, evolving demography, and changing illness type, the emergency clinic part is battling with numerous indistinct issues. In a booming country, like India, the quantity of new clinics is expanding day and night and henceforth, the competitiveness. In such a situation, OPD of the medical clinic becomes one of the significant zones as it is the primary spot of direct experience with the patient and one of the significant incomes producing zone too. The multifaceted nature and contribution of numerous partners speak to it as a vulnerable and time-subordinate procedure. Operational challenges like an unpredictable number of cases, OPD workflow, and increased waiting time at different OPD stations are the major problem areas for most of the hospital.

This study targets decreasing patient holding up time at Registration, Refraction, and Retina department of Sankara Eye Hospital by utilizing the DMAIC approach of Lean six sigma. Lean six sigma has its effective conveyance in numerous areas including health care that are continually utilizing it to convey quality. There are numerous studies in the past which show the efficacy of LSS in reducing waiting time in hospital.

In this study, data was collected by Time and motion methodology using a mobile stopwatch.

The data used in the study were entered into a predefined Excel sheet and the analysis was done using Excel. The control chart and Ishikawa diagram were used in the analysis and get the result.

- The objective of the study: -
 1. To map the current process flow.
 2. To analyze the cause of increased patient waiting time at Registration, Refraction, and Retina department (if any).
 3. To provide appropriate suggestions in reducing patient waiting time at Registration, Refraction, and Retina department.

Literature review

Year	Authors	Title	Research Design	Conclusion
2020	Biswadeep Sengupta, Pankaj Kumar Mandal, Arkadeb Kar, Nabanita Bhattacharyya, Shounak Biswas	A Time Motion Study of Healthcare Delivery System at General OPD of Rural Hospital of West Bengal	An observational descriptive study with a cross-sectional design	The average waiting time in the different departments was watched and examined. The examination uncovered that the most extreme time is spent by a patient sitting right outside OPD. Interviews of patients were likewise led with respect agreeable to them and proposals were given to decrease OPD blockage.
2018	B.P. Mahesh Bhimsen Soregaon, Anandkumar R Annigeri	Reduction of patient waiting time at a multi-specialty hospital using DMAIC methodology and factor analysis	Cross-sectional	DMAIC procedure has been applied to reduce patient waiting time and factor analysis has been done for patient data. With the utilization of six-sigma, it was discovered that

				there was a decrease in waiting time from 77.4 minutes to 26.57 minutes.
2016	Suneeta Dubey, Lokesh Chauhan, Nishi Gupta, Ashok Singh, Arun Arora	Using lean six- sigma to improve throughput efficiency at a tertiary care eye hospital	A prospective study using the DMAIC approach of six- sigma	In this study, the lead time of the patient was assessed during the measure phase of DMAIC using a time-motion study. It was perceived that there was a decrease of 19% in the lead median time at different stations of the OPD application of Lean Sigma.
2016	Hisahiro Ishijima, Eliudi Eliakimu, Jonatha Mcharo	The “5S” approach to improve a working environment can reduce waiting time Findings from hospitals in Northern Tanzania	Cluster-Randomised control trial conducted	The examination shows noteworthy measurable criticalness in the decrease of waiting time in the clinical record (p=0.002) and interview room (p=0.020). The pattern was likewise a similar utilizing DID

				investigation (- 15.66 moment in the clinical record, - 41.90 minutes in the conference room).
2014	Shreeranga Bhat, N.A. Jnanesh	Application of Lean Six Sigma methodology to reduce the cycle time of out-patient department service in a rural hospital	Scoping review (case study based)	The article justifies the usage of Lean six-sigma in a provincial emergency clinic in India for improving quality and offering support on schedule. The outcomes were diminished process duration of the procedure from 4.27 minutes to 1.5-minute, 97% decrease in normal waiting time, and a 91% decrease in line length.
2014	Dr. Nirmalya Manna, Dr. Md. Samsuzzaman, Dr. Saikat Das	A time-motion study in the OPD clinic of a rural hospital of West Bengal	An observational descriptive study	Time motion study helped the organization in proper time supervision in health care delivery systems

				and later steps were taken accordingly. According to the study, 46.88 % population stated that the total time was high. 42.70 % population was unsatisfied with the total time taken in the OPD. Out of the total population, the suggestions were given by 29.16 % out of which 42.86 % had suggested appointing more doctors.
2013	E V Gijo, Jiju Antony	Reducing patient waiting time in OPD using Lean six-sigma methodology	Observational descriptive study	The article addresses long waiting times in OPD of a super specialty hospital. Six-sigma methodology was used to solve the issue which resulted in a decrease in average waiting time from 57 min

				to 24.5 minutes and a standard deviation from 9.27 to 31.15 minutes.
2012	Amitabha Chattopadhyay, Ritu Ghosh, Sucharita maji, Tapobroto Guha Ray, Saibendu Kumar Lahiri	A time-motion study in the immunization clinic of a tertiary Care hospital of Kolkata, West Bengal	Observational cross-sectional	The study helped in an in-depth analysis of the bottleneck in the existing health care system. Initially, the meantime at the registration table was 120s (IQR=120) which was reduced to 60s (IQR=60).
2010	Antz Joseph, Elizabeth Cuevas	Improving process turnaround time in an outpatient clinic	Descriptive cross-sectional study	Reduction in total TAT from 22% to 18% was noted without compromising with patient care.

