

RADIOLOGY AND CARDIOLOGY EQUIPMENT LANDSCAPE IN METROPOLITAN HOSPITALS: A HOLISTIC VIEW

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Master of Business Administration (MBA)

in

Hospital and Health Management

By

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Under the Supervision and Guidance of

Dr J. P. Singh

2024

INTERNSHIP COMPLETION CERTIFICATE

This is to certify that **DR. DEBAM SAHA** in partial fulfillment of the requirements for the award of the degree of MBA (Hospital and Health Management) from the IIHMR University, Jaipur has successfully completed his internship at **Shimadzu Medical India Pvt. Ltd.** during April 01 - June 30, 2024.

I wish him all the success in his future endeavours.

Place: Mumbai

Date: 30th June, 2024


Rajiv Jha



General Manager,

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DECLARATION BY STUDENT

I hereby declare that this dissertation titled **Radiology and Cardiology Equipment Landscape in Metropolitan Hospitals: A Holistic View** is the bonafide record of my original researchwork. I declare that it has not been submitted to any other university or institution for the award of any degree or diploma. Information derived from the published or unpublished work of others has been duly acknowledged in the text.



(Signature)

Name of student: DR. DEBAM SAHA

Date: 30.06.2024

CERTIFICATE

This is to certify that dissertation titled “**Radiology and Cardiology Equipment Landscape in Metropolitan Hospitals: A Holistic View**” is a record of the research work undertaken by **DR. DEBAM SAHA** in partial fulfilment of the requirements for the award of the degree of MBA (Hospital and Health Management) from the IIHMR University, Jaipur under my guidance and supervision and his approach to the research study has been sincere, scientific and analytical.

Jagjeet Band Singh

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ABSTRACT

Introduction:

Technological advancements in healthcare, necessitate state-of-the-art diagnostic equipment for precise diagnosis and effective treatment planning. NABH-Accredited hospitals, emphasize procurement of high-quality medical equipment to uphold high standards and improve patient care quality.

Objectives:

This study aimed to identify preferred brands of medical equipment across Mumbai Metropolitan Region hospitals, for X-ray, Mobile X-Ray, Fluoroscope, C-arm, and Cath-Lab machines. It assessed hospital satisfaction based on parameters such as Accuracy, Ease of Use, Image Quality, Durability, and Support Services. Furthermore, it examined weightage of influential factors in hospital buying decisions, including Cost, Safety Features, Performance, Brand Image, and Technology.

Methodology:

Conducted over a period of 3 months, this descriptive cross-sectional study focused on medical equipment in NABH-accredited hospitals in Mumbai. A purposive sample of 145 medical equipment units, in use for over 3 years, was collected. Data collection involved interviews with concerned hospital personnel and utilized structured tools designed to capture brand usage, user satisfaction levels, and weightage of factors influencing buying decisions.

Results:

The study found a diversified market for X-ray and Mobile X-Ray machines, whereas Siemens dominated the Fluoroscope segment with a 64% market share. Siemens, Allengers, and Philips emerged as preferred brands for C-Arm machines, while Philips led in Cath-Lab segment. Equipment by Shimadzu received the highest satisfaction ratings among the users. Safety Features was the most crucial factor for buying decision followed by Performance, Technology, Cost and Brand Image.

Conclusion:

These findings are pivotal for equipment manufacturers and hospital administrators, highlighting the need for strategic decision-making. Despite Allengers' significant market

presence, their lower satisfaction scores necessitate attention towards improving future performance. Conversely, Shimadzu's high satisfaction ratings suggest potential for increasing market share through enhanced marketing efforts. Hospitals should conduct thorough market research before procurement to avoid mediocre equipment and a multidisciplinary team should be responsible for purchase decisions.

Keywords: medical equipment, brand, user satisfaction, buying decision

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I see this opportunity as a significant milestone in my career development. I will endeavor to utilize the skills and knowledge acquired to their fullest potential and continue working on improvements to achieve my career goals.

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ABBREVIATIONS

CAGR: Compound Annual Growth Rate

Cath-Lab: Cardiac Catheterization Laboratory

Radio: Radiology

Cardio: Cardiology

NABH: National Accreditation Board for Hospitals & Healthcare Providers

OT: Operation Theatre

DICOM: Digital Imaging and Communications in Medicine

MMR: Mumbai Metropolitan Region

PACS: Picture Archiving Communication System

USG: Ultrasonography

Mob X-Ray: Mobile X-Ray

CHAPTER 1:

INTRODUCTION

BACKGROUND:

The hospital environment is constantly changing with rapid advancements in technology. The healthcare field is heavily dependent on medical equipment for early diagnosis and treatment. This is especially true with respect to the radiology and cardiology departments. It is very important on part of the hospital to select and equip medical equipment which serve their purpose to the fullest and provide complete satisfaction not only to the patient but also to the user of those equipment. Properly selecting, purchasing and utilizing medical equipment is of utmost important when it comes to providing first class quality patient care within the hospitals. As medical technology is continuously developing, at the same time the patient needs are also continuously evolving. It is therefore important for hospitals to upgrade themselves with the latest inventions in medical equipment. This not only guarantees proper patient care but also improves the financial state of the healthcare institution.¹

In India, the healthcare industry is experiencing a booming growth as compared to global trends. This progress can be attributed to upgradation in medical technology, improved standard of living, and a want for a better quality of life. There is nowadays also an increased focus on preventive efforts and a rising demand for better diagnostic and therapeutic solutions. Also, the increasing partnership between public and private sector institutions and facilities, the growth of the health insurance market, and the efforts of the government to provide accessible, available and also affordable healthcare services have contributed to the industry's steady continuous growth. The market size of medical devices stood at around \$512.29 billion in 2022 globally and is projected to grow from \$536.12 billion (2023) to \$799.67 billion (2030).² India enjoys a very comfortable position when it comes to medical devices as it ranks 4th among the Asian medical device market after China, Japan and South Korea and is also present amongst the top 20 medical devices markets globally. The Indian medical device market stood at a staggeringly high Rs. 90,000 crore (\$11 billion) in the year 2022 and is expected to continue to increase up to \$50 billion by the year 2030.³ As India currently sits at the centre of global attention; the country is rapidly becoming the go to destination for all kinds of medical services. Hospitals and other healthcare facilities are rapidly adapting by focusing on the structural, financial, operational, and sociocultural needs and requirements in order to meet the ever-rising demand for medical services. This trend is supported by the rise in revenue from

medical tourism, new healthcare institutions in the country, the upcoming NHP, higher life expectancy, and a keener interest in life insurance.⁴

As India is an attractive market, most of the medical imaging equipment manufacturers/brands are either already present in the country or are trying to enter it tirelessly. It is therefore not a surprise that a few out of these countless manufacturers are preferred amongst the hospitals. It has been seen that 70% of the medical devices being used in India are imported.⁵ Key players in the medical imaging equipment market in India are: GE Healthcare, Siemens Medical Solutions, Philips, Allengers, Shimadzu, Toshiba India Pvt. Ltd. etc. They offer an extensive range of products at lower costs to achieve higher penetration. Every year, better and high-level products are also introduced into the Indian market.

Hospital satisfaction with medical imaging equipment is paramount for delivering high-quality patient care and optimizing operational efficiency. It is to be noted that certain brands are preferred over the rest because of the high user satisfaction which in this case are the hospitals. The satisfaction of the hospitals not only depends on the availability of the medical devices but also on various other factors such as user friendliness, durability and reliability of the equipment, maintenance requirement, safety features installed in the medical equipment etc.⁶ The satisfaction of the patients visiting the hospital for diagnostic and treatment purposes will in turn increase the confidence of the hospital in that particular vendor and increases the chances of that particular vendor being selected for future procurement.

