

**IMPLEMENTING SIX SIGMA METHODOLOGIES FOR
QUALITY ASSURANCE IN THE DEPARTMENT OF
RADIOLOGY**

**Internship Training
at
Metro Manas Arogya Sadan Heart Care and Multispecialty Hospital,
Jaipur**

**By
Lalita Mandia**

**Under the guidance of
Dr. Monika Chaudhary**

**MBA Hospital & Health Management
2013–15**


**Institute of Health Management Research
Jaipur
2015**

Dissertation
In
Metro Manas Arogya Sadan Heart Care and Multispecialty Hospital Jaipur

(Feb1st to Apr 31st, 2015)



A Project
On
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IN THE DEPARTMENT OF RADIOLOGY

By
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Under the guidance of
Dr. Monika Chaudhary

MBA Hospital and Health Management

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Institute of Health Management Research, Jaipur

TO WHOMSOEVER MAY CONCERN

This is to certify that Dr.Lalita Mandia student of MBA Hospital and Health Management from IIHMR University, Jaipur has undergone internship training at Metro MAS Hospital on Implementing Six Sigma Methodologies for Quality Assurance in the Department of Radiology from 1st February 2015 to 30th April 2015.

The Candidate has successfully carried out the study designated to her during internship training and her approach to the study has been sincere, scientific and analytical.

The Internship is in fulfillment of the course requirements.

I wish her all success in her future endeavors.



Col. (Dr.) Ashok Kaushik

Dean, Academics and Student Affairs

IIHMR, Jaipur



Dr. Monika Chaudhary

Professor

IIHMR, Jaipur



we treat..... HE CURES

Metro Manas Arogya Sadan Heart Care & Multi Speciality Hospital

(A Unit of Metro MAS Hospital Pvt. Ltd.)

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Date: 9th May 2015

TO WHOMSOEVER IT MAY CONCERN

This is to certify that Dr.Lalita Mandia has successfully completed her dissertation on Implementing Six Sigma Methodologies for Quality Assurance in the Department of Radiology in Metro MAS Hospital, Jaipur from 1st February to 30th April 2015 under my guidance and supervision.

Her performance during the period in the department was excellent. During her tenure of internship she comes across as a willing, sincere and intelligent person who has a strong drive and zeal for learning.

We wish her all the best for all her future endeavours.



CERTIFICATE BY SCHOLAR

This is to certify that the dissertation titled **Implementing Six Sigma Methodologies for Quality Assurance in the Department of Radiology in Metro MAS Hospital, Jaipur** submitted by me, Dr. Lalita Mandia Enrollment No. 1458 under the supervision of Prof. (Dr.) Monika Chaudhary for award of MBA Hospital and Health Management of the university carried out during the period from 1st February, 2015 to 30th April, 2015 embodies my original work and has not formed the basis for the award of any degree, diploma associate ship, fellowship, titles in this or any other Institute or other similar institution of higher learning.


Signature

“Successful passage and outcome of every work comes with dedication, determination and team work. All these turn futile in the absence of visionary guidance.”

The study has been a novel experience as a exposure to hospital industry. This study helped in understanding and learning the hospital setup, its various departments, their function and their interrelation. However none of this would ever have been possible without the priceless support of several people .I wish to take this opportunity to express my deepest gratitude to all of them who have made this endeavour possible.

I would remiss if I do not specifically mention some individuals who supported me. I would like to thanks specially to Mr. Anil Sharma (Administrator), Dr. Manisha Batra (Operations Manager) for their help and guidance.

I would like to extend our thanks to the management, medical, paramedical staff of METRO MAS Hospital for giving me all information and support required to complete my Dissertation.

My deepest gratitude to my mentor Dr. Monika Choudhary, who have always been a source of encouragement and guidance which enabled us to do a good job in METRO MAS Hospital, Jaipur.

I would like to thanks to all others who left their mark in the projects and helped me insipte of their busy schedule and hectic work hours.

Last but not least, I acknowledge the moral support of my parents, family members and friends during my dissertation.

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ACRONYMS/ ABBREVIATIONS

- Metro MAS- Metro Manas Arogya Sadan
- DMAIC- Define Measure Analyze Improve Control
- PPP- Public Private Partnership
- OPD- Out-patient Department
- IPD- In-patient Department
- ED – Emergency department
- HR- Human Resource
- CSSD- Central Sterile Services Department
- CTVS- Cardio Thoracic Vascular Surgery
- ICU- Intensive Care Unit
- IT- Information Technology
- MICU- Medical Intensive Care Unit
- OT- Operation Theatre
- PHC-Preventive Health Check-up
- CT- Computerized Topography
- USG- Ultrasonography
- ECG- Electrocardiogram
- EMR- Electronic Medical Record
- SIPOC- Supplier-Input-Process-Output-Customer
- CTQ- Critical to Quality
- SOP- Standard Operating Procedure
- TAT- Turnaround Time
- DPMO- Defects per Million Opportunity
- TPA- Third Party Administrator

PART I
INTRODUCTION

INTRODUCTION OF DISSERTATION

The internship is an essential part of the course. The importance lies in learning the application of the theoretical knowledge gained during the study tenure. During the internship, the experiences gained were full of learning. The learning had a very vast horizon covering different aspects of management ranging from managing day to day activities to following a DMAIC approach.

The following report is an effort to put into words the learning during my dissertation in Metro MAS Hospital. During my training I carried out the study of various departments in hospital. The main purpose of the study is to get orientation towards the functioning and management of various departments and to complete the assigned task which includes my respective projects.

Objective of Dissertation:-

- To get an overview of the hospital and functioning of various departments.
- To get practical exposure to hospital administration.

1.1 Introduction about the Project

- Healthcare industry is a service driven, so patient satisfaction plays a prime role in all the domains of healthcare industry. Report turnaround on time is a critical bottleneck for efficient patient flow in radiology department. It is one of the most critical factors in assessing the overall patient satisfaction with imaging services. Radiology process flow is one part which needs to be standardized and is getting a huge attention in the hospital setup, as at times diagnosis or even discharge gets delayed due to non availability of reports on time. Slow or unpredictable process flow translates into delay in report generation and dispatch. So a properly defined process needs to be designed.
- Objective: Basically the objective of this project was:
- To study the current process flow of radiology department, find out the gaps, modify and streamline the same in such a way that maximum efficiency can be achieved by reducing the turnaround time of reports.
- Six-sigma approach is one of a quality tools through which we find value added and non value added activities. This approach aided in reducing the non value added time, improved the process flow and finally reduced the report turnaround time.
- As a management trainee, my role in this project was to understand the process flow. Further, design a study pattern which included identification of key problem area(s), data collection, analysis followed by generating possible solutions and implementing them and finally monitoring the results.

Justification: During regular monitoring by administration and feedback from staff regarding their issues, it was seen that there was delay in reporting of investigations in radiology department. Since radiology is a revenue generating centre in the hospital, immediate need

was felt to calculate the turnaround time and find out gaps so that the quality of services could be maintained. Another concern was on maximum utilization of the facility. In order to maximize the utilization of radiology services by patients, it is essential to know the process flow & time spend in various activities done during the process followed by identifying the factors resulting in under utilization of the facility.

1.2 Quality Improvement Initiative in Radiology Department

Radiology Film Wastage

It was observed in the department audit that film wastage was on a higher side if we compare it with benchmarks. In view of this, data for the month of January was seen for wastage. Film wastage was then compared with the cost affected/average loss of revenue. Cost over 100 films was (8x10:6700rs, 11x14:11500rs, 14x17:15100rs).

Etiology

- Technical error related to machines.
- Manual error in handling the scanner.
- Consultant demand for extra copy of film for CME's.

Improvements

- Strict instructions given to the technician staff regarding the safe handling of radiology films. Concerned staff's name will be added in the remarks if he/she found engaged in film wastage.
- Calibrator came and did the necessary improvements in the machines & scanner.
- Biomedical engineer comes on frequent basis as per the requirement.

After doing the necessary improvements, Continuous monitoring shows subsequent reduction in wastage of films in Radiology department.

1.3 Executive Summary

Increased focus is being placed on the quality of care provided by hospital healthcare systems around the country. In the face of changing healthcare systems and increased competition, radiology department in a hospital needs to become efficient. Even the largest facilities face the need for increased efficiency. One measurement of efficiency is promptness in producing a final report with minimal film wastage. Even if everything else went satisfactorily, a slow report turnaround process can result in low patient satisfaction.

Reducing turnaround time for radiology reports with minimal film wastage improves the efficiency, quality of patient care as well as satisfaction of patients. For this an integrated system should be developed that allows continual monitoring of radiology work flow and thus of opportunities to apply interventions.

Implementing interventions for more efficient report turnaround time can be greatly enhanced by the Application of Six Sigma approach. The point of deploying six sigma in

healthcare is not to diminish the authority of radiologist, physician or nurse, but enhance the predictability of positive outcomes, whether clinical or operational. It can form an important component of the quality management process in the radiology department.

The project undertaken “Implementing Six Sigma Methodologies for Quality Assurance in the Radiology Department of Metro MAS Hospital, Jaipur.” Is mainly focusing on reducing the report turnaround time using effective Six Sigma tools from the time investigation starts to the time report is ready to dispatch. The standard timeline followed for report turnaround time at Metro MAS Hospital varies between 1–3 hours for different investigations.

During the initial scoping of this project, it was divided into five major components:

Define Phase: A problem statement was defined to identify why the project needs to be done. (10 days)

Measure Phase: To study the process map along with data collection to indicate the performance. (30 days)

Analysis Phase: Process, Fishbone & data analysis. (20 days)

Improvement Phase: Improvements by redesigning the process. (30 days)

Control Phase: Ensuring sustainable results by continuous monitoring. (3 months)

Baseline retrospective data was collected for 30 days for CT Scan, Ultrasound, X-Ray which revealed the “from-investigation start-report ready to dispatch” sub-process required approx CT Scan(OP)-2.73 hours, CT Scan (IP)-3.43 hours, CT Scan(Critical)-1.96 hours, USG(OP)-2.28 hours, USG(IP)-3.37 hours, USG(Critical)-1.55 hours, X-Ray(OP)-1.83 hours, X-Ray(IP)-6.69 hours. The whole analysis was done through proper process mapping of the existing system. Later process & data analysis was done using six sigma tools followed by generation of possible solutions, implementing them (improvement phase) & comparing with the existing performance. Control phase will begin by monitoring the improvements made using control charts. In the end, the overall project helped in reducing the non productive part of report generation and also to reduce average turnaround time.

PART II

HOSPITAL PROFILE

2.1 History

Metro Manas Arogya Sadan Heart Care & Multi Speciality Hospital, Jaipur is one of the first flagship hospital in Jaipur made on **Public Private Partnership (PPP)** mode with State of art infrastructure supported by **Rajasthan Government. Multi Speciality hospital of 220 Bedded** catering to patients from all over the state of Rajasthan.

With a vision to provide the highest quality of health care at the most affordable cost, Managing Director, Dr. Purshotam Lal (Padma Vibhushan, Padma Bhushan and recipient of Dr. B.C. Roy National Award, a pioneer of Interventional Cardiologist), founded Metro Group of Hospitals with Metro Heart Institute, Noida as its first hospital in 1997.

We represent a collaborative approach toward patient treatment, dedicated to “Treat like family member”.

Our Chairman Dr Purshotam Lal, with highest number of Angioplasties as a single operator in the country to his credit has developed the concept of ‘Metro Coronary Screening’ wherein angiography can be done with the use of minimal dye from the arc. The procedure reduces the cost of an angiography and takes only 5 minutes and the individual be back to home in 60 minutes. He has performed more than 13,000 cases with 100% success, the largest series in medical literature.

We believe in providing highest quality of care at most affordable cost, With highly advanced medical infrastructure, broad knowledge base, medical expertise and extensive integration, Metro Manas Arogya Sadan Heart Care & Multi Speciality Hospital makes an ideal partner for patients seeking affordable treatment. The hospital offers globally benchmarked healthcare services administered by surgeons and physicians, who are trained in internationally recognized protocols

We are pleased to inform that our Hospitals & Laboratory services have been accredited by Quality council of India, today we have **6 NABH accredited Hospitals and 5 NABL accredited Laboratories.**

We assure you of providing the same affordable & quality care at **Metro Manas Arogya Sadan Heart Care & Multi Speciality Hospital, Jaipur** & strive to achieve NABH & NABL at the earliest.

2.2 Location and area

The 220 bedded Metro hospital with 80 ICU beds is housed in 11 acres of plot built across 5 floors with complete 36 medical services, situated on Shipra Path near Mansarovar at a prime location on connecting to Ajmer and Tonk Road.

2.3 Catchment area

The catchment area is whole Jaipur city along with other parts of Rajasthan. The hospital has truly put the state on the international map as large of patients from different parts of the world come to the hospital for advanced medical treatment not available in their country .

