

A STUDY ON UTILIZATION OF EQUIPMENTS AND QUALITY ASSURANCE IN THE RADIOLOGY DEPARTMENT OF A TERTIARY CARE HOSPITAL

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Abstract— In the current generation of availability of high end equipment and services, customer satisfaction has become a serious concern for service providers in the industry. Hospitals unlike other service providers deal with a very diverse group of customers which turns out to be a challenging task for the management. The hospital receives customers also known as patients who require immediate intervention and services to keep them satisfied. One of the departments in the hospital which serves the patients' needs is the radiology department which is mainly involved in diagnostic procedures and at times for interventional and therapeutic also. Considering the importance of the radiology department within the hospital, the study has been conducted to find out the utilization rates of equipments in the department which will help the management gauge the status of the department in terms of effectiveness and efficiency. The equipments chosen in this study was Magnetic Resonance Imaging MRI scanning machine, Computer Tomography (CT) and Mammography. The study also focuses on the quality assurance aspect and compliance rate of the department to the National Accreditation Board for Hospitals and Healthcare Providers. The study includes various tools to assess the utilization rate of selected equipments, one of which being the Time and Motion study which will bring out a clear picture on time taken for examinations performed. Based on the overall findings and peer literature reviews suggestions on accurate appointment systems have been given to the department wherein inpatients examinations can be conducted post OPD hours to avoid overcrowding which will also reduce the waiting time for patients. Better marketing strategy is required to increase the patient load on mammography which the management has to implement.

Keywords— Time & Motion Study, Utilization, quality assurance, Computed tomography, Mammography, Magnetic resonance imaging.

I. INTRODUCTION

1.1 Introduction to Radiology

The World Health Organization's definition for health states that it's a state of complete physical, mental and social well being and is just not the absence of diseases or any kind of infirmities and the health of a country is usually referred to as the physical and mental state of its population. If basic needs such as hygienic environment, social infrastructure or efficient healthcare services are not adequately structured the health status of that country is not at its positive side. The prime objective of any country should be to promote good health in their development process. Good health in the society will directly influence on the development process of the society as a whole. Radiology is considered crucial to the healthcare industry as it plays a critical role in diagnosing, treating and also patient management. With the current technology equipments are able to detect tissues and organs, analyze assess them which would have been obscured. Some of the types of medical imaging include Magnetic resonance imaging, Computed tomography, X ray imaging, Ultrasonography etc. The Imaging services are being extensively utilized to diagnose as well as treat some of the medical conditions and the two most commonly used imaging equipments are the

Magnetic Resonance Imaging scanners and the Computerized Tomography units which constitutes a large ratio of investment in the medical devices category in the hospital. Apart from them being expensive their life cycle also remains short with expensive maintenances involved when compared to the initial investment made in setting up these equipments. With major advancements in radiology technology, turn over time for results have become lesser and more accurate leading to effective and instant treatments. Along with the advancements in technology also come its expenditures therefore careful evaluation of manpower, drugs as well as equipments is necessary to remain competitive in the industry for every organization and in an effort to control the costs every healthcare facility has become highly selective in the evaluating and purchase of medical devices and equipments which top the charts in terms of principal expenditure in providing a service.

II. LITERATURE REVIEW

This study was conducted during the industrial engineering program from the Arizona state university which is about the imaging equipment utilization and productivity where his main focus was on proposal of standardized measures for imaging

