Lean Six Sigma Implementation in Radiology

By

Neha Raisane

Dissertation submitted for the partial fulfillment of the

MBA Hospital and Health Management

Academic year, 2014-2016

The IIHMR University, Jaipur

1, Prabhu Dayal Marg, Sanganer Airport
Jaipur-302029, Rajasthan
Ph: 0141 3924700, Fax: 3924738
Website: www.iihmr.edu.in

INSTITUTE OF HEALTH
MANAGEMENT RESEARCH
(WHO Collaborating Centre for District Health System Based on Primary Health Care)

IIHMR UNIVERSITY

TO WHOMSOEVER MAY CONCERN

This is to certify that **Neha Raisane student** of MBA Hospital and Health Management from The IIHMR University, Jaipur has undergone internship training at Narayana Multispecialty Hospital, Ahmedabad from February 8th 2016 to May 8th 2016.

The Candidate has successfully carried out the study designated to him during internship training and his approach to the study has been sincere, scientific and analytical.
The Internship is in fulfillment of the course requirements.
I wish him all success in all future endeavors.

Dr. Ashok Kaushik
Dean, Academics and Student Affairs
The IIHMR University, Jaipur

Neetu Purohit
Associate Professor
The IIHMR University, Jaipur

1, Prabhu Dayal Marg, Near Sanganer Airport, Jaipur - 302029, Rajasthan, India.
Ph.: 0141 - 3924700, 2791431 - 32, Fax: 0141 - 3924738, E-mail: iihmr@iihmr.edu.in, Web.: www.iihmr.edu.in

NH Narayana™
Multispeciality Hospital
Unit of Narayana Health

CERTIFICATE

To Whom So Ever It May Concern

This is to certify that Dr. Neha Raisane, a student of MBA hospital management at IIHMR Jaipur has carried out project report on **"Implementing Lean Six sigma in Radiology department" of Narayana Multispecialty Hospital, Ahmedabad** at Narayana Multispecialty Hospital Ahmedabad.

This project work has been prepared by the student and this work has not been presented earlier for any other academic activity.

I wish them all success in life and bright future ahead.

Dr (Maj) Akshaya Kiledar

Clinical Director

Narayana Multispecialty Hospital, Ahmedabad

NH Helpline 079-7122 2222

Narayana Hrudayalaya Limited
(Previously Narayana Hrudayalaya Pvt. Ltd.) CIN: L85110KA2000PLC027497
Opp. Police Station, Rakhial Cross Road, Ahmedabad 380023
Fax:+91 79 71222 687. info.ahd@nhhospitals.org, www.narayanahealth.org
Registered Office: 258/A, Bommasandra Industrial Area, Anekal Taluk, Bangalore 560099
Corporate Office: 261/A, 2nd Floor, Bommasandra Industrial Area, Anekal Taluk, Bangalore 560099

THE IIHMR UNIVERSITY, JAIPUR

CERTIFICATE BY SCHOLAR

This is to certify that the dissertation titled "**A Study on Lean Six Sigma Implementation in Radiology department of Narayana Multispecialty Hospital, Ahmedabad**"and submitted by Dr. Neha Raisane Enrollment No.IIHMR-U/01/2014-16/0178 under the supervision of Associate Professor Neetu Purohit for award of MBA in Hospital and Health of the University carried out during the period from February 15,2016 to April 30,2016 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.

Raisane

Signature

PREFACE

Dissertation is an integral part of MBA-HM curriculum. As a part of the course, the students of second year are required to undergo dissertation at any reputed organization to get in depth exposure to various departments of the organization and understanding of health care delivery system and its functions.

The major objectives of the dissertation are as follows:

1. To understand and learn day to day operational management of a Hospital/ Health Care organization and its service contents.
2. To identify issues/problems with certain operational areas.
3. To acquire more knowledge on roles and responsibilities of key players and stakeholders in the hospital.
4. To gain perspective in the functions of various departments by interaction with key stakeholders, policy makers, academicians and researchers.
5. To work on a Project assigned by the dissertation organisation.

During the dissertation, I had an overview of several departments of the hospital and the project which I worked upon is:

1. Lean Six Sigma in Radiology

ACKNOWLEDGEMENTS

I extend my sincere gratitude to **Dr. Akshay Kiledar, Clinical** Director, for giving me the opportunity to do my internship and undergo the process of learning at Narayana Multispecialty Hospital, Ahmedabad. I appreciate the guidance provided by him on my projects.

I am also very grateful to all the staff of the hospital for their cooperation and providing me with the necessary information for my learning and projects.

I would take this opportunity to extend my sincere thanks to **Dr. S.D. GUPTA,** Director, IIHMR University, Jaipur and **Neetu Purohit** (Faculty and Mentor), IIHMR University, Jaipur for their valuable contribution and support.

However, I accept the sole responsibility for my possible error of omission and would be extremely grateful to the readers of this project report if they bring such mistakes to my notice.