2.4 Targeted population

The main targeted population is middle and upper middle class. The camps are been organised throughout year in various districts of Rajasthan.



Dr. Purshotam Lal
Chairman - Metro_Group
of Hospitals & Director
Interventional Cardiology

2.5 VISION

Our immediate agenda is to set up more such dedicated centers for providing wholesome treatment to the patients from all over the country and abroad. We are committed in continually serving the humanity at every needful hour with our state of the art facilities and world's best professionals. We are motivated by the immense faith that our patients have kept in us, we will stand by our principles and policies and will pursue the same with full dedication in future as well.

2.6 MISSION

Our vision is to achieve excellence in Healthcare services by offering unique expertise, state of the art technology & patient care. Metro Group of Hospitals is committed in providing world class health care at an affordable cost, irrespective of the education background, caste, creed or social status and beliefs followed by one and all, with complete dedication alike.

2.7 QUALITY POLICY

With a view to establish a system of clinical excellence, patient centricity, service delivery and ethical practices, team Metro MAS, through adherence to establish standards of healthcare delivery; will apply medical science and technology in such a way so as to maximize benefits to health without concomitant risks.

GROUP OF HOSPITALS UNDER OPERATION

- **Metro Manas Arogya Sadan Heart Care & Multi Speciality Hospital, Jaipur.**
- **Metro Hospitals & Heart Institute, Noida (Cardiology wing)**
- **Metro Hospitals & Heart Institute, Noida (Multispeciality wing)**
- **Metro Hospitals & Heart Institute, Lajpat Nagar, Delhi**
- **Metro Hospitals & Cancer Institute, Preet Vihar, Delhi**
- **RLKC Hospitals & Metro Heart Institute, Naraina Road, Delhi**
- **Metro Hospitals & Heart Institute, Meerut City**
- **Metro UMKAL Hospitals & Heart Institute, Rewari**
- **Metro Heart Institute with Multi Speciality, Faridabad**
- **UMKAL Hospitals & Metro Heart Institute, Gurgaon.**
- **Metro Hospital & Research Institute, Vadodara.**
- **Metro Hospitals & Heart Institute, Haridwar**

- **Our two new projects are coming up in Moga & Greater Noida.**

2.8 SCOPE OF SERVICES

CLINICAL SERVICES

- Cardiology
- Cardiothoracic Surgery
- Dentistry
- Dermatology
- Dietetics and Nutrition
- ENT
- Executive health check up
- Gastroenterology
- Gastro Intestinal Surgery
- General Medicine
- General Surgery

- Nephrology
- Neurology
- Neuro Surgery
- Obstetrics and Gynaecology
- Ophthalmology
- Orthopaedics
- Paediatrics and Neonatology
- Paediatric surgery
- Paediatric Neurology
- Physiotherapy
- Plastic surgery
- Psychiatry
- Pulmonary Medicine (Chest & T.B)
- Rehabilitation
- Speech Therapy & Audiology
- Urology

24-Hour Service

- Emergency Services
- Ambulance Services
- Pharmacy Services
- Laboratory Services and Imaging Services for IPD
- Blood Bank

Diagnostic Services

- X-ray
- Ultra Sonography
- Mammography
- CT Scan
- Endoscopy
- Cardiac Catheterization Laboratory
- Neuro Diagnostic Labs like EEG, EMG, EV
- Audiometry & Speech Therapy Testing
- Cardiac Test includes:

- Electrocardiogram
- Echocardiography
- Holter Monitor
- Stress Testing
- Pathology

Including all pulmonary test e.g. Sleep Study Test

Utility services

- Cafeteria Mortuary

INTENSIVE CARE UNIT (ICU)

- Cardiac Medical-I
- Cardiac Medical – II
- Cardiac Surgical
- Medical ICU
- Neuro ICU
- Surgical ICU
- Paediatric ICU
- Neonatal ICU (IPU & PCU)

OUT PATIENT DEPARTMENT

Outpatient department is defined as a part of the hospital with allotted physical facilities and medical and other staff in sufficient number with regularly scheduled hours, to provide care for patients who are not registered as in patient. The OPD facilities provide the main linkage of the hospital with the community.

Main purpose of OPD

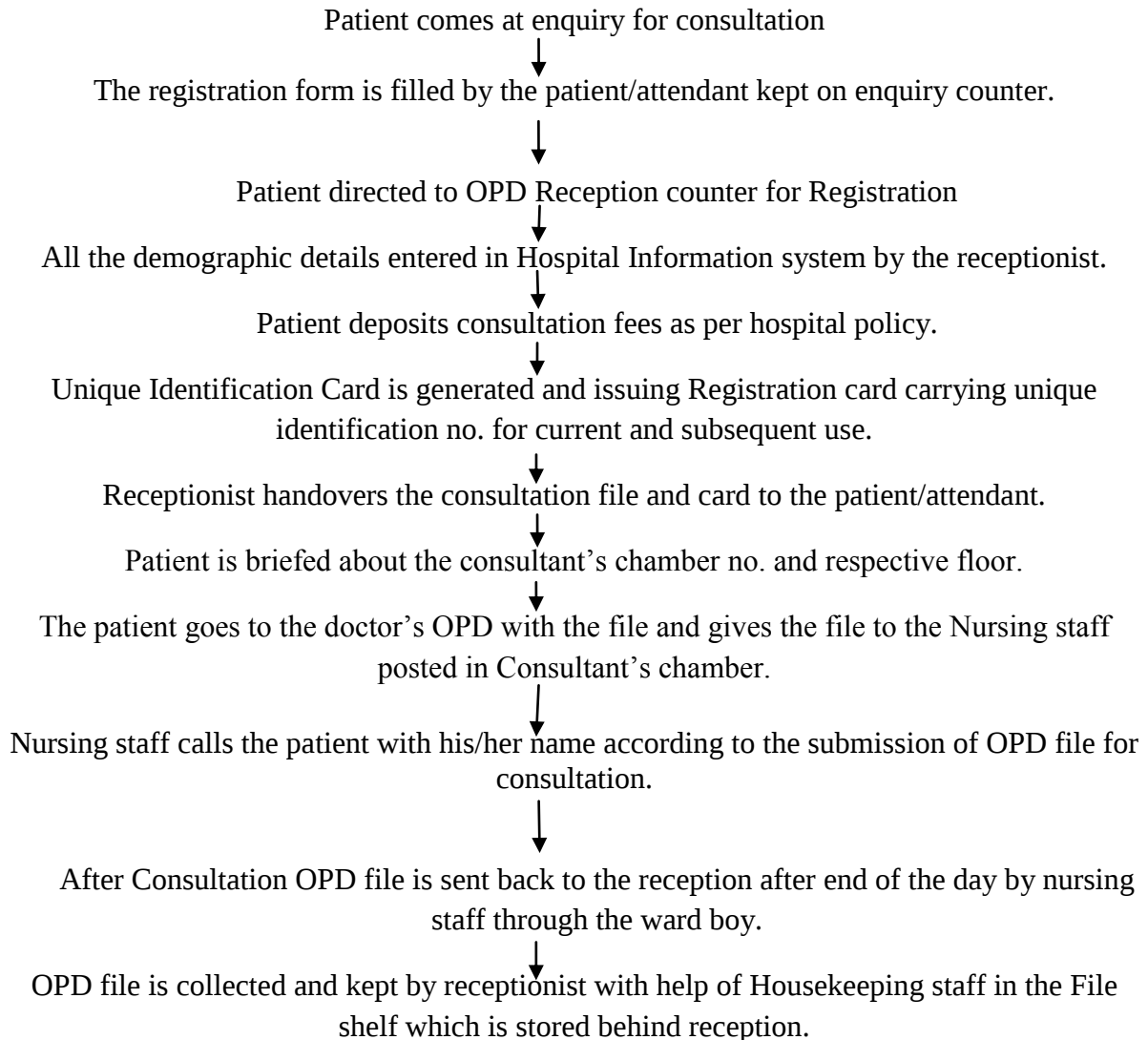
Ambulatory medical care is provided to patient who are not confined to bed can be provided at a general practitioners clinic specialized clinic, a health centre or a hospital, which are part of a hospital such care is called outpatient care. This care is provided through the OPD'S for fabricating of good health to patients.

REGISTRATION

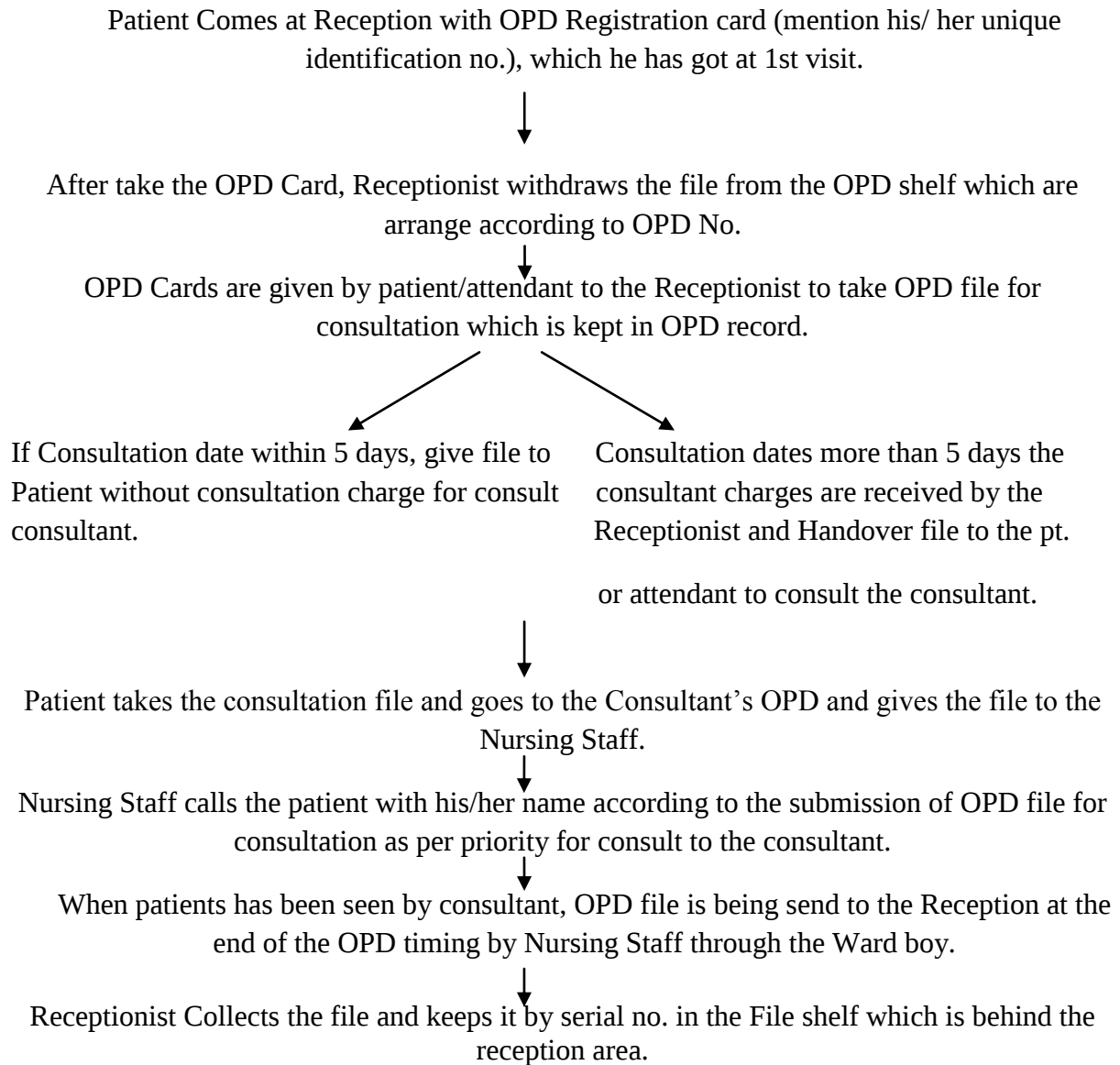
In order to avail the services offered at the hospital, the patient should be registered himself/herself at the main reception. The IPD registration is done round-the-clock and the form for the same is to be filled up and handed over at the counter itself. Please make sure that you provide accurate information in this form. It is highly recommended to write your details as per legal documents to avoid inconvenience especially for medical reimbursement / LIC purpose. Please carry the OPD Registration card and patient file on every hospital visit. Your Unique Hospital Identification Number (UHID) is important to make sure that you receive timely services.