equipment productivity. In his research he had developed a new tool to continuously and automatically track equipment efficiencies called the Dicom Index Tracker which has been internationally accepted by many diagnostic and interventional imaging equipment manufacturers. In his study he identified three main time based metrics namely, Examination duration time (EDT), Inter- patient time (IPT) and the appointment interval time (AIT) where the EDT measured the actual time taken for scanning patients, IPT measured the time the equipment was idle and the AIT captured the estimated scheduled time for examinations. In his second part of the focus is on the factors which influencing equipment utilization and productivity. He has used various methods like statistical analysis and computer software to arrive at his results and he found that the factors which mainly influenced EDT were imaging modality, patient age, and the type of examination which was been performed. Factors which influenced the IPT were imaging equipment location, patient gender and age along with the examination type being common. AIT factors included imaging modality equipment location, patient gender – age interaction and examination type. However there was a limitation in the study since it considered only few factors. The author concludes his study stating that current medical practices and academic research have focused on measuring imaging equipment productivity and utilization, determining factors impacting equipment productivity and utilization, and proposing strategy for productivity improvement. (Mengqi Hu, 2011)

This study was on quality management systems in radiology at Massachusetts USA. The main aim of the study was to assess quality management systems in medical X ray facilities in Kenya. The study focused on benchmarking of level of quality management systems using evidence based records ensuring improvements in safety and overall quality. The reason behind the study was that, in Kenya very few studies have been conducted to develop and effective programme based on the socio-economic status of the region. During the study it was observed that in the developing countries there was a shortage of data regarding the procedures, performance of quality control tests and the organizational frame works of the department, hence the present study focused on benchmarking national quality management systems and compare it with the safety standards which are already well established around the globe. The methodology used was a quality management inspections and survey method conducted among 140 X-ray facilities, which was equivalent to 47% of the total number of operating facilities in Kenya. A total of 54 (20%) representative X-ray facilities were visited to make QA presentations, QC measurements, in-person observations of radiological examinations, to interact with hospital staff, and to encourage participation in

the survey. The results observed that only 61% compliance with the least QA performance indicators being the interventional cardiology tests performed among adults with 25% and the highest being the x ray quality control test at 88%. (G K Korir and J S Wambani, 2013)

Below is a prospective study retrieved from Kasturba Medical College and Hospital which has led to the findings on out the utilization of CT scan in a multi specialty hospital. The author mainly focused on the utilization patterns of high end CT scan machine. He also conducted an observational study and analyzed the workload on the equipment which was calculated with the use of records and 1993 cases in total where 1190 were plain CT and 803 were taken after administering contrast. The average scans per month were 332 highest cases in May and lowest in April where 90% of cases were from the institution and only 10% from referrals. He also found that the Neurological sciences department was the main user of CT scan in the hospital. He has stressed on the outcomes of optimum utilization of equipments which will result in Quality patient care and satisfaction achieved with minimal costs incurred. The study was conducted for a time period of six months calculating the required parameters and arriving at the results. Based on the results he concluded that utilizing equipments to its maximum is the responsibility of the management and underutilized equipments will lead to loss to the management and its stake holders. (Dr. P. Naveen Kumar, 2014)

Aim

- To study and assess the utilization of MRI, CT and Mammography and quality assurance in the radiology department of MS Ramaiah Memorial Hospital Bangalore.

Objectives

- To study and assess the utilization of medical equipments in the department (MRI, CT, Mammography)
- To study the major factors responsible for effective utilization of equipments
- To study the compliance of the department to the standard regulatory guidelines (NABH) indicators
- To recommend suggestions to the department based on the results obtained

Scope of Present Investigation

The main purpose of the dissertation is to study and analyze the utilization rates of selected equipments in the radiology department of M S Ramaiah hospital Bangalore. The study also focuses on the factors that influence the rate of utilization. This particular study will help the department to find out the utilization of selected equipments and also help in planning of

examinations and also extend their equipment inventory.

Methodology

- The first objective in the study was to find out the utilization rate of equipments mentioned early which was calculated using the standard formula used in various manufacturing as well as service industries. To arrive at the actual number of procedures that can be performed a time and motion study was conducted for most common performed procedures by the equipments selecting a particular sample size.
- The second objective was to study the major factors responsible in attaining optimum

utilization rates by conducting a thorough research on previously done studies and literature reviews across various industries.