Date: 9 May 2016

Dr. Neha Raisane

IIHMR University, Jaipur

LIST OF FIGURES

LIST OF APPENDICES

ABBREVIATIONS

- AERB: Atomic Energy Research Board
- BARC: Bhabha Atomic Research Centre
- CSSD: Central Sterilisation & Supply Department
- CT: Computed Tomography
- EBM: Evidence Based Medicine
- ECG: Electro Cardio Gram
- ECHO: Echocardiography
- ED- Emergency Department
- ER-Emergency Room
- GM: General Manager
- GI: Gastro Intestinal
- HOD: Head Of the Department
- HR: Human Resource
- ICU: Intensive Care Unit
- IP: In-patient
- IPD: In-patient Department
- IV: Intravenous
- MOU: Memorandum Of Understanding
- MRI: Magnetic Resonance Imaging
- MS: Medical Superintendent
- NABH: National Accreditation Board For Hospital and Healthcare service providers
- NICU: Neonatal Intensive Care Unit
- NS: Nursing Superintendent
- OP: Out-patient
- OPD: Out-patient Department
- TRF: Test Requisition Form
- USG: Ultra Sonography
- WHO-World Health Organisation

I.INTRODUCTION:

Radiology is a medical specialty that uses imaging to diagnose and treat diseases seen within the body.

Radiology represents a branch of medicine that deals with radiant energy in the diagnosis and treatment of diseases. This field can be divided into two broad areas – diagnostic radiology and interventional radiology. A physician who specializes in radiology is called radiologist.

In Diagnostic radiology a variety of imaging techniques such as X- Ray, Ultrasound, Computed tomography, Magnetic resonance Imaging (MRI) are used to diagnose or treat diseases.

Interventional radiology is the performance of (usually minimally invasive) medical procedures with the guidance of imaging technologies.

Medical imaging and interventional radiology have sustained dramatic changes in the last few years, mainly as a result of technological breakthroughs, the rise in workload, a deficit in the workforce and globalisation. Consequently there is an expanding concern about standards of care, maintaining patient safety and the management of risk in radiology.

Lean is an organizational redesign approach that is increasingly being used in health care. The term "Lean Production" was coined by an MIT research team studying leading automotive manufacturers around the world. At its core, Lean focuses on the elimination of waste, with waste defined as any activity that consumes resources (staff, time, money, space) without adding value to those being served by the process. Lean can be implemented in many ways. The world's leading example of Lean production is the Toyota Production System (TPS). Toyota, more than any other company in any industry, has established both the cultural and operational elements required to continuously drive waste out of its production processes. Some argue that Lean's focus on processes makes it especially appropriate for solving complex health care issues. Others argue that Lean's use in manufacturing as opposed to a service industry, and its focus on standardization and defining value from the customer perspective, renders it inappropriate for health care because patients have unique needs, and there are multiple customers (e.g., employers, insurers, patients).

II.Review of Literature

Lean is gaining steam in the healthcare and imaging world. Lean is known from its start with Toyota around the 1970s. Though they didn't use the term lean then, the Japanese manufacturer started delivering cars that were cheaper and higher quality than its American counterparts.

While any facility can gain from using lean techniques, some experts feel that the hospitals and executives most enthusiastic about using them are those pushed to the financial breaking point. Lean is a big change, and those who are in a better place financially may not be willing to take the risk.

Radiology is a good fit for the lean tools and approach, said Jonathan B. Kruskal, MD, PhD, radiology professor at Harvard Medical School and chair of the radiology department at Beth Israel Deaconess Medical Centre, given imaging's many different complex processes (2014 Newsletter SCBT- MR)

The opportunities for lean to improve the radiology workplace are endless. Radiology inefficiencies might include time transporting equipment or patients, wait time, scanning inefficiency, excess image acquisition, excess radiation dose, inventories of radioactive isotopes that expire and fumbled processing of images.

Another advantage to using lean principles is standardizing approaches to care. "When it comes to physicians' work, 80 percent is routine. They can do it almost without thinking," said Andrew Gomes, MD, chief executive officer at the lean consulting firm Casper Radiology.

One lean success at Gould was moving the nursing work out of the CT suite, saving five minutes of cycle time per scan. They now schedule 40 scans in the same time they previously slotted 25. They reduced their cost per MRI, CT and ultrasound by an average of 40 percent, plus are making patient-focused decisions based on data. They're working better as a team and less as a silo, said Edge (February 4, 2014)

Jens Karstoft and Lene Tarp have the following outcomes of working with Lean - decreasing waiting time for the patients, optimised workflow during the examinations, and an increased number of patients processed during a working day with only a marginal increase in costs, a higher productivity and more time gained for the staff for education, etc. In addition to the higher productivity, one of the benefits were- Instead

of doing things the way the employees used to, day after day, they started thinking of alternatives, showing more interest and giving thought to how they work(March 2011).

Lean thinking is not typically associated with health care, where waste — of time, money, supplies, and good will — is a common problem. The principles of lean management can, in fact, work in health care in much the same way they do in other industries. This paper presents a brief overview of lean management principles, and provides examples of two health care organizations that are successfully using lean thinking to streamline processes, reduce cost, and improve quality and timely delivery of products and services. Lean thinking is not a manufacturing tactic or a cost-reduction program, but a management strategy that is applicable to all organizations because it has to do with improving processes. All organizations — including health care organizations — are composed of a series of processes, or sets of actions intended to create value for those who use or depend on them (customers/patients). The core idea of lean involves determining the value of any given process by distinguishing value added steps from non-value-added steps, and eliminating waste (or muda in Japanese) so that ultimately every step adds value to the process. To maximize value and eliminate waste, leaders in health care, as in other organizations, must evaluate processes by accurately specifying the value desired by the user; identifying every step in the process (or "value stream," in the language of lean) and eliminating non-value-added steps; and making value flow from beginning to end based on the pull — the expressed needs — of the customer/patient. When applied rigorously and throughout an entire organization, lean principles can have a dramatic affect on productivity, cost, and quality.