OPD PROCESS FLOW

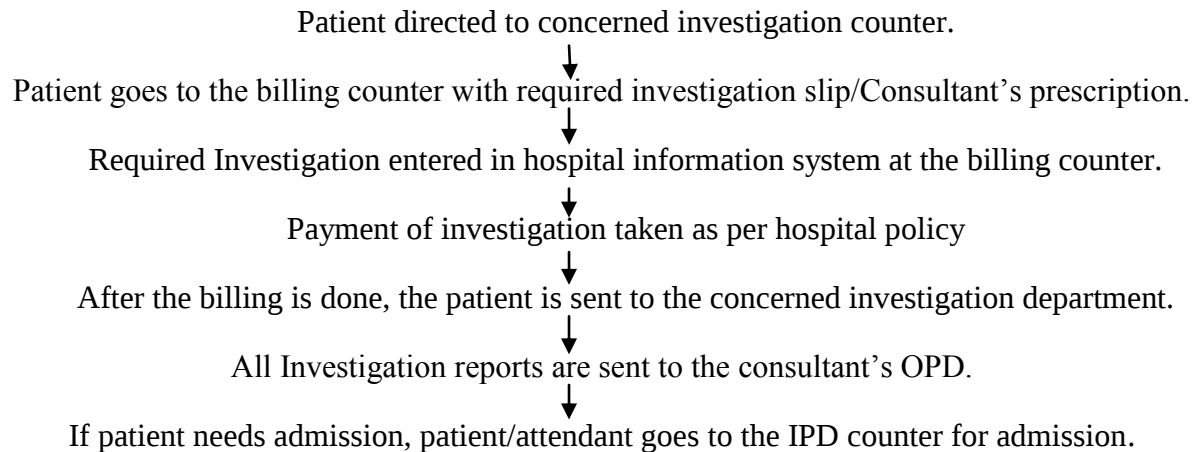
For New Patient



For Old Patient

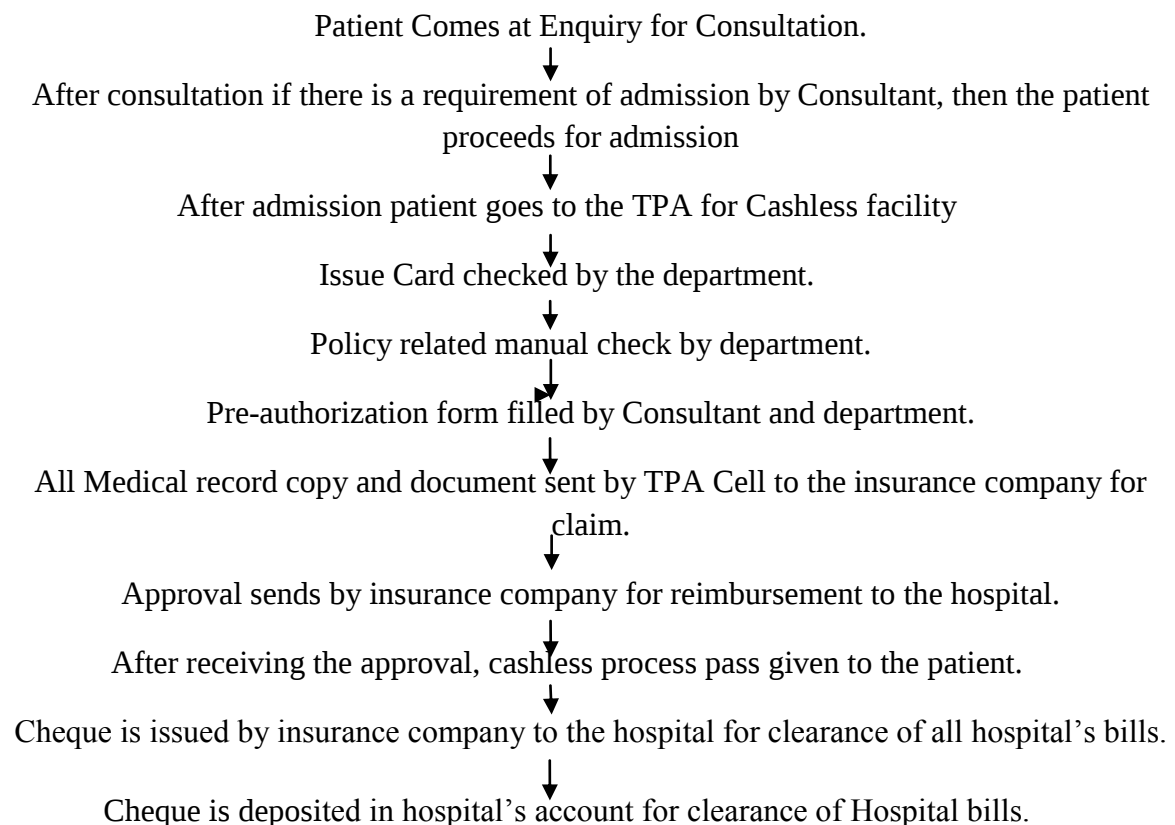


Process flow if investigation required



INSURANCE CLAIM

PROCESS FLOW (For TPA Insurance claim)



EXECUTIVE HEALTH CHECKUPS (EHC)

Specially designed packages are also made available for a comprehensive health check-up. The packages are made considering the age group and gender of the patient. The below mentioned shall be a brief description of the variety of Health Preventive Tests that we have planned to cover for various ailments and health groups:

- Cardiac Health preventive Package
- Cancer Preventive Screening Package
- Obesity Preventive Package
- Diabetes Preventive Screening Package
- Gastrointestinal Health Preventive Screening Package
- Orthopaedic Health Preventive Package
- Stroke Preventive Screening Package
- Neurological Disorder Preventive Screening Package
- Stone Preventive Screening Package

Age Specific Health Checkups:

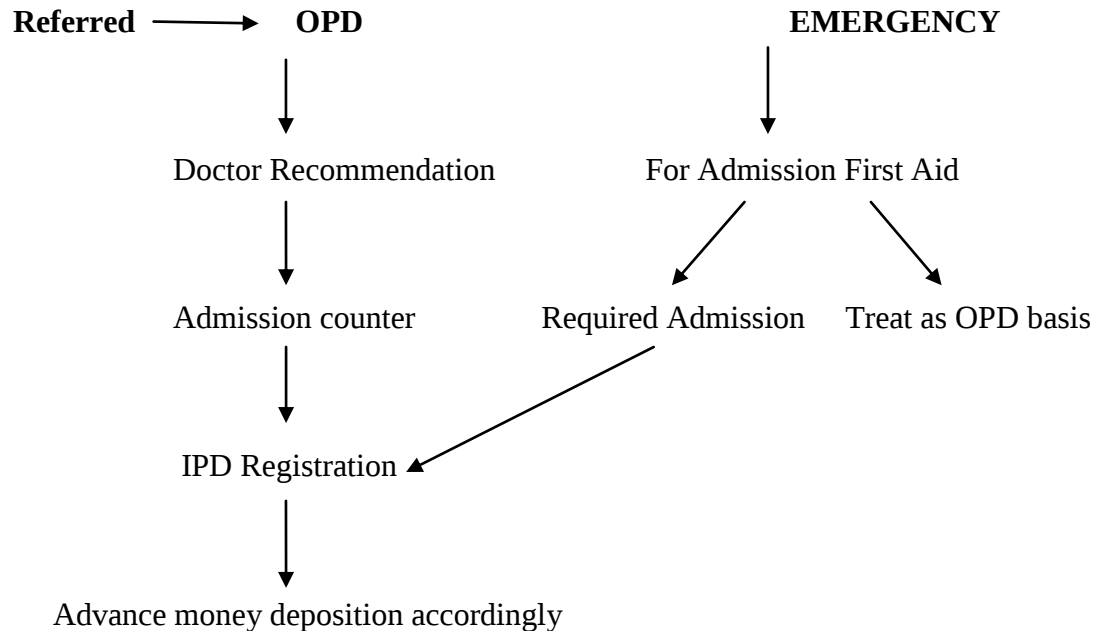
Along with age comes wisdom and the decision making ability to distinguish between the right and the wrong. But in today's time, with age come- fitness problems, cardiac complications, obesity, hypertension, pain in bones and joints, kidney related problems, gynecological issues, menstrual and post menstruation problems. These are the everyday issues that the middle aged face. At times silent killers and benign pathogens can also affect the well being of the individuals; hence we at Metro Hospital, Jaipur have designed a plethora of Preventive Health packages.

- Health Packages for Kids
- Health Packages for Women
- Health Packages for Men
- Health Packages for Adolescents- Girls/Boys
- Health Packages for the Aged

IN PATIENT DEPARTMENT: In Door Patient Department caters the services for patients who require continue observation and supervision of experts, acute & intensive medical care and emergencies.

Flow of Patient in IPD

NEW PATIENT



OPERATION THEATRE – 8 fully equipped modern Minor and Major operation theatres with laminar air flow and Hepafilters to offer highest sterility. Equipped with all modern machines including C-Arm machine.

RADIOLOGY – Fully loaded with hi-tech 16 slice CT scan from GE dealing with whole body CT, Ultrasound & Color Doppler, Digital X-Ray 500 MA, All CT guided & USG guided interventional Procedures.

LAB DIAGNOSTICS – Fully automated 24x7 days lab with state of art equipment as per guidelines of NABL, Online lab report, fully trained pathologist and microbiologist.

BLOOD BANK – 24 x 7 services. Licensed for blood & components.

PHARMACY – 24x7 services for IPD and OPD patients.

AMBULANCE – 24 x 7 Services.

PARKING – Great Ambiance with lot of parking space with easy approachability.

SECURITY SERVICES – 24x7 security guarding hospital.

DIETARY SERVICES & CAFETERIA – Hygienic food for patients and their attendants.

LAUNDRY FACILITY

Emergency

Department of Emergency is located at ground floor of IPD building. It caters 24*7 services. Patient coming at emergency required to deposit Rs.200 as file charge or registration charge at admission counter. From there patient get their unique identity no. There are three duty rosters in each shift with one doctor and three staff nurse. In emergency doctors are ACLS/BLS certified. Training for this conducted by hospital time to time.

Frequently coming emergencies are fall injuries, Cardiac emergencies and poisonous intake etc. There is minor OT in emergency department for suturing and other minor procedures. In minor OT there is an OT table, High Mask Light and Emergency Medicines are there.

List of Equipment in Emergency Department

- ☐ Crash cart
- ☐ Defibrillator
- ☐ ECG Machine
- ☐ Pulse Oxy meter
- ☐ Suction

EMERGENCY & CRITICAL CARE MEDICINE - 24 hours ambulance services, State of art monitoring Intensive Care Unit, Coronary Care unit, Medical Intensive Care Unit, Surgical Intensive Care Unit, Neo-natal Intensive Care Unit and High Dependency Units with International quality life support equipments manned by trained staff of Intensivists, Cardiac anesthetists & Qualified nurses round the clock.

*We look forward to treating you with the highest quality and affordable health care and hope that your experience here with **Metro Manas Arogya Sadan Heart Care & Multi Speciality Hospital, Jaipur** will be an enriching one!*

A Project

On

**IMPLEMENTING SIX SIGMA METHODOLOGIES FOR
QUALITY ASSURANCE IN THE DEPARTMENT OF
RADIOLOGY**

PART III

Methodology

3.1. Research Design:

The study is Prospective cum Retrospective Analytical Study. A Comprehensive study has been conducted to assess the overall existing performance of Radiology Department.

- To analyze Patient Perception towards various components of care and support services like clinical care, quality of service, infrastructure facilities availing from Radiology Department.
- To analyze overall satisfaction level considering factors affecting performance of job responsibilities of all the health care providers engaged in the Radiology Department.

3.2. Study Area: Radiology Department at Metro MAS Hospital, Jaipur.

3.3. Method of Data Collection:

(a) Primary Data: Patient feedback forms.

- Self administered Interview Schedule for Patients Perspective.
- Questionnaire for Patients Perspective.

(b) Secondary Data: Obtained from HIS (system & records)

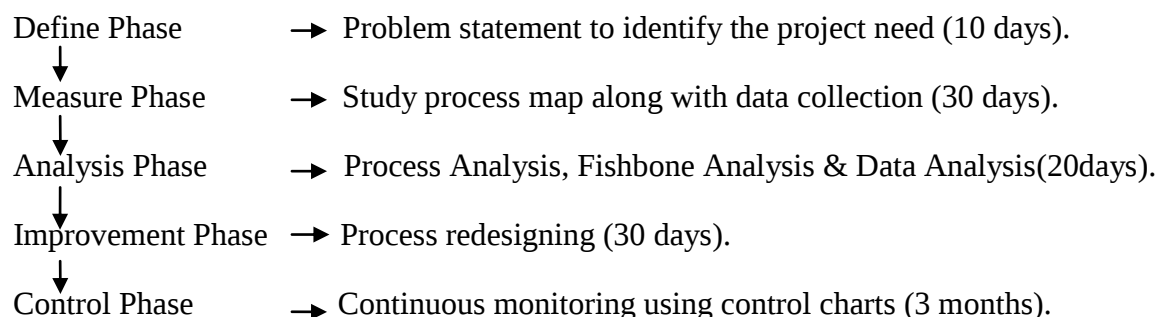
3.4. Sample size:

(a) Customer Feedback: 70 patients were interviewed. The sampling for each investigations is done on random basis

(b) CT Scan: 161	}	Data for 30 days
(c) USG: 931		
(d) X-Ray: 1630		

3.5. Study Framework: Six Sigma approach was used in the study framework. Here DMAIC theory was applied.

Figure No.6



3.6. Study Tools: SIPOC diagram, Process Mapping, Voice of Customers, CTQ Prioritization Matrix, Process Analysis, Fishbone Analysis, and Process Redesigning.