Methodology

Key research question

1. What is the current process flow of the OPD department of the hospital?
2. What are the possible factors, directly affecting increased waiting time in Registration, Refraction, and Retina department (if any)?
3. What are the possible solutions for reducing the waiting time?

Research Design

1. Study design – Descriptive Cross-sectional
2. Study setting – Sankara Eye Hospital, Coimbatore
3. Study Duration – 3rd February 2020 to 2nd May 2020
4. Sample size – 150
5. Sampling Technique – Non- probability, Convenient Sampling
6. Target population – Patient in OPD
7. Data collection method-
 - Primary data- Real-time tracking with a mobile stopwatch
 - Secondary data- Information gathered from HIS
8. Inclusion criteria-
 - Data were collected of the patient visiting OPD between working hours 9 am to 6 pm
 - Data were collected only from 3 OPD departments i.e., registration, refraction, and retina
9. Exclusion criteria-
 - Investigation, counseling, optical and pharmacy waiting time are not included
10. Operational definition-
 - **Time- motion study**- Time motion study targets decreasing procedure time- Frederick Taylor (1856–1915) dedicated his exploration to this issue. Beforehand, time study was depicted as definite perceptions of laborers utilizing a stop-watch to decide the time required to finish the work. This technique was later extended by Taylor's devotees, Frank and Lilian Gilbreth, who concentrated more on the movement. The Motion Study strategy was utilized to make the organization progressively productive by lessening the movements in question. These two

strategies, time studies, and motion study got incorporated into a broadly acknowledged strategy known as Time Motion Studies (TMS). [10]

- **Six- sigma-** It is an information-driven methodology that define, measure, analyze, improve, and control and uses DFSS (Treichler et al., 2002). As indicated by Mader (2002), "DFSS is a technique that uses devices, preparing, and estimations to empower the association to plan items and procedures that meet client desire and can be delivered at Six-Sigma quality levels." DFSS has two principal objectives:

1 Minimizing deformity rates for coming to the Six-Sigma level.

2 Maximizing positive impact during the developed stage of the products. [11]

Define	Define customers and requirements (CTQs)	Project charter	Fully trained team is formed, supported and committed to work on improvement project Customers identified and high impact Characteristics (CTQs) defined, team charter developed, business process mapped
	Develop problem statement, goals and benefits	Process flowchart	
	Identify champion, process owner and team	SIPOC diagram	
	Define resources	Stakeholder analysis	
	Evaluate key organizational support	DMAIC work breakdown structure	
	Develop project plan and milestones	CTQ definitions	
	Develop high level process map	VOC	
Measure	Define defect, opportunity, unit and metrics	Process flowchart	Key measures identified, data collection planned and executed, process variation displayed and communicated, performance base lined, sigma level calculated
	Detailed process map of appropriate areas	Data-collection-plan/example	
	Develop data collection plan	Benchmarking	
	Validate the measurement system	Measurement-system analysis	
	Collect the data	VOC	
	Begin developing $Y = f(x)$ relationship	Process sigma calculation	
	Determine process capability and sigma baseline		
Analyze	Define performance objectives	Histogram	Data and process analysis, root cause analysis, quantifying the gap/opportunity
	Identify value/non-value-added process steps	Pareto chart	
	Identify sources of variation	Time series/run chart	
	Determine root cause(s)	Scatter plot	
	Determine vital few x's, $Y = f(x)$ relationship	Regression analysis	
		Cause and effect diagram	
		Whys	
Improve	Perform design of experiments	Statistical analysis	Generate (and test) possible solutions, select the best solutions, design implementation plan
	Develop potential solutions	Non-normal data analysis	
	Define operating tolerances of potential system	Brainstorming	
	Assess failure modes of potential solutions	Mistake proofing	
	Validate potential improvement by pilot studies	Design of experiments	
	Correct/re-evaluate potential solution	Pugh matrix	
		House of quality	
Control		FMEA	Documented and implemented monitoring plan, standardized process, documented procedures,
		Simulation software	
	Define and validate monitoring and control system	Process sigma calculation	
	Develop standards and procedures	Control charts (variable and attribute)	

Source- <https://sci-hub.tw/https://doi.org/10.1108/01445151111104209>

Figure 1 DMAIC- steps to be taken and apparatuses to be utilized

Define

In the first phase of the process that is define phase, problems were identified by meeting with some of the important stakeholders and the problem statement “increased waiting time in different outpatient stations” was identified. Other operational challenges include an unpredictable number of cases per day, OPD workflow, and waiting at different OPD stations. The benefits of these are a decrease in delay in seeing consultants which will finally lead to patient satisfaction which is found to be the ultimate goal of every organization. This phase continued for 1 week during which project charter was prepared to achieve the goal on time. Project charter consists of project title, background, aim benefits, and schedule of the study which was made in the guidance of the project coordinator.