Additionally, assessing procurement factors will provide valuable insights into the decision-making process behind acquiring important equipment, shedding light on specific criteria that influence these crucial investments. The procurement of medical equipment is a complex task with consequences not only for the efficiency and reliability of healthcare services, but also involving the allocation of considerable resources.⁷ However, just the cost of the medical equipment should not guide the hospital during the procurement/buying process. Shifting away from a purely price-driven paradigm towards a comprehensive model integrating patient outcomes, is anticipated to increase efficiencies and enhance health outcomes for patients.⁸ Evidence suggests that adopting a value-based approach in medical equipment procurement holds the potential for improved health outcomes and heightened cost-effectiveness within hospital settings.⁸ Moreover, this approach bears promise in identifying avenues for innovation.⁸ For example, research by Smith et al. (2019) shows that when choosing radiology equipment,

picture quality and radiation dose management should take precedence above cost. However, a European study conducted by Müller and Schmidt (2018) indicated that economic factors such as cost and long-term maintenance, played a significant role in decision-making. Procurement decisions are influenced by other equally if not more important factors such as technology, performance, regulatory compliances, vendor reputation etc. When it comes to technology, equipment that support DICOM are very much preferred as compared to those that don't as it helps in streamlining the radiological procedure and reduces the workload of the doctors. Medical equipment have undergone a significant transition as a result of technological advancements, improving healthcare accuracy and efficiency. These days, doctors can diagnose and treat patients better due to high-tech sensors installed in the machines. Modern MRI and CT scanners, for instance, generate crisper, more detailed images, enabling earlier and more accurate disease detection. PACS is another technological feature which is highly favoured amongst the healthcare specialists and makes their life easier to a certain degree. However, development and incorporation of technology into the healthcare system also has its cons. It comes with more financial burden upon the hospitals to procure such equipment and instruments and thus has a significant effect on the annual budget. It also requires training of the already existing professionals within the facility regarding the new technology to maintain smooth flow of work or else hiring new personnel who are well versed with these technologies and thus has further negative impact on the budget. Hence it is highly likely that technological features in the medical equipment plays a big role when it comes to procurement. High quality instruments are much more likely to be procured as compared to cheap low-quality instruments. In today's fiercely competitive business landscape, manufacturers of medical instruments should place greater emphasis on offering a sustainable, top-notch service-oriented marketing approach to bolster customer satisfaction and stimulate purchasing intent.⁹ This approach is imperative for fostering enduring relationships with customers and ensuring their ongoing loyalty amidst a crowded market. By prioritizing long-term quality service over short-term gains, these manufacturers can forge stronger connections with their clientele, instill trust, and ultimately elevate their competitive standing in the industry.

MMR is a hub of top-notch well-equipped hospitals. It is not only home to some of the oldest and best hospitals in the country such as P.D. Hinduja Hospital and Research Centre, Lilavati Hospital and Research Centre, Jaslok Hospital etc. but is also a welcoming destination for the chain hospitals namely Apollo, Fortis etc. All of these hospitals are NABH Accredited and therefore these hospitals focus on providing the best

services to their patients in order to increase customer loyalty and don't compromise on their quality. It therefore also serves as a lucrative destination for the medical device manufacturers to try their luck and secure business partnerships with the top hospitals of the country.

The definitive purpose of this research is to identify the preferred brands of medical equipment, the user satisfaction level for the preferred brands and also understand the weightage of the factors which influence the buying decision regarding radiology and cardiology equipment in hospitals of MMR. There are many kinds and types of medical equipment. However, this study will be focused only on X-Ray, Mobile X-Ray, Fluoroscope, C-Arm and Cath-Lab machines. While the X-Ray, Mobile X-Ray and Fluoroscope units are used for diagnostic purposes, the C-Arm machine is usually used in case of orthopedic surgeries and Cath-Lab equipment is used for performing some of the most important and expensive procedures such as angiography, angioplasty, PCI etc. Even though there have been studies in the past which have discussed the important factors which influence the buying decision, there is a lack of study in which tells us what medical device companies are usually preferred in metropolitan hospitals and how satisfied are the users (hospitals and healthcare professionals) with these equipment. The findings of the research will provide very important information not only to the medical equipment manufacturers, but also to the hospital administrators, and healthcare facilities, allowing them to make informed decisions. By understanding all these aspects, the industry can design their products and tactics to better meet the needs and preferences of hospitals and diagnostic centres, thereby ultimately improving the patient care quality and improving operational efficiency.

RESEARCH QUESTIONS:

1. Which brands of radiology and cardiology equipment are preferred among hospitals in the Mumbai Metropolitan Region (MMR)?
2. What is the level of user satisfaction with these preferred brands of radiology and cardiology equipment in MMR hospitals in terms of accuracy, ease of use, quality of image, durability and support services?
3. What are the key factors influencing the purchasing decisions for radiology and cardiology equipment in MMR hospitals, and how much weight do these factors carry?

OBJECTIVES:

1. To analyze and identify the preferred brands of radiology and cardiology equipment used in hospitals within the Mumbai Metropolitan Region.
2. To evaluate the satisfaction levels of hospitals with the preferred medical equipment brands in the Mumbai Metropolitan Region, focusing on accuracy, ease of use, quality of image, durability and support services.
3. To analyze the key factors influencing the purchasing decisions for medical equipment in hospitals and determine the weightage of these factors, such as cost, technology, safety features, performance and brand image.

CHAPTER 2:
LITERATURE REVIEWS:

Table 2.1: Literature Review

Author (Year)	Study Location	Sample Size	Sampling Technique	Salient Features
Jung et al. (2015)	South Korea	116	Purposive Sampling. Due to nature of sampling, results may not be applicable to other sectors of medical devices or in smaller hospitals due to capability limitations.	The main objective of the study was to understand the relationship between the factors affecting purchase decision of medical device, satisfaction and the intention to repurchase USG machines. Focus was on hospitals as big as a general hospital or larger. 18 items of measurement were constructed and each measured on 0-5 Likert scale. AMOS 21.0 & SPSS 21.0 was used for analysis of the study which was carried out in 3 stages. It was found out that brand is an important factor which affects the purchase decision which positively influences satisfaction and repurchase. Further, price was found to be negatively impacting satisfaction while performance had a positive impact on satisfaction.
Sicotte et al. (2006-2007)	Quebec, Canada	127	Purposive Sampling. Findings may not be applicable to countries limited technological expertise.	The study was conducted to understand the benefits offered by the PACS system and to understand perspectives of radiologists, radiological technologists and medical specialists regarding system benefits. 2 types of uses of PACS were studied, inter and intra hospital use. Users were found to be more satisfied with the PACS system when it was being used within the hospital premises as compared to between hospitals. They found the quality of data to be better in intra-hospital use. However, there were complaints regarding the response time for inter-hospital use. This problem was solved via upgrades made to the telecommunication network's capacity and increasing its bandwidth, thus highlighting importance of infrastructural and technological development. In terms of ease of use and perceived usefulness, users found intra-hospital use to be more favourable. Despite dissatisfaction with inter-hospital use, users remained optimistic about using the system in the future.

Table 2.1: Literature Review continued

Mohamed Gendia, Hamed M Shamma (2022)	Kuwait	120	Simple Random Sampling. Due to nature of sampling, the results of the study should be applicable to other orthopedic doctors around the world.	The study was conducted to understand what are the most crucial factors which affect an orthopaedic doctor's decision regarding purchase of medical equipment and devices from medical device companies which will help in formation of realistic business strategy and allocation of higher resources for important factors and reduced money wasting on less important factors, thus positively impacting profitability of the hospital/company. It was found that implant review in a journal was the most important factor according to the doctors. It was then followed by brand. However, doctors would not procure a branded product with insufficient reviews in a journal. The other significant factors include price, technological support, after sales service, innovation and training. However, journal reviews can be funded by brands and be biased and new products may not be published promptly leading to lag. For new market entrants it serves as a barrier and other marketing strategies and funding for research will be required.
H. Prem Kumar, Dr. R Prabhusankar (2022)	Tamil Nadu, India	510	Simple Random Sampling. Nature of sampling ensures that results are applicable all across the region for such devices and provides concrete evidence for the vendors.	The main objective of the study was to understand the factors which are responsible for determining a consumer's decision to purchase a medical device for home usage to propose strategies to medical device companies based on the findings of the study. It was found that customers prefer to use medical devices that are branded and have a good market image. The price was not significant when it came to purchase decision. This is due to the respondents already using other pricey equipment and could easily afford glucometers. Results of this study may not be applicable to large medical equipment as they are much costlier and more advanced and require significant capital investment on the part of the buyer.

Table 2.1: Literature Review continued

Sunardi (2023)	Indonesia	60	Purposive Sampling. The findings of the study provide in depth insights but are less likely to be applicable to other medical devices or different study settings.	The purpose of the study was to find out what were the factors that shaped the purchase of domestically produced USG product. At the end of the study, it was found that relationship factor was the most important decision factor when deciding to purchase medical equipment. These include trust, loyalty etc. Relationship factor can be built over time by transparent communication, consistency in services provided and positive past experiences. It was followed by reliability factor which includes after-sales service, product delivery condition, payment mechanisms etc. Third was the environmental factors such as competition, availability of supply. It was further followed by product price, product quality, standards. Brand name, technology and market factor such as market trends were found to be the least influencing factors related to purchase decision.
Tourani et al. (2014)	Tehran, Iran	560	Purposive Sampling. Due to nature of sampling, the results of the study are less generalizable and may not be applicable widely.	The study was conducted to investigate the factors which should be given priority for purchase of medical equipment. The data collected was collected from managers, nurses, users of equipment and medical equipment committee members. Hierarchical analysis model was used to prioritize factors. Descriptive and inferential analysis was used. For descriptive, statistical charts and distribution tables were used. In inferential analysis to prioritize factors affecting purchase, AHP model and Expert software were used. It was found that there were 4 main factors which influenced the purchase decision. The main influencing factor was quality of the medical equipment. It was then followed by the after sales service provided by the manufacturer. The brand and the price of the product were the other 2 important factors.