PART IV

FINDINGS

The radiology project began by establishing a framework to identify why the project needed to be done. A problem statement was defined followed by SIPOC (supplier, input, process, output and customer) diagram. Further factors critical to quality (CTQ) were established by

examining voice of customer (VOC-Customer Feedback). In the measure phase a total data of 30 days was collected for the three different investigations. Analysis of the data showed an average TAT for CT-3.17 hrs, USG-2.71 hrs, X-Ray-4.97 hrs. In the analysis phase, process analysis, fishbone analysis & data analysis was done. In data analysis, data was compared with the standard protocols followed at hospital. It showed that 66% of cases did not follow the guidelines of Standard Operating Procedures. 31% cases did not follow the guidelines Metro MAS Hospital, Jaipur. Improvement phase included a data collection of 15 days which showed a significant improvement.

4.1 Define Phase

Problem Statement: Lack of standardized process flow from the last 2 years leads to delay in 66% of report dispatch in the department of radiology, resulting in under utilization of the services and decreased customer satisfaction.

Goal Statement: The goal of this project is:

- To develop a standardized methodology to decrease the report turnaround time.
- To improve patient satisfaction.

Project Objectives: Objectives for this project are:

- To study the existing process flow.
- To measure the data in order to identify the extent of problem.
- To analyse the data and comparing it with the standard process.
- Provide a project roadmap to improve the process flow and develop appropriate solutions.
- Proper training of nursing & technician staff to improve the quality of documentation required for maintaining record for turnaround time.
- Proper monitoring for sustainability of results.

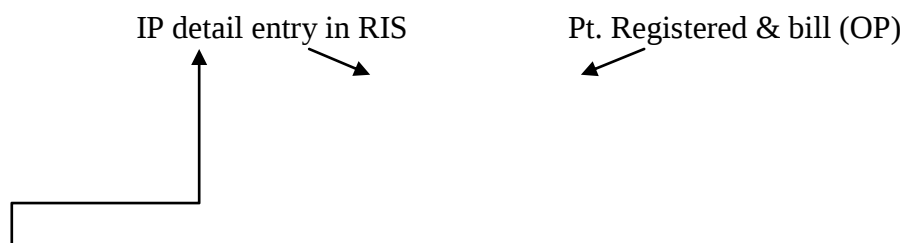
Table No. 1: SIPOC Diagram (Supplier-Input-Process-Output-Customer Diagram)

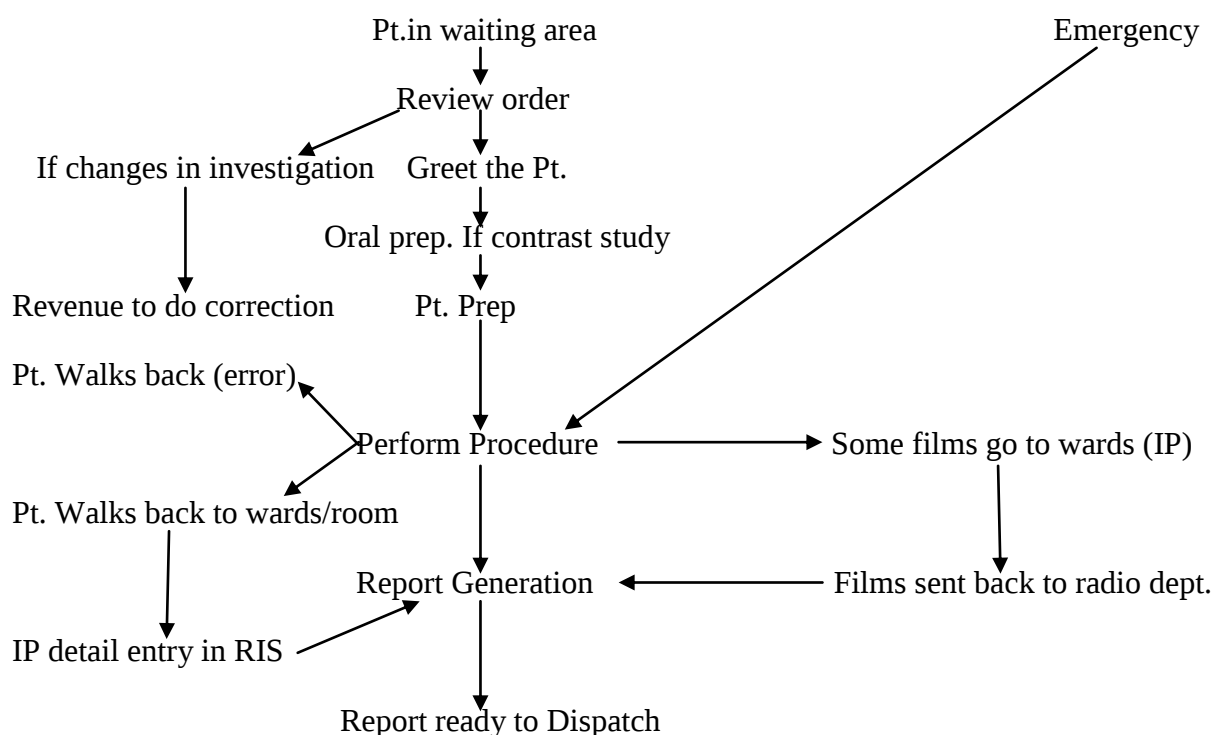
SUPPLIER	INPUT	PROCESS	OUTPUT	CUSTOMER
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Inpatient Dept/wards	1.Inpatient staff (correct information of patient- addressograph), Complete information related to patient(history- current health status, concerned doctor, type of investigation, expected bill) 2.Housekeeping staff(for carrying the patient towards/for investigation, preparation of patients, staff for taking the patient report to doctors) 3.Revenue dept. For billing of inpatients. 4.Outpatient staff(billing of outpatients, customer care staff) 5. BME for machine calibration. 6. IT dept. For maintaining RIS. 7. Report transcriptionist.	Test Performed	Report Delivered On time	Doctors
OPD Counter		Report Printed		Nursing staff
Emergency		Report Delivered		Technician staff

This SIPOC diagram is followed by the process mapping at the radiology department.

Process Mapping





Voice of Customers (Patient Feedback)

Voice of customers was obtained in order to identify the major areas of concerns in the department. For this feedback form was used to measure the voice of customers which can be seen in annexure no.4

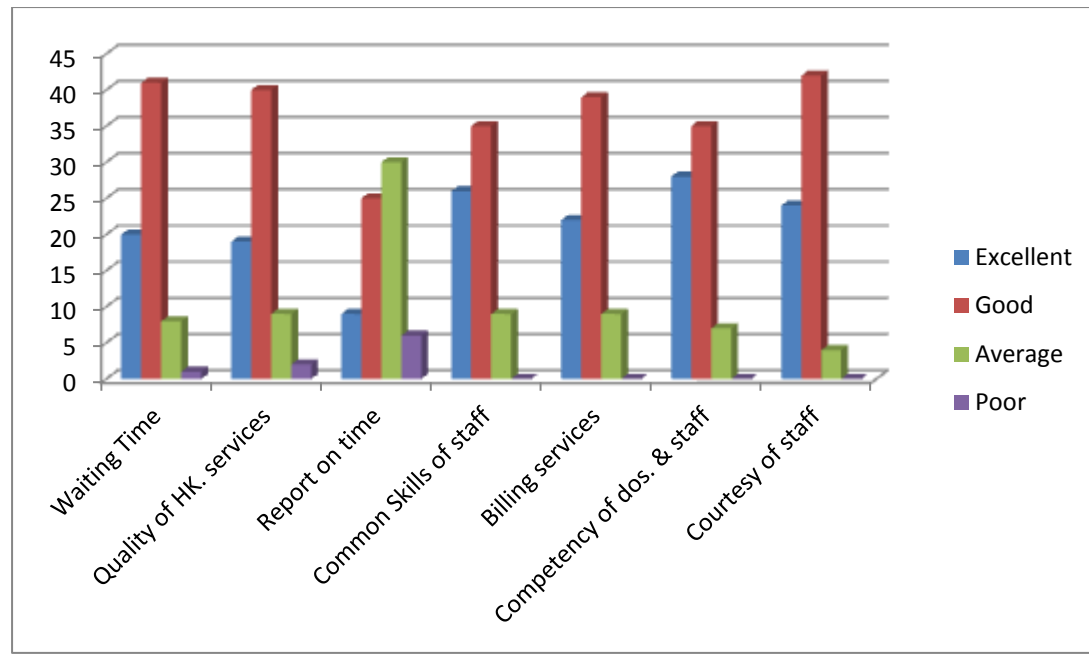
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Table No. 2: Voice of customers showing patient Feedback

Sr.No.	Quality Indicator	Excellent	Good	Average	Poor
1	Waiting Time	20	41	8	1
2	Quality of HK. services	19	40	9	2
3	Report on time	9	25	30	6
4	Common Skills of staff	26	35	9	0
5	Billing services	22	39	9	0
6	Competency of Doctors & staff	28	35	7	0
7	Courtesy of staff	24	42	4	0

- Most dissatisfying feedback is for reports on time.

Graph No. 1: For Voice of Customers showing Patient



From the Voice of Customer's, 5 factors critical to quality were derived on the basis of performance.

Factors Critical to Quality (CTQ): Total 5 factors were identified

Table No.3: Factors Critical to Quality

Sr. No.	Factors
1	Waiting Time
2	Quality of HK. services
3	Report on time
4	Comm. Skills of staff
5	Billing services

From the 5 factors critical to quality, prioritization matrix was done in order to identify the critical factor on which six sigma has to be applied.

CTQ Prioritization Matrix

- This matrix cannot be used for more than 5 variables.
- Rating of importance to customers is done on the scale of 1-5-9.
Scale 1 – No impact
Scale 5 – Medium impact
Scale 9 – High impact
- Relationship Rating is the relationship between variables and the impact of variables and is done on the scale of 1-5-9.
Scale 1 – Low/Weak
Scale 5 – Medium
Scale 9 – High/Strong

Table No.4: CTQ Prioritization Matrix

Sr. No.	Factors Critical to Quality	Impact of 1 on custo.(9)	Impact of 2 on custo.(5)	Impact of 3 on custo.(5)	Impact of 4 on custo.(5)	Impact of 5 on custo.(5)	Total
1	Report on time	9	5	5	1	1	141
2	Quality of HK. service	5	9	1	1	1	105
3	Comm. Skills of staff	5	1	9	1	1	105
4	Waiting Time	1	1	1	9	5	89
5	Billing services	1	1	1	5	9	89

- Total Score is calculated by: (relationship rating1 x importance rating1) + (relationship rating2 x importance rating2) +
- In the prioritization matrix priority is given to a variable which has the highest score.
- Here the highest score is 141 i.e. for report on time. So this prioritization matrix assignment correlated with the problem statement which was designed in the define phase.