Project title: Time Motion study to reduce patient waiting time by using DMAIC approach of Six- sigma at Registration, Refraction and Retina department of Sankara Eye Hospital, Coimbatore

Background: The TAT of the OPD process in the hospital was increasing beyond their desired limit, increasing their average waiting time of the patient and average queue length. The current situation is affecting the productivity of the organization in terms of quality and on-time service delivery.

Aim of the project: Reducing patient waiting time at Registration, Refraction and Retina department of Sankara Eye Hospital by using the DMAIC approach of Lean six sigma

Support staff: Project coordinator, VCT

Expected benefit: The benefits of the project are a decrease in delay in seeing the consultant, eliminating unnecessary motion and rework, and increased patient capacity.

<u>Schedule:</u>	Define	1 week
	Measure	3 week
	Analyze	2 week
	Improve	*****
	Control	*****

Table 1 Project charter

Before starting a project management study, it is important to have a high level of knowledge scope of the study. SIPOC process was developed, within which the working will be constrained.

Supplier	Input	Process	Output	Customer
Registration desk staff	Patient information	Registration	Patient detailed record	Patient
Consultant	Information on the availability of the consultant	Consultation	Patient report	

Table 2 SIPOC process for OPD process

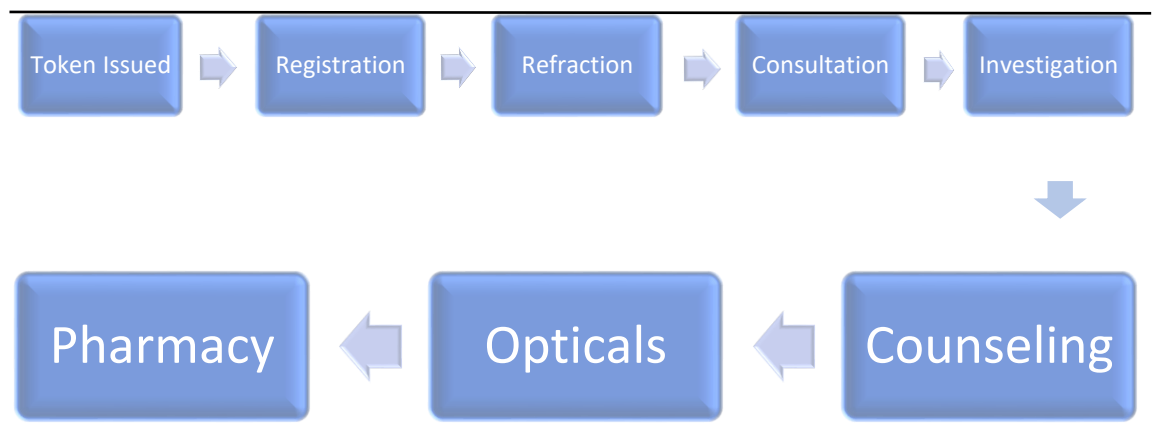


Figure 2 OPD Process flow

Result

Measure

Under the measure phase of the DMAIC approach, the current process is determined and the problem is quantified. A detailed plan for data collection was defined using an appropriate format. A time and motion study was conducted using a mobile stopwatch. During the initial phase of data collection, it was found that there was a variation in waiting time for different stations. Hence, data was collected department wise.

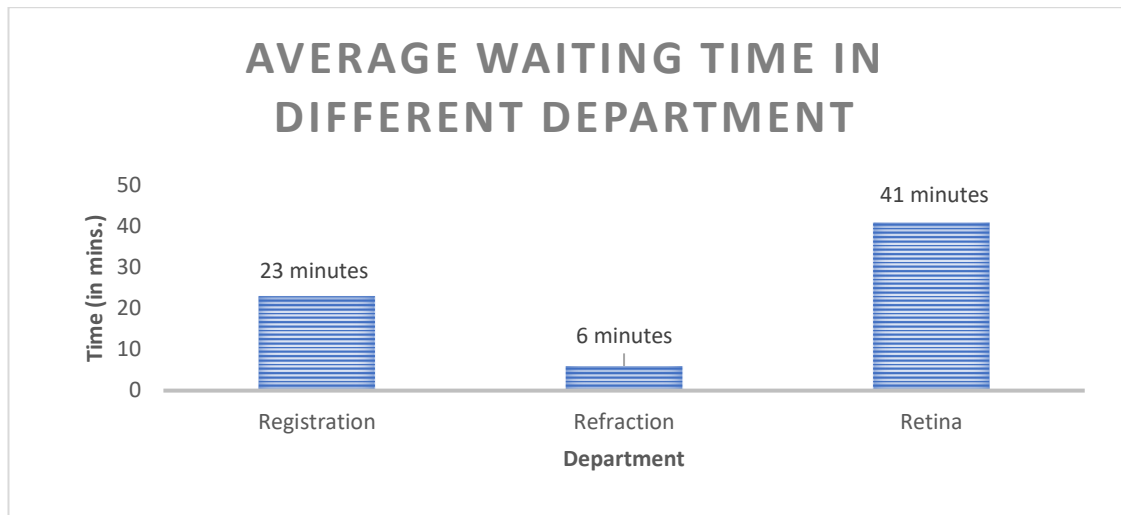


Figure- 3 Average waiting time in different departments

Average waiting time at registration, refraction, and retina were 23 minutes, 6 minutes, and 41 minutes respectively.