Table 2.1: Literature Review continued

Rabinovich et al. (2022)	Argentina	401	Purposive Sampling. The findings of the study as a result may not be applicable to other departments of the hospital or to other medical devices.	The purpose was to evaluate the user satisfaction with AI for automatic detection of findings in Chest X-Ray. Radiology doctors and emergency physicians were selected for the study. 4 factors were studied: Actual system use, Perceived usefulness, Perceived ease of use & output quality. All participants agreed to continue to use the tool and recommend to others. They also found it to be usefulness and used it for second opinion. The perceived output quality was also high. Highest satisfaction was for ease of use while it was found that output quality (performance) was the decisive factor in user satisfaction.
Al-Kwafi SO, McNaughton RB (2013)	Global	635	Purposive Sampling. As the sampling is purposive, the findings are less likely to be generalizable and may not be applicable when it comes to other medical devices.	The objective was to provide evidence that long term success of capital-intensive technological products requires continuous innovations which meet the users' preferences. Doctors, scientists, physicists, technologists etc. took part in the online survey and were asked to rank importance of different factors for selecting MRI technology. It was found that product features was the most important factor responsible for the decision to switch brands. It was followed by research collaboration and product service. Price and product bundling were found to have less importance.

Table 2.2: Literature Review Comparative Analysis Table

Author (Year)	Country	Equipment Focus	Key Factors Identified	Sampling Method	Key Findings
Jung et al. (2015)	South Korea	USG machines	Brand, Price, Performance	Purposive Sampling	Brand positively impacts satisfaction and repurchase; price negatively impacts satisfaction.
Sicotte et al. (2006-2007)	Canada	PACS system	Ease of Use, Infrastructural Support	Purposive Sampling	Users preferred intra-hospital use due to better data quality and response time.
Mohamed Gendia, Hamed M Shamma (2022)	Kuwait	Orthopedic Equipment	Journal Reviews, Brand, Technological Support	Simple Random Sampling	Journal reviews most crucial; brand important but secondary to reviews.
H. Prem Kumar, Dr. R Prabhusankar (2022)	India	Home Medical Devices	Brand, Market Image, Price	Simple Random Sampling	Brand and market image significant; price not significant due to affordability.
Sunardi (2023)	Indonesia	USG Product	Relationship, Reliability, Environmental Factors	Purposive Sampling	Relationship factor most important; brand and technology least influencing.
Tourani et al. (2014)	Iran	General Medical Equipment	Quality, After-Sales Service, Brand, Price	Purposive Sampling	Quality most important; followed by after-sales service, brand, and price.
Rabinovich et al. (2022)	Argentina	X-Ray (AI)	Actual System Use, Perceived Ease of Use, Output Quality, Perceived Usefulness	Purposive Sampling	User satisfaction was highest for Perceived ease of use; Postive feedback for all factors; Output quality decisive factor for user satisfaction.
Al-Kwif SO, McNaughton RB (2013)	Global	MRI	Product Features, Research collaboration, Product Service, Price, Product Bundling	Purposive Sampling	Product feature decisive factor for brand switching; Research collaboration and product service also important; Price and Product bundling least influential factors.

CHAPTER 3:

METHODOLOGY

RESEARCH DESIGN:

This study's design is a descriptive cross-sectional study which was carried out over the course of three months (April–June 2024) at the top hospitals which have earned the NABH accreditation. During these 3 months, the equipment usage followed a typical pattern with no seasonal variation. Qualitative as well as quantitative data was collected via the use of a structured questionnaire which was created specifically for this purpose.

STUDY SETTING:

The study is conducted in the Mumbai Metropolitan Region. MMR refers to Mumbai, Navi Mumbai and Thane. MMR is one of the largest and most densely populated metropolitan area in the country which is home to many NABH-accredited hospitals that employ cutting edge medical technology. Its diverse patient demographics and vast range of healthcare providers offer a comprehensive landscape to examine brand preferences, user satisfaction levels and buying decision factors.

STUDY POPULATION:

The radiology and cardiology equipment used in MMR hospitals accredited by NABH make up the study population in this study. The study focuses exclusively on X-Rays, Fluoroscopes, Mobile X-ray machines, C-arms, and Cath-Lab equipment.

RESEARCH PROCEDURE/APPROACH:

A detailed questionnaire was used to collect data regarding the radio and cardiology equipment used in the hospitals. The questionnaire was filled due to valuable inputs provided by the radiologists, radiology technicians, biomedical engineers, purchase managers, OT technicians and cardiology technicians who are well informed and have vast knowledge regarding the equipment being used in their hospitals. Data was collected regarding user satisfaction level on 5 parameters – Accuracy, Ease of Use, Quality of Image, Durability and Support and Maintenance Service, using 1-5 Likert scale and for 5 factors influencing buying decision – Cost, Safety Features, Performance, Brand Image and Technology, using an Ordinal scale. The quantitative data was analysed using descriptive statistics such as mean and mode while qualitative data was analysed to

understand different patterns and gain insights. Visualization tools such as pie charts, bar graphs and tables were used in order to depict the data clearly and concisely.

SAMPLE SIZE:

145 samples were collected over a period of 3 months from the 3 different cities of MMR i.e., Mumbai, Thane and Navi Mumbai.

Table 3.1: Location-wise Equipment Utilization Summary

Location	X-Ray	Mobile X-Ray	Fluoroscope	C-Arm	Cath-Lab	Total Machines
Thane	9	9	4	3	4	29
Navi Mumbai	16	11	3	12	6	48
Mumbai	17	19	4	17	11	68

SAMPLING TECHNIQUE:

Purposive Sampling. It allowed to specifically select hospitals which upheld quality meaning the data came from high standard institutions which enhanced the validity of the findings. Moreover, focusing on equipment which have been used for at least 3 years, gives more insight regarding the long-term performance of the equipment and user satisfaction. However purposive sampling may lead to results which may not be generalisable to all the hospitals, a smaller sample size and bias as the selection process is subjective and relies on researcher's judgement.

INCLUSION CRITERIA:

Radiological and cardiological equipment which have been in use for more than 3 years in a consenting NABH-Accredited hospital of the Mumbai Metropolitan Region.

EXLCUSION CRITERIA:

Radiological and cardiological equipment have been in use for less than 3 years. Equipment which are in use in a non-consenting hospital or hospital outside MMR.

OPERATIONAL DEFINITIONS:

Certain terms have been defined in the study for better understanding. They are:

Brand Preference: The degree to which certain brands of radiology and cardiology equipment are favoured by hospitals.

User Satisfaction Level: The level of contentment among the hospitals and healthcare professionals regarding the equipment

Buying Decision Factors: The different criteria which influence the procurement of radiology and cardiology equipment.

Accuracy: The degree ability of the equipment to produce results that are in line with the true results.

Ease of Use: Refers to how simple it is for the user to use the machine during procedure.

Quality of Image: The ability of the radiology and cardiology equipment to produce sharp and clear images.

Durability: The ability of the equipment to withstand wear and tear and be used repeatedly without much degradation or down time.

Support and Maintenance Service: The standard and rapidness with which technical support and preventive services are provided by the equipment manufacturer.

Cost: The amount of monetary resources that is required for procurement and maintenance of the equipment.

Safety Features: The functions incorporated in the equipment to ensure patient and user safety to the highest degree possible during the procedure.

Performance: The ability of the equipment to deliver accurate, reliable, high-quality results consistently.

Brand Image: The perception that the consumers have with a particular brand of radiology or cardiology equipment.

Technology: The new innovative features and technological capabilities installed within in the equipment.

ETHICAL CONSIDERATIONS:

Informed consent was obtained from all the participating hospitals and healthcare professionals prior to collection of data. Participants were informed regarding the purpose of the study and measures were taken to maintain the confidentiality of their identity and responses.

CHAPTER 4:

RESULTS

The data collected during the study has been analysed and the results have been displayed in the form of bar graphs and pie charts for better understanding.