4.2 Measure Phase

After viewing the process map, voice of customers and CTQ prioritization matrix exercises, the factor that became primary performance indicator needed to evaluate patient satisfaction was timely reporting of results. A total of 30 days was collected for the three different investigations. Analysis of the current process showed that average turnaround time for various investigations calculated was as follows:

Table No.5: Average Turnaround time for CT scan, USG, and X-Ray

Investigation	CT Scan	USG	X-Ray
Calculated Average TAT	3.17 hours	2.71 hours	4.97 hours

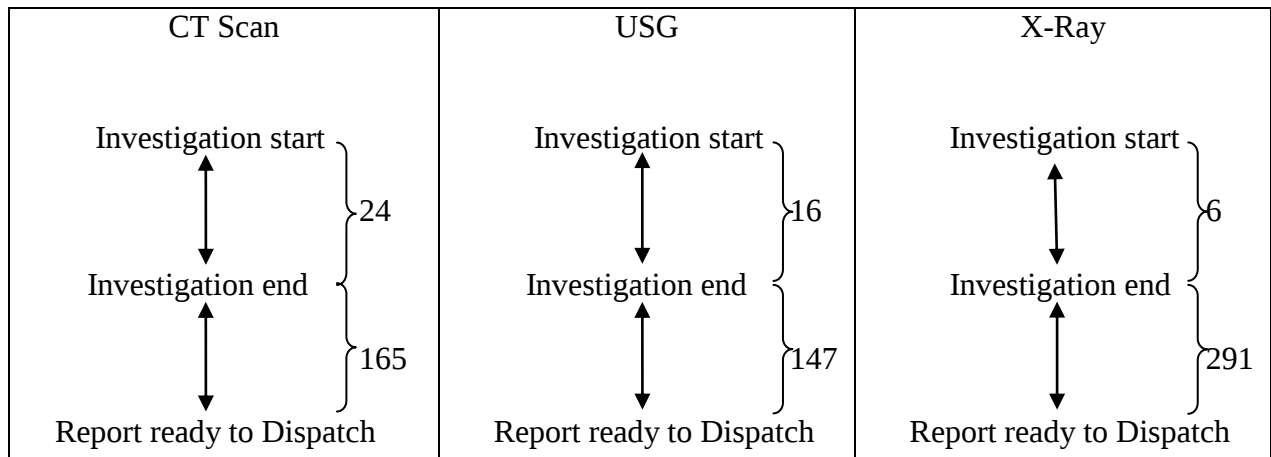
SOP for Radiology Report TAT in units of Metro MAS Hospital: See annexure no. 1

Policy for radiology TAT which was followed at Metro MAS Hospital, Jaipur before starting the project: See annexure no. 2

As this policy was not meeting the guidelines of Standard Operating procedures so with immediate effect this policy was changed accordingly: See annexure no. 3

Keeping in view the policy data collection was started for turnaround time for CT Scan, USG, X-Ray which included 2 components: Investigation time and report generation time.

A data timeline (in minutes) is given below:



A. Data Measurement for CT Scan

Table No. 6: CT scan showing average TAT

Category	Size	Mean TAT(hrs)
OP	60	2.73
IP	101	3.43
Critical	11	1.96
Total(OP+IP)	161	3.17

Table No. 7: Showing TAT Ranges for OP and IP cases of CT Scan

Range in Hours for Average TAT	OP Cases	OP Av.TAT	IP Cases	IP Av. TAT
0-1	6	2.73 hrs	3	3.43 hrs
1-2	31		32	
2-3	8		26	
3-4	6		14	
4-5	2		14	
5-6	0		0	
6-7	0		0	
7-8	2		2	
8-9	0		0	
9-10	2		2	
10-15	3		8	

Table shows the number of OP & IP cases for the range of 1 hr. Mean TAT for OP cases came in the range of 2-3 and mean TAT for IP cases came in the range of 3-4.

DPMO (Defects Per Million Opportunity)

- $DPMO = (1,000,000 * \text{No. Of Defects}) / \text{No. Of Units} * \text{No. Of opportunity}$

Table No.8: Showing DPMO for CT scan as per SOP

Category	Units	Defects	No. Of Opportunity	DPMO
CT Scan(OP)	61	22	2	180327
CT Scan(IP)	100	39	2	195000
CT Scan(Critical)	11	10	2	454545
Total(OP+IP)	161	61	2	189440

Defects indicate the number of patients who failed to follow the SOP for TAT. 61 cases of 161 cases show a defect of 38%.

Table No.9: Showing DPMO for CT scan as per policy followed at Metro MAS Hospital, Jaipur.

Investigation	9-11am by 2pm	11am-5pm by 7.30pm	5pm-9am by 12pm	Total Defects	No. Of Opportunity	DPMO
CT(OP)	6/12	0/38	6/10	12/60	2	100000
CT(IP)	13/27	5/46	14/28	32/101	2	158415
Total	19/39	5/84	20/38	44/161	2	136645

Maximum No. of defects are shown in the time duration between 5pm-9am.

B. Data Measurement for Ultrasound

Table No.10: Ultrasound showing average TAT

Category	Size	Mean TAT(hrs)
OP	573	2.28
IP	358	3.37
Critical	44	1.55
Total(OP+IP)	931	2.71

Table No.11: Showing TAT Ranges for OP and IP cases of Ultrasound

Range in Hours for Average TAT	OP cases	OP Av. TAT	IP Cases	IP Av. TAT
0-1	49	2.28hrs	9	3.37hrs
1-2	317		107	
2-3	173		102	
3-4	0		54	
4-5	0		30	
5-6	0		26	
6-7	0		4	
7-8	0		4	
8-9	0		0	
9-10	4		4	
10-15	30		18	

Table shows the number of OP & IP cases for the range of 1 hr. Mean TAT for OP cases came in the range of 2-3 and mean TAT for IP cases came in the range of 3-4.

DPMO (Defects Per Million Opportunity)

- $DPMO = (1,000,000 * \text{No. Of Defects}) / \text{No. Of Units} * \text{No. Of Opportunity}$

Table No.12: Showing DPMO for USG as per SOP

Category	Units	Defects	No. Of Opportunity	DPMO
USG(OP)	573	203	2	177137
USG(IP)	358	146	2	203910
USG(Critical)	44	39	2	443181
Total(OP+IP)	931	349	2	187432

Defects indicate the number of patients who failed to follow the SOP for TAT. 349 of 931 cases show a defect of 37%.

Table No.13: Showing DPMO for USG as per policy followed at Metro MAS Hospital, Jaipur

Investigation	9-11am by 2pm	11am-5pm by 7.30pm	5pm-9am by 12pm	Total Defects	No. Of Opportunity	DPMO
USG(OP)	62/308	17/185	40/80	119/573	2	103839
USG(IP)	31/97	13/155	48/106	92/358	2	128491
Total	93/405	30/340	88/186	211/931	2	113319

Maximum No. of defects are shown in the range of 5pm-9am.

C. Data Measurement for X-Ray

Table No.14: X-Ray showing Average TAT

Category	Size	Mean TAT(hrs)
OP	564	1.83
IP	1066	6.68
Critical	-	-
Total(OP+IP)	1630	4.97

Table No.15: Showing TAT Ranges for OP and IP cases of X-Ray

Range in Hours for Average TAT	OP Cases	OP Av.TAT	IP Cases	IP Av. TAT
0-1	55	1.83hrs	58	6.68hrs
1-2	366		146	
2-3	120		205	
3-4	13		185	
4-5	3		65	
5-6	0		58	
6-7	3		29	
7-8	0		39	
8-9	4		39	
9-10	0		43	
10-15	0		199	

Table shows the no. Of OP & IP cases for the range of 1 hr. Mean TAT for OP cases came in the range of 1-2 and mean TAT for IP cases came in the range of 6-7.

DPMO (Defects Per Million Opportunity)

- **DPMO = (1,000,000*No. Of Defects)/No. Of Units*No. Of Opportunity**

Table No. 16: Showing DPMO for X-Ray as per SOP

Category	Units	Defects	No. Of Opportunity	DPMO
X-Ray(OP)	564	509	2	451241
X-Ray(IP)	1066	868	2	407129
X-Ray(Critical)	-	-	2	-
Total(OP+IP)	1630	1377	2	422392

Defects indicate the number of patients who failed to follow the SOP for TAT. 1377 out of 1630 cases show a defect of 84%.

Table No.17: Showing DPMO for X-Ray as per policy followed at Metro MAS Hospital, Jaipur

Investigation	9-11am by 2pm	11am-5pm by 7.30pm	5pm-9am by 12pm	Total Defects	No. Of Opportunity	DPMO
X-Ray(OP)	6/321	0/175	3/68	9/564	2	7978
X-Ray(IP)	68/146	94/272	388/648	550/1066	2	257973
Total	74/467	94/447	391/716	559/1630	2	171472

Maximum no. of defects are shown in the range of 11am-5pm.

4.3 Analysis Phase: Divide into 3 parts

- Process Analysis
- Fishbone Analysis
- Data Analysis

Table No.18: Showing Process Analysis

Steps	Process Flow	Analysis
1	Patient Registration ↓	(OP)Outpatient gets the registration done. (IP)In patient comes to radiology from ward/room. There is no specific protocol for taking a mid night census & handover to radiology department for the next day investigations. So radiology staff is unaware about the patient load on daily basis. In some of the cases, investigation requisition details are not entered into HIS before the test & entry is done only after investigation part is over. Without the entry, report cannot be prepared. At times this gets delayed & affects TAT. (Critical)Patient from emergency may be an outpatient or may be admitted so a confusion always remain regarding the registration(OP/IP) as without registration investigation can be done in some cases but report cannot be generated. This causes increase in report turnaround time.
2	Patient walks to waiting room ↓	(OP)Outpatient after getting the registration done wait for some time till their number comes. (IP)For Inpatients, prior phone call is done whether the staff is free or not. (Critical)Emergency patients are attended immediately.
3	Greet the patient with review of order. ↓	In case of Inpatients, review order takes more time in some cases, as the requisition forms are not fully filled. Due to this the radiologist has to confirm from the sending department regarding the type of investigation. This allows patient to wait more in the department. In some cases, the radiologist demands some different investigation to be done. For this the nursing staff sends a correction mail to revenue. After correction a fresh entry is made in HIS. Delay in entry causes delay in report preparation.
4	Oral preparation in case any contrast study. ↓	-
5	Patient preparation ↓	-
6	Procedure preparation ↓	Time takes for different investigations varies. Especially in contrast studies, it takes more time for the procedure.

7	Report preparation with consultant signature. ↓	Only one transcriptionist is available for report preparation. This creates a chaos situation especially in the morning hours when the patient load is more. It affects & takes more time in report preparation. In IP/Emergency cases, sometimes films are sent to consultant for review. But there is no specific timeline to send the films back to radiology. Without the film report cannot be generated. It affects the TAT.
8	Report dispatch	In IP cases, at times due to shortage of the housekeeping staff reports are not been sent to wards though they are ready for dispatch.

Figure No.8: Fishbone Analysis

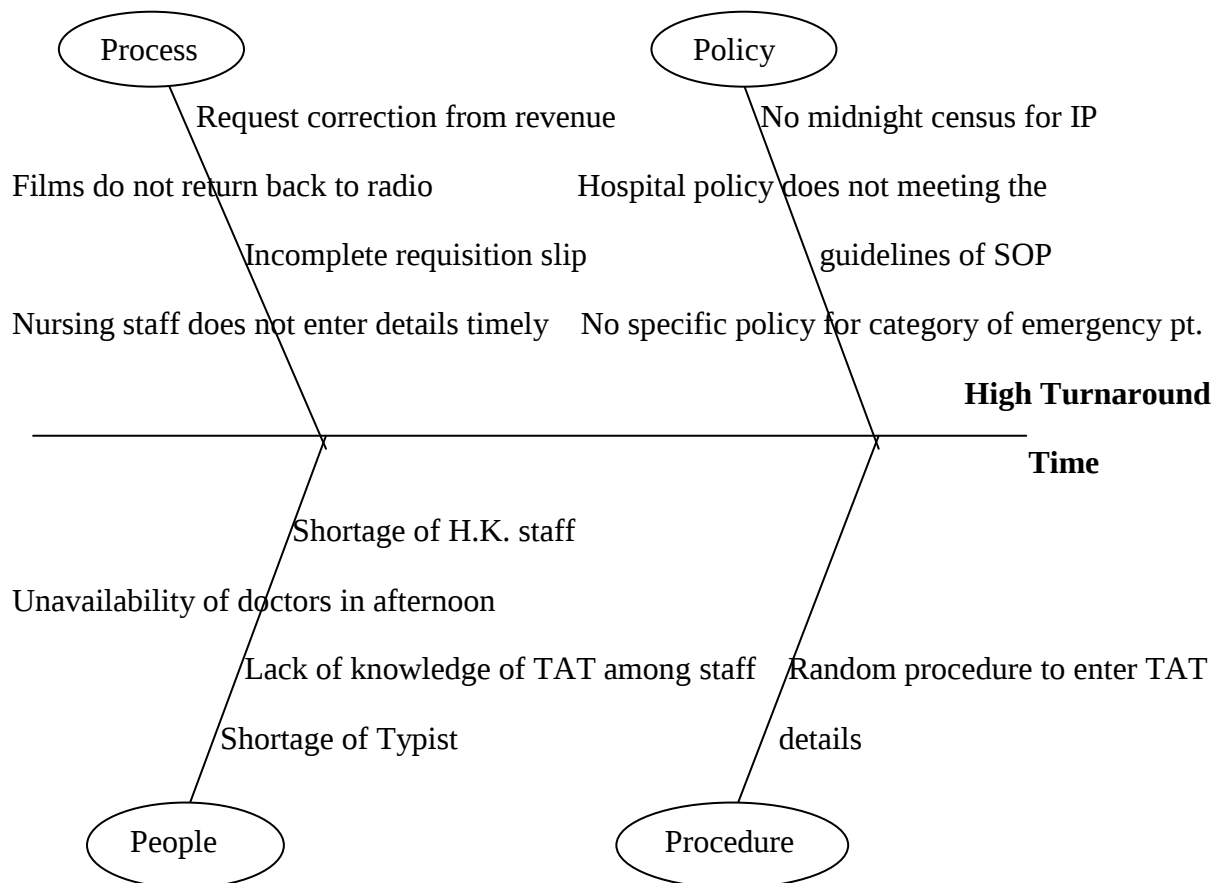


Table No.19: Showing % hike of Actual TAT with SOP for TAT

Category	SOP TAT(hrs)	Actual TAT(hrs)	% Hike
CT Scan(OP)	2	2.73	27
CT Scan(IP)	3	3.43	14
CT Scan(Critical)	1	1.96	96
USG(OP)	2	2.28	14
USG(IP)	2	3.27	19
USG(Critical)	1	1.55	55
X-Ray(OP)	1	1.83	83
X-Ray(IP)	2	6.69	234
X-Ray(Critical)	1	-	0

Highest percentage hike is shown in the case of X-Ray IP cases (234%).