Virginia Mason Medical Centre in Seattle, Washington, has been using lean management principles since 2002. By working to eliminate waste, Virginia Mason created more capacity in existing programs and practices so that planned expansions were scrapped, saving significant capital expenses: $1 million for an additional hyperbaric chamber that was no longer needed; $1 to $3 million for endoscopy suites that no longer needed to be relocated; $6 million for new surgery suites that were no longer necessary.

III. Rationale

Radiology department in Narayana multispecialty hospital Ahmedabad was in a dreadful condition. In one week, there were about 6-7 complaints regarding issues in radiology department Radiology department is a high revenue generating department if it functions properly and patient satisfaction is also very high if high quality services are provided. Lean six sigma increases patient satisfaction as well as reduces errors by improving the processes. So, this study was done to improve the processes in radiology.

V.Research Question

What are the problems in radiology department and find the solutions to close the gaps between ideal and current state by implementing lean tools.

V. AIM

The aim of this study is to identify the gaps between current state and ideal state and detailed analysis of the major problem with the help of lean tools.

VI. Objectives

- To identify the gaps between the current state and ideal state as per the internal benchmarks set by the organisation.
- To suggest the solutions for the problems and implement it.

VI. Methodology

- Research design- Descriptive, Observational research design
- Study time line- Two and half months
- Area of Study- Narayana Health, Ahmedabad
- Study Population - Patients who have availed the radiology facilities
- Sample size – It depends on the tool used
- Sampling technique-Non-probability, Purposive Sampling
- Data collection- Primary data would be gathered by observing the patients from the registration counter to the radiology department till they get their reports and leave the department.

VII.Data Analysis and Results:

Many lean tools are available for creating and sustaining a lean process. In addition to seven basic quality control tools, there are more advanced lean tools that may be used for specific purposes- to collect data, describe the current situation, outline countermeasures and manage the process.

- Data Analysis- It can be done through applying lean tools like Gemba (visiting the workplace),Kaizen(In Japanese which means continuous improvement),DMAIC (Define,Measure,Analyze,Improve and Control)
- Software used for analysis- MS Excel
- Plan of execution-

  Visit the radiology department and observe all the processes .List all the problems according to their priority (This was done by Gemba tool)

  For major problems like longer reporting time and IPD billing errors data is collected and detailed analysis done using MS Excel to calculate the Turnaround time taken for radiology. After calculating the turnaround time, DMAIC is done to improve the process and find the solutions to improve the reporting time..Kaizen was done to reduce the IPD billing errors.

  Gemba – To identify all the problems

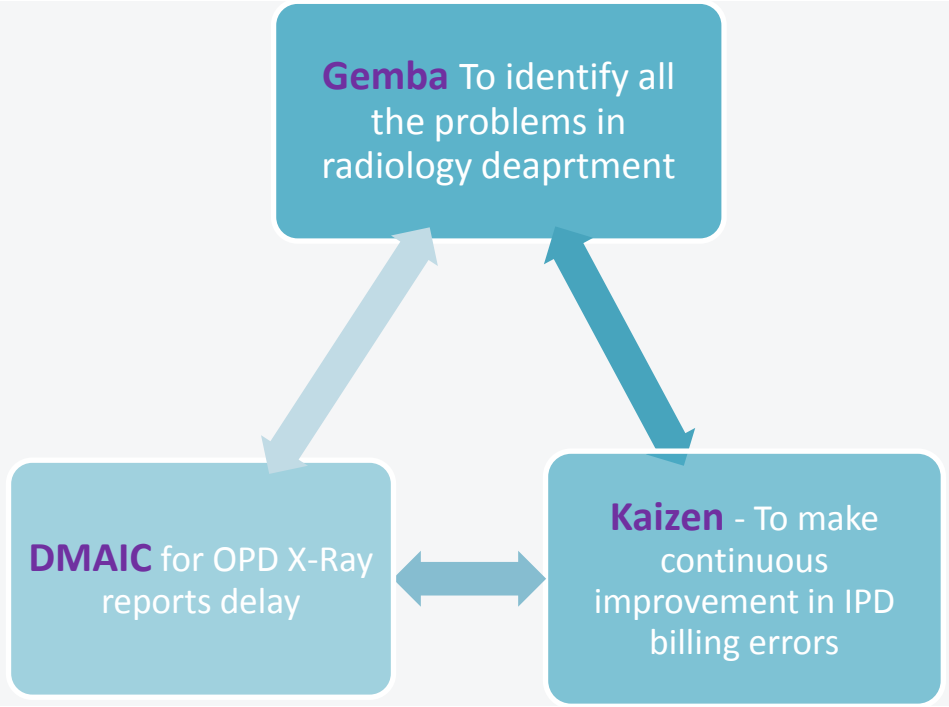

Figure 7.1- Tools used

Various tools used in this study are:

1. Gemba-Literally translated, *"Gemba"* means 'the real place". In lean, s means the place where work is actually being done or value is being created. A gemba (and sometimes genba) walk is the term used to describe personal observation of work – where the work is happening. The original Japanese term comes from *gembutsu*, which means "real thing."[1] It also sometimes refers to the "real place."

This concept stresses:

- Observation: In-person observation, the core principle of the tool
- Value-add location: Observing where the work is being done (as opposed to discussing a warehouse problem in a conference room)
- Teaming: Interacting with the people and process in a spirit of Kaizen ("change for the better")

After observing the processes in the radiology department – evaluation of work environment, interaction with the staff, safety hazards and inefficiencies were identified as follows;

1. Long reporting time for X- ray OPD patients – It was observed that turnaround time for both waiting and reporting time was very high and most of the patients were dissatisfied due to this reason.So, the Turnaround time for both waiting time and reporting time were collected for patients and data was analyzed. The detailed analysis of this problem is done by DMAIC.