- The third objective was to study the compliance and deviations tabulated by the department to the National Accreditation Board for Hospitals and Healthcare providers by collecting data of NABH indicators data from the department.

III. ANALYSIS AND INTERPRETATION

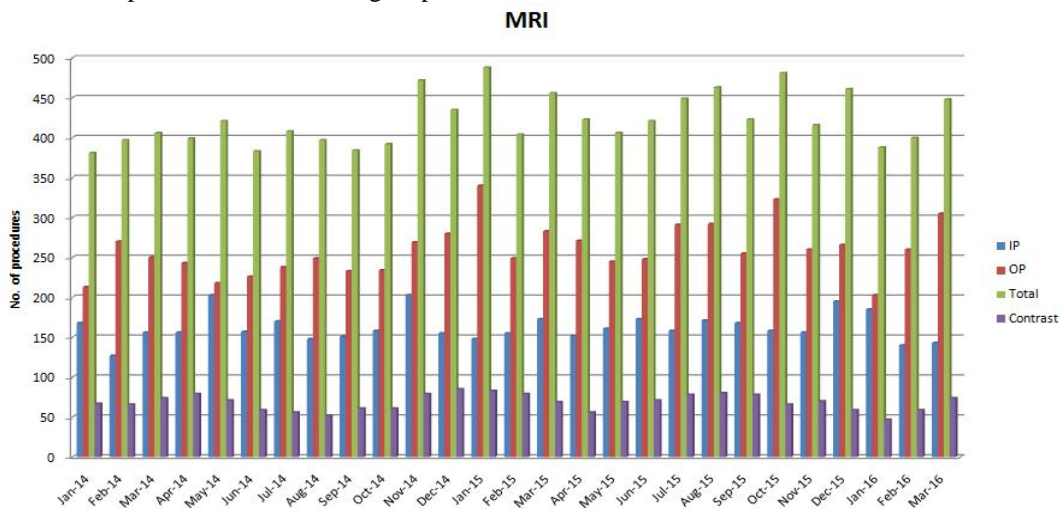


Figure 3.1 Total number of examinations MRI

As per the above figure it was observed it that there is an increase in the total number of examinations in the recent years. In the year 2014 November had the highest of examination with 472 and January being the lowest at 381 examinations. In the year 2015

January had the highest with 488 and May being the lowest with 406. In the year 2016 there is an increasing trend in the no. of examinations performed.

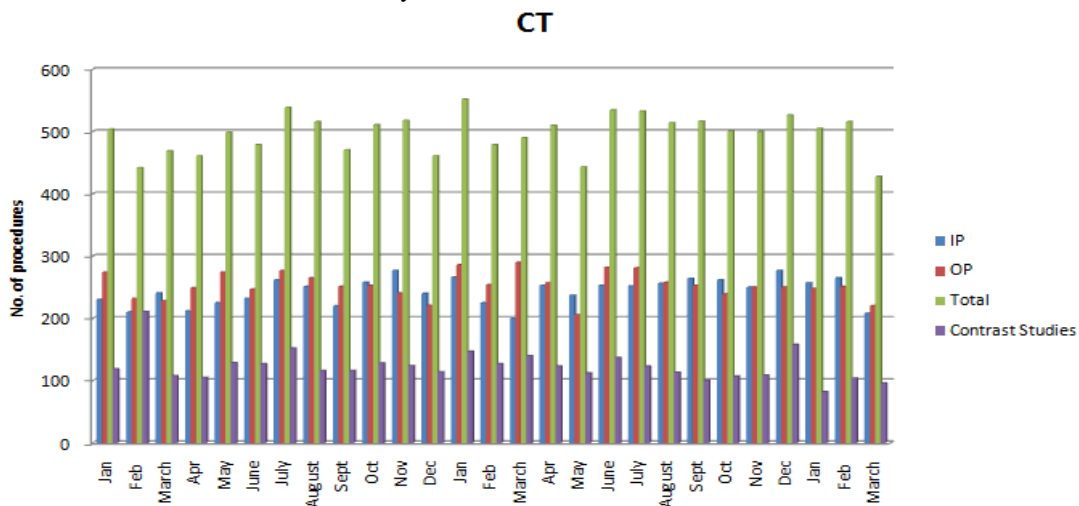


Figure 3.2 No. of examinations CT

As per the above figure it was observed that in 2014 July had the highest no. of examinations with 539 and February had only 442. In the year 2015 January had the highest with 552 examinations and May being the

lowest with 443 examinations. In 2016 February had 516 and March had only 428 examinations performed.