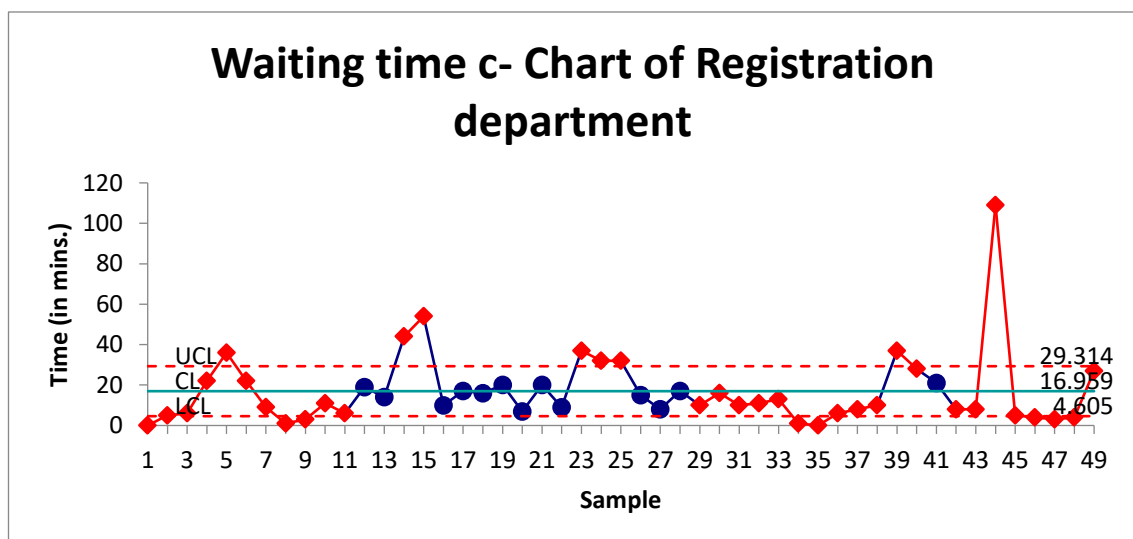


Figure- 4 C- chart of the registration department

The control chart at the registration counter shows that the process is not stable. By plotting this graph various causes can be determined which are explained later in the study.

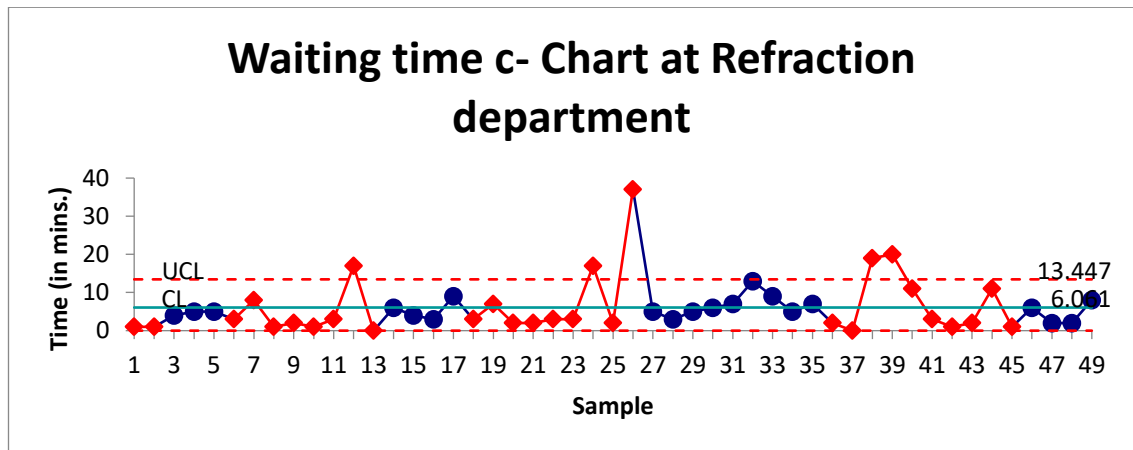


Figure- 5 C- chart of refraction department

The given data set suggests that the process is not stable. Samples show the presence of special causes for the delay which are identified and presented in cause and effect diagram.