2. Billing errors in IPD- For IPD patients it was found that there were billing errors- in most of the cases after the patient gets discharged, it is known that most of the radiology procedures were not entered in the computer system. This leads to revenue leakage and most of the IPD patients get discharged without paying for the radiology procedures.

3. Patient Disorientation – about 80 % of patients were disoriented and not confident where they have to go, they ask at the reception counter which signifies the need for signages.

4. Patient safety-There is no double lock and key system present for MRI room and most of the patients enter in MRI room directly as there was one signage only in English language(most of the patients are lower class).

5. Employee safety- Technicians were not wearing TLD Badges regularly and lead apron during the procedure.

S.No	Current State	Ideal State
1	For X-ray Opd patients reporting time was very long	As per the internal benchmarks set by the organisation, the reporting time for X-ray should be 60 minutes.
2	Billing error for IPD patients who are beneficiaries of radiology procedures	Every procedure done in any department should be entered in the patient bill and it shall be charged.
3	Patient feel disoriented when they visit radiology department	Signages and Guide system should be proper in the hospital.
4	Patient safety- not ensured	Double lock and key should be present and all the signages should be clear so that patient does not enter danger zones.
5	TLD badges, lead shield and lead apron used sometimes	TLD badges and Lead apron lead shield should be used regularly.

Table 1

DMAIC-

- Six Sigma uses a five-step problem-solving process called DMAIC, an acronym for Define, Measure, Analyze, Improve and Control. The first step is to define the problem. The scope of problem is defined.
- Defining the problem in quantifiable terms and determining how the performance is measured.
- The main problem focused here is delay in reporting time in X-ray reports.
- It is important to follow the internal benchmark so as to increase the patient satisfaction.
- Method: Observational study

Tool: Process mapping

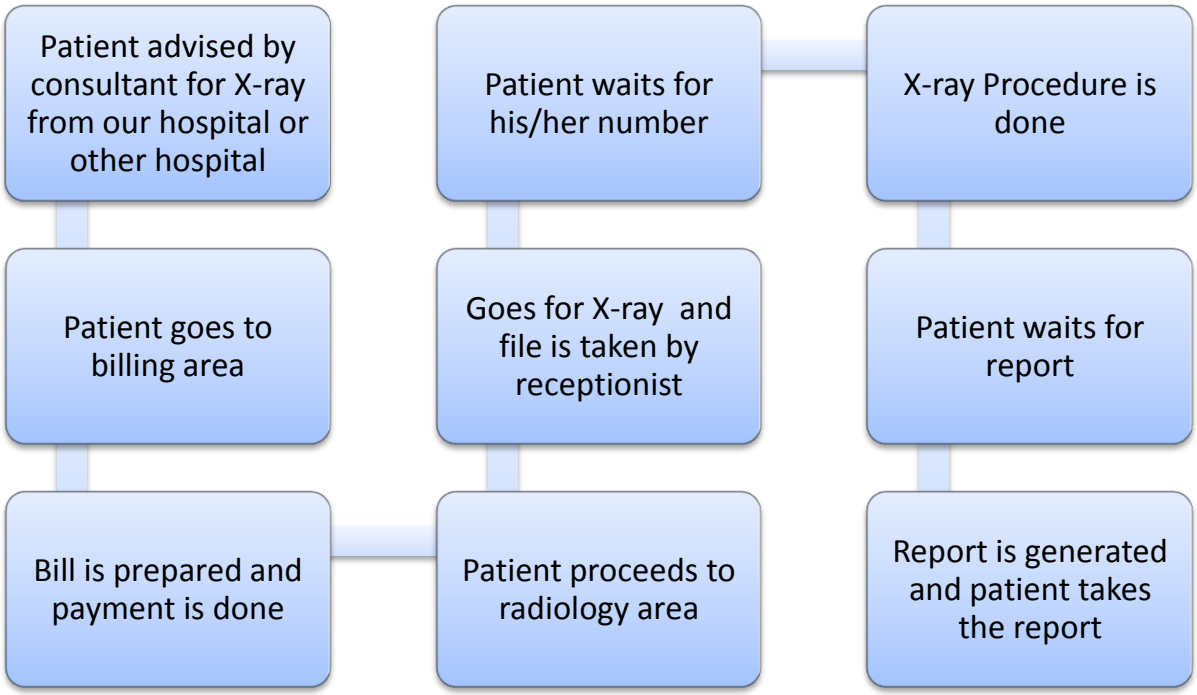

FIGURE 7.2

PHASE II- MEASURE

- This is a phase of data collection.
- This measurement will provide the current or the baseline data before any intervention made for improvement.
- Method: Time motion study
- **Total cycle time**= The time at which the patient has entered the radiology department and has given his or her file up to the time in which he gets his/her reports.
- **Standard reporting time=** as per internal benchmarks reporting time should be 60 minutes.

Turnaround Time for X-ray

- Sample size – 100

- Exclusion criteria- IPD patients and Health check up patients.
- The following data is for 72 patients:
    - **Waiting time -0:13:43**
    - **TAT (reporting time) -1:47**
    - For 28 patients the report is delayed more than one day.

