FACTORS AFFECTING MRI MACHINE UTILIZATION IN MEDANTA – THE MEDICITY , GURUGRAM

Dissertation Submitted to

The IIHMR University, Jaipur

for the partial fulfillment for the award of the degree of

Master of Business Administration (MBA)

in

Hospital and Health Management

by

RASHI SINHA

Under the Supervision and Guidance of

DHIRENDRA KUMAR

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CONTENTS

LIST OF FIGURES

INTRODUCTION

"Global Health Limited (Medanta) is the largest multi-speciality tertiary care provider in the North and East regions of India in terms of bed capacity (2,467 installed beds)." Medanta delivers advanced, affordable end-to-end healthcare in Delhi, Gurugram, Indore, Ranchi, Patna and Lucknow through our network of five hospitals, six Mediclinic, diagnostic laboratories, home-care and telemedicine services. Medanta aims to extend specialised care for complex cases in under-served densely populated areas through our patient-first model of healthcare.

Medanta - The Medicity, located in Gurugram (previously known as Gurgaon), is a world-class medical institution that is dedicated to providing top-quality healthcare services to patients from all over India and around the world. Established in 2009, Medanta has become one of the most prestigious and advanced hospitals in India, with over 1,600 beds and 22 super-specialty departments.

Medanta is spread across a sprawling campus of 43 acres and boasts of some of the most advanced medical facilities in the country. The hospital has state-of-the-art diagnostic and imaging equipment, including MRI, CT scan, PET-CT, DEXA, mammography and digital X-ray machines. The hospital's surgical facilities are also equipped with the latest technology and equipment, including robotic surgery systems like the Da Vinci robotic surgery system and advanced anaesthesia equipment.

Medanta is staffed by some of the most experienced and renowned doctors and administrators in India, who have trained and worked in some of the world's most prestigious medical institutions. The hospital's cardiology department, led by Dr. Naresh Trehan, is one of the most advanced in the world, with experts in all aspects of cardiology and cardiac surgery.

History and Mission

Dr. Naresh Trehan founded Medanta with the mission of providing patients with world-class medical care in a safe and comfortable environment. His vision was to create a hospital that would offer the latest technology, advanced medical procedures, and a team of highly skilled doctors and healthcare professionals.

Over the years, Medanta has grown to become one of the leading hospitals in India, attracting patients from around the world. The hospital has a strong focus on research and innovation and collaborates with leading research institutions to improve medical outcomes and advance the field of medicine.

Facilities and Services

Medanta offers a wide range of medical services and facilities, including cardiology, neurology, gastroenterology, oncology, orthopedics, and many others. The hospital has a team of highly skilled doctors and healthcare professionals who specialize in various fields and are dedicated to providing patients with the best possible medical care.

The hospital is equipped with the latest technology, including advanced diagnostic and imaging equipment, and offers state-of-the-art medical procedures. It also has a research center, Medanta Institute of Education & Research is an autonomous organization recognized by the Department of Scientific and Industrial Research (DSIR) as a "Scientific and Industrial Research Organization (SIRO)", to carry out research, educational and training programs in the quest of quality health care. MIER undertakes and promotes scientific and medical research programs that have a bearing on the health, social, economic and industrial needs of India.

The hospital has an active research program, with ongoing research in various areas of medicine, including cardiology, neurology, oncology, and others. Medanta also provides training and education programs for medical professionals, including postgraduate courses and fellowships.

In addition to medical services, Medanta also provides a range of support services to patients and their families, including, transport, and translation services. The hospital has a patient-centric approach and is committed to providing patients with a safe and comfortable environment.

Apart from providing world-class medical services, Medanta is also committed to serving the community. The hospital has various initiatives in place to provide affordable and accessible healthcare to all, including free health camps, mobile clinics, and outreach programs. Medanta is also involved in various CSR activities, including providing education and skill development programs to underprivileged children.

Recognition and Awards

Medanta has received numerous awards and recognition for its commitment to providing world-class medical care. The hospital is accredited by the Joint Commission International (JCI), which is a global leader in healthcare accreditation. It has also been awarded the NABH (National Accreditation Board for Hospitals & Healthcare Providers) accreditation, which is the highest accreditation for healthcare providers in India.

In addition to these accreditations, Medanta has received several awards for its excellence in healthcare. Fourth year in a row, Medanta Gurugram has been accredited as the Best Private Hospital in India in the prestigious Newsweek Best Hospitals survey. Medanta has also been featured among Top 200 Hospitals in the World, and are the only Indian Private Hospital to have been included in this list. It has been ranked as the Best Multi-Specialty Hospital in India by various publications, including The Week and India Today. The hospital has also been recognized for its contribution to research and innovation in the field of medicine.

Conclusion

Medanta is a world-class multi-specialty hospital that offers patients high-quality medical care in a safe and comfortable environment. The hospital has a strong focus on research and innovation and collaborates with leading research institutions to improve medical outcomes and advance the field of medicine. It has received numerous awards and recognition for its commitment to providing world-class medical care and is one of the leading hospitals in India. Medanta Gurugram is a world-class medical institution that is dedicated to providing top-quality healthcare services to patients from all over India and around the world. With state-of-the-art facilities, experienced doctors, and a commitment to affordable and accessible healthcare, Medanta is rightly considered one of the best hospitals in India.

CHAPTER 1 : INTRODUCTION

The purpose of this dissertation is to comprehensively examine the factors that influence MRI utilization in Medanta Hospital, with the aim of understanding the complexities and challenges associated with MRI services. MRI plays a crucial role in modern healthcare by providing detailed imaging of soft tissues, organs, and structures. However, optimal utilization of MRI machines is essential to ensure efficient healthcare delivery and maximum benefit to patients. This thesis seeks to explore and analyze the various factors that affect MRI utilization, both within and outside the hospital setting, to provide strategic insights and recommendations for improving utilization rates.

Specific objectives include:

Identifying Technological Factors:

a. Evaluating the technological capabilities and limitations of MRI machines in Medanta Hospital.

b. Assessing the impact of MRI machine upgrades, software advancements, and equipment maintenance on utilization.

Examining Operational Factors:

a. Analyzing the workflow processes associated with MRI services, including patient scheduling, appointment systems, and wait times.

b. Assessing the efficiency of resource allocation, such as MRI machine usage and time optimization.

c. Investigating the impact of operational bottlenecks, such as equipment downtime, on MRI utilization.

Exploring Patient-related Factors:

a. Examining patient demographics and clinical indications for MRI scans.

b. Assessing patient awareness, preferences, and satisfaction levels related to MRI services.

c. Investigating barriers to access, such as wait times, patient education, and communication channels.

Analyzing Regulatory and Policy Factors:

a. Evaluating compliance with regulatory standards and guidelines for MRI services.

b. Assessing the impact of healthcare policies, accreditation requirements, and insurance policies on MRI utilization.

c. Investigating the influence of reimbursement structures and payment models on utilization rates.

Synthesizing Findings and Providing Strategic Recommendations:

a. Analyzing the collected data to identify trends, patterns, and interdependencies among the various factors affecting MRI utilization.

b. Providing evidence-based recommendations for enhancing MRI utilization in Medanta Hospital, considering the specific challenges and opportunities identified.

c. Developing a comprehensive strategic framework that addresses the identified factors and enables effective utilization management.

By conducting this in-depth analysis, the thesis aims to contribute to the body of knowledge on MRI utilization in healthcare settings, with a specific focus on Medanta Hospital. The findings will offer valuable insights to healthcare administrators, policymakers, and practitioners, enabling them to make informed decisions and implement targeted strategies to optimize MRI utilization. Ultimately, the thesis seeks to improve patient access, enhance operational efficiency, and facilitate better patient outcomes through efficient utilization of MRI services at Medanta Hospital.

RESEARCH QUESTION

The research question for this dissertation is: What are the factors that impact MRI machine utilization rates in Medanta - The Medicity hospital, and how can hospital management improve MRI machine utilization rates and reduce the waiting times.

OBJECTIVE

The objectives of this dissertation are:

- To identify and examine the factors that affect MRI machine utilization rates in the hospital.
- To explore how hospital management can improve MRI machine utilization rates.
- To suggest strategies for optimal utilization of MRI machines in hospitals, thereby improving patient care.

Magnetic Resonance Imaging (MRI)

MRI is a noninvasive, painless imaging technique with high contrast resolution that uses exposure to magnetic fields, not ionizing radiation, to obtain an image of bone and soft tissue. MRI is based on the effect of a strong magnetic field on hydrogen atoms. MRI is used to assess for spinal cord tumors, intracranial disease, and some types of CNS diseases (e.g., multiple sclerosis); it largely replaced myelography in the evaluation of disc pathology. It also aids in the diagnosis of muscle, meniscal and ligamentous tears, synovial pathology, abnormal patellofemoral tracking, joint pathology, cartilage, bone marrow pathology, osteonecrosis, stress fractures, and osteochondral lesions.

It has revolutionized the field of medical imaging and has become an indispensable part of medical practice. However, the utilization rate of MRI may vary across healthcare facilities, and various factors may affect its usage. The efficient utilization of MRI is critical for timely and accurate diagnosis, which is essential for providing quality healthcare to patients.

Medanta, located in Gurgaon, India, is one of the leading multi-specialty hospitals in the country, offering state-of-the-art medical facilities and services. Medanta has a large and diverse patient population and provides a broad range of medical services, including imaging

and diagnostics. As one of the leading diagnostic tools, MRI is an integral part of Medanta's imaging and diagnostics department. However, the utilization rate of MRI at Medanta may vary depending on several factors.