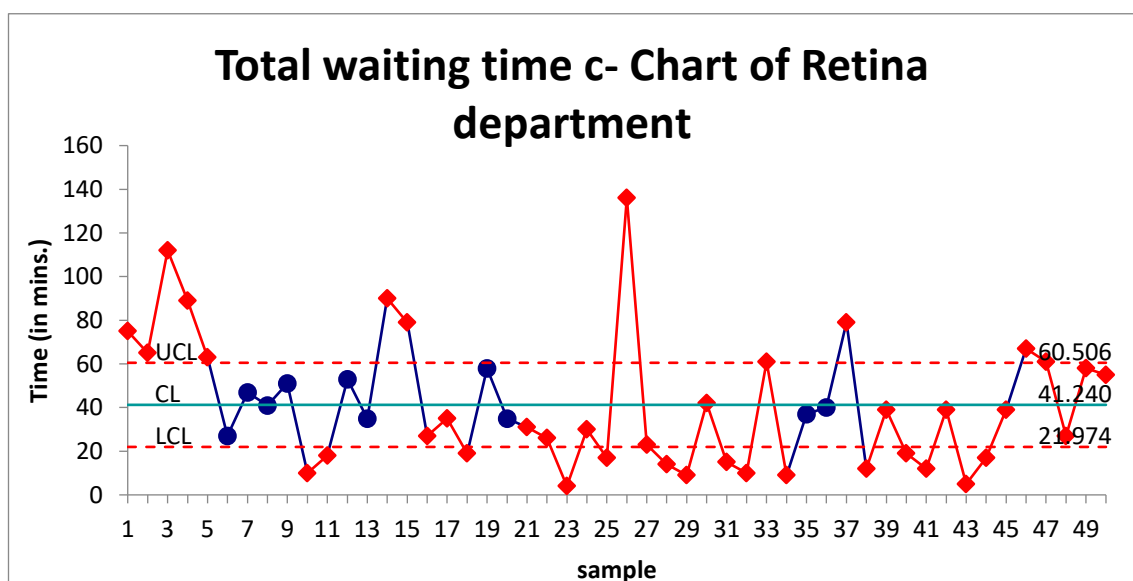


Figure- 6 C- chart of retina department

C-chart of retina department also shows the variation in the process which is mostly due to special causes. The causes were identified and presented in the Ishikawa diagram.

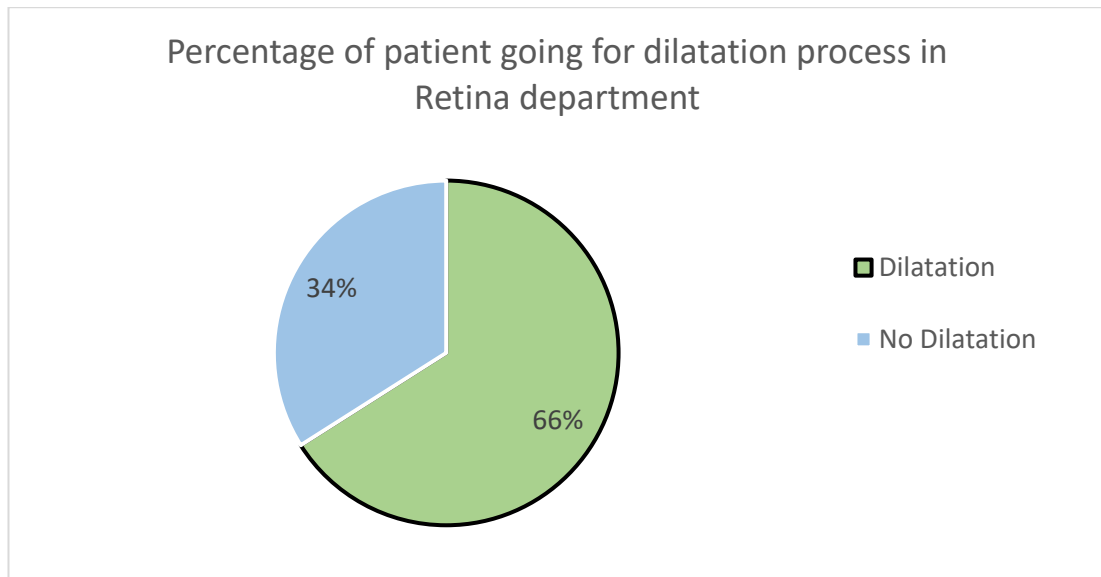


Figure- 7 Percentage of the patient undergoing dilatation process

66 percent of total patients going to the retina department were given dilatation drop which was found to be one of the important causes of delay in the waiting time of the retina department.