Mammography

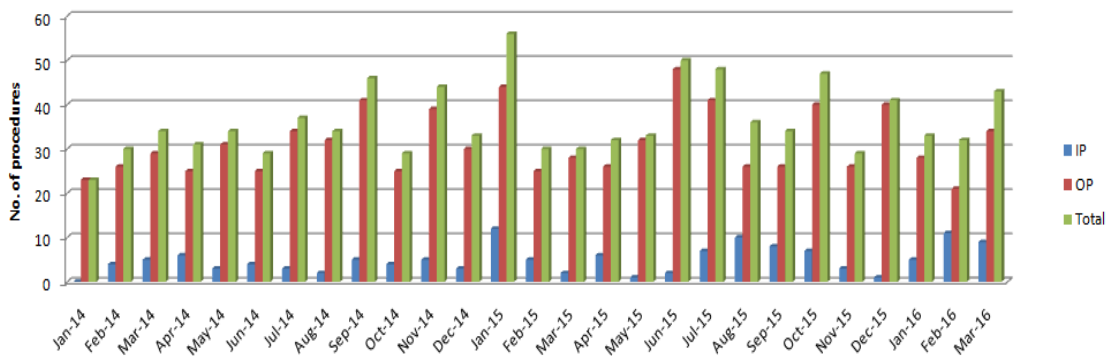


Figure 1.3 No. of examinations Mammography

As per the above figure it was observed that in 2014 September had the highest examinations with 46 while January had 23. In the year 2015 it was observed that there has been an increase in no. of

examinations overall with 56 being the highest in the month of January while November had only 29. The year 2016 has observed a good patient load with March having the highest no. of examinations.

MRI Utilization

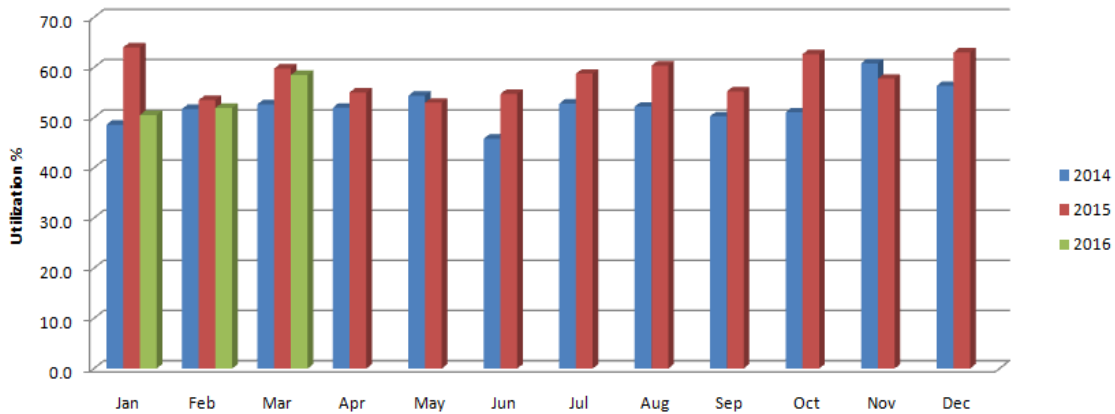


Figure 3.4 MRI utilization rates

As per the above figure it was observed that there has been an increase in the utilization rates of the MRI examinations down the years. In the year 2014 November had the least downtime and highest

utilization rate while June had the lowest. In the year 2015 January had the highest utilization rate while February and May had low utilization rates. 2016 had an increasing trend in the utilization rates.