BRAND PREFERENCE:

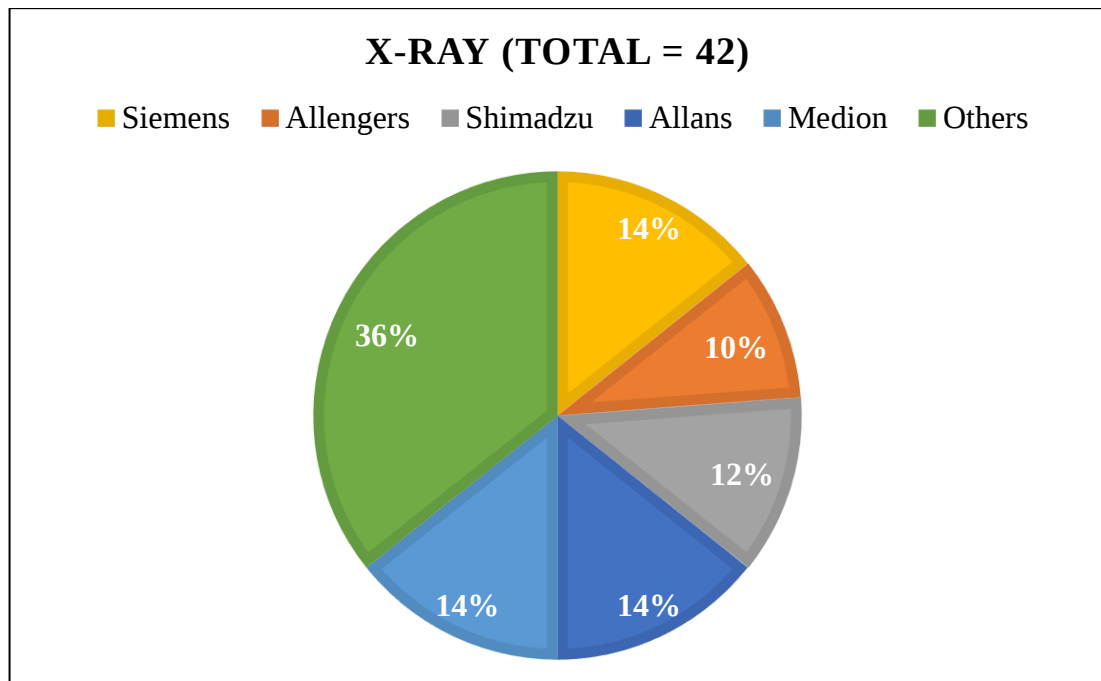


Figure 4.1: Brand Preference for X-Ray.

The pie chart shows the preferred brands for X-Ray units among MMR hospitals. It indicates which brand have more market presence than the rest. It can be seen that there is no major brand dominating the market, with “Others” accounting for 36% of the market share. The “Others” accounts for the various small brands of medical equipment such as SkanRay, Kiran, OMS, Olympicks, MedX, Cura etc. The prominent brands of medical equipment in the market such as Siemens, Allans, Allengers and Shimadzu have 14%, 14%, 14% and 12% of the X-Ray market share respectively thus depicting a fragmented market.

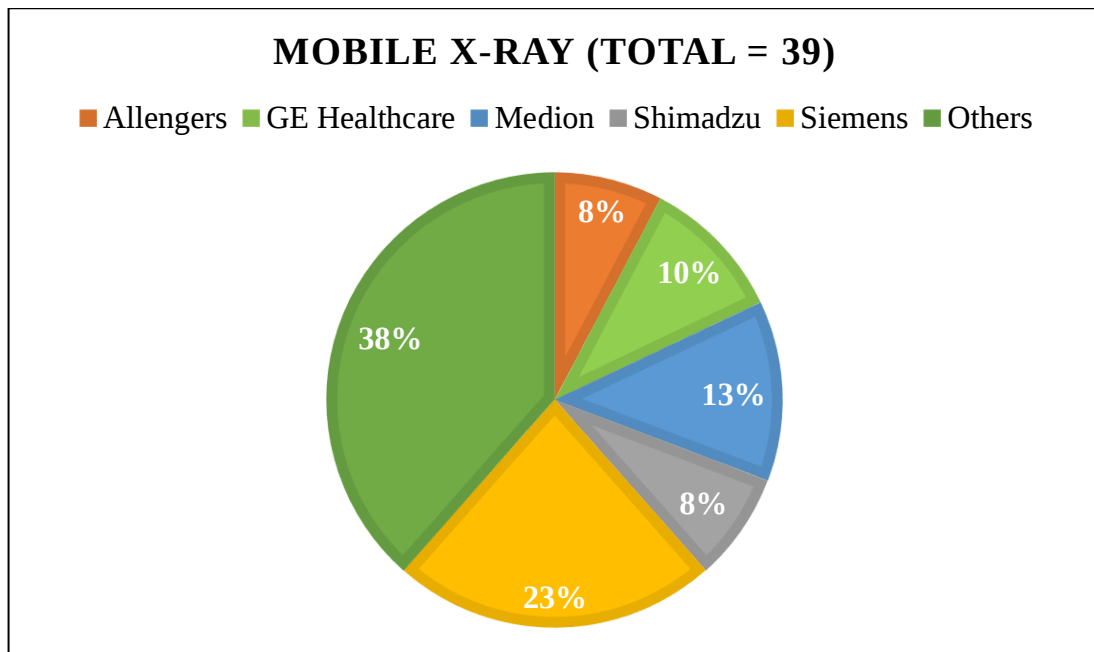


Figure 4.2: Brand Preference for Mobile X-Ray.

The pie chart shows the preferred brands for Mobile X-Ray units among MMR hospitals. The market is similarly dispersed with “Others” accounting for 38% of the market share while Allengers leads the line amongst the prominent brands with a 23% share.

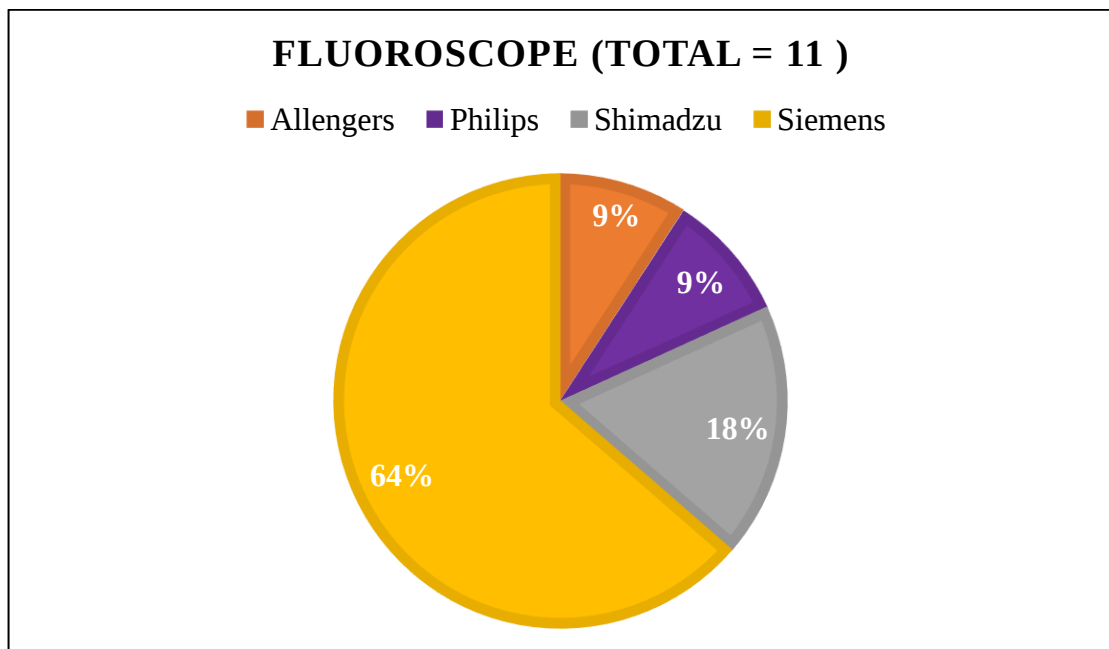


Figure 4.3: Brand Preference for Fluoroscope Machines.

The pie chart shows the preferred Fluoroscope machine brands in MMR hospitals. Siemens is the most preferred brand holding 64% market share. Shimadzu is distant

second with a 18% market share and therefore offers not much competition to Siemens when it comes to dominance in this market.

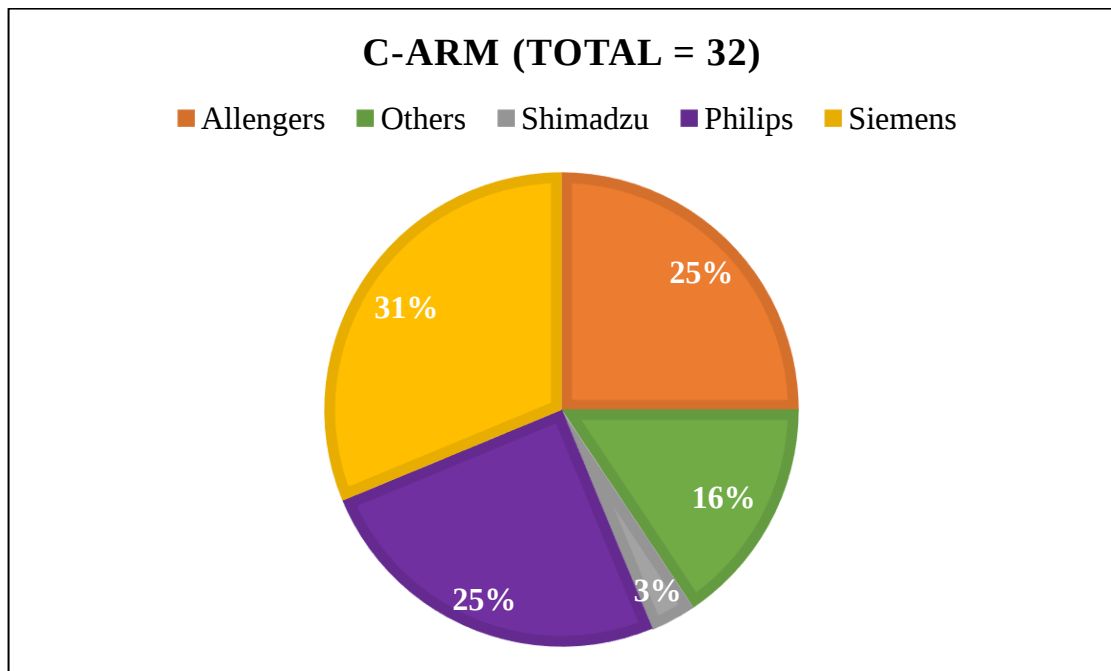


Figure 4.4: Brand Preference for C-Arm Machines.