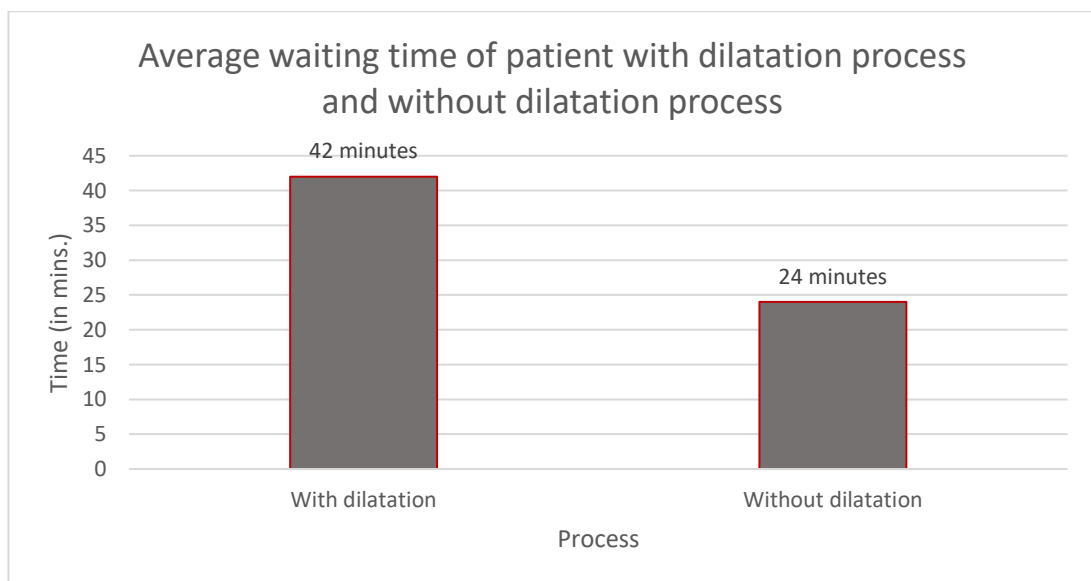


Figure- 8 Average waiting time of patient with and without undergoing dilatation process

The graphs show the average waiting time of patients with dilatation process and without dilatation process which is 42 minutes and 24 minutes respectively. This is a common cause and cannot be eliminated as it is the patient dependent process.

Waiting time in the retina department is calculated in three parts which are discussed in the table below.

Waiting time - 1	Waiting time from the arrival of patient in the department till meeting consultant
Waiting time -2	Waiting time from consultant meeting till dilatation
Waiting time -3	Waiting time after dilatation completed until meeting with the consultant

Table- 3 Three divisions of waiting time in the retina department

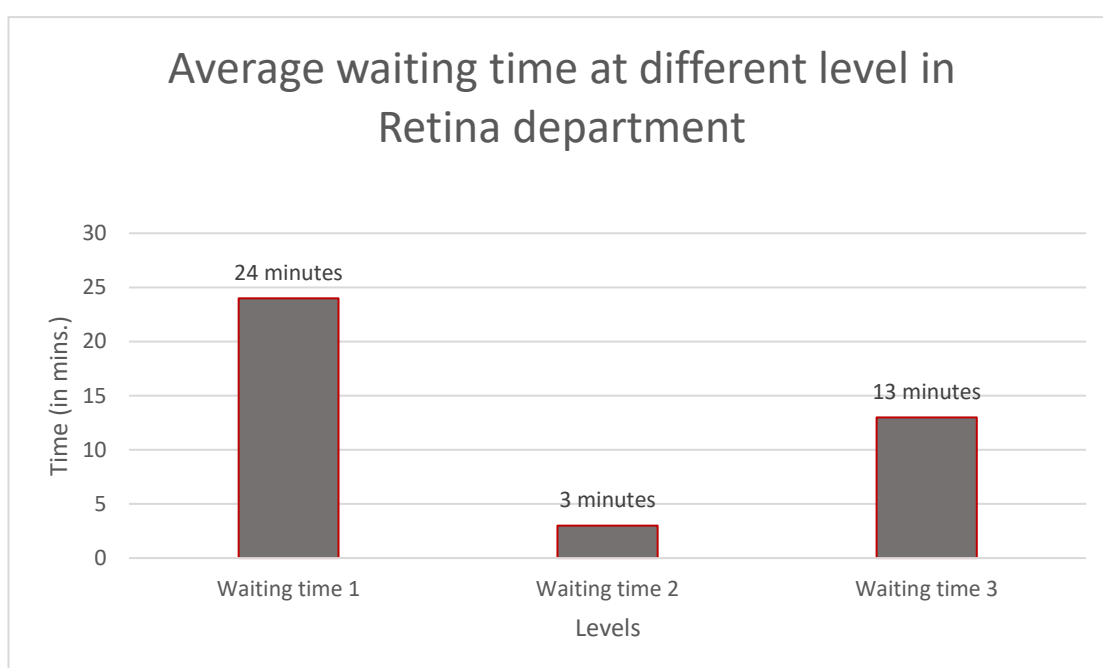


Figure- 9 Average waiting time at different levels of the retina department

The above graph shows the average waiting time at different steps in the retina department which are illustrated in figure- 7. According to the graph, the average waiting time at different levels which are 24 minutes, 3 minutes, and 13 minutes.