PHASE III – ANALYZE

- This is to analyze the current performance both qualitatively and statistically for identifying the root cause of delay in reports of X-ray.
- Method used:
    - Identifying cause for delay: **Fish bone analysis**

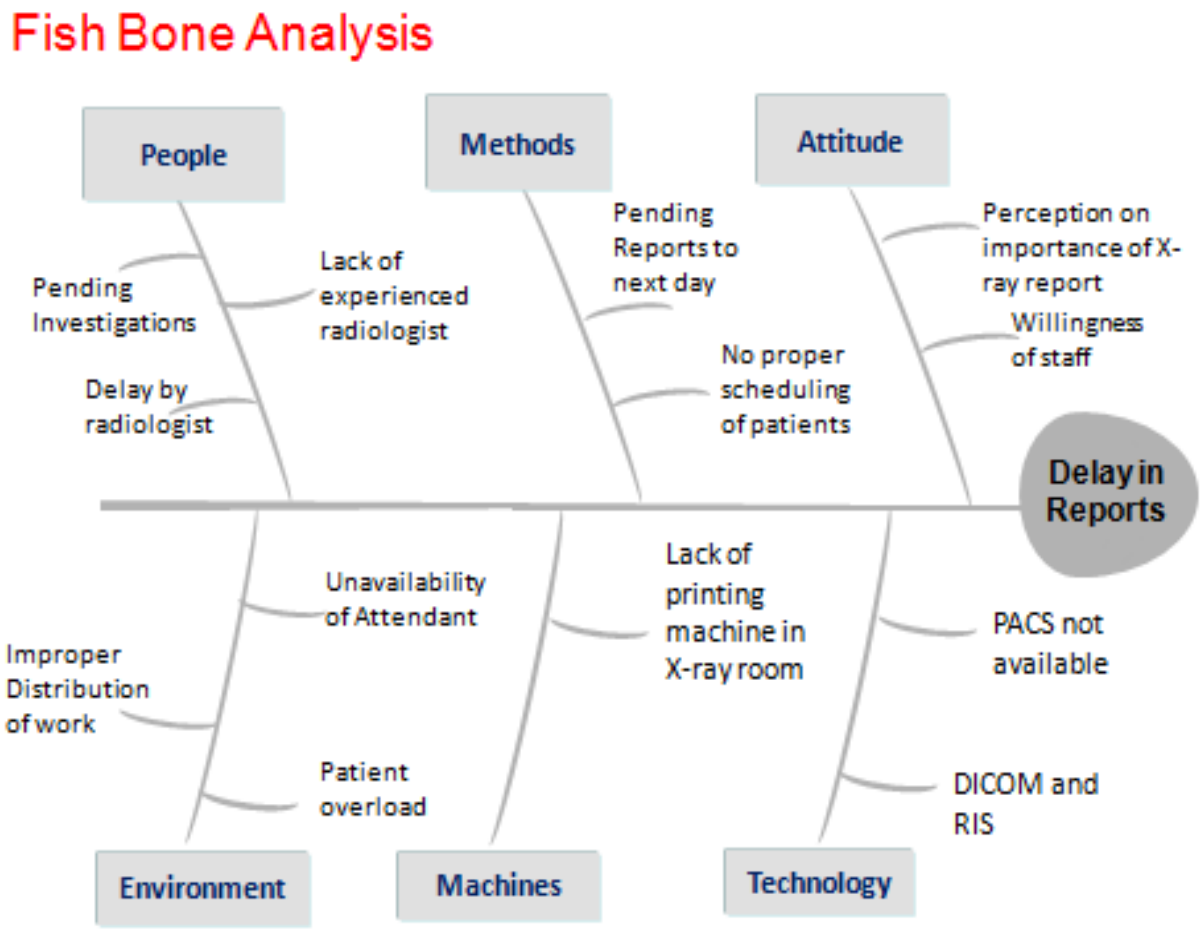

FIGURE 7.3- FISH BONE ANALYSIS

Solutions to these problems:

- **For Radiologists (implemented)**

  1. A duty roster can be made for doctors so that one consultant shall be assigned for X-ray reports, one for Sonography and one for CT scan and MRI as the patients are less for CT, MRI.

  2. Proper scheduling should be done for all the procedures-USG, MRI, CT, X-ray separate number should be given to each patient turn wise.

  3. Hiring of one full time experienced radiologist.

- **For patients (implemented)**

  Proper signage should be there and one full time attendant should be present to guide all the patients.

  A series of informational handouts should be given to the patients regarding the procedure as many patients are unaware of the reason for scheduled procedures,

or what they were supposed to do or not do leading up to the day of their procedures.

- **Advanced Technology (not implemented)**
  PACS, RIS and DICOM should be implemented.
  One more computer printing machine required in X-ray room.

2. Kaizen

Kaizen means "continuous improvement" *Kaizen* is a Japanese philosophy that focuses on continual improvement throughout all aspects of life. When applied to the workplace, Kaizen activities can improve every function of a business, from manufacturing to marketing and from the CEO to the assembly-line workers. Kaizen aims to eliminate waste in all systems of an organization through improving standardized activities and processes. By understanding the basics of Kaizen, practitioners can integrate this method into their overall Six Sigma efforts.

The purpose of Kaizen goes beyond simple productivity improvement. When done correctly, the process humanizes the workplace, eliminates overly hard work, and teaches people how to spot and eliminate waste in business processes.

The continuous cycle of Kaizen activity has seven phases:

1. Identify an opportunity
2. Analyze the process
3. Develop an optimal solution
4. Implement the solution
5. Study the results
6. Standardize the solution
7. Plan for the future

Kaizen generates small improvements as a result of coordinated continuous efforts by all employees. *Kaizen events* bring together a group of **process owners** and managers to map out an existing process and identify improvements that are within the scope of the participants.