The pie chart shows the preferred brands for C-Arm machines among the MMR hospitals. Siemens is the market leader holding 31% of the market share and is closely followed by Philips and Allengers, each of them having a 25% market share. This indicates a competitive landscape with a preference for established and leading medical equipment brands.

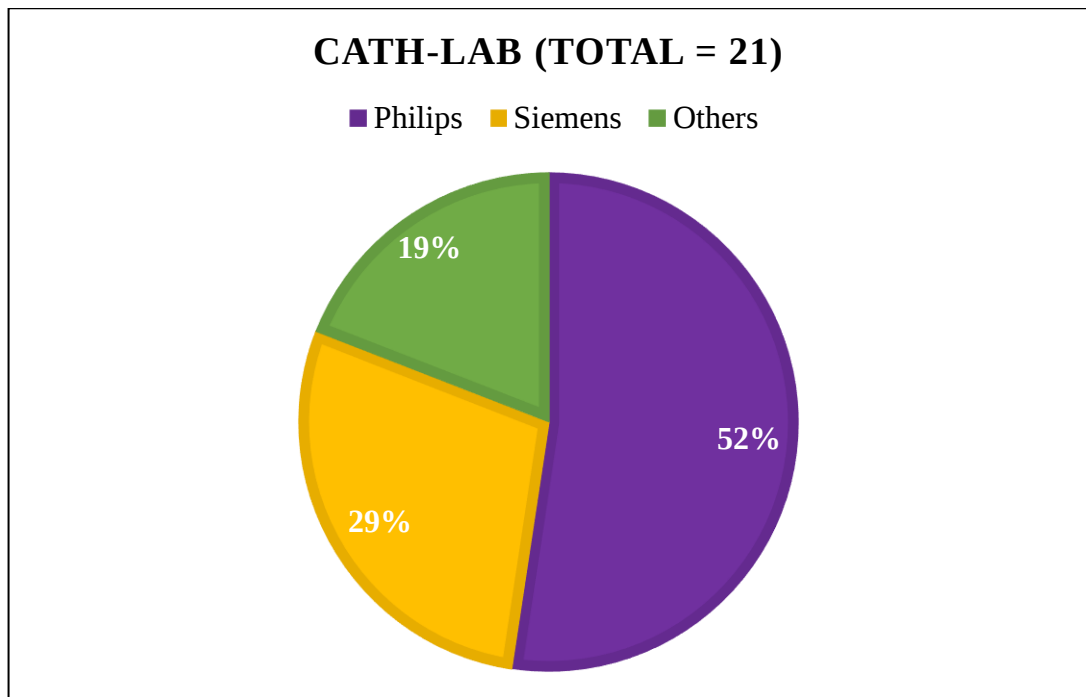


Figure 4.5: Brand Preference for Cath-Lab Machines.

This pie chart shows the preferred brands for Cath-Lab equipment in the hospitals. Philips is the leading brand in the market for Cath-Lab machines holding 52% of the market share. Siemens comes in second, far behind Philips, having only 29% of the market share.

The findings of this study align with those of Jung et al. (2015) which highlighted that brand significantly influences purchase decisions as well as repurchase intention, which aligns with our findings showing certain brands being preferred over others.¹⁰

USER SATISFACTION LEVEL:

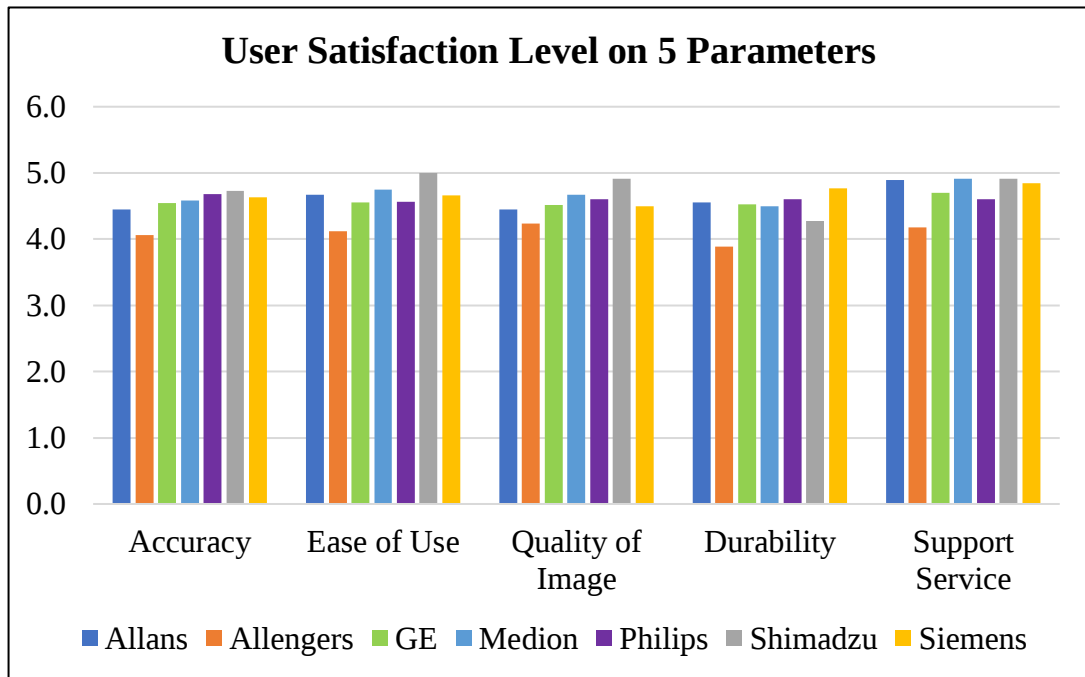


Figure 4.6: User Satisfaction Level for Preferred Equipment Brands on 5 Parameters.

The bar graph shows user satisfaction level for the preferred medical equipment brands amongst the hospitals of MMR, across five parameters: Accuracy, Ease of Use, Quality of Image, Durability, and Support and Maintenance Service. It can be seen that Shimadzu is consistently rated as having the highest user satisfaction in all of the factors (Highest being 5/5 for Ease of Use), except for Durability where Siemens takes the lead having a score of 4.8 out of 5. The main concern is that one of the leading brands of medical equipment, Allengers, consistently scored the lowest on all 5 factors with the lowest score of 3.9 out of 5 for Durability of the machines. Such low satisfaction level may hamper the future market share of Allengers.

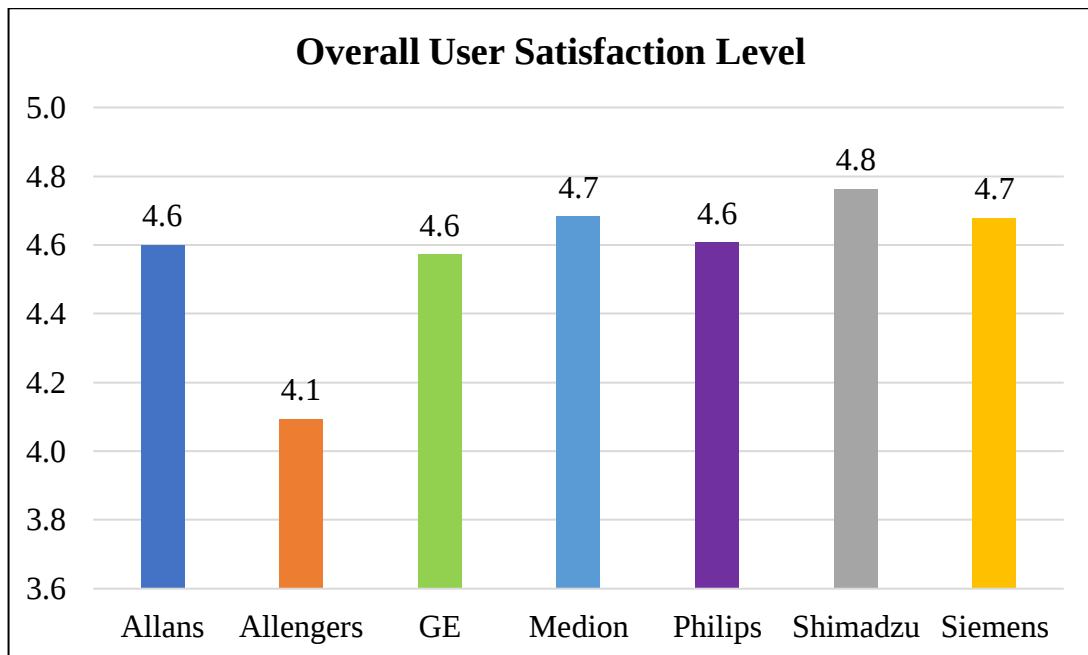


Figure 4.7: Overall User Satisfaction Level for Preferred Equipment Brands on 5 Parameters.