Table No.20: Showing Six Sigma Performances Level as per SOP

Category	DPMO	Sigma Level
CT Scan(OP)	180327	Between 2-3
CT Scan(IP)	195000	Between 2-3
CT Scan (Critical)	454545	Between 1-2
USG(OP)	177137	Between 2-3
USG(IP)	203910	Between 2-3
USG(Critical)	443181	Between 1-2
X-Ray(OP)	451241	Between 1-2
X-Ray(IP)	407129	Between 1-2
X-Ray(Critical)	-	-

Performance of CT scan critical cases, USG Critical, X-Ray OP& IP cases is poor and showing sigma level between 1-2.

Table No.21: Showing Overall Performance of Radiology Department as per SOP

Category	Units	Defects	No. of Opportunity	DPMO	Sigma Level
CT Scan	161	61	2	189440	Between 2-3
USG	931	349	2	187432	Between 2-3
X-Ray	1630	1377	2	422392	Between 1-2
Total	2722	1787	2	328251	Between 1-2

Table No.22: Showing Six sigma performance in terms of DPMO

Level of Sigma	DPMO
2	308537
3	66807
4	6210
5	233
6	34

- Overall performance of X-Ray is between 1-2 sigma level which is on a lower side needs to be improved.
- Overall performance shows that Radiology Department is working at nearly 2 sigma level.
- 38% cases in CT scan, 37% cases in USG & 84% cases in X-Ray do not meet customer's expectations.
- 66% cases in hospital did not meet the customer's expectations.

Graph No.2: Showing percentage defects in CT Scan, USG, X-Ray cases.

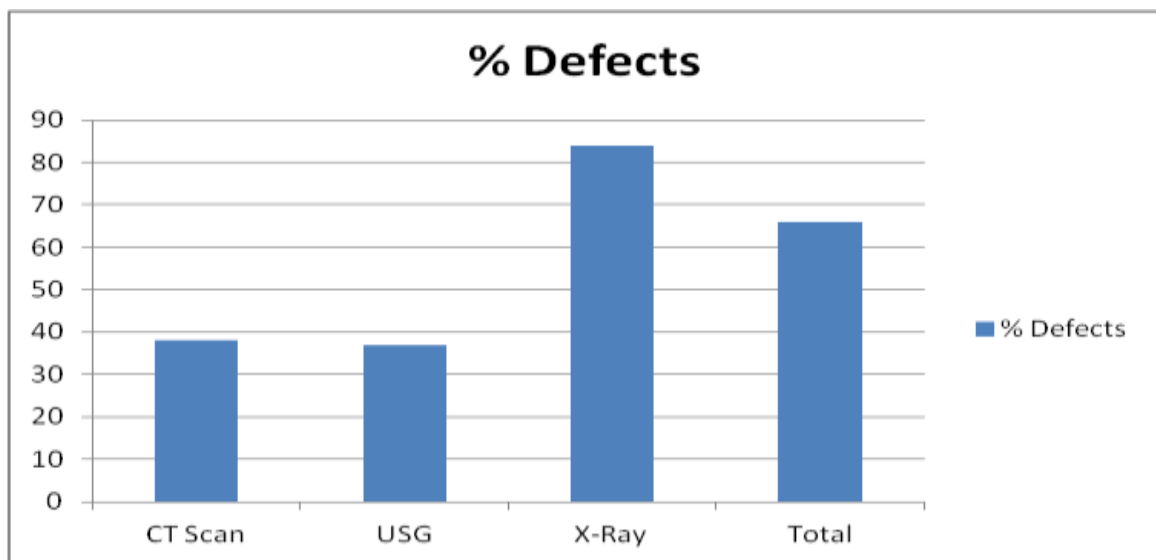


Table No.23: Showing Six sigma performances level as per policy followed at Metro MAS Hospital, Jaipur

Category	DPMO	Sigma level
CT Scan(OP)	100000	Between 2-3
CT Scan(IP)	158415	Between 2-3
USG(OP)	103839	Between 2-3
USG(IP)	128491	Between 2-3
X-Ray(OP)	7978	Between 3-4
X-Ray(IP)	257973	Between 2-3

Performance of X-Ray OP cases is good with sigma level between 3-4.

Table No.24: Overall Performance of Radiology Department as per policy followed at Metro MAS Hospital, Jaipur

Category	Units	Defects	No. of Opportunity	DPMO	Sigma level
CT Scan	161	44	2	136645	Between 2-3
USG	931	211	2	113319	Between 2-3
X-Ray	1630	559	2	171472	Between 2-3
Total	2722	814	2	149522	Between 2-3

Table No.25: Showing Six sigma performance in terms of DPMO

Level of Sigma	DPMO
2	308537
3	66807
4	6210
5	233
6	34

- Overall performance shows that Radiology Department is working between 2-3 sigma level.
- 27% cases in CT scan, 23% cases in USG & 34% cases in X-Ray do not meet customer's expectations.
- 30% cases in Hospital did not meet the customers expectations.

Graph No.3: Showing percentage defects in CT scan, USG & X-Ray cases.

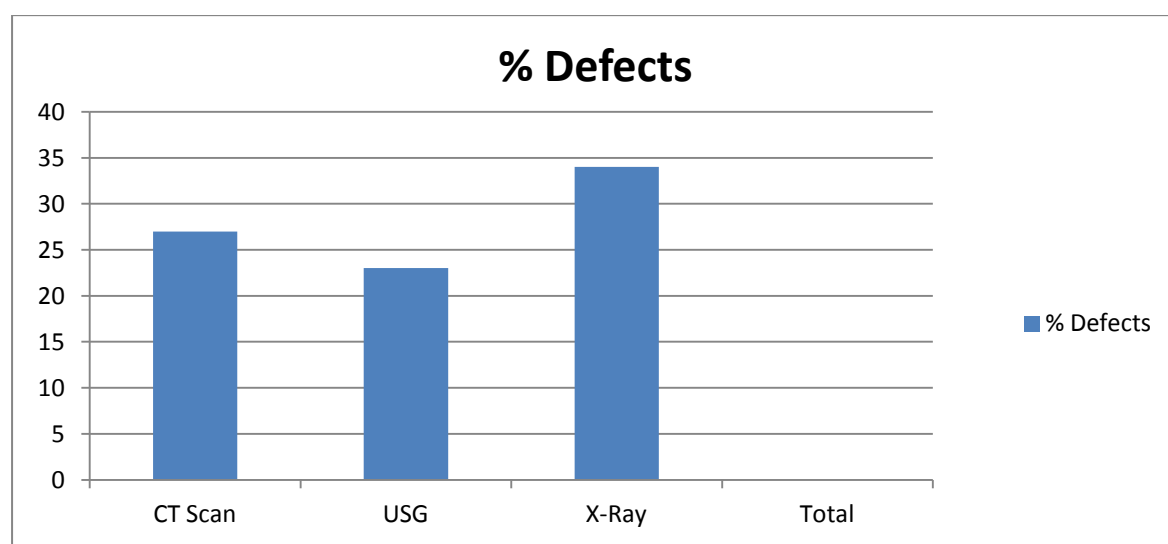


Table No.26: Six sigma performance comparisons between the cases following SOP for TAT & cases following the policy for TAT maintained at Metro MAS Hospital, Jaipur.

Category	Sigma level for SOP for TAT	Sigma level for policy at METRO MAS unit
CT Scan	Between 2-3	Between 2-3
USG	Between 2-3	Between 2-3
X-Ray	Between 1-2	Between 2-3
Total	Between 1-2	Between 2-3

Performance as per SOP for TAT is poor compared to the policy which is followed at METRO MAS Hospital, Jaipur.

After doing the process analysis, fishbone analysis & data analysis is following independent variables were identified determining the CTQ (higher TAT) behaviour.

Table No.27: Showing Independent variables determining higher TAT

Sr. No.	Variables
1	Patient investigation detail's entry on time.
2	Standardized time protocol for sending films back to radiology department.
3	Policy followed at hospital v/s SOP for TAT.
4	Policy for category of patients coming from emergency.
5	Incomplete requisition slips to radiology from the wards.
6	Shortage of transcriptionist & H.K. staff
7	Randomized recording of TAT details.
8	Policy for making corrections in requisition.

4.4 Improvement Phase

Recommendations:

- According to a new policy, all IP investigations would be done only after the entry of patient details is made.
- All films which go towards/patient rooms should be sent back to radiology according to a specific time frame. Films which go in evening & night should be returned back in morning soon after the consultant rounds (11:30am-12:30pm) & films of the day time should come back after the rounds by evening (3:30pm-4:30pm).
- Nursing staff need not to wait for deletion of the older entry by revenue department. They can directly put a fresh entry into RIS so that transcriptionist does not have to wait long for the report making.
- Patient who comes from emergency will be considered as an Outpatient. Accordingly billing will be done at the counter & timely report will be dispatched. In case patient gets admitted then the nursing staff will ensure that repeat entry is not done in RIS for the investigations.

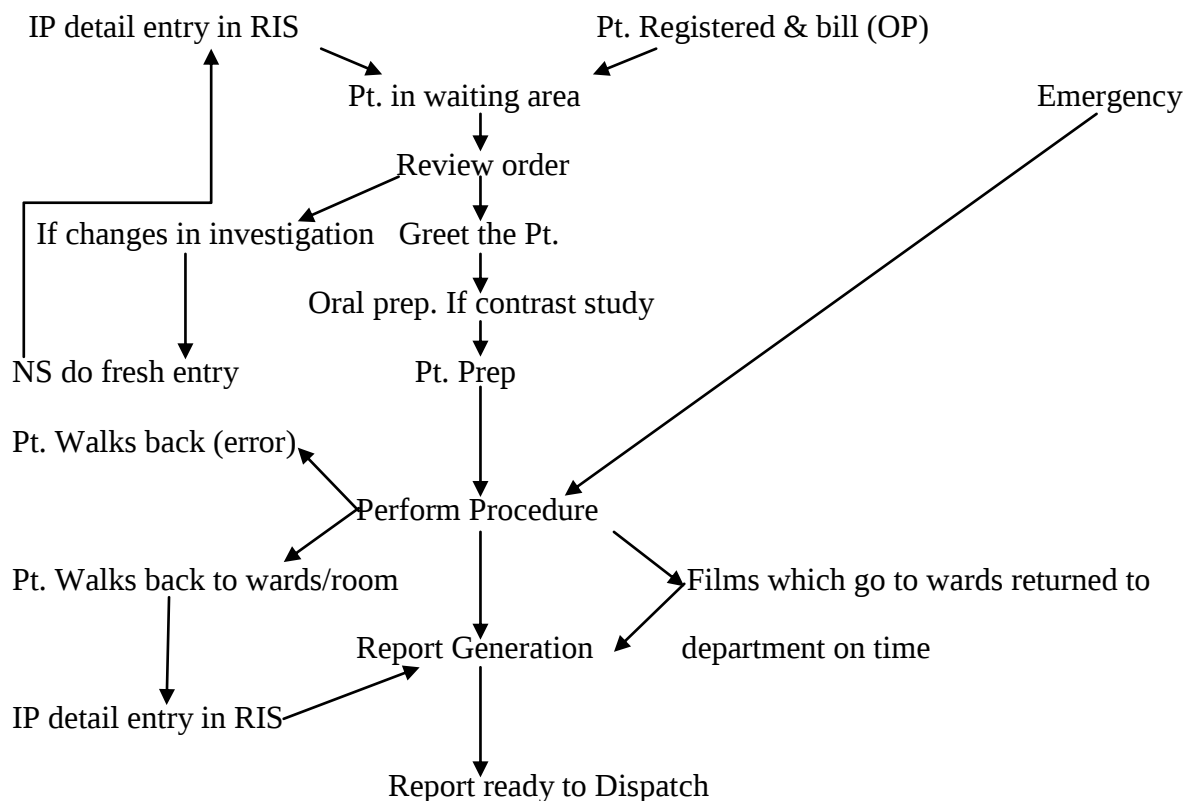
- Complete IP midnight census will be prepared on daily basis by the nursing staff and will be hand over to radiology department in the morning.
- Medical officers on duty will ensure that requisition slip for investigation of patients will be completely filled before coming to radiology.
- To change the policy for report dispatch as per the requirement of SOP for TAT.
- Keeping in view that patient load is more in morning hours, an additional transcriptionist to be appointed in the reporting room.
- Training to be given to nursing & technician staff in radiology department about the guidelines of SOP for TAT, also how to calculate it accurately.