Step 1- Identify an opportunity- Kaizen was used to correct IPD billing errors. It has been noted during Gemba Walk that there were errors in IPD billing. The patient attendant comes with the requisition form (X-Ray/CT/MRI/USG) and the procedure

was done but the same entry was not made in the computer system. The work of making entries for all the radiology tests was assigned to the nurses.

Step 2- Analyze the process- The process of ordering radiology procedures was observed in inpatient department. In most of the procedures the nurses were not doing entry in the computer system because of work overload. The process is as follows:

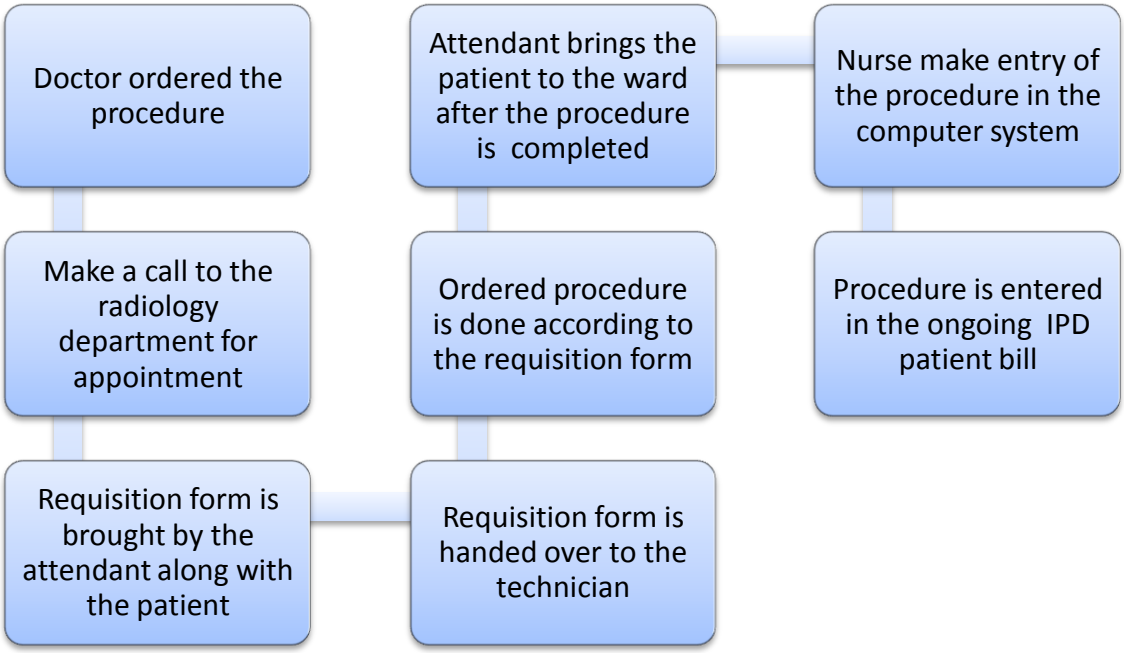

FIGURE 7.4 – CURRENT PROCESS

Step 3 – Develop an optimal solution – An IPD checklist was made which is planned to check the patients in real records with the computer entry. After checking the list, entry is to be made for the patients whose records are not maintained in the computer system.

Step 4-Implement the solution

For this checklist entry were made by the technician staff (for CT, MRI, X-Ray) and for USG nursing staff was responsible for making entry.

Step 5 – Study the results

The results were studied and it was found that major gaps were in the X-ray procedures, thereafter in the USG and CT scan and MRI.