CT Utilization Rate

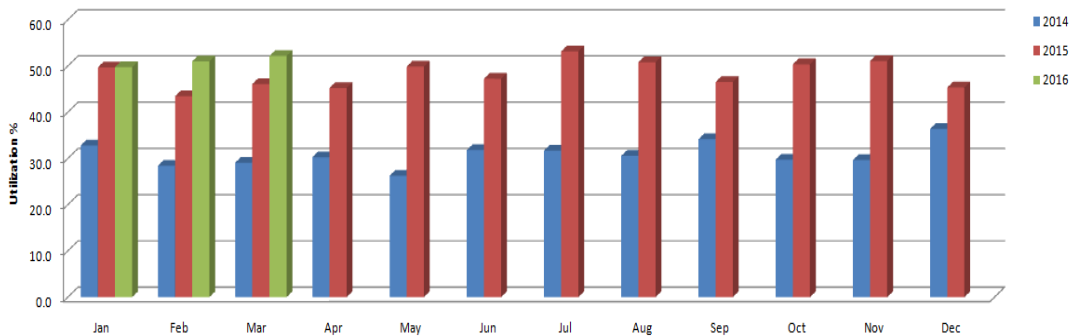


Figure 3.5 CT Utilization rates

As per the above figure it was observed that there was a high rise in the utilization rates in the year 2015

when compared to 2014. In the year 2016 there is a constant increase in the utilization of CT.

Mammography Utilization

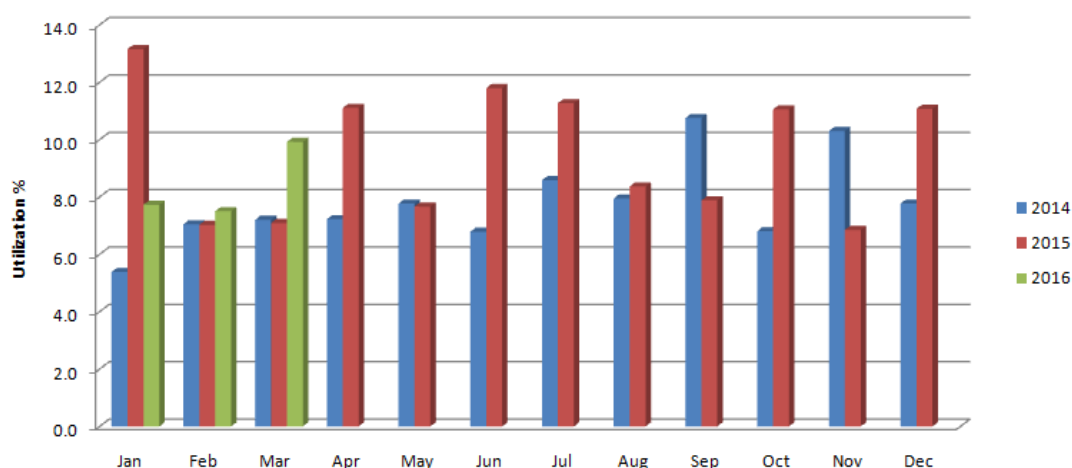


Figure 3.6 Mammo Utilization rates

As per the above figure it was observed that the overall utilization rate for 2015 is comparatively high when projected along with 2014. January 2014 had the lowest utilization rate while January 2015 had the highest.