Possible Improvements done:

- Complete IP midnight census preparation has been started by a staff (Emergency-team leader on duty).
- A new policy has been formulated for report dispatch as per the requirement of SOP for TAT.
- An additional transcriptionist has been appointed at reporting room (9:00am-4:00pm).
- Proper education of the technicians & nursing staff has done about the SOP for TAT. After the education, staff members have started recording the TAT details accurately.
- After the strict instructions to the nursing in charges, staff has started entering IP investigations details of all patients in RIS before the test is getting done.
- As per the previous policy, radiology films which are sent to wards/ patient rooms are returning back to radiology department on daily basis. Evening-night investigation films between 11:30am-12:30pm (next day) & morning-afternoon films by 3:30pm-4:30pm. Strict monitoring is being carried out by the nursing in charges.
- Nursing staff need not to wait for deletion of the older entry by revenue department. They can directly put a fresh entry into RIS so that transcriptionist does not have to wait long for the report making.
- Patient who comes from emergency will be considered as an Outpatient. Accordingly billing will be done at the counter & timely report will be dispatched. In case patient gets admitted then the nursing staff will ensure that repeat entry is not done in RIS for the investigations.
- Medical officers on duty will ensure that requisition slip for investigation of patients will be completely filled before coming to radiology.

Process Redesigning:

After doing the necessary improvements, a new process map was designed.



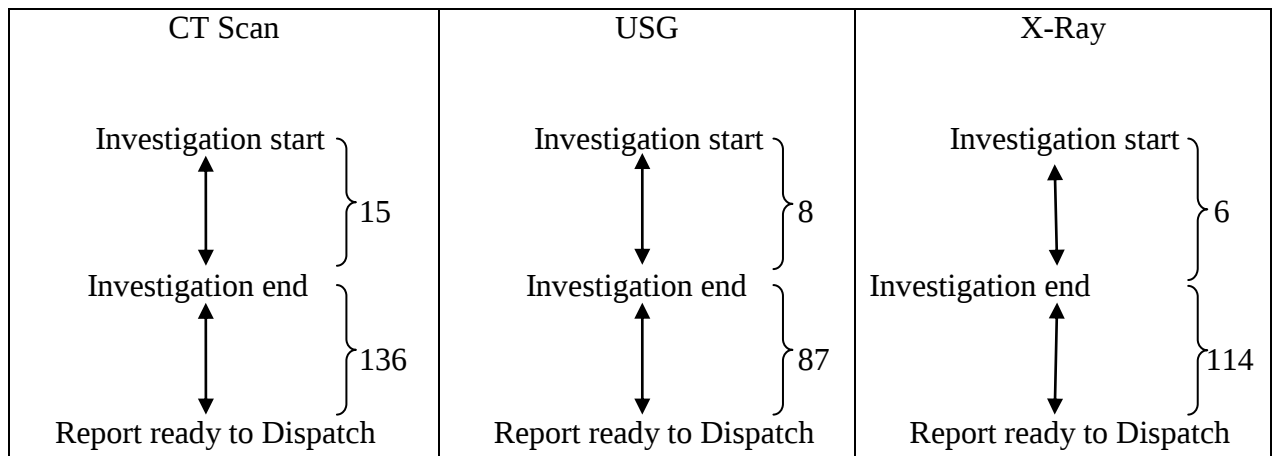
Data measurement after Improvements:

After implementing some of the possible solutions & redesigning the process flow, a fresh set of data was collected for 7 days for 3 different investigations (CT Scan-37 cases, USG-180 cases & X-Ray-320 cases). Analysis of the new process showed that average turnaround time for various investigations calculated was as follows:

Table No.28: Showing Average TAT for CT scan, USG & X-Ray

Investigation	CT Scan	USG	X-Ray
Calculated Av. TAT	2.55 hrs	1.58 hrs	2 hrs

A data timeline (in minutes) is given below:



A. CT Scan

Table No.29: CT scan showing average TAT

Category	Size	Mean TAT(hrs)
OP	16	1.6
IP	21	3.31
Total	37	1.73

Mean TAT is still on a higher side than median value.

Table No.30: Showing TAT Ranges for OP and IP cases of CT Scan

Ranges in hours for Av. TAT	OP cases	OP Av. TAT	IP cases	IP Av. TAT
0-1	0	1.6 hrs	0	3.31 hrs
1-2	13		11	
2-3	3		7	
3-4	0		0	
4-5	0		0	
5-6	0		0	
6-7	0		0	
7-8	0		0	
8-9	0		0	
9-10	0		0	
10-15	0		3	

OP cases show a range of 1-2 hrs while IP cases are on higher side with a range of 3-4 hrs.

DPMO (Defects Per Million Opportunity)

- $DPMO = (1,000,000 * \text{No. Of Defects}) / (\text{No. Of Units} * \text{No. Of opportunity})$

Table No.31: Showing DPMO for CT Scan as per SOP

Category	Units	Defects	No. Of Opportunity	DPMO
CT Scan(OP)	16	3	2	93750
CT Scan(IP)	21	10	2	238095
Total	37	13	2	175675

- Defects indicate the number of patients who failed to follow the SOP for TAT.13 of 37 cases show a defect of 35%.

B. Ultrasound

Table No. 32: USG showing average TAT

Category	Size	Mean TAT(hrs)
OP	118	1.4
IP	62	1.95
Total	180	1.58

Table No.33: Showing TAT Ranges for OP and IP cases of USG

Ranges in hours for Av. TAT	OP cases	OP Av. TAT	IP cases	IP Av. TAT
0-1	0	1.6 hrs	0	3.31 hrs
1-2	113		32	
2-3	5		20	
3-4	0		0	
4-5	0		0	
5-6	0		0	
6-7	0		0	
7-8	0		0	
8-9	0		0	
9-10	0		0	
10-15	0		10	

OP cases show a range of 1-2 hrs while IP cases show a higher range of 3-4 hrs.

DPMO (Defects Per Million Opportunity)

- $DPMO = (1,000,000 * \text{No. Of Defects}) / \text{No. Of Units} * \text{No. Of opportunity}$

Table No.34: Showing DPMO for USG as per SOP

Category	Units	Defects	No. Of Opportunity	DPMO
USG(OP)	118	7	2	29661
USG(IP)	62	14	2	112903
Total	180	21	2	58333

Defects indicate the number of patients who failed to follow the SOP for TAT. 21 of 180 cases show a defect of 12%.

C. X-Ray

Table No. 35: X-Ray showing average TAT

Category	Size	Mean TAT(hrs)
OP	125	1.3
IP	195	2.41
Total	320	2

Table No.36: Showing TAT Ranges for OP and IP cases of X-Ray

Ranges in hours for Av. TAT	OP cases	OP Av. TAT	IP cases	IP Av. TAT
0-1	24	1.3 hrs	67	2.41 hrs
1-2	91		75	
2-3	10		5	
3-4	0		14	
4-5	0		5	
5-6	0		5	
6-7	0		0	
7-8	0		17	
8-9	0		0	
9-10	0		2	
10-15	0		5	

OP cases show a range of 1-2 hrs while IP cases show a higher range of 2-3 hrs.

DPMO (Defects Per Million Opportunity)

- $DPMO = (1,000,000 * \text{No. Of Defects}) / \text{No. Of Units} * \text{No. Of opportunity}$

Table No.37: Showing DPMO for X-Ray as per SOP

Category	Units	Defects	No. Of Opportunity	DPMO
X-Ray(OP)	125	101	2	404000
X-Ray(IP)	195	53	2	135897
Total	320	154	2	240625

Defects indicate the number of patients who failed to follow the SOP for TAT. 154 of 320 cases show a defect of 48%.

Table No.38: Showing Performance after Improvements

Type	CT Scan		USG		X-Ray	
Category	OP	IP	OP	IP	OP	IP
SOP for TAT	2 hrs	3 hrs	2 hrs	2 hrs	1 hr	2 hrs
Actual TAT	1.6 hrs	3.31 hrs	1.4 hrs	1.95 hrs	1.3 hrs	2.41 hrs
% Hike	NA	10.3	NA	NA	30	20.5

Results after improvement are remarkable with CT Scan OP, USG OP & IP and X-Ray show average turnaround within SOP limit.

Table No.39: Showing Six sigma performance level

Category	Units	Defects	No. of Opportunity	DPMO	Sigma level
CT Scan	37	13	2	175675	Between 2-3
USG	180	21	2	58333	Between 3-4
X-Ray	320	154	2	240625	Between 2-3
Total	537	188	2	175046	Between 2-3

A total of 188 out of 537 cases, 35% defects are seen with sigma level performance in the range of 2-3.

Table No.40: Showing Six sigma level performance in terms of DPMO

Level of Sigma	DPMO
2	308537
3	66807
4	6210
5	233
6	34

- Overall performance shows that now Radiology Department is working between 2-3 sigma level.
- 35% cases in CT Scan, 12% cases in USG & 48% cases in X-Ray do not meet customer's expectations.
- 35% cases in Hospital did not meet the customer's expectations.

Table No.41: Comparative Analysis of performance before and after improvements

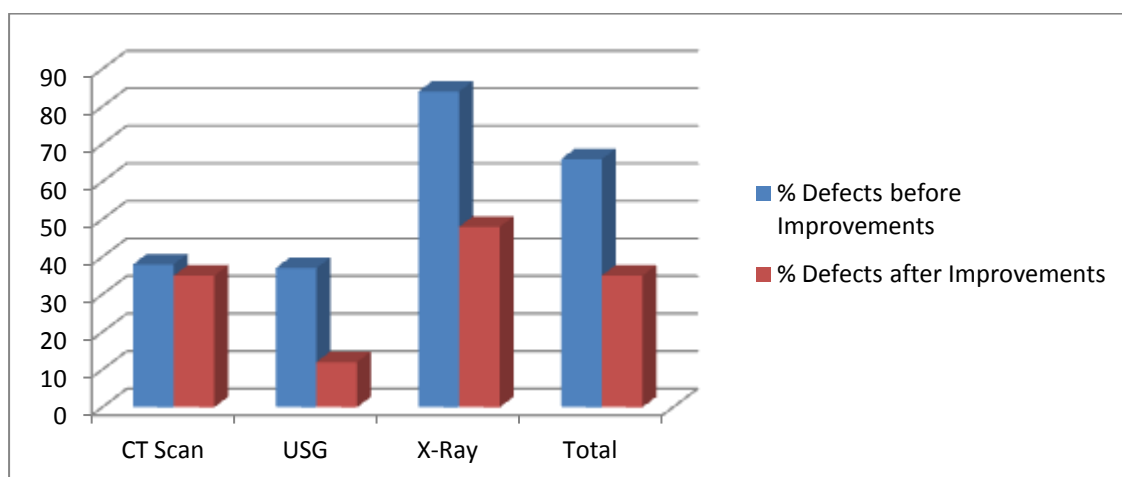
Type	CT Scan		USG		X-Ray	
Category	OP	IP	OP	IP	OP	IP
SOP for TAT	2 hrs	3 hrs	2 hrs	2 hrs	1 hr	2 hrs
TAT before improvement	2.73 hrs	3.43 hrs	2.28 hrs	3.27 hrs	1.83 hrs	6.69 hrs
TAT after improvement	1.63 hrs	3.31 hrs	1.4 hrs	1.95 hrs	1.3 hrs	2.41 hrs

- Significant improvements are seen in case of CT scan (OP) & USG (OP& IP), as here the average TAT calculated is under the limit of SOP for TAT.

Table No.42: Comparative Analysis of performance before and after improvements in terms of defects.

Category	% Defects before Improvements	% Defects after Improvements	Sigma level before Improvements	Sigma level before Improvements
CT Scan	38	35	Between 2-3	Between 2-3
USG	37	12	Between 2-3	Between 3-4
X-Ray	84	48	Between 1-2	Between 2-3
Total	66	35	Between 1-2	Between 2-3

Graph No.4: Performance in terms of % Defects



- Though sigma level performance is almost same for CT scan, but the % defects level has reduced.
- Sigma level performance for USG & X-Ray shows significant improvement.