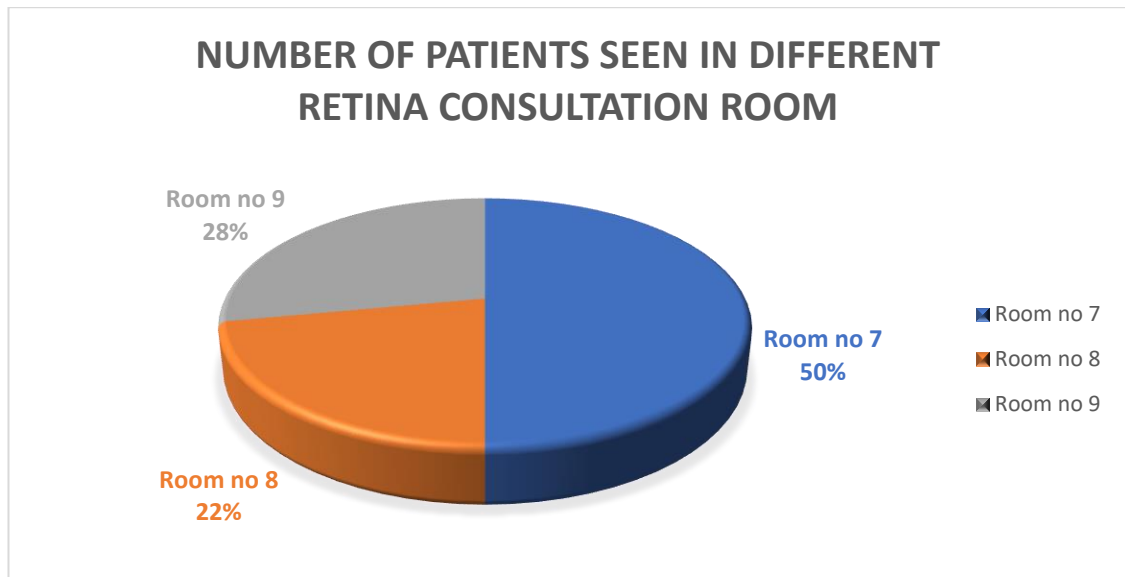


Figure- 10 Number of patients seen in the different retina consultation room

This pie – chart depicts that of all the patients seen by a consultant, during the time of data collection, 50 percent of the total cases were seen by a consultant in room no 7 followed by a consultant in room no 9 (28 percent of the total cases) followed by a consultant in room number 8 (22 percent of the total cases).

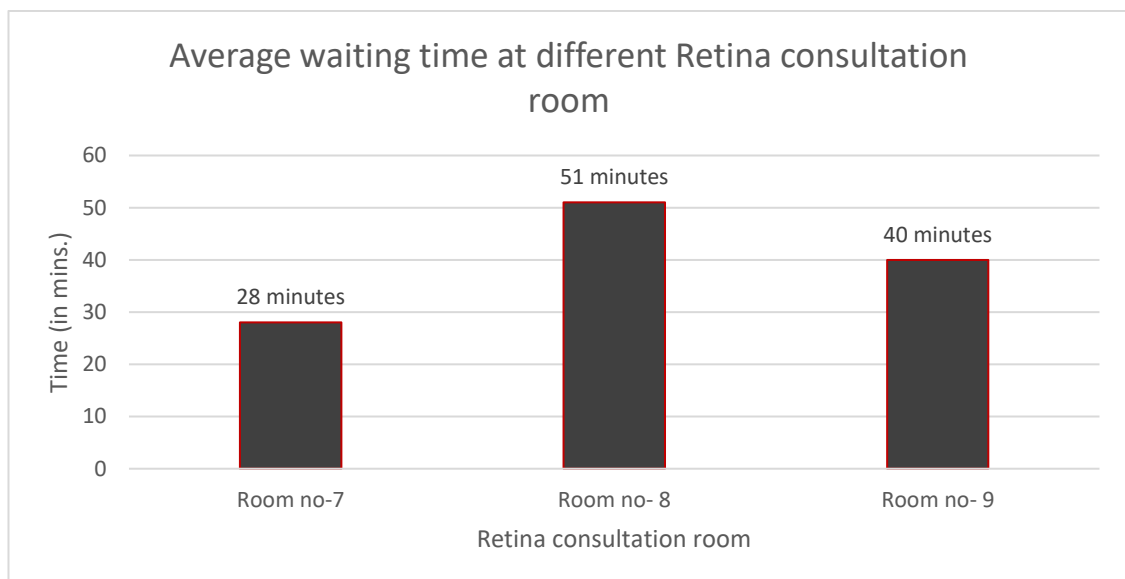


Figure- 11 Average waiting time at the different retina consultation room

The graphs show total waiting time in different retina consultant rooms. When calculating the average waiting time of each room it is seen that despite seeing 50 percent of the cases by the consultant in room number 7 the average waiting time in room number 7 is lowest i.e.,28 minutes followed by room number 9 (average waiting time- 40 minutes) and room

number 8 (average waiting time- 51 minutes). This makes the total average waiting time of retina consultation to be 39.66 minutes (nearly equals to 40 minutes).

Analyze

The purpose of the analyze phase of the DMAIC approach is to distinguish the reason for the underlined issue. The Fishbone graph was made to portray the reason for the delay in the OPD procedure.