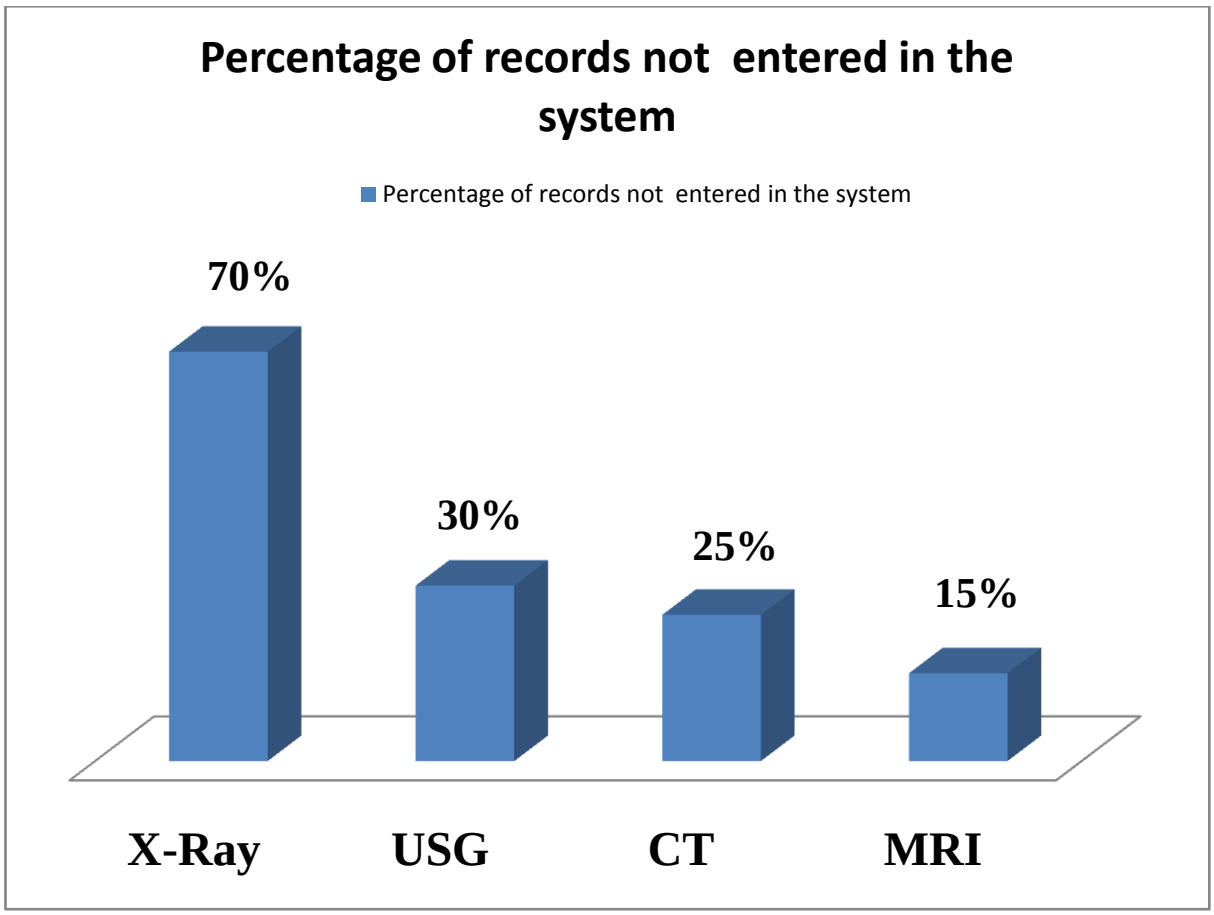

FIGURE 7.5

Step 6 - Standardize the solution

This checklist was made compulsory for the technicians and the nursing staff to fill regularly and updation was done by the accounts staff by matching the entries with the checklist. This was made a standardized procedure till any other innovative solution was implemented.

Step 7-Plan for the future

For the future it was planned that a separate billing counter should be made for the radiology reception and both OPD and IPD billing would be done at the counter. This will help in the way that:

1. The checklist will not be needed as direct entry will be made in the computer system for IPD patients as soon as the patient arrives with the requisition form.
2. This will help in saving time and wastage of manpower for the same work.
3. Revenue leak will be terminated which was earlier happening due to delayed entries or no entries in the computer system.

4. Nurse's workload would be lessened so that they can focus their attention on patient care needs.

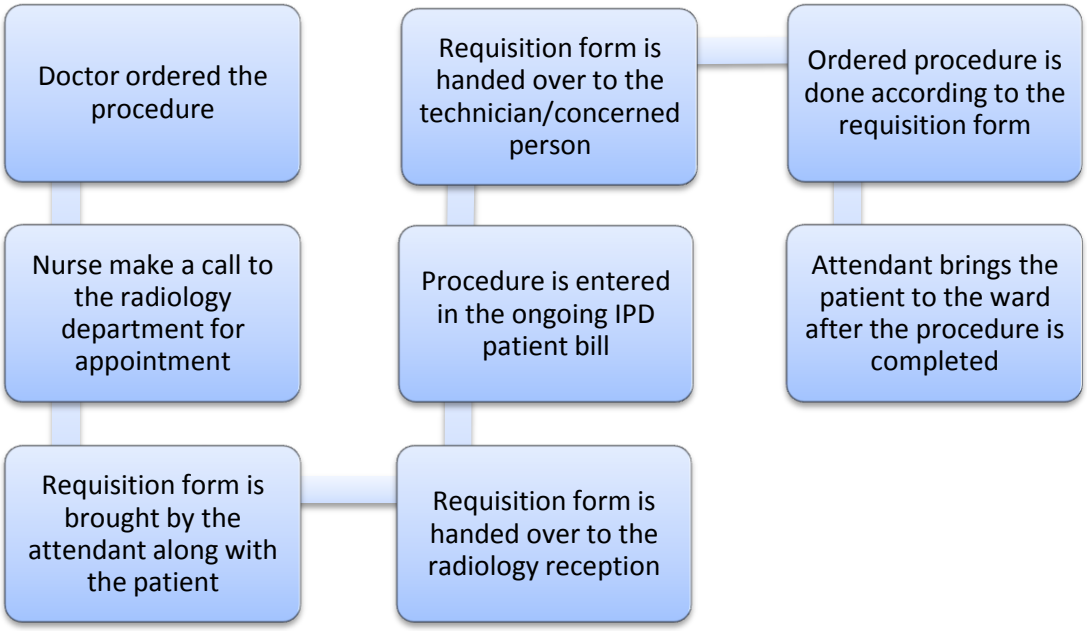

FIGURE 7.6 – FUTURE PROCESS PLAN

FINDINGS:

Various Findings From the tools used are:

1. Gemba- Process was observed and problems were identified which further suggested the use of another lean tools – DMAIC and Kaizen.
2. DMAIC-After implementing the DMAIC two phases were compared and it was found that there was improvement in reporting time by applying lean six sigma. Earlier the reporting time was one hour forty seven minutes and after interventions it became thirty eight minutes. The reports (for 28 patients which were pending for more than one day and now no reports are pending – all the reports are delivered on the same day).