4.5 Control Phase

For ensuring sustainable results, changes were imbedded in departmental processes. Continuous monitoring would be done using control charts and it is expected that radiology turnaround time will continue to decrease as volume goes up.

4.6 Limitations:

- Hospital is unable to follow accurately the standard operating procedure for report turnaround time as the consultants are unavailable for their services during 2pm-4.30pm every day.
- Due to shortage of time, patient satisfaction analysis could not be done after the improvement phase of the project & also a fresh could be collected for 7 days after the improvement.
- Due to unavailability of a proper radiology information system, there is no proper appointment system available at the radiology counter which could actually help in measuring the patient waiting time for the investigation.

PART V. Conclusion:

The project on “**Implementing Six Sigma Methodologies for Quality Assurance in the Department of Radiology at Metro MAS Hospital, Jaipur**” was started around 3 months back. In the initial phase, the main problem statement was defined using voice of customers & internal department assessment. Later data was collected for 30 days & average TAT was collected for **CT Scan(OP: 2.73hrs, IP:3.43hrs),USG(OP:2.28hrs, IP:3.27hrs),X-Ray(OP:1.83hrs, IP:6.69hrs)** . In the analysis phase calculated TAT was compared with the SOP for TAT followed at Metro MAS Hospital, which showed TAT on a significantly higher side. As a result, overall process flow was analyzed & was modified as per the need in the improvement phase. A fresh data was again collected for 7 days which was compared with the data before improvements. The results were outstanding. Average TAT for all the investigations got reduced. **(CT scan OP: 1.6hrs from 2.73hrs, CT scan IP: 3.31hrs from 3.34hrs, USG OP: 1.4hrs from 2.28hrs, USG IP: 1.95hrs from 3.27hrs, X-Ray OP: 1.3hrs from 1.83hrs, X-Ray IP: 2.41hrs from 6.69hrs)**. In the control phase, continuous monitoring would be there for the various improvements done in order to have sustainability in the results.

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ANNEXURE

ANNEXURE 1:

Policy: Standard Operating Procedure for Radiology Turn Around Time

Metro MAS Hospital Radiology department shall provide all the routine/emergency tests reports within the defined time frame.

Radiology department has defined the turnaround time for all radiological tests.

TAT:

Starting point is the start of investigation and end time is when the report is ready for dispatch. In the exceptional situation TAT may be augmented.

This TAT is applicable for timing of 8:00am to 8:00pm. For emergency in night & holiday emergency TAT will be followed.

Table No.43:

Sr. No.	Investigation's Name	Turn Around Time			Remarks
		Routine Reports		Emergency Reports	
		OPD	IPD		This emergency report time will not be applicable for night investigations which are not emergency
1	Routine X-Ray	1 hr	2 hr	1 hr	
2	Sonography	2 hr	2 hr	1 hr	
3	CT Scan	2 hr	3 hr	1 hr	
4	Mammography	24 hrs			

ANNEXURE 2: Policy which was followed at Metro MAS Hospital, Jaipur before starting the project.

Table No.44:

OPD Pt.	X-Ray	USG	CT Scan	Mammography
9am-1pm	6pm	6pm	6pm	Mammography will be done between 9am-1pm on appointment basis & report will be dispatched by 1 pm next day.
1pm-4pm	1pm next day	1pm next day	1pm next day	
4pm-7pm	1pm next day	1pm next day	1pm next day	
7pm-9am	1pm next day	1pm next day	1pm next day	

- All indoor patients USG/CT provisional reports will be conveyed to concerned consultant/registrar ASAP after completion of study either telephonically or writing on file.
- Cases requiring review of previous reports or evaluation by other modality or review of literature may take more time and will be displaced as soon as possible.
- All critical reports will be conveyed to concerned consultant/registrar immediately telephonically after completion of study.

As this policy did not meet the requirements of standard operating procedure, it was changed to annexure no.3

ANNEXURE 3: Policy which did not meet the requirements of Standard Operating Procedure

Table No.45:

OPD Pt.	X-Ray	USG	CT Scan	Mammography
9am-11am	2pm	2pm	2pm	Mammography will be done between 9am-1pm on appointment basis & report will be dispatched by 1pm next day.
11am-5pm	7:30pm	7:30pm	7:30pm	
5pm-9am	12pm next day	12pm next day	12pm next day	

- All indoor patients USG/CT provisional reports will be conveyed to concerned consultant/registrar ASAP after completion of study either telephonically or writing on file.
- Cases requiring review of previous reports or evaluation by other modality or review of literature may take more time and will be displaced as soon as possible.
- All critical reports will be conveyed to concerned consultant/registrar immediately telephonically after completion of study.

ANNEXURE 4:

FEEDBACK FORM

This feedback form is designed specifically for patients coming to radiology department at Metro MAS Hospital, Jaipur. The purpose of the survey is to analyze the satisfaction level of patients. Your specific answers, in combination with those of others are extremely important to us. So please take a few minutes to complete this feedback form.

Patient Name:

Phone No. :

Sr. No. :

Tick the answer you find most appropriate.

E-Excellent;	G-Good;	A-Average;	P-Poor	E	G	A	P
1. What is your opinion about the waiting time before the procedure to be done?							
2. Give your opinion about the competence level of doctors and staff.							
3. Give your opinion about the quality of housekeeping services.							
4. How do you grade the report availability on time?							
5. Give your opinion about the communication skills of staff members.							
6. Give your opinion about the courtesy of staff members.							
7. Give your opinion about the billing services.							

Suggestions

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ANNEXURE 5: TAT (CT scan)

Patient Name	Scan date	Scan start time	Report received date	Report received time	TAT
Mr. Ratan Sharma	11/2/15	9:43	11/2/15	1:50	4:07
Mr.Girdhar	11/2/15	9:51	11/2/15	2:00	4:09
Mrs. Sunita Devi	11/2/15	10:35	11/2/15	4:37	6:32
Baby Pooja	11/2/15	11:18	11/2/15	4:52	5:34
Mr. Chetan Prakash	11/2/15	11:43	11/2/15	1:55	2:12
Mr. Vivek Khandelwal	11/2/15	3:17	12/2/15	5:07	1:50
Master Mayank	11/2/15	8:04	12/2/15	9:07	11:03
Mr. Govardhan Lal	12/2/15	9:59	12/2/15	12:00	2:01
Mr. Ravi Singh	12/2/15	10:37	12/2/15	2:00	3:23
Mr. Kanhiya Lal	12/2/15	11:27	12/2/15	4:07	4:40
Mrs. Anita Kanwar	12/2/15	11:33	12/2/15	4:58	5:25
Ms. Usha Gupta	12/2/15	1:14	12/2/15	5:13	3:59
Mr. Girdhari Lal	12/2/15	9:10	13/2/15	9:24	12:14
Mr. Arjun Das	14/2/15	10:23	14/2/15	1:05	2:42
Mrs. Satwant Kaur	14/2/15	10:42	14/2/15	1:25	2:43
Mr. Lokesh Saini	14/2/15	11:07	14/2/15	1:20	2:13
Mr. Ganesh Sharma	14/2/15	11:09	14/2/15	5:13	6:04
Mr. Devi Lal	14/2/15	11:07	14/2/15	2:03	2:56
Mr. Murlidhar Sharma	14/2/15	4:17	14/2/15	5:58	1:41
Mr. Satan Lal Meena	14/2/15	4:21	14/2/15	6:03	1:42
Mrs. Vidhya Devi	15/2/15	2:00	15/2/15	9:37	7:37
Mr. Sparsh Agarwal	16/2/15	9:10	16/2/15	11:17	2:07
Mr. Mool Chand	16/2/15	9:53	16/2/15	12:04	2:11
Mr. Vivid Sharma	16/2/15	10:37	16/2/15	1:07	2:30
Mr. Gopi Lal	16/2/15	1:39	16/2/15	4:56	3:17

ANNEXURE 6: TAT (USG)

Patient Name	Scan date	Scan start time	Report received date	Report received time	TAT
Mrs. Anita Devi Khandelwal	11/2/15	9:13	11/2/15	10:15	1:02
Mr. Kailash Chand Jindal	11/2/15	9:20	11/2/15	10:25	1:05
Mr. Dinesh Kumar Gupta	11/2/15	9:27	11/2/15	10:54	1:27
Mr. Hans Raj Meena	11/2/15	9:35	11/2/15	11:04	1:29
Mr. Gulab Chand Mongal	11/2/15	9:46	11/2/15	11:04	1:18
Master Harshit Jain	11/2/15	9:58	11/2/15	11:09	1:11
Mrs. Fatima Qureshi	11/2/15	10:07	11/2/15	11:19	1:12
Mrs. Jyoti Sharma	11/2/15	10:16	11/2/15	12:02	1:44
Mrs. Savitri Devi	11/2/15	10:31	11/2/15	12:54	2:23
Ms. Naina Jain	11/2/15	10:44	11/2/15	12:54	2:10
Mr. Hari Narayan	11/2/15	10:53	11/2/15	12:59	2:06
Mrs. Geeta Sharma	11/2/15	11:02	11/2/15	1:30	2:28
Mrs. Saroj Bansal	11/2/15	11:20	11/2/15	1:30	2:10
Baby Navya	11/2/15	11:28	11/2/15	1:35	2:07
Mr. Shashi Harpavat	11/2/15	11:37	11/2/15	1:45	2:08
Mr. Sulabh Agarwal	11/2/15	11:49	11/2/15	1:59	2:10
Mr. Manish Bhardwaj	11/2/15	12:01	11/2/15	4:05	4:04
Baby Joyana	11/2/15	12:13	11/2/15	4:07	3:54
Mrs. Raj Kumari	11/2/15	12:21	11/2/15	4:07	3:46
Mrs. Vandana Sharma	11/2/15	12:35	11/2/15	4:07	3:32
Mr. Brij Mohan	11/2/15	12:46	11/2/15	4:50	4:04
Baby Avi Saxena	11/2/15	12:59	11/2/15	4:50	3:51
Mr. Kailash Chand	11/2/15	1:13	11/2/15	5:02	3:49
Master Krish	11/2/15	1:22	11/2/15	5:08	3:46
Mr. Deepak Meena	11/2/15	1:36	11/2/15	5:10	3:34

ANNEXURE 7: TAT (X-Ray)

Patient Name	Scan date	Scan start time	Report received date	Report received time	TAT
Mr. Pukhraj Shah	11/2/15	9:13	11/2/15	1:37	4:24
Mrs. Evadeep Saxena	11/2/15	9:20	11/2/15	1:37	4:17
Mr. Kishan Chand Basandani	11/2/15	9:27	11/2/15	1:37	4:10
Mrs. Sumanlata Choudhary	11/2/15	9:35	11/2/15	1:37	4:02
Mr. Jagdish Bonsai	11/2/15	9:46	11/2/15	1:37	3:51
Mr. Tej karan Jain	11/2/15	9:58	12/2/15	9:37	11:39
Ms. Naina Jain	11/2/15	10:07	11/2/15	1:37	3:30
Mr. Chetan Prakash	11/2/15	10:16	11/2/15	1:37	3:21
Mr. Sandeep Jain	11/2/15	10:31	11/2/15	1:37	3:06
Mrs. Kalpana Sharma	11/2/15	10:44	11/2/15	1:37	2:53
Mr. Sunil Kumar	11/2/15	10:53	11/2/15	1:37	2:43
Mrs. Asha Rani Gupta	11/2/15	11:02	11/2/15	4:05	5:03
Mrs. Heera Devi	11/2/15	11:20	11/2/15	4:05	4:45
Mr. Jitesh Nama	11/2/15	11:28	11/2/15	4:05	4:37
Mrs. Patasi Devi	11/2/15	11:37	11/2/15	4:05	4:28
Mr. Ghure Lal Sharma	11/2/15	11:49	11/2/15	4:05	4:16
Mr. Brij Mohan	11/2/15	12:01	11/2/15	4:53	4:52
Mrs. Sushma Saxena	11/2/15	12:13	11/2/15	4:53	4:40
Mr. Chetan Agarwal	11/2/15	12:21	11/2/15	4:53	4:32
Mrs. Ganga Lahari	11/2/15	12:35	11/2/15	4:53	4:18
Mrs. Vidhya Devi	11/2/15	12:46	11/2/15	4:53	4:07
Mrs. Manju Goyal	11/2/15	12:59	11/2/15	4:53	3:54
Mrs. Rubina Khan	11/2/15	1:13	12/2/15	9:19	8:06
Master Devensh Garg	11/2/15	1:22	11/2/15	4:53	3:31
Mrs. Rajeshwari Bansal	11/2/15	1:36	11/2/15	5:01	3:25