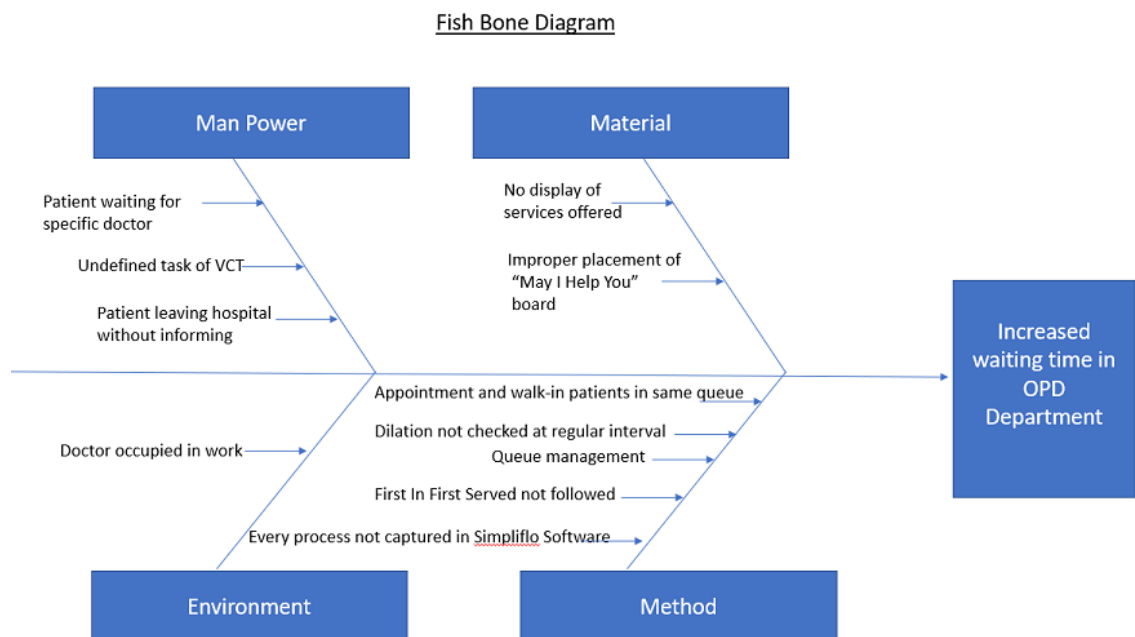


Figure- 12 Ishikawa diagram

Discussion

Process	Actual average waiting time	Waiting time details given by the hospital
Registration	23 minutes	10 minutes
Refraction	2 minutes	20 minutes
Doctor's consultation	40 minutes	10 minutes
Dilatation procedure	34 minutes	30 minutes
Doctor's review	13 minutes	10 minutes

Table- 4 Comparison of actual average waiting time and waiting time details given by hospital at different process

Improve

In the “improve” phase of the project, appropriate solutions were provided for the listed cause. Some of the solutions are as follow: -

<u>Problems</u>	<u>Suggestion</u>
Appointment and walk-in cases are considered the same.	Appointment must be given priority and the patient should be encouraged to book an appointment before their visit.
May I help you person given other roles and responsibility as well.	Dedicated person for may I help you desk and he/she should be allowed to help people in filling registration form who so ever needs.
Improper placement of May I Help You board	Must be in clear view.
No display about fast track services.	Must be displayed in printed form near registration so that patients can avail of the service.
The undefined task of VCT and optometrist.	Maintaining duty roaster for them.
Dilation not checked at regular intervals.	Introduction of dilation sheet.
Patient waiting for specific doctors.	Displaying consultant timings in OPD as well as an online platform.

The patient entered in system but physically called after some time	Bar code can be introduced as a band to patient
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Table- 5 Problems and their suggestion

Control

Control phase which is the last phase of the DMAIC approach guarantees that the procedure keeps on working appropriately, giving the ideal result and keeping up the quality of service.

Description	Measurement Method	Monitor	Frequency	Responsibility
Patient total time	Manual measurement tool	Control chart	Weekly	Floor manager
Patient arrival in OPD depart	Manual measurement tool	Control chart	Weekly	Head of the respective OPD department
Patient departure in OPD depart	Manual measurement tool	Control chart	Weekly	Head of the respective OPD department

Table- 6 Control plan for monitoring patient waiting time

Limitations of the study

- Because of the time constraint, the sample size was reduced to 50 in each department which can lead to some biases in the result because of the small sample
- Data was collected and observed for 18 days during COVID-19, which may result in biases
- Keeping the current situation in mind, the study was postponed for some time so the “improve” and “control” phase of the DMAIC approach is delayed until further approval from the organization

Conclusion

The time-motion study was initiated with a view of reducing waiting time in different OPD departments by using the DMAIC approach of six- sigma. Average waiting time at different OPD station shows huge variation among the departments as well as within the department. Average waiting time at registration was found to be 23 minutes, average waiting time at refraction was found to be 6 minutes, and waiting time at retina was found to be 41 minutes. Within retina department, average waiting time in different consultations room was- 28 minutes in consultant room number 7 while average waiting time in room number 8 and 9 was 51 and 40 minutes and a difference in the number of cases seen by each consultant varies from- 50% cases seen by a consultant in room number 7, 28% cases seen by a consultant in room number 9 and 22% cases seen by a consultant in room number 8. Control charts were drawn for the registration, refraction, and retina department which confirms unpredictability and instability in the process. After determining the problems, the Ishikawa diagram was made. In the improve phase of the DMAIC approach, suggestions were given for different causes identified in the Ishikawa diagram.

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