Understanding the factors that affect MRI utilization at Medanta is crucial for optimizing the use of this essential diagnostic tool and improving patient care outcomes. This dissertation aims to analyze the factors affecting the MRI utilization rate at Medanta. The study will examine the relationship between the utilization rate of MRI and various factors such as patient demographics, preparation time, and availability of alternative diagnostic modalities. By identifying the factors affecting MRI utilization, the study aims to provide insights into how to optimize the usage of MRI at Medanta and improve patient care outcomes.

The utilization of MRI is influenced by several factors, including patient demographics such as age and gender. Referral patterns and physician recommendations may also impact the utilization of MRI. Additionally, insurance coverage and availability of alternative diagnostic modalities may affect the usage of MRI. Other factors that may impact the utilization rate of MRI at Medanta include the hospital's policies and procedures regarding the usage of MRI, the availability of MRI machines, and the efficiency of the diagnostic process.

Overall, this dissertation aims to provide insights into the factors affecting MRI utilization at Medanta, which could be used to optimize the usage of MRI and improve patient care outcomes. By understanding the factors that influence the utilization of MRI, healthcare providers at Medanta and other healthcare facilities can make informed decisions and develop strategies to optimize the utilization of this essential diagnostic tool.

MRI scans can be performed with or without the use of contrast agents, which are substances that enhance the visibility of certain tissues or abnormalities. Let's delve into the specifics of MRI plain and contrast imaging:

MRI Plain Imaging:

MRI plain imaging, also known as unenhanced or non-contrast imaging, involves acquiring images without the use of contrast agents. In plain MRI, the intrinsic properties of tissues, such as their inherent water content and molecular composition, are utilized to generate images. The hydrogen atoms in the body's tissues align with the magnetic field, and when

subjected to radio waves, they emit signals that are detected by the MRI machine and processed into detailed images.

Plain MRI scans are useful for evaluating a wide range of anatomical structures and conditions. They provide excellent soft tissue contrast, allowing for the assessment of organs, muscles, bones, joints, blood vessels, and the central nervous system. Plain MRI is commonly employed for the diagnosis, staging, and monitoring of various conditions, including but not limited to:

Neurological disorders: Brain tumors, multiple sclerosis, stroke, and neurodegenerative diseases.

Musculoskeletal injuries and pathologies: Fractures, ligament tears, cartilage abnormalities, and bone tumors.

Abdominal and pelvic conditions: Liver and kidney diseases, gallbladder disorders, pelvic tumors, and gastrointestinal abnormalities.

Thoracic conditions: Lung nodules, mediastinal masses, and cardiac evaluation.

Breast imaging: Detection and characterization of breast tumors and screening for high-risk individuals.

Spinal conditions: Disc herniation, spinal cord compression, and spinal infections.

MRI Contrast Imaging:

Contrast-enhanced MRI involves the administration of contrast agents to improve the visibility and characterization of certain tissues or abnormalities. Contrast agents used in MRI are typically gadolinium-based and are administered intravenously. These agents have paramagnetic properties, which alter the local magnetic field, enhancing the contrast between different tissues.

Contrast agents help highlight specific areas of interest, such as tumors, blood vessels, inflammation, or areas of disrupted blood-brain barrier. They can provide valuable

information about the vascularity, perfusion, and cellular activity within tissues. Contrast-enhanced MRI is particularly valuable in various clinical scenarios, including:

Tumor detection and characterization: Contrast agents accumulate in tumor tissues due to their increased vascularity and leaky blood vessels, aiding in tumor identification, localization, and assessment of tumor extent.

Evaluation of inflammatory and infectious conditions: Contrast agents help identify regions of inflammation, such as abscesses, inflammatory bowel disease, or infections.

Vascular imaging: Contrast-enhanced MRI can visualize blood vessels, providing detailed information about their patency, flow dynamics, and potential abnormalities like aneurysms or vascular malformations.

Assessment of vascular permeability: Contrast agents can help evaluate the integrity of the blood-brain barrier and identify areas of increased permeability, which may be indicative of conditions like brain tumors, multiple sclerosis, or cerebral ischemia.

Characterization of liver lesions: Liver-specific contrast agents can aid in the differentiation between benign and malignant liver lesions, such as hepatocellular carcinoma or metastatic tumors.

It's important to note that while contrast-enhanced MRI is generally safe, there can be potential risks associated with contrast agents, such as allergic reactions or nephrogenic systemic fibrosis in patients with severe kidney dysfunction. The decision to administer contrast agents is based on the clinical indications, individual patient factors, and a careful assessment of the potential risks and benefits.

In conclusion, MRI plain imaging provides valuable anatomical information with excellent soft tissue contrast, while contrast-enhanced MRI improves the visualization and characterization of specific tissues or abnormalities. The choice between plain and contrast-enhanced MRI depends on the clinical question, the area of interest, and the specific diagnostic requirements for each patient. MRI imaging techniques continue to advance, offering increasingly detailed and accurate information to aid in the diagnosis and management of a wide range of medical conditions.

MRI UNDER GENERAL ANESTHSIA

In some cases, certain patients, such as young children, individuals with severe anxiety, or those unable to remain still during the scan, may require MRI under general anesthesia. This procedure involves administering anesthesia to ensure the patient's comfort and safety throughout the imaging process. Let's explore the details of MRI under general anesthesia:

Patient Selection:

MRI under general anesthesia is typically considered for patients who cannot tolerate the scan while awake. This may include infants, young children, individuals with developmental disabilities, severe claustrophobia, or patients requiring lengthy or complex imaging sessions. The decision to proceed with general anesthesia is made by a multidisciplinary team, including an anesthesiologist and the referring physician, considering the patient's medical condition, age, cooperation level, and the diagnostic necessity of the MRI scan.

Pre-Anesthetic Assessment:

Before the MRI procedure, the patient undergoes a pre-anesthetic assessment. This involves a thorough medical evaluation, including a review of the patient's medical history, physical examination, and relevant laboratory tests. The anesthesiologist assesses the patient's overall health, previous anesthetic experiences, and any potential risk factors to ensure the safe administration of anesthesia during the MRI scan.

Anesthesia Administration:

On the day of the procedure, the patient is brought to the preparation room or an MRI suite. An anesthesiologist administers the general anesthesia, typically through intravenous (IV) medications. The choice of anesthetic agents depends on the patient's age, weight, medical condition, and the anticipated duration of the MRI scan. Anesthesia induction aims to achieve a state of deep sedation or unconsciousness to ensure the patient remains immobile, relaxed, and unaware during the scan.

Monitoring and Support:

During the MRI scan, the anesthesiologist continuously monitors the patient's vital signs, including heart rate, blood pressure, oxygen saturation, and carbon dioxide levels. Monitoring equipment, such as electrocardiography (ECG), blood pressure cuff, pulse oximeter, and capnography, is used to assess the patient's physiological status and ensure their safety throughout the procedure. The anesthesiologist and support staff remain present and vigilant to address any potential complications that may arise during the MRI scan.

Scan Procedure:

Once the patient is under general anesthesia, they are carefully positioned on the MRI table. Anesthesia personnel ensure that the patient's airway is protected and secured, and appropriate padding or support is provided to maintain a stable position during the scan. The MRI technologist then proceeds with acquiring the necessary images based on the diagnostic requirements. The duration of the scan depends on the complexity of the imaging protocol and the specific needs of the patient.

Post-Anesthetic Care:

Following the completion of the MRI scan, the patient is gradually awakened from anesthesia in a controlled environment. The patient is monitored during the recovery phase to ensure a smooth transition from anesthesia to wakefulness. The anesthesiologist assesses the patient's vital signs, pain levels, and overall well-being before determining their readiness for discharge.

MRI under general anesthesia allows for the successful completion of scans in patients who would otherwise be unable to tolerate the procedure. It ensures their comfort, safety, and cooperation during the imaging process, enabling accurate diagnosis and appropriate medical management. The multidisciplinary approach involving anesthesiologists, radiologists, and technologists ensures the smooth execution of MRI under general anesthesia, providing valuable diagnostic information for patients in need.

Clinical Benefits of MRI:

Detailed Soft Tissue Imaging: MRI provides exceptional soft tissue contrast, allowing for detailed visualization of organs, muscles, ligaments, tendons, and the central nervous system. This capability is particularly valuable in diagnosing and monitoring a wide range of conditions, including tumors, injuries, degenerative diseases, and neurological disorders.

Multi-Planar Imaging: MRI can acquire images in multiple planes (sagittal, coronal, and axial), providing comprehensive information about anatomical structures from various angles. This versatility aids in accurate diagnosis, treatment planning, and surgical guidance.

No Ionizing Radiation: Unlike X-ray and CT scans, which use ionizing radiation, MRI uses magnetic fields and radio waves. This makes MRI a safer option, especially for pediatric patients, pregnant women, and individuals requiring multiple scans over time. The absence of ionizing radiation reduces the long-term risks associated with cumulative radiation exposure.

Enhanced Diagnostic Accuracy: MRI's superior soft tissue contrast and multi-planar capabilities often result in improved diagnostic accuracy compared to other imaging modalities. It can detect subtle abnormalities, differentiate between healthy and diseased tissues, and provide more precise information for clinical decision-making.

Revenue Benefits of MRI:

Higher Reimbursement Rates: Generally, MRI procedures tend to have higher reimbursement rates compared to X-ray and CT scans. The complexity and specialized nature of MRI examinations justify higher reimbursement from insurance payers. This can contribute to increased revenue for healthcare facilities.

Expanded Service Offerings: By offering MRI services, healthcare facilities can expand their range of diagnostic capabilities. This attracts more referring physicians, specialists, and patients who require advanced imaging. Providing comprehensive services can enhance the facility's reputation and increase patient volume, leading to improved revenue generation.

Attracting Complex Cases and Subspecialty Referrals: MRI's ability to provide detailed and comprehensive imaging is particularly valuable for complex cases and subspecialty evaluations. By offering advanced MRI services, healthcare facilities can attract more complex cases and gain the trust of referring physicians. This can result in increased referrals, patient loyalty, and revenue growth.