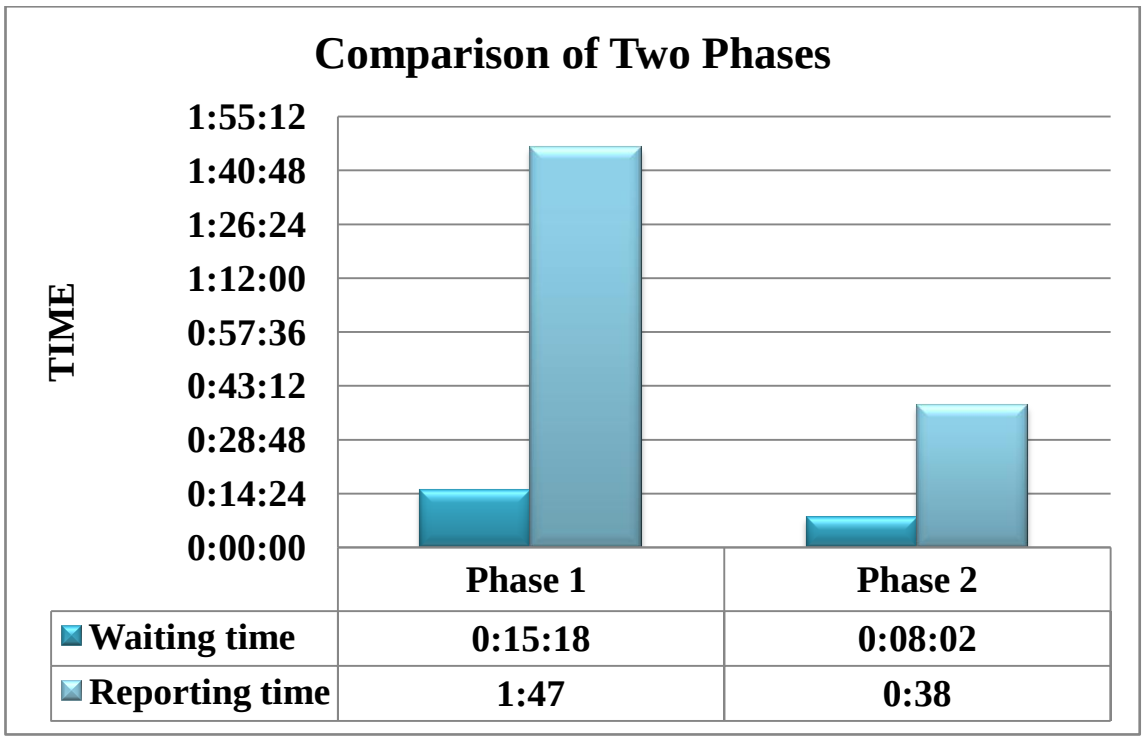

FIGURE 7.7 – COMPARISON OF TWO PHASES

3. Kaizen-

It has been shown that 70% X-ray records,30% USG records, 25% CT scan and 15 % MRI records were missed earlier and this data is now tracked through IPD audit form.

Conclusions:

- Radiology is part of the service industry and as a service provider one needs to understand quality and delivery of service. This includes knowledge of customer service, customer satisfaction and all its related issues as well as quality assurance and improvement issues
  .
- Lean Six sigma if applied can improve all the processes
  and can eliminate all the errors in radiology department and increase the patient satisfaction.

Lean principles hold the promise of reducing or eliminating wasted time, money, and energy in health care, creating a system that is efficient, effective,

and truly responsive to the needs of patients — the "customers" at the heart of it all.

Recommendations:

- **For Patient safety**

  Double lock should be present in MRI room and keys should be present with the staff.

  A signage is required in Gujrati language for patients to understand the risk of entering the MRI room without precautions.

- **For Patient Overload**
  - A schedule can be maintained for OPD and IPD patients as both the IPD and OPD patients appear simultaneously in the radiology department. Different slots can be maintained.

- **For employee safety**

TLD badge delay -This form can be kept with the HR department so that as soon as any new employee comes – he/she can fill the form or it should be mailed immediately from RSO to the new employee in radiology department.

- **Separate billing Counter**

  A separate billing counter can be made for the radiology department to ensure minimum billing errors.

References:

- Is Lean Management implementable in a department of radiology? Jens Karstoft and Lene Tarp
- Jimmerson C, Weber D, Sobek DK. Reducing waste and errors: piloting lean principles at Intermountain Healthcare. *Jt Comm J Qual Patient Saf* 2005;31(5):249–257. Medline
- Roth CJ, Boll DT, Wall LK, Merkle EM. Evaluation of MRI acquisition workflow with lean six sigma method: case study of liver and knee examinations. *AJR Am J Roentgenol* 2010;195(2):W150–W156. CrossRef, Medline
- Amaral CS, Rozenfeld H, Costa JM, MdeF Magon, Mascarenhas YM. Improvement of radiology services based on the process management approach. *Eur J Radiol* 2011;78(3):377–383. CrossRef, Medline
- Halsted MJ, Froehle CM. Design, implementation, and assessment of a radiology workflow management system. *AJR Am J Roentgenol* 2008;191(2): 321–327. CrossRef, Medline
- Teichgräber UK, de Bucourt M. Applying value stream mapping techniques to eliminate non-value-added waste for the procurement of endovascular stents. *Eur J Radiol* 2011 Feb 10. [Epub ahead of print]
- Kaplan RS, Norton DP. How to implement a new strategy without disrupting your organization. *Harv Bus Rev*2006;84(3):100–109, 150. Medline
- Elshaug AG, Bessen T, Moss JR, Hiller JE. Addressing "waste" in diagnostic imaging: some implications of comparative effectiveness research. *J Am Coll Radiol* 2010;7(8):603–613. CrossRef, Medline

X- Ray /USG/CT Scan/MRI AUDIT FORM

Date:

NO	MRN	NAME	IPD	PROCEDURE NAME
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

Submit Name_____ /Emp. ID._____

Auditor Sign._____