Table 3.1 NABH Indicators

Year	Indicator	Remarks	No. of deviation	Observed %
2014	Percentage of Contrast Related Reactions	Total CT Patients were 5,870	2	0.01
	Percentage OF Reports Co-Relating with Clinical Diagnosis	(Jan-july 18129/34742) (Aug- Sept 2729/4557)		47/60
	Percentage of Re-Do's	Total Patients - 62732	7	0.05
	Percentage Of Film Wastage	total films used - 65389	11	0.0075
	Percentage Of Reporting Errors for 1000 Reports	Total reports - 62732	8	0.01
	Percentage Of Equipment Downtime	CT- 172hrs and MRI 6hrs		
2015	Percentage of Contrast Related Reactions	Total patients - 11485		0.08
	Percentage OF Reports Co-Relating with Clinical Diagnosis	(MRI total reports Jan- dec 5228) CT Jan-Dec 6101		61/59
	Percentage of Re-Do's	Total patients - 67502	9	0.02
	Percentage Of Film Wastage	Total films used - 73050	20	0.03
	Percentage Of Reporting Errors for 1000 Reports	Total reports - 67502	16	0.03
	Percentage Of Equipment Downtime	CT- 10hrs MRI 87hrs		

As per the above figure it was observed that the compliance of the radiology department to the regulatory guidelines was almost perfect as it had very less deviations and errors. The equipment downtimes were very low as the department had a good preventive maintenance plan in place.

IV. FINDINGS

- At MSRMH it was observed that they had implemented the appointment system as per the patient's requirement in the radiology department, however at times there were overcrowding issues during the OPD hours since the department was catering the needs of the inpatients as well as outpatients. This issue can be solved by proper re assessment of the time taken to in shifting of inpatients from the wards to the department so that the patient need not wait for too long to access services

provided by the system. Inpatients can be preferably given access to the services after the OPD hour which requires proper planning by the clinical team as well as the management.

- At MSRMH it was observed that the radiology department was one of the most efficient departments with a very good reporting rate and timeliness. The utilization rates of chosen equipment were considerably good except for Mammography which had very low patient load. The current issue can be solved by including the service under health packages so that the service will be utilized on a steady rate. Creating awareness on diseases related to women and proper counseling for the required age group among the female population in the surrounding region would increase the usage of this particular service drastically. The equipment can also be used for research purpose and shared with the M S Ramaiah

teaching hospital to increase the patient load. Camps can also be conducted to create awareness among the population which will let them know the availability of the service available at the hospital.

CONCLUSION

Effective utilization is very essential for any organization to achieve its goal and also quicken the break even of the investment made for the equipment. However just obtaining the best equipment available in the market alone will not be useful to achieve the target, proper training and allocation of staff is required to utilize the equipment to its full potential. Proper quality control programme is another aspect every organization has to look into to avoid any unnecessary downtimes faced by the equipments. Preventive maintenance should be implemented in all areas which is the best solution to avoid breakdowns and comprehensive maintenance contracts help reduce the costs incurred in case of any accidental breakdowns. In a hospital it is very crucial to maintain a stringent quality assurance program failing which the safety of the patients as well as the staffs is in danger. The hospital can also create a medical device formulary which would maintain the data base of the available equipments in the hospital. The main objective of the formulary would include clinical judgments and suggestions for the management regarding the equipments. After conducting the study it was found that equipment utilization and quality assurance are closely related where small deviations from any quality aspect would affect the utilization rates and most of the times a lot of factors are involved in depicting the utilization.

VI. RECOMMENDATIONS

- **Appointment system:** The process of reduction of waiting times begin with the accurate measurement of time taken to provide a particular service such that the actual waiting can be reduced by giving accurate appointment time for the customer. Benchmarking of waiting times for each and every service in the

healthcare industry should be considered as the main priority for the regulatory authority and design policies accordingly to achieve maximum efficiency and satisfaction.

- **Development of better marketing strategies:** In a hospital setup patients are under immense pressure to achieve ever increasing expectations with fewer resources, minimum time and with high awareness come higher expectations. Hence it's the managements' responsibility to make sure the services available reaches the right patient at the right time. Marketing in healthcare is a new concept and letting the customers know the facilities available is very crucial in attain the breakeven of the investments made by the management for a particular service.

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