Reduced Follow-up Scans: MRI's superior diagnostic accuracy can help minimize the need for additional imaging studies and follow-up scans. This reduces healthcare costs by avoiding unnecessary procedures and streamlining the diagnostic process. It also improves patient satisfaction by providing a more efficient and effective diagnostic experience.

Long-Term Cost-Effectiveness: While MRI equipment and maintenance costs may be initially higher than other imaging modalities, the long-term cost-effectiveness of MRI can be significant. MRI's ability to provide accurate and targeted diagnoses can lead to better treatment planning, reduced hospital stays, and improved patient outcomes. This can result in long-term cost savings for healthcare facilities and patients.

In conclusion, MRI offers significant clinical benefits, including detailed soft tissue imaging, multi-planar capabilities, and functional assessment. From a revenue perspective, MRI provides higher reimbursement rates, expanded service offerings, attracts complex cases and referrals, reduces follow-up scans, and offers long-term cost-effectiveness. Incorporating MRI services can enhance patient care, attract more patients and referrals, and contribute to the financial success of healthcare facilities.

CHAPTER 2 : REVIEW OF LITERATURE

Author	Title	Methodology	Findings
Kenneth K. Agwu et al, 2021	Improving Patient Flow: - Case Study of Radiology at Miyoshi Hospital	Improving Patient Flow: - Case Study of Radiology at Miyoshi Hospital	"The arrival times of patients exhibited an unpredictable and uncertain pattern. On average, there were 7 +- 5.4 patients per hour per day. Between 7 am and 10 am, the number of patients arriving reached its peak at 12 per hour. The average duration of each patient's service was 15 minutes. The average cumulative waiting time for patients was 116 minutes. It was observed that the waiting time had a significant positive correlation with the rate of patient arrivals (P <0.05)."
L. Hof man,2014	Capacity Management in Isala's RadiologyManagement of Planned and	Cross-sectional study	"By modifying the planning process, it is possible to mitigate the adverse effects of

	Unplanned Patient Arrival Variability		bottlenecks that hinder performance and introduce variability. The volatile nature of demand makes it extremely challenging to accurately forecast future needs. However, enhancing performance in terms of access time, latency, utilization, workload, and cost can be achieved by eliminating bottlenecks."
Dr (Brig). A.P. Pandit, Ms. Tanima Debmallik,2016	Radiology Waiting and Reporting Times at Kolkata Tertiary Medical Hospital Reduced Using Lean Six Sigma	Six Sigma DMAIC approach, Genbawalk interviews and time motion studies	"The cause of the delay was shown using a Pareto chart. As the solution approaches to improve patient orientation and readiness to perform scans, pre-test latency is reduced, and operation is smoother."

Rajeev Saxena, Sartaj Sharma, Vivek Sharda, Nalini G, Manoj Kumar Yadav **("Calculation of parameters for the consultation | Download Table")**	to visit the outpatient clinic and provide new recommendations for conducting research to enhance the healthcare system	From a pool of patients who visited various OPDs, 100 respondents were chosen at random. Data were collected by questionnaires and inperson interviews.	"The majority of patients (95) registered in less than 30 minutes, while 49% had consultations that lasted longer than 30 minutes. One of the main causes of delay has been due to a number of factors, including round overlap, OPD wait times, lab sample transportation, and preparation times in radiology. A real-time waiting system, advanced simulations, and queueing techniques will all be very beneficial for delivering effective and appropriate medical care."
Shyamkumar Shriram,2012	How demographics, hospital ownership and ambulance arrivals affect waiting time	For this study, data was collected from 830 patients seeking outpatient treatment in 30 randomly selected	"Profit-owned hospitals have a shorter wait time than other hospitals, patients who arrive by ambulance have

		districts in Nellore, India. Linear and logistic regression models were used to identify the effect of various determinants on hospital waiting time	a shorter wait time than patients who don't arrive by ambulance. It has also been observed that people of high economic status have shorter waiting times than others, so some changes need to be made to the health system to ensure equal access to health care for all categories of patients.”
V. Rema, and K Sikdar	Optimizing waiting time in the outpatient department of a multi-speciality Indian hospital	Introduction of technology and model based on Queue Monte Carlo simulation, snowball sampling technique using questionnaire was used to collect the data	“Key performance indicators have been calculated to enable the management of patient flows and improve the operational efficiency of the service by identifying ways to reduce delays”
Sabina Nuti, Milena Vainieri	To analyze variation in the delivery of diagnostic services in order to suggest possible solutions to	Waiting time measured per day was compared on the basis of the utilization rate of	“Significant differences were found in domains related to age, gender, and

	reduce waiting time and increase quality of service and decrease financial cost	CT and MRI imaging in Tuscany	mortality, suggesting that radiology services were suboptimal and that services are underused or overused and need improvement"
Melesse Belayneh, Mirkuzie Woldie, Negalign Berhanu	To access patients waiting time and its determinants in Debre Markos & Felge Hiwot referral hospitals of Amhara regional state in the north-west, Ethiopia	Cross-sectional study design was used along with Quantitative data collection using a questionnaire and checklist	The major causes of long waiting times were an outsized number of patients with few doctors, the long attempting to find patient cards, and also the long waiting time for registration. there's a requirement for healthcare facilities and hospital administration to handle gaps in human resources, infrastructure and other internal procedures getting to reduce waiting time and ensure effective healthcare
Md Obaidul Haque, Sharmin Akter,	Study on Outpatient Waiting Time for	Queuing Model	According to this calculation, (i) at

Anwar Hossen, Zillur Rahman	Treatment using Multiple Servers Queuing Model at Public Eye Hospital in Bangladesh (“A CASE STUDY ON OUTPATIENT WAITING TIME FOR TREATMENT WITH MULTIPLE ...”)		BIOEH, the average waiting time for each patient in this system is 29.4 minutes and the average number of patients is 1264.2. The average number of patients or patient flow in this hospital is very high, but the number of specialists in this hospital is not enough. This hospital must therefore increase the number of specialists. (ii) In the ophthalmology department of Comilla Medical College Hospital, the average number of patients is very low, but a large number of specialists. In conclusion, to increase the patient flow of this hospital, this

			hospital could go digital
Mor Armony, Shlomo Israelit, Avishai Mandelbaum, Yariv N. Marmor, Yulia Tseytlin, and Galit B. YomTov	Patient Flow in Hospitals: A Data Based Queueing Science Perspective	Queuing Model	As patients advance during their hospital stay, their medical needs change (generally for the better), and so does the precision with which their LOS can be predicted, operational performance is the simplest approach to define, measure, monitor, and react in real time. This knowledge can be highly beneficial for successfully juggling responsibilities.

METHODOLGY

1. Study Design

• MIXED METHODS RESEARCH

2. Data Collection

• Primary Data Collection

• Observer-based tracking

1. Study population

• Patients visiting the radiology department to avail of the MRI services at the hospital with prior appointment or intimation both Male & Female Population

• Age criteria- 4 years to 92 years

2. Sampling

• Study Setting – Radiology Department, Medanta Hospital , Gurugram

• Sample Size – 105

• Sampling Method – Random

• Type of Data – Quantitative data

• Tools- MS Excel, process mapping software

5. Inclusion Criteria – All outpatients, IPD & Emergency Patients coming to the radiology department for MRI Scan services with prior appointment or intimation

6. Exclusion Criteria – none

7. Limitation of Study

• Fixed Duration of study

• Radiology department of a single hospital was the center of study , the result cannot be generalized to the whole population

OBSERVATIONS :

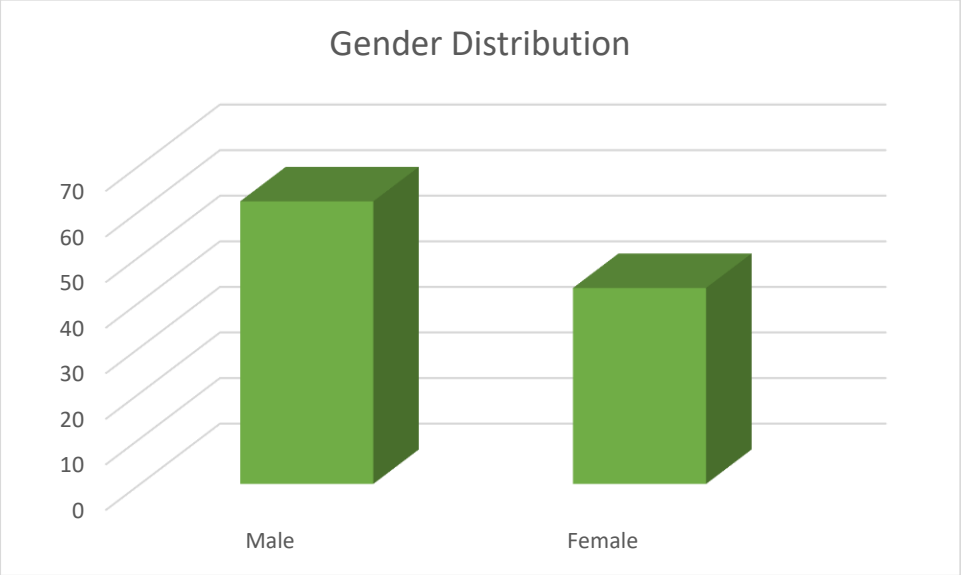

Fig 1 : Demographic distribution of the data

Demographic data :

Out of 105 patients who visited the Radiology department of Medanta for MRI scans :

Males: 59.05%

Females : 40.95%.

The results of the study indicate valuable insights into the waiting time and preparation time for MRI scans, specifically focusing on a sample size of 105 scans. The average waiting time for all scans was found to be approximately 27 minutes, while the average preparation time for contrast-enhanced scans was determined to be around 12 minutes. These findings shed light on the efficiency and effectiveness of the MRI department's operations and provide important information for optimizing patient flow and enhancing overall MRI utilization.

PROCEDURE TYPE :

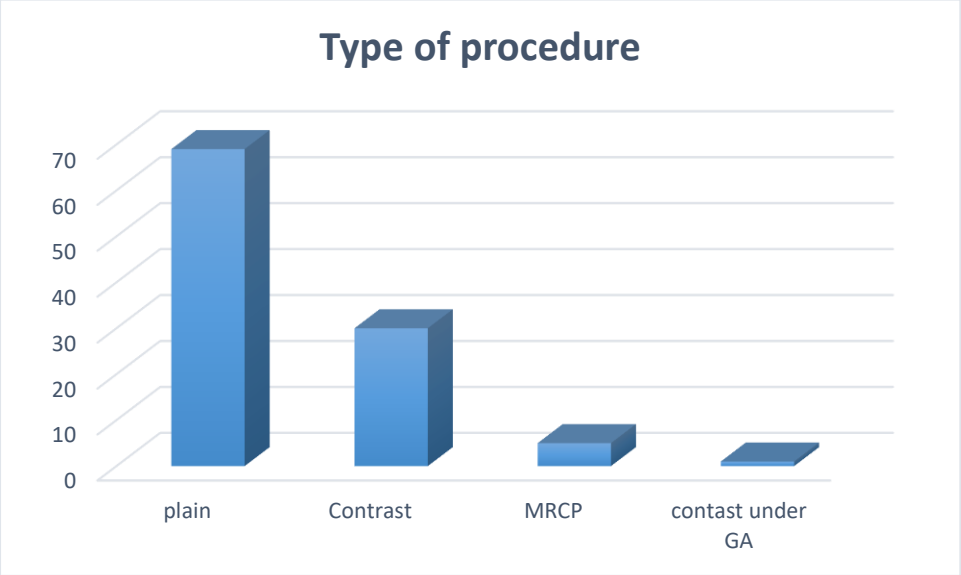

Fig 2 : Types of scans

Out of the 105 cases observed ,

"Plain" Procedures: The most frequently performed procedure type was "plain," accounting for 69 out of the total 105 procedures (65.7% of the total). This indicates that plain procedures were the most common in this dataset.

"Contrast" Procedures: The second most common procedure type was "contrast," with a count of 30 (28.6% of the total). While less frequent than plain procedures, contrast procedures still comprised a significant portion of the dataset.

"MRCP" Procedures: The count of "MRCP" procedures was 5 (4.8% of the total). MRCP procedures were performed less frequently compared to plain and contrast procedures, suggesting they were a relatively less common procedure type in this context.

"Contrast under GA" Procedures: There was only one instance of a "contrast under GA" procedure, representing a very small proportion of the total (0.9%).

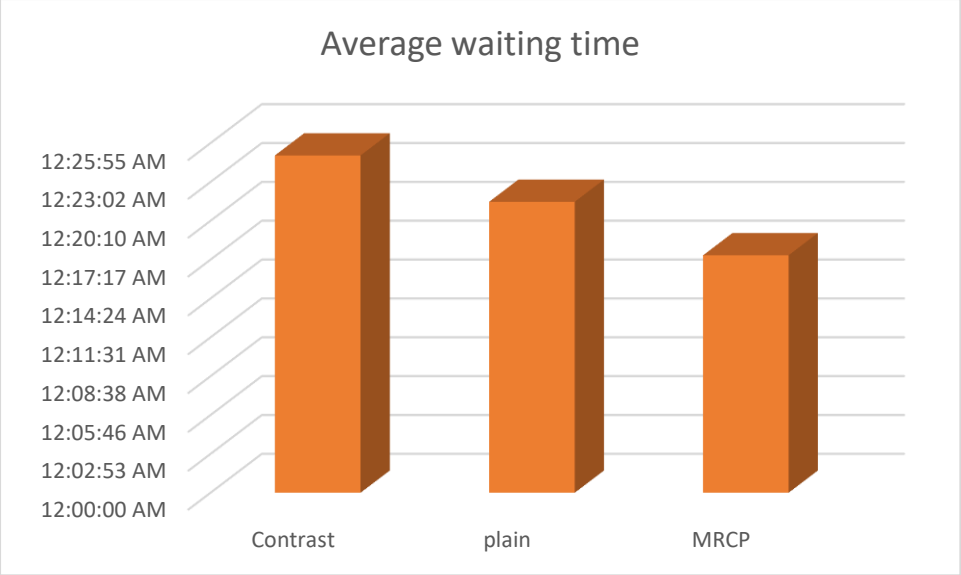

Fig. 3 : Average waiting time as per scan type.

Average Waiting Time:

The study revealed that patients experienced an average waiting time of approximately 22 minutes before undergoing their MRI scans. This waiting time encompasses the period from the patient's arrival at the MRI department until the actual start of the scan. Factors contributing to the waiting time may include administrative procedures, patient check-in processes, availability of scan rooms, and the overall patient load in the department.

The average waiting time provides a quantitative measure of the efficiency of the MRI department in managing patient flow. It serves as a benchmark for evaluating and improving the scheduling and resource allocation practices to minimize patient wait times and maximize MRI utilization.

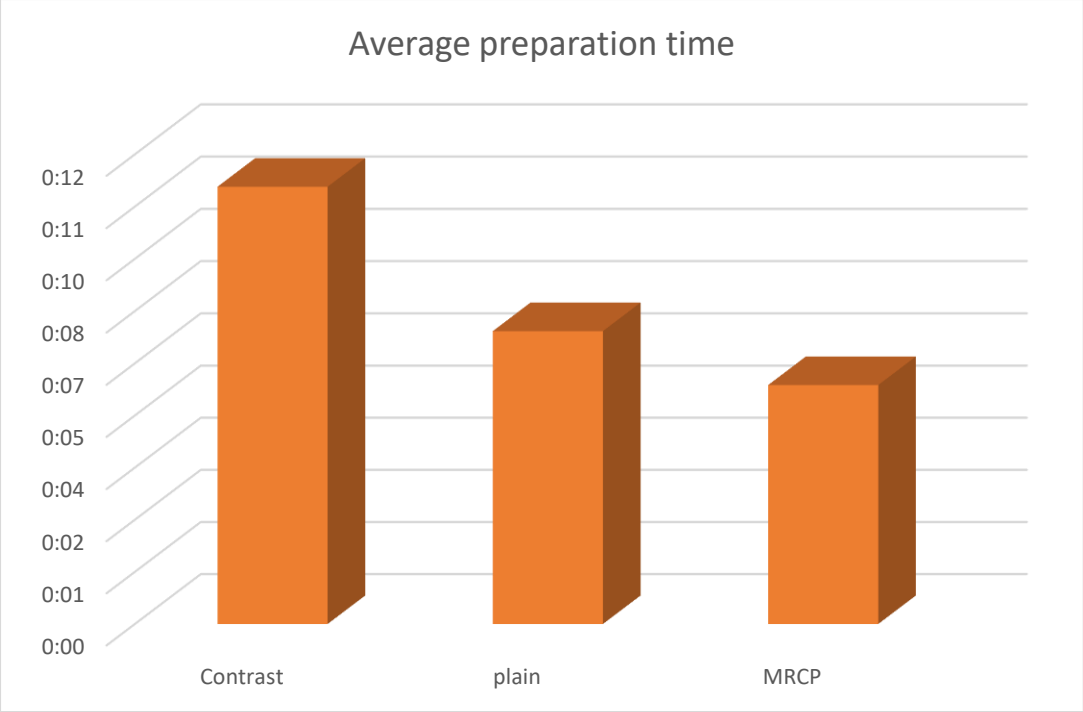

Fig 4 : Average preparation time as per scans

Average Preparation Time for Contrast Scans:

For contrast-enhanced scans, which require additional preparation and administration of contrast agents, the study found an average preparation time of approximately 12 minutes. This preparation time includes activities such as verifying patient information, obtaining consent, explaining the procedure, and administering the contrast agent when the patient is shifted inside the machine. The preparation time can vary based on the complexity of the patient's condition, the type of contrast agent used, and the efficiency of the department's processes.

The average preparation time provides insights into the efficiency and effectiveness of the MRI department's protocols for contrast-enhanced scans. It can guide efforts to optimize the preparation process, streamline workflows, and ensure timely administration of contrast agents to improve patient care and satisfaction.

It is important to note that the results are specific to the sample size of 105 scans and may not be generalized to the entire patient population. Further studies with larger sample sizes and additional variables can provide a more comprehensive understanding of the waiting time and preparation time dynamics in the MRI department.

The findings of the study provide a detailed and elaborate understanding of the various factors contributing to delays in shifting patients from different departments to the MRI department. The following results highlight the specific delays encountered and their impact on MRI utilization:

Delay in Shifting from IPD, ICU, Emergency to MRI:

The study identified delays in transferring patients from the Inpatient Department (IPD), Intensive Care Unit (ICU), and Emergency Department to the MRI department. These delays can occur due to several reasons, including the availability of transportation, prioritization of emergency cases, or administrative procedures. Such delays can significantly impact MRI utilization by prolonging wait times and affecting the overall patient flow within the MRI department.

Delay in Cannulation and Nurses' Busyness:

Delays in cannulation, particularly when nurses are occupied with shifting other patients, were observed. This can occur due to resource constraints or high patient volumes, which result in limited nursing staff available for cannulation procedures. These delays can lead to prolonged patient preparation time and impact the efficiency of MRI utilization.

Delay in Changing:

The study highlighted delays in patients changing into appropriate attire, such as wearing hospital gowns or removing metallic objects, before undergoing the MRI scan. This delay can occur due to factors such as inadequate changing facilities, patients' unfamiliarity with the process, or insufficient staff assistance. Delays in changing can prolong the overall patient preparation time and contribute to reduced MRI utilization.

Delay in Pre-medicating:

The study identified delays in pre-medicating patients before their MRI scans. This delay can arise when the prior preparation of giving oral medication is not completed, leading to the

need for additional time before proceeding with the scan. Such delays can impact MRI utilization by extending the overall patient turnaround time and affecting the scheduling of subsequent patients.

Delay in Shifting from Bed/Wheelchair to Stretcher:

Delays were observed in transferring patients from beds or wheelchairs to the MRI stretcher. These delays can occur due to logistical challenges, lack of available staff, or difficulties in maneuvering patients safely. Delayed shifting can disrupt patient flow and affect MRI utilization by increasing the time required for patient preparation and scan completion.

Limited Availability of Anesthesia Doctors:

The study revealed that the presence of only one anesthesia doctor in the radiology department , this can lead to delays in MRI and other procedures that require anesthesia administration. The limited availability of anesthesia doctors can result in scheduling constraints and longer wait times for patients. Improving staffing levels or implementing efficient scheduling practices can help minimize these delays and optimize MRI utilization.

Technical Issues with the Machine:

Technical issues with the MRI machine were identified as a factor contributing to delays. Equipment malfunctions or maintenance requirements can disrupt the workflow, leading to rescheduling of appointments or extended downtime for repairs. These technical issues can hinder MRI utilization by reducing the overall availability of the machine and impacting patient throughput.

Delay Due to Pre-MRI Tests:

Delays in MRI examinations were observed when patients required pre-MRI tests, such as blood work or imaging scans. The completion of these tests before the MRI procedure can introduce additional wait times and affect the overall efficiency of MRI utilization.

Delay in Doctor Arrival for Consultation before Contrast:

Delays in the arrival of doctors for consultation before contrast-enhanced MRI scans were identified. These delays can occur due to conflicting schedules, emergencies, or logistical challenges. Delayed consultations can result in extended patient wait times and impact the scheduling of subsequent patients, thus affecting MRI utilization.

Tech Unavailability and Delay in Shifting Ventilated Patients:

The study revealed that delays can occur when a technician is unavailable to assist in the shifting of ventilated patients. These delays can result from resource constraints or the need for specialized personnel to ensure safe patient transfer. The delay in shifting ventilated patients can impact MRI utilization by prolonging patient preparation time and affecting the overall patient flow.

Lack of Communication from IPD Nurses to MRI Reception:

The study found that IPD nurses sometimes failed to communicate delays to the MRI reception. This lack of communication can lead to mismanaged patient schedules, increased wait times, and reduced MRI utilization. Improving interdepartmental communication channels and emphasizing the importance of timely information sharing can help address this issue.

Patient-Related Events:

Patient-related events, such as motion, claustrophobia, anxiety, or discomfort, were identified as factors contributing to delays in MRI procedures. These events can result in the need for additional patient reassurance, sedation, or rescheduling of the scan. Addressing patient-related events through proper patient education, anxiety management techniques, or alternative imaging options can help minimize delays and optimize MRI utilization.

Overall, the study highlights the diverse range of factors contributing to delays in shifting patients to the MRI department, emphasizing the importance of addressing these challenges

to optimize MRI utilization. Implementing strategies such as improved interdepartmental coordination, resource allocation, streamlined workflows, and enhanced communication channels can help minimize delays, improve patient care, and enhance the overall efficiency of the MRI department.

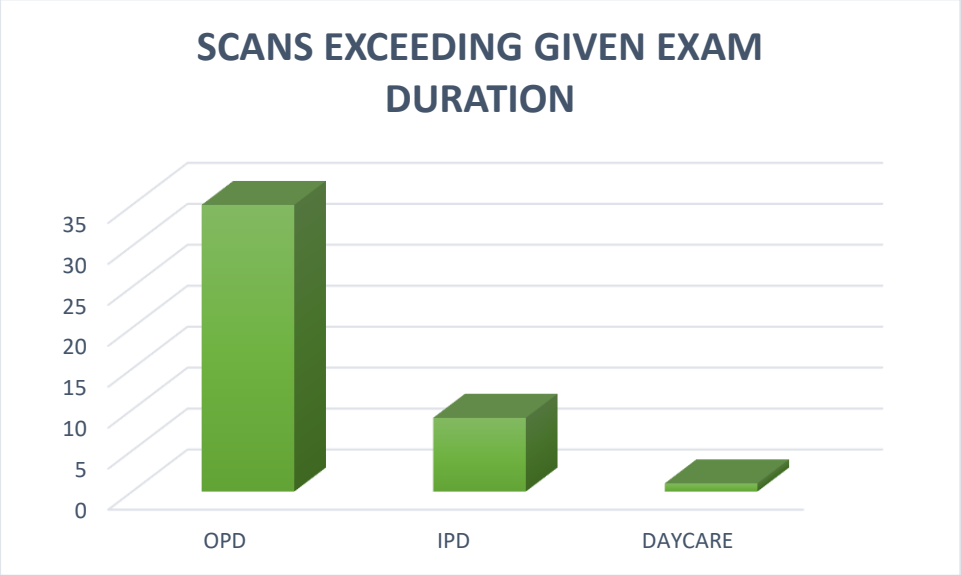

Fig 5 : Scans exceeding given exam duration

FISH BONE / ISHIKAWA DIAGRAM

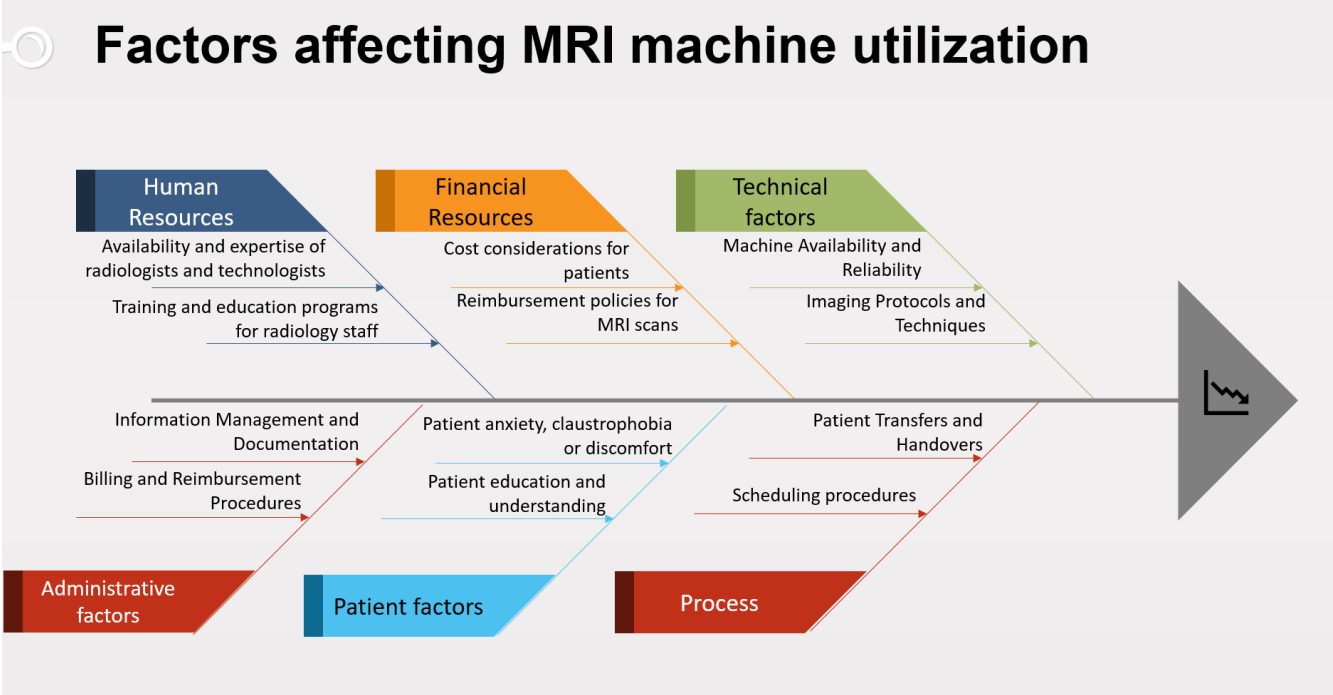

Fig 6 : Fishbone diagram

DISCUSSION :

1. TECHNOLOGICAL FACTORS

TYPES OF MRI MACHINE AVAILABLE AT MEDANTA

1.5 Tesla MRI Machine:

A 1.5 Tesla MRI machine refers to a magnetic resonance imaging system that generates a magnetic field with a strength of 1.5 Tesla (or 15,000 Gauss). Here are some key points about 1.5 Tesla MRI machines:

1. Image Quality:
- 1.5 Tesla MRI machines offer excellent image quality and are widely used in clinical practice.
- They provide high-resolution images with good tissue contrast, allowing for the detection and characterization of various anatomical structures, lesions, and pathologies.
- The image quality is suitable for a broad range of applications, including neuroimaging, musculoskeletal imaging, abdominal imaging, and more.
2. Clinical Applications:
- 1.5 Tesla MRI machines are versatile and commonly used for a wide range of clinical indications.
- They are suitable for routine imaging exams, such as brain, spine, joint, and abdominal scans.
- While they may not provide the highest resolution or sensitivity for certain specialized applications, they are generally sufficient for most clinical scenarios.

3 Tesla MRI Machine:

A 3 Tesla MRI machine refers to a magnetic resonance imaging system that generates a magnetic field with a strength of 3 Tesla (or 30,000 Gauss). Here are some key points about 3 Tesla MRI machines:

1. Image Quality:
- 3 Tesla MRI machines offer enhanced image quality compared to 1.5 Tesla machines.

- The higher magnetic field strength improves signal-to-noise ratio, resulting in sharper and more detailed images.
- The improved image quality can aid in the detection and characterization of subtle lesions, small anatomical structures, and functional imaging studies.

2. Clinical Applications:

- 3 Tesla MRI machines are particularly valuable for specialized imaging applications and research studies.
- They are often preferred for neuroimaging, as they can provide detailed visualization of brain structures, white matter tracts, and functional MRI (fMRI) studies.
- 3 Tesla machines may also be beneficial for musculoskeletal imaging, cardiac imaging, breast imaging, and advanced vascular imaging studies.

Impact of Upgrades and Maintenance on MRI Utilization

MRI machines are essential diagnostic tools in modern healthcare, and their optimal performance is crucial for efficient patient care. Upgrades and maintenance procedures play a significant role in ensuring the reliability, functionality, and utilization rates of MRI machines.

Frequency of Upgrades:

Regular upgrades of MRI machines are essential to keep pace with technological advancements and enhance imaging capabilities. The frequency of upgrades can vary depending on factors such as the age of the machines, budgetary considerations, and the availability of new technologies. In Medanta Hospital, a comprehensive evaluation of the upgrade cycle is conducted to determine the optimal frequency of upgrades.

The impact of upgrades on utilization rates is twofold. Firstly, upgrades expand the range of imaging techniques and sequences available, allowing for more accurate diagnoses and improved patient care. Higher field strengths, advanced imaging sequences, and enhanced image reconstruction algorithms provided by upgrades enable radiologists to obtain high-quality images and make precise interpretations. Consequently, the utilization rates of MRI machines tend to increase as the upgraded systems offer enhanced diagnostic capabilities.

Secondly, upgrades often reduce scan times, thereby increasing the efficiency of MRI examinations. Faster scan times allow for more patients to be accommodated within a given timeframe, improving patient throughput and utilization rates. Moreover, shorter scan durations enhance patient comfort and satisfaction, contributing to a positive overall experience.

Effectiveness of Maintenance Procedures:

Maintenance procedures are critical for ensuring the optimal performance and longevity of MRI machines. Regular inspections, calibrations, and preventive maintenance help identify and address issues before they escalate into major problems. The effectiveness of maintenance procedures directly influences the utilization rates of MRI machines.

Effective maintenance procedures minimize unexpected breakdowns and reduce machine downtime. By proactively addressing technical issues, maintenance procedures ensure that MRI machines are available for scheduled examinations and minimize disruptions to workflow. Timely repairs and replacements of faulty components contribute to uninterrupted service provision and higher utilization rates.

In addition, routine maintenance helps identify potential performance issues, such as image artifacts or suboptimal image quality, which can affect diagnostic accuracy. Regular calibrations and quality control checks optimize image acquisition and ensure the reliability of diagnostic results.

Furthermore, adherence to manufacturer-recommended maintenance schedules and procedures is essential. This includes regular updates of software and firmware to address known issues and optimize machine performance. Strict compliance with maintenance protocols provides a proactive approach to address potential challenges and ensure optimal utilization rates.

Conclusion:

In conclusion, upgrades and maintenance procedures have a significant impact on MRI utilization rates. Regular upgrades expand the imaging capabilities, improve diagnostic accuracy, and enhance patient throughput. Effective maintenance procedures minimize downtime, ensure optimal performance, and contribute to uninterrupted service provision. Medanta Hospital has established an upgrade cycle and robust maintenance protocols to maximize MRI utilization rates and enhance patient care.

OPERATIONAL FACTORS

SCHEDULING

Effective scheduling is crucial for optimizing MRI utilization. This factor involves the process of appointment booking, managing time slots, and minimizing wait times for patients.

APPOINTMENT SYSTEM

Appointments for MRI can be scheduled in several ways:

Online: Patients can book appointments for radiology services through the Medanta website. The website provides a list of available radiology services, along with appointment dates and times. Patients can select their preferred service, date and time, and book the appointment online.

By phone: Patients can call the Medanta customer service center to schedule an appointment for radiology services. The customer service representative will help schedule an appointment at a convenient date and time.

Through the Medanta app: Patients can also book radiology appointments through the Medanta app, which is available for download on iOS and Android devices. The app allows patients to select the radiology service they require and schedule an appointment.

In-person: Patients can also schedule an appointment for radiology services in person at the hospital's radiology department. They can walk into the radiology department and speak with the receptionist, who will help schedule an appointment.

WAIT TIMES AND PATIENT SATISFACTION

Wait times for MRI examinations can significantly impact both patient satisfaction and overall MRI utilization rates. This section provides a comprehensive analysis of the relationship between wait times, patient satisfaction, and MRI utilization in Medanta Hospital. It examines the factors contributing to wait times, the impact on patient satisfaction, and strategies to optimize wait times and enhance patient experience.

Factors Contributing to Wait Times:
Several factors can contribute to wait times for MRI examinations. Understanding these factors is crucial for identifying areas of improvement. The following factors should be considered:

Appointment Scheduling and Workflow:
Efficient scheduling processes and workflow management play a significant role in reducing wait times. An optimized appointment scheduling system should consider factors such as examination priority, available time slots, and patient needs. Streamlined workflow and effective communication between departments ensure timely patient handoffs and minimize delays.
Equipment Availability and Maintenance:
The availability of MRI machines and their operational status directly impact wait times. Equipment breakdowns, routine maintenance, and upgrades can lead to decreased availability and increased wait times. Regular maintenance protocols, effective equipment management, and quick response to technical issues are essential to minimize equipment-related delays.

Technologist Capacity and Efficiency:
The number of available MRI technologists and their efficiency in performing examinations directly affect wait times. Adequate staffing levels, optimized scheduling of technologists' shifts, and ongoing training contribute to efficient workflow and reduced wait times. Ensuring that technologists are proficient in advanced imaging techniques and possess excellent time management skills can enhance examination efficiency.

Impact on Patient Satisfaction:

Wait times have a substantial influence on patient satisfaction levels. Prolonged wait times can lead to patient dissatisfaction, anxiety, and frustration. Patients may perceive long wait times as a reflection of poor service quality or inefficiency, which can negatively impact their overall experience and satisfaction with Medanta Hospital.

Additionally, wait times can also affect patients' perception of the quality of care. Patients may believe that delays in receiving an MRI examination could delay their diagnosis or treatment, leading to increased stress and uncertainty. Addressing wait times is crucial to improve patient satisfaction, enhance patient-provider relationships, and foster a positive perception of the hospital's services.

Strategies to Optimize Wait Times and Enhance Patient Experience:
To optimize wait times and enhance patient experience, Medanta Hospital has implemented the following strategies:

Efficient Appointment Scheduling:
Medanta has implemented a centralized scheduling system that optimizes the allocation of MRI slots based on examination priority, patient needs, and equipment availability. Utilization of appointment reminder systems is done and patients are provided with clear instructions on preparation to minimize delays and no-shows.

Streamlined Workflow and Communication:
Enhance interdepartmental communication and collaboration to streamline workflow and minimize handoff delays. Utilize technology solutions, such as electronic medical record systems, to facilitate seamless information exchange and real-time updates between departments involved in the MRI process.

Patient Education and Communication:
Educate patients about the MRI process, including preparation instructions and expected wait times, to manage their expectations. Provide clear and timely communication about any changes or delays to their scheduled appointments. Engage in proactive communication with patients to address their concerns and provide updates on their status in the waiting process.

Continuous Process Improvement:

Regularly review and analyze MRI workflow data to identify bottlenecks and areas for improvement. Implement process improvement initiatives, such as lean methodologies or automation of manual tasks, to optimize workflow efficiency and reduce wait times. Regularly evaluate the impact of implemented changes on wait times and patient satisfaction.

Conclusion:
Wait times for MRI examinations have a significant impact on patient satisfaction and overall MRI utilization rates in Medanta Hospital. By understanding the factors contributing to wait times and implementing strategies to optimize workflow, enhance communication, and improve efficiency, Medanta Hospital minimizes wait times, enhance patient satisfaction, and optimize MRI utilization. Prioritizing patient-centered care and continuously monitoring and improving the MRI process will contribute to a positive patient experience and improved outcomes.

COMMUNICATION AND COORDINATION

Communication and Information Exchange
Effective communication and information exchange play a critical role in optimizing MRI utilization and ensuring quality patient care. This section provides a comprehensive analysis of communication and information exchange processes within Medanta Hospital's MRI department. It examines the importance of communication, challenges faced, and strategies to enhance communication and information exchange for improved MRI utilization.

Importance of Communication in MRI Utilization:
Communication is a fundamental aspect of MRI utilization, impacting workflow efficiency, patient care, and overall utilization rates. The following aspects highlight the importance of communication in MRI utilization:

Interdepartmental Collaboration:
Efficient communication between the MRI department and other departments, such as IPD ,ER, referring physicians, and scheduling departments like front office or reception or

operations control center, is crucial for streamlined workflow and optimal MRI utilization. Collaborative communication ensures the timely transfer of patient information, examination requests, and results, enabling seamless coordination and maximizing MRI utilization.

Patient Preparation and Education:

Clear and effective communication with patients is vital for successful MRI examinations. Technologists or front office staff should provide detailed instructions to patients regarding preparation procedures, including dietary restrictions, medication requirements, and dress code. Proper education and communication alleviate patient anxiety, enhance cooperation during the examination, and contribute to a positive patient experience. Patients should be counselled about the time duration of their scan and how they should stay still during the scan and should be asked prior to the scan if they are claustrophobic or get uncomfortable in enclosed areas like the machine to avoid repetition of scans and delay in other patients.

