

Evaluation of Barriers in the Adoption of Hospital Information