The bar graph provides an aggregate view of the overall user satisfaction level across the parameters. We can see that Shimadzu is the brand which has the highest overall score of 4.8 out of 5, closely followed by Siemens, having an overall user satisfaction score of 4.7 out of 5 while Allengers scores the lowest at 4.1.

This indicates that while the market share is dispersed, high satisfaction levels are associated with these leading brands, suggesting that users value quality and reliability in their imaging equipment. The findings correlate with study conducted by Jung et al. (2015) which found that brands play an important role in purchase decision and thereby also on satisfaction and repurchase intention.¹⁰

BUYING DECISION FACTORS:

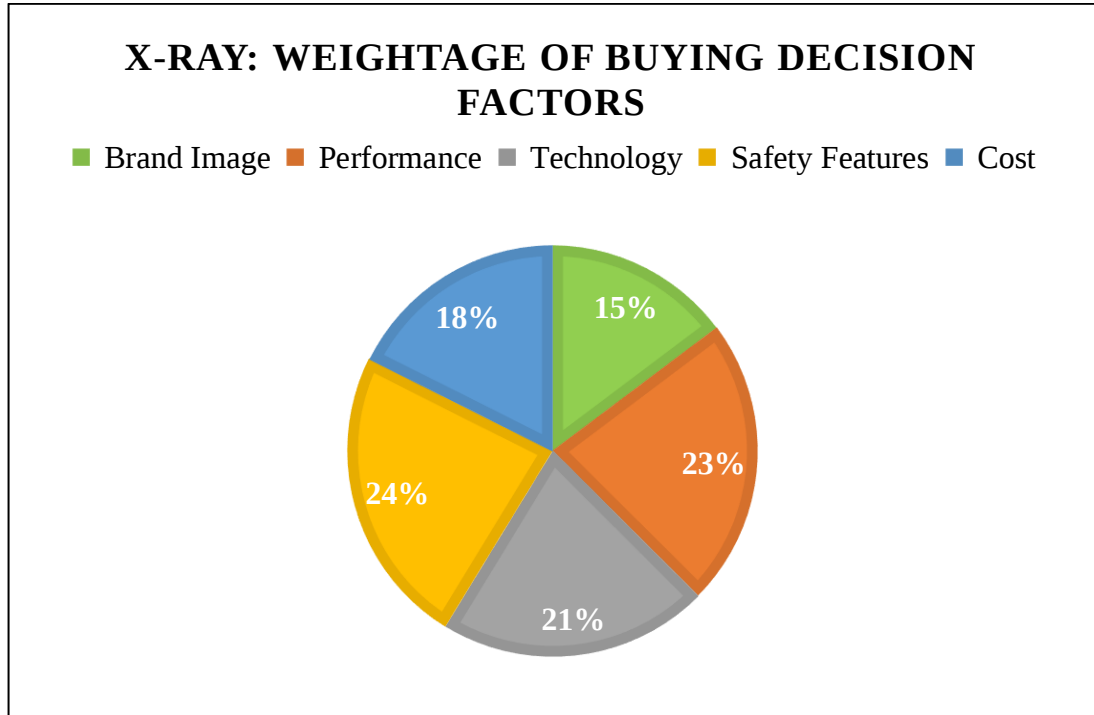


Figure 4.8: X-Ray: Weightage of Buying Decision Factors.

The pie chart shows the relative importance of the 5 buying decision factors for X-Ray machines. It shows that while purchasing X-Ray machines, Safety features and Performance are the major factors which influence the buying decision. It is followed by technology, cost and lastly brand image.

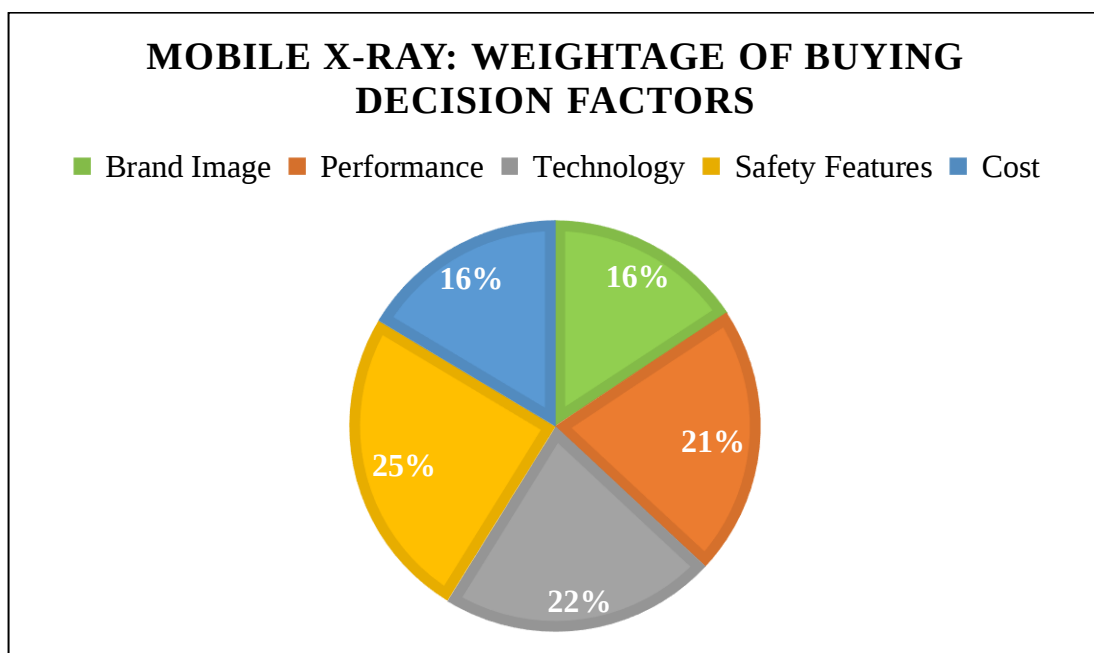


Figure 4.9: Mobile X-Ray: Weightage of Buying Decision Factors.

The pie chart shows the relative importance of the 5 buying decision factors for Mobile X-Ray machines. It shows that again the Safety features and Performance of the equipment are the major factors which played a role in the procurement of the equipment, closely followed by Technology. The Brand Image and Cost have the least role to play.

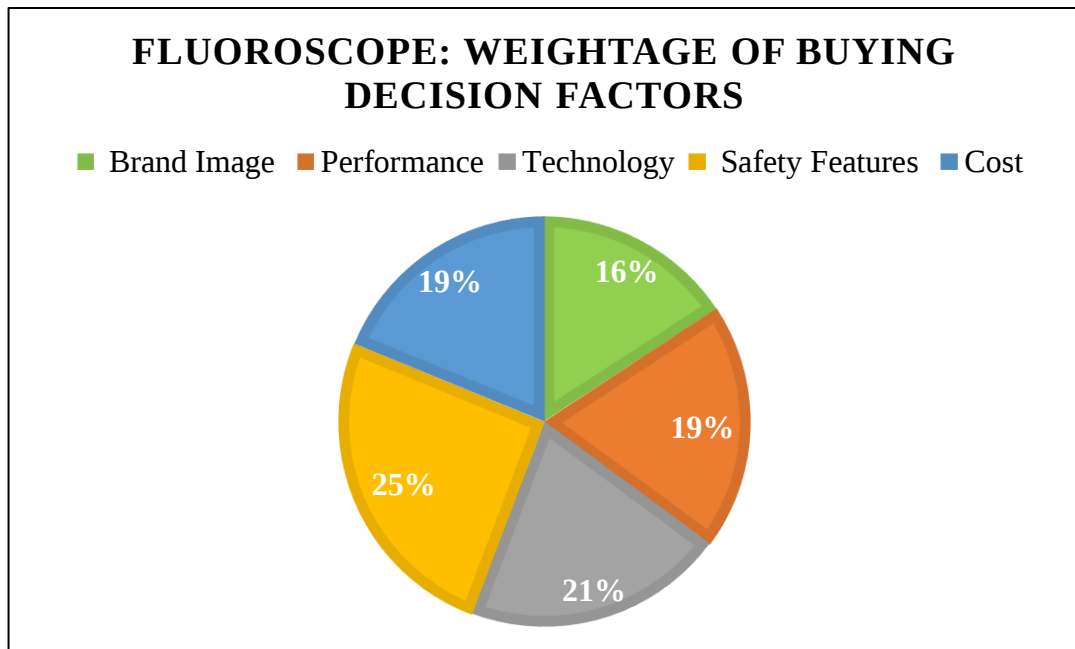


Figure 4.10: Fluoroscope: Weightage of Buying Decision Factors.