Clinical Information Exchange:

Effective communication and information exchange between referring physicians and MRI technologists/radiologists are essential for accurate diagnosis and appropriate examination selection. Timely sharing of clinical information, including relevant medical history, symptoms, and specific examination requirements, ensures that MRI protocols are tailored to meet patient needs, resulting in better diagnostic outcomes.

Challenges in Communication and Information Exchange:

Several challenges may impede effective communication and information exchange within the MRI department. Understanding these challenges is crucial for implementing targeted strategies to overcome them. The following challenges should be considered:

Technological Limitations:

Outdated communication systems or incompatible software platforms may hinder efficient information exchange. Lack of integration between the electronic medical record system, radiology information system, and the MRI system can lead to delays, errors, and miscommunication.

Workflow Bottlenecks:
Complex workflow patterns, fragmented processes, and unclear roles and responsibilities can hamper effective communication. Lack of standardized communication protocols and inefficient handoff processes may result in information gaps, delays, and potential errors.

Language and Cultural Barriers:
Multicultural and diverse patient populations can present language and cultural barriers that impact communication effectiveness. Language interpretation services and culturally sensitive communication approaches should be considered to ensure accurate information exchange and patient understanding.

Strategies to Enhance Communication and Information Exchange:
To overcome communication challenges and enhance information exchange, Medanta Hospital has implement the following strategies:

Technological Integration:
Medanta has implemented an integrated communication system that links the electronic medical record, radiology information system, and MRI system to facilitate seamless information exchange. Utilize picture archiving and communication systems (PACS) for efficient sharing and storage of images and reports.

Standardized Communication Protocols:
Develop standardized communication protocols, including clear guidelines for information handoffs, report generation, and result notification. Standardized protocols promote consistency, reduce errors, and facilitate efficient communication among healthcare professionals.

Training and Education:

Provide comprehensive training programs for MRI technologists, radiologists, and other healthcare professionals involved in the MRI process. Training should focus on effective communication techniques, cultural competency, and patient-centered communication to enhance information exchange and patient satisfaction.

Patient Engagement Tools:
Utilize patient portals, mobile applications, or online platforms to facilitate communication between patients and the MRI department. These tools can provide patients with access to appointment scheduling, preparation instructions, and result notifications, promoting patient engagement and active participation in their care.

Continuous Quality Improvement:
Regularly evaluate communication processes and identify areas for improvement. Implement feedback mechanisms, such as patient satisfaction surveys or staff feedback systems, to gather insights and make data-driven improvements in communication and information exchange practices.

Conclusion:
Effective communication and information exchange are vital for optimizing MRI utilization and providing quality patient care in Medanta Hospital. By implementing strategies such as technological integration, standardized protocols, training programs, patient engagement tools, and continuous quality improvement, Medanta Hospital has overcome communication challenges, enhance information exchange, and improve overall MRI utilization rates, patient satisfaction, and clinical outcomes.

RESOURCE ALLOCATION AND MANAGEMENT

Effective resource allocation and management are critical factors that impact MRI utilization in Medanta Hospital. This section provides a comprehensive analysis of resource allocation and management practices within the MRI department. It examines the importance of

resource optimization, challenges faced, and strategies to enhance resource allocation and management for improved MRI utilization.

Importance of Resource Allocation in MRI Utilization:

Optimal resource allocation is crucial for maximizing MRI utilization and ensuring efficient patient care. The following aspects highlight the importance of resource allocation in MRI utilization:

MRI Machine Availability:

Effective allocation of MRI machines is essential to meet patient demand and minimize wait times. Proper scheduling, coordination, and maintenance of MRI machines ensure their optimal availability, reducing patient backlogs and enhancing MRI utilization rates.

Technologist Workforce:

Adequate staffing of skilled MRI technologists is essential for efficient workflow and timely examinations. Proper allocation of technologist shifts, workload distribution, and skill mix optimization ensure that patient appointments are accommodated promptly, reducing wait times and optimizing MRI utilization.

Ancillary Resources:

Apart from MRI machines and technologists, other resources such as contrast agents, coils, and sedation equipment should be properly allocated and managed. Ensuring the availability of these resources and optimizing their utilization contributes to streamlined workflow and improved MRI utilization rates.

Challenges in Resource Allocation and Management:

Several challenges may hinder effective resource allocation and management within the MRI department. Understanding these challenges is crucial for implementing targeted strategies to overcome them. The following challenges should be considered:

Equipment Maintenance and Downtime:

Unplanned equipment breakdowns and routine maintenance can impact MRI utilization. Balancing scheduled maintenance activities with patient demand and ensuring quick resolution of technical issues is essential to minimize downtime and optimize machine availability.

Staffing Constraints:

Limited availability of trained MRI technologists can pose challenges in meeting patient demand. Staffing constraints, including leaves, turnover, and training requirements, should be effectively managed to ensure adequate coverage and optimize MRI utilization.

Resource Misalignment:

Misalignment between patient demand, equipment availability, and staffing levels can lead to inefficient resource allocation. Inaccurate forecasting of patient volume, inadequate scheduling, and suboptimal resource utilization can result in underutilization or overutilization of resources, leading to increased costs and reduced efficiency.

Strategies to Enhance Resource Allocation and Management:

To overcome resource allocation challenges and optimize MRI utilization, Medanta Hospital can implement the following strategies:

Demand Forecasting and Capacity Planning:

Implementing a data-driven demand forecasting models to anticipate patient volume and allocate resources accordingly. This includes analyzing historical data, understanding referral patterns, and considering seasonality factors to accurately plan MRI machine availability, technologist staffing, and ancillary resources.

Preventive Maintenance and Equipment Management:

Establish a preventive maintenance program to minimize unplanned equipment downtime. Regular equipment inspections, calibration, and proactive repairs help maintain optimal machine performance and reduce unexpected disruptions in MRI utilization.

Cross-Training and Skill Development:

Promote cross-training and skill development among MRI technologists to enhance flexibility and optimize staff allocation. Ensuring that technologists are proficient in a wide range of MRI examinations and advanced imaging techniques allows for efficient workload distribution and improved resource utilization.

Real-Time Monitoring and Adjustments:

Implement real-time monitoring systems to track resource utilization, patient flow, and wait times. Utilize dashboard analytics or software solutions to identify bottlenecks, make timely adjustments, and optimize resource allocation for maximum MRI utilization.

Collaboration with Referring Physicians:

Engage in proactive communication and collaboration with referring physicians to align MRI utilization with clinical needs. Regular meetings, feedback loops, and joint decision-making

processes ensure that MRI examinations are appropriately requested and scheduled, optimizing resource allocation.

Conclusion:

Effective resource allocation and management are crucial for optimizing MRI utilization and delivering efficient patient care in Medanta Hospital. By implementing strategies such as demand forecasting, preventive maintenance, cross-training, real-time monitoring, and collaboration with referring physicians, Medanta Hospital can overcome resource allocation challenges, enhance resource utilization, and maximize MRI utilization rates, ultimately improving patient access, satisfaction, and clinical outcomes.

DELAY IN SHIFTING FROM IPD TO MRI DEPARTMENT

Timely access to MRI services is crucial for accurate diagnosis, treatment planning, and overall patient care. Delays in shifting patients from IPD to the MRI Department can lead to increased wait times, reduced patient throughput, and decreased MRI utilization.

Factors Contributing to Delays:

a. Workflow Challenges:

Inefficient Communication Channels: the lack of effective communication channels between IPD, ER and the MRI Department can lead to delays in patient transfers.

Conflicting Priorities: situations where conflicting priorities among departments can result in delays, such as emergency cases taking precedence over elective MRI scans.

b. Administrative Procedures:

Scheduling Conflicts:

Scheduling conflicts between IPD and the MRI Department can occur due to various reasons, such as limited availability of MRI slots, overlapping appointment schedules, or miscommunication between departments. These conflicts can lead to delays in patient transfers and affect MRI utilization. It is important to establish effective communication

channels and scheduling protocols to minimize conflicts and ensure smooth patient transitions.

Lack of Coordination:

A lack of coordination between IPD and the MRI Department can significantly contribute to delays. This can occur when there is a lack of standardized protocols, unclear responsibilities, or ineffective interdepartmental communication channels. For example, delays may arise if there is no designated process for notifying the MRI Department about patients ready for transfer or if there is a lack of clarity on the necessary documentation required for the transfer. Enhancing interdepartmental coordination and implementing clear communication channels are essential to address these challenges.

Documentation and Logistical Challenges:

Incomplete or delayed documentation, insurance authorizations , panel approvals, or logistical issues can create barriers to smooth patient transfers. For example, if there is a delay in obtaining insurance approval for an MRI scan, it can hinder the timely transfer of the patient from IPD to the MRI Department. Additionally, logistical challenges, such as arranging transportation or coordinating patient preparation requirements, can lead to delays. Streamlining documentation processes, implementing electronic health record systems for efficient information exchange, and addressing logistical challenges proactively can help minimize delays.

Interdepartmental coordination :

The role of interdepartmental coordination is crucial in ensuring smooth patient flow and minimizing delays in shifting patients from the Inpatient Department (IPD) to the MRI Department. Here is an elaboration on the role of interdepartmental coordination:

Efficient Patient Transfers:

Interdepartmental coordination plays a vital role in facilitating efficient patient transfers between IPD and the MRI Department. Effective communication and collaboration between these departments ensure that patients are promptly identified, scheduled, and prepared for their MRI scans. Coordination helps in streamlining the transfer process, reducing wait times, and optimizing the utilization of MRI resources.

Timely Information Exchange:

Interdepartmental coordination involves the seamless exchange of relevant information between IPD and the MRI Department. This includes patient medical history, pre-scan requirements, and any specific instructions from the referring physicians. Timely and accurate information exchange enables the MRI Department to adequately prepare for the patient's arrival, ensuring a smooth transition and minimizing potential delays caused by missing or incomplete information.

Synchronized Scheduling:

Coordinated scheduling practices are vital to minimize conflicts and delays. Interdepartmental coordination allows for synchronized scheduling between IPD and the MRI Department, taking into consideration the availability of MRI slots, patient priority, and clinical urgency. By aligning schedules and optimizing patient flow, interdepartmental coordination helps maximize MRI utilization and reduce patient wait times.

Streamlined Protocols and Workflows:

Interdepartmental coordination involves the development and implementation of streamlined protocols and workflows. By establishing clear procedures for patient transfers, including documentation requirements, consent processes, and patient information sharing, departments can work together seamlessly. Standardized protocols ensure that all necessary steps are followed consistently, reducing confusion and delays in patient transfers.

Collaborative Problem-solving:

Interdepartmental coordination fosters a culture of collaboration and problem-solving. When challenges arise, such as unexpected emergencies or changes in patient condition, effective coordination allows IPD and the MRI Department to work together to find solutions and make necessary adjustments to prioritize patient care. Collaborative problem-solving minimizes delays, improves patient safety, and ensures a smooth patient flow.

Continuous Improvement:

Interdepartmental coordination also plays a crucial role in the continuous improvement of processes and workflows. By regularly assessing the effectiveness of interdepartmental coordination, healthcare institutions can identify areas for improvement, address bottlenecks, and implement changes to enhance patient transfers and optimize MRI utilization. Continuous improvement efforts involve feedback collection, data analysis, and collaborative decision-making to drive positive changes.

Overall, interdepartmental coordination is essential for optimizing patient transfers, minimizing delays, and maximizing MRI utilization. Effective communication, streamlined protocols, synchronized scheduling, and collaborative problem-solving contribute to enhanced patient care, improved operational efficiency, and a positive patient experience within the healthcare facility.

Strategies to Optimize MRI Utilization:

Improved Scheduling Practices: Recommend implementing efficient scheduling practices, such as synchronized scheduling between IPD and the MRI Department, prioritizing urgent cases, and optimizing MRI utilization during non-peak hours.

Enhanced Documentation and Information Exchange: Highlight the importance of accurate and timely documentation, electronic health record integration, and seamless information exchange to expedite patient transfers.

Staff Training and Education: Emphasize the need for staff training on efficient patient flow, interdepartmental coordination, and the significance of optimizing MRI utilization.

Conclusion:

Delays in shifting patients from IPD to the MRI Department have a significant impact on MRI utilization, leading to decreased efficiency and increased patient wait times. Effective interdepartmental coordination, streamlined processes, and enhanced communication channels are essential for minimizing delays and optimizing MRI utilization. Implementing strategies to address these challenges can improve patient care, maximize MRI throughput, and enhance overall healthcare services.

Patient-Related Issues

Introduction:

Patient-related factors play a significant role in the utilization of MRI services in Medanta Hospital. This section focuses on the impact of patient anxiety and discomfort on MRI utilization rates. It explores the challenges posed by these issues, their implications for patient care, and strategies to address them for improved utilization.

Patient Anxiety and Its Impact on MRI Utilization:

Patient anxiety is a common issue that can affect MRI utilization in the following ways:

1.1 Increased Refusal Rates:

Anxiety related to the MRI procedure, such as claustrophobia, fear of confinement, or fear of loud noises, can lead to increased refusal rates. Patients may postpone or avoid MRI examinations altogether, impacting utilization rates.

1.2 Lengthy Examination Times:

Anxious patients may require additional time for preparation and support during the MRI examination. This can result in longer examination times, reducing the overall capacity of the MRI department and potentially decreasing utilization rates.

1.3 Need for Sedation:

In cases of extreme anxiety or claustrophobia, patients may require sedation to undergo MRI examinations. The need for sedation adds complexity to the procedure, requires additional resources, and may limit the number of patients who can be accommodated, thus affecting MRI utilization.

Patient Discomfort and Its Impact on MRI Utilization:

Patient discomfort can also have implications for MRI utilization:

- Inability to Remain Still:

Certain medical conditions or discomfort during the examination can make it challenging for patients to remain still. Movement during the scan can result in image artifacts, necessitating repeat examinations and potentially reducing the overall efficiency and utilization of the MRI machine.

- Increased Scan Time:

Patient discomfort, such as pain or physical limitations, may lead to increased scan times. Patients requiring repositioning or breaks due to discomfort prolong the duration of each examination, reducing the number of patients that can be accommodated and affecting MRI utilization rates.

Strategies to Address Anxiety and Discomfort for Improved MRI Utilization:

Patient Education and Communication:

Provide detailed information to patients about the MRI procedure, addressing common concerns and alleviating anxiety. Clear communication about the benefits, safety, and steps involved in the examination can help reduce anxiety levels and encourage patients to undergo MRI scans.

Pre-Scan Assessment and Preparation:

Conduct pre-scan assessments to identify patients with anxiety or discomfort issues. Tailor preparation protocols to address their specific needs, such as providing relaxation techniques, offering music or earplugs to mitigate noise concerns, or using open MRI machines for claustrophobic patients.

Patient Support and Comfort Measures:

Implement patient support strategies to enhance comfort during MRI examinations. This may include offering pillows or cushions, using blankets to regulate body temperature, and employing distraction techniques, such as music or audio-visual entertainment, to reduce anxiety and discomfort.

Collaborative Approach:

Involve radiology technologists, radiologists, and referring physicians in the management of anxious or uncomfortable patients. Collaborative discussions can help identify appropriate sedation protocols, if necessary, to minimize patient anxiety and optimize the MRI utilization process.

Staff Training:

Provide comprehensive training to MRI technologists and staff on techniques to manage anxious or uncomfortable patients. Training should include effective communication skills, patient-centered care approaches, and strategies to ensure patient comfort throughout the examination process.

Conclusion:

Patient-related issues such as anxiety and discomfort significantly impact MRI utilization rates. By addressing these challenges through patient education, tailored preparation, support measures, collaborative approaches, and staff training, Medanta Hospital can minimize patient anxiety, enhance comfort, and optimize MRI utilization. Ultimately, these efforts

contribute to improved patient experiences, increased acceptance of MRI examinations, and higher utilization rates.

The results of the study indicate valuable insights into the waiting time and preparation time for MRI scans, specifically focusing on a sample size of 100 scans. The average waiting time for all scans was found to be approximately 27 minutes, while the average preparation time for contrast-enhanced scans was determined to be around 12 minutes. These findings shed light on the efficiency and effectiveness of the MRI department's operations and provide important information for optimizing patient flow and enhancing overall MRI utilization.

Average Waiting Time:

The study revealed that patients experienced an average waiting time of approximately 27 minutes before undergoing their MRI scans. This waiting time encompasses the period from the patient's arrival at the MRI department until the actual start of the scan. Factors contributing to the waiting time may include administrative procedures, patient check-in processes, availability of scan rooms, and the overall patient load in the department.

The average waiting time provides a quantitative measure of the efficiency of the MRI department in managing patient flow. It serves as a benchmark for evaluating and improving the scheduling and resource allocation practices to minimize patient wait times and maximize MRI utilization.

Average Preparation Time for Contrast Scans:

For contrast-enhanced scans, which require additional preparation and administration of contrast agents, the study found an average preparation time of approximately 12 minutes. This preparation time includes activities such as verifying patient information, obtaining consent, explaining the procedure, and administering the contrast agent. The preparation time

can vary based on the complexity of the patient's condition, the type of contrast agent used, and the efficiency of the department's processes.

The average preparation time provides insights into the efficiency and effectiveness of the MRI department's protocols for contrast-enhanced scans. It can guide efforts to optimize the preparation process, streamline workflows, and ensure timely administration of contrast agents to improve patient care and satisfaction.

CONCLUSION

In conclusion, this dissertation has explored the various factors that impact the utilization of MRI machines in Medanta Hospital. Through a comprehensive analysis of administrative and operational factors, it is evident that multiple elements contribute to the efficiency and effectiveness of MRI utilization.

Administrative factors, such as appointment scheduling, referral patterns, financial policies, and resource allocation, play a crucial role in optimizing MRI utilization. These factors require strategic decision-making, clear guidelines, and effective management to ensure equitable access, minimize waiting times, and enhance patient flow.

Operational factors, including workflow integration, equipment maintenance, staffing and training, protocol standardization, and patient experience, significantly influence the efficiency of MRI utilization. Efficient workflow integration and standardized protocols streamline operations, while proper equipment maintenance and staffing ensure optimal machine performance and accurate interpretations. Prioritizing patient experience by addressing anxiety and discomfort can lead to increased patient acceptance and cooperation.

Moreover, this dissertation has shed light on technological advancements and their impact on MRI utilization. Upgrades and maintenance procedures are essential to maximize machine capabilities and minimize downtime, ensuring continuous availability and reliable performance. The availability of specialized MRI techniques further enhances the diagnostic capabilities of the hospital, catering to a broader range of patient needs.

By understanding and addressing the factors discussed in this dissertation, Medanta Hospital can enhance the utilization of its MRI machines, leading to improved patient care, timely diagnoses, and better outcomes. Effective management strategies, informed decision-making, and ongoing monitoring of these factors will contribute to the optimization of MRI services.

However, it is important to recognize that MRI utilization is a complex and dynamic process influenced by multiple interrelated factors. Therefore, ongoing research and continuous evaluation of these factors are crucial to adapt to evolving patient needs, technological advancements, and healthcare demands.

This dissertation serves as a foundation for further exploration and improvement in MRI utilization within Medanta Hospital and beyond. By addressing the identified factors, implementing evidence-based strategies, and fostering a culture of continuous improvement, Medanta Hospital can maximize the utilization of its MRI machines, ensuring efficient healthcare delivery and enhancing patient outcomes."

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