The pie chart shows the relative importance of the 5 buying decision factors for Fluoroscope machines. We see that Safety features of the machine play a major role in buying decision which can be seen from Figure 4.10. It is then followed by the other 3 factors (Technology, Performance, Cost) playing a more or less equally important role while Brand Image is given the least weightage.

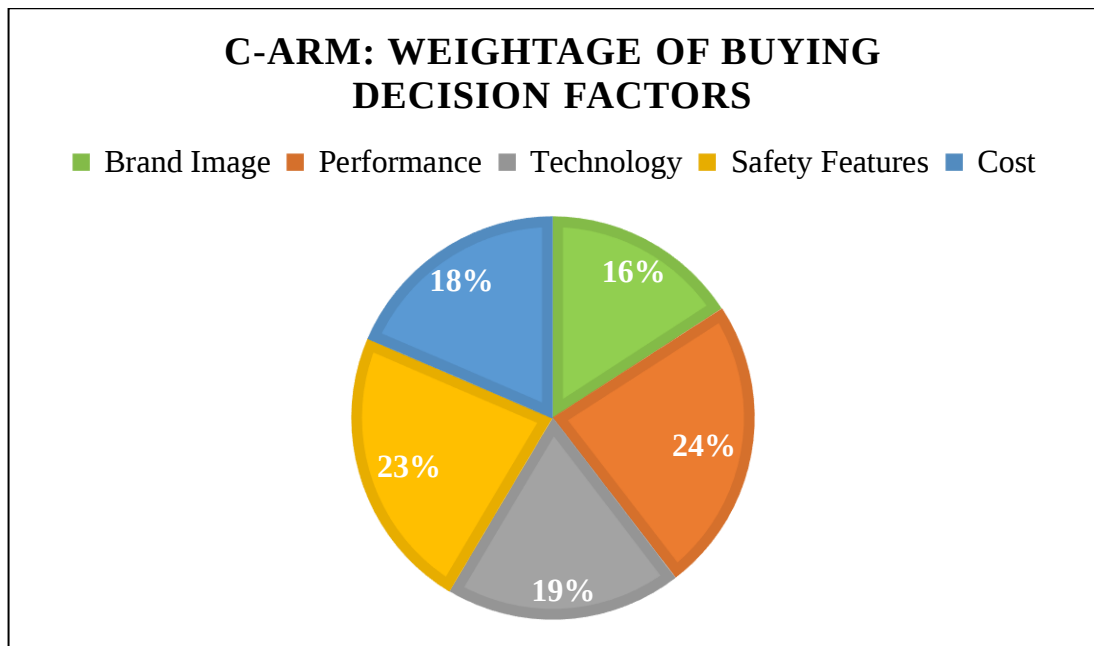


Figure 4.11: C-Arm: Weightage of Buying Decision Factors.

The pie chart shows the relative importance of the 5 buying decision factors for C-Arm units. It is seen that the most important factor for purchase of such machines is the Performance of the machine which is closely followed by the safety features of the machine. Technology, Cost and Brand Image follow.

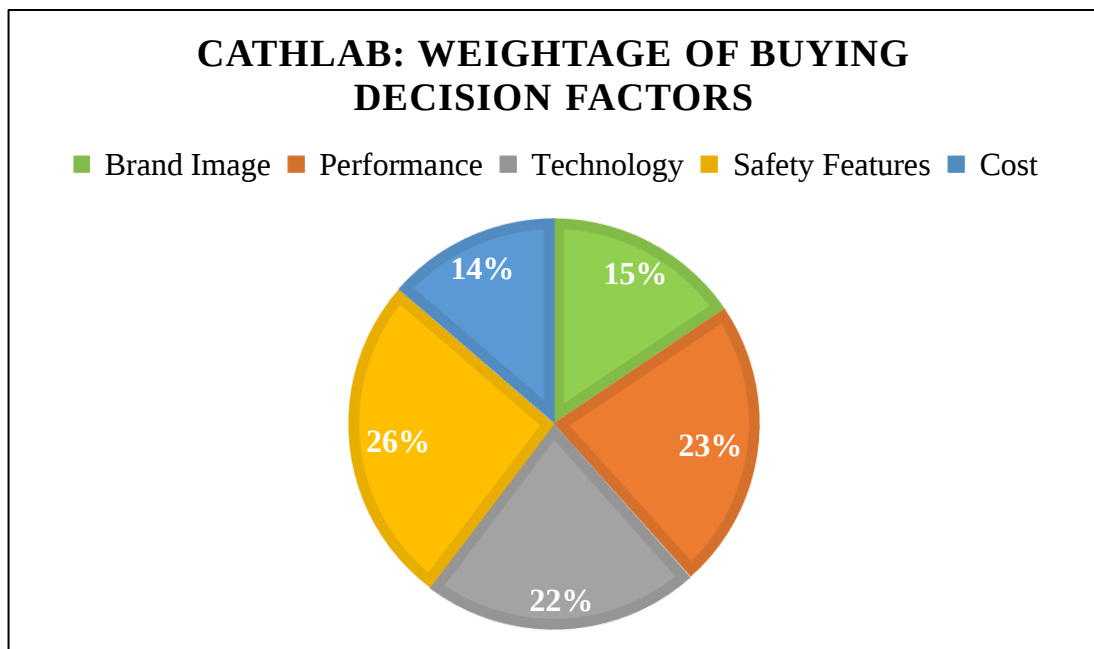


Figure 4.12: Cath-Lab: Weightage of Buying Decision Factors.

The pie chart shows the relative importance of the 5 buying decision factors for the Cath-Lab equipment. Here again Safety Features top the list of priorities. It is followed

by performance and technology with little importance to cost of the equipment and brand image.

Table 4.1: Weightage of Buying Decision Factors Matrix

FACTORS	X-Ray	Mob X-Ray	Fluoroscope	C-Arm	Cath-Lab
Brand Image	MIN	MIN	MIN	MIN	2ND MIN
Performance	2ND MAX	MID	MID	MAX	2ND MAX
Technology	MID	2ND MAX	2ND MAX	MID	MID
Safety Features	MAX	MAX	MAX	2ND MAX	MAX
Cost	2ND MIN	2ND MIN	2ND MIN	2ND MIN	MIN

This table ranks the weightage of different buying decision factors for each type of equipment. It is seen that Safety Features is the most important factor which emphasizes a significant focus on well-being of the patients and users. Performance is the second most important factor which is crucial but not as dominant as safety features. Technology plays a moderate role in the buying decision as it can enhance the appeal of the product but is not a decisive factor. Cost is a consideration but is not a primary driver as consumers are more interested in meeting their needs. Brand Image is the least influential factor as consumers prioritize the product's features over the brand name.

The findings are consistent with that of Sicotte et al. (2006-07) where participants were in favour of quality, technology and ease of use.¹¹ However, the findings of our study are in contrast to that conducted by Mohamed Gendia, Hamed M Shamma (2022) which showed that while price, technology and also after sales played an important role in buying decision, brand was the most important factor.¹² The findings of our study also differ from that conducted by H. Prem Kumar, Dr. R Prabhusankar (2022) where it was found that brand mattered more to consumers as compared to price. However, it could be due to the fact that the study was about glucometers and not such expensive medical equipment and most of the participants were already able to afford glucometers and other costly equipment.¹³ On the other hand, the findings of our study are supported by those

of Sunardi (2023) who conducted a study in Indonesia and found that brand was one the least important factor.¹⁴ The findings of the study are also in line with the study conducted by Tourani et al. (2014) which showed that quality/performance was a very important factor for the purchase of medical equipment.¹⁵ The findings of our research also collaborate with that of Rabinovich et al. (2022) where it was found that technology is usually favoured by the users and output quality/performance was the decisive factor for user satisfaction.¹⁶ Our findings also align with that of Al-Kwafi SO and McNaughton RB (2013) where it was concluded that product features are the most important factor while price and product bundling were the least important factor.¹⁷

CHAPTER 5:

DISCUSSIONS

The study aimed to find out the preferred brands, user satisfaction level and the weightage of key factors influencing the buying decision of radiology and cardiology equipment in NABH-accredited hospitals of MMR. The findings provide valuable insights into the market dynamics and help the hospital as well as the brands of medical equipment to understand the current scenario.

BRAND PREFERENCE:

The study found that no single brand dominates the X-Ray and Mobile X-Ray market in the MMR. Instead, the smaller brands collectively hold the majority of the market share. This is in contrast to the more concentrated market preferences found elsewhere. A study by Li et al. (2019) found that in China, there was a preference for well-known brands such as Siemens, Philips and GE when it came to high resolution medical equipment. A similar trend was observed by Johnson and Brown (2020) in Europe, where the healthcare professionals held Siemens and Philips in high regard due to their cutting-edge technology and reliability which are crucial for patient safety and accurate diagnosis.

The smaller brands are able to dominate these markets as they are able to fulfil the requirements of the MMR hospitals such as affordability, features etc. A study by Patel et al. (2021) found that cost and after sales service play an important role in equipment selection by hospitals of India.

In contrast, Siemens is a market leader for fluoroscopy machines with a 64% market share while Philips is the leader in the Cath-Lab market with more than 50% market share. Thompson and Harris (2018) found that Siemens's innovation and customer service are the reason for their global presence. The C-Arm market which is dominated by Siemens & Philips align the findings of Li et al. (2019) which found a preference for high quality, reliable brands. It highlights the importance of technology and reliability for medical equipment, as also noted by Martinez and Gonzalez (2022) in the Latin American markets.

USER SATISFACTION LEVEL:

User satisfaction level in the MMR is the highest for Shimadzu, followed by Siemens, with Shimadzu leading in all parameters except durability, where Siemens excels. This strong user satisfaction score for Siemens and Shimadzu indicates a high level of trust in

their equipment's performance and quality. This trend is not only limited to MMR but also all around the world where these brands are celebrated for their technological advancements, user friendly interface and consistently high performance. A study by Kim et al. (2018) also found that Siemens equipment was favoured in South Korea due to reliability and features, aligning with our study.

However, Allengers despite being a well-known brand, scored the lowest in all satisfaction parameters in the study. Similar concerns have been found in other studies as well. A study by Rodriguez and Martinez (2017) also found that certain models from well-known brands received low satisfaction scores because of customer service and maintenance issues. Such low scores for Allengers highlights the importance of continuous quality improvement in order to maintain customer satisfaction. The findings remind us that even well renowned brands need to address their customers' concerns in order to maintain a good market position.

FACTORS INFLUENCING BUYING DECISION:

In MMR, Safety Features is the buying decision factor having the maximum weightage, emphasizing a significant focus on well-being of the patients as well as the users. Products which concentrate on safety are going to attract more customers as hospitals are more focused on minimizing risks and ensuring a safe environment. This finding aligns with Smith et al. (2018) who found that hospitals across the world consider patient safety as top priority when selecting equipment.

Performance is the relatively second most important factor following Safety Features as it is important for accurate diagnosis and efficiency. Similar findings are seen in a study by Chen and Wu (2017), which found that reliability and consistency impact the user satisfaction and their repurchase intention.

Technology plays a moderate role as it enhances the appeal of the product but is not the primary decisive factor. Though technological advancements are welcome by the hospital, they are not given preference over safety and performance. It was also seen by Johnson and Brown (2020) that technological features are supplementary to the core function of safety as well as performance.

Cost is a consideration but not a driver in purchase decisions. Hospitals are much more interested in equipment which fulfil their need rather than those which are budget friendly

but can be used only for a short period of time. This was also observed by Patel et al. (2021), that though hospitals have budget constraints, they are willing to spend more for high quality equipment.

Brand Image is found to be the least influential factor. It is seen that customers prioritize product which satisfy their needs over the brand reputation. This is in alignment with the study of Martinez and Gonzalez (2022) who found that even the smaller brands can gain a large market share if they focused on better performance and safety.

LIMITATIONS:

While this study provides valuable insights, its limitations include geographical confinement to MMR and the exclusion of certain chain hospitals such as Fortis and Cloudnine, potentially affecting generalizability. Additionally, being a cross-sectional study, the findings represent a specific point in time and may evolve with technological advancements. User satisfaction is subjective, and the study focuses only on specific equipment types. Future studies should consider a broader range of equipment and incorporate additional factors to gain a more comprehensive understanding.

CHAPTER 6:

CONCLUSION

This study aimed to understand brand preferences, user satisfaction levels and weightage of key factors which influence the buying decision of NABH-Accredited hospitals for radiology and cardiology equipment in the Mumbai Metropolitan Region. The findings of the study reveal diverse market landscape and also helps us to understand the user satisfaction associated with the leading brands of medical devices and what is the most important factor which influences procurement of these machines.

For X-Ray and Mobile X-Ray machines, no single brand dominates the market with a sizeable portion of it belonging to the smaller players. In the fluoroscope market, Siemens comes out to be the market leader which shows its strong reputation in advanced imaging technology. Siemens and Philips are the significant brands when it comes to the C-Arm market while the market for Cath-Lab equipment is completely dominated by Philips.

User satisfaction scores were the highest for Shimadzu followed by Siemens, indicating that these brands are very highly valued for their quality and reliability. Safety feature emerges as the most critical factor influencing the buying decision across most equipment, followed by performance and technology while cost and brand are found to be generally the least important.

RECOMMENDATIONS:

For Medical Equipment Companies: Emphasize safety features and superior performance to meet the requirements of the top hospitals and build trust and reliability. Regular collection of user feedback for the products is required to improve the customer service and requires development of customer engagement programs.

For Shimadzu: Capitalize on high user satisfaction levels by promoting this to potential customers, increasing market presence in the X-Ray and Mobile X-Ray markets where there is no clear leader. Aggressive marketing efforts can help replace smaller brands currently in use.

For Siemens: Use market presence as well as positive image to further their cause and improve their products with even more innovation in order to keep the hospitals happy.

For Allengers: Focus on improving product quality and features to address low satisfaction scores. Without these improvements, their market presence may decline as hospitals opt for brands offering premium features, even at higher costs.

For Phillips, GE, Allans and Medion: Enhance presence in markets where it is currently low. Developing and effectively marketing products that meet hospital needs will help expand market share.

For Hospitals: Conduct thorough market research in order to identify all market players for each modality to procure equipment from premium product developers who may lack strong marketing but offer superior quality. Engage in vendor partnerships and build long-term relationships with vendors who deliver safe, reliable, and high-quality products. Improvements in procurement processes are required by involving a multidisciplinary team of radiologists, surgeons, radiological technicians, OT technicians, cardiology technicians, biomedical engineers, and purchase managers in the purchase process to ensure comprehensive decision-making. Focus should be on procuring equipment that integrates easily with existing systems for higher compatibility. Implementation of performance monitoring systems will ensure early identification of issues and reduce downtime.

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APPENDIX:

Appendix A: The following questionnaire was used to collect data for the study titled “Radiology and Cardiology Equipment Landscape in Metropolitan Hospitals: A Holistic View”

Radiology and Cardiology Equipment Landscape in Metropolitan Hospitals: A Holistic View

To understand preferred brands, user satisfaction level and weightage of different buying decision factors regarding radiology and cardiology equipment in hospitals of Mumbai Metropolitan Region.

* Indicates required question

1. Equipment belongs to which modality *

Mark only one oval.

- ☐ X-Ray
- ☐ Mobile X-Ray
- ☐ Fluoroscopy
- ☐ C-Arm
- ☐ Cath-Lab

2. Which brand does the equipment belong to?

3. Satisfaction Score of Machine with respect to Accuracy *

Mark only one oval.

Very Low Satisfaction

1 ☐

2 ☐

3 ☐

4 ☐

5 ☐

Very High Satisfaction

4. Satisfaction Score of Machine with respect to Ease of Use *

Mark only one oval.

Very Low Satisfaction

1 ☐

2 ☐

3 ☐

4 ☐

5 ☐

Very High Satisfaction

5. Satisfaction Score of Machine with respect to Quality of Imaging *

Mark only one oval.

Very Low Satisfaction

1 ☐

2 ☐

3 ☐

4 ☐

5 ☐

Very High Satisfaction

6. Satisfaction Score of Machine with respect to Durability *

Mark only one oval.

Very Low Satisfaction

1 ☐

2 ☐

3 ☐

4 ☐

5 ☐

Very High Satisfaction

7. Satisfaction Score of Machine with respect to Support ^{*}
and Maintenance Services

Mark only one oval.

Very Low Satisfaction

1 ☐

2 ☐

3 ☐

4 ☐

5 ☐

Very High Satisfaction

8. This Question is meant to understand the weightage given to each of the following factors when making a Purchase Decision. Please rate each of the 5 factors on a scale of 1-5 where 1 means most important and 5 means least important. Please remember that 1 rating can be given only to 1 factor and cannot be repeated.

Mark only one oval per row.

	1	2	3	4	5
Cost	☐	☐	☐	☐	☐
Safety Features	☐	☐	☐	☐	☐
Performance	☐	☐	☐	☐	☐
Brand Image	☐	☐	☐	☐	☐
Technology	☐	☐	☐	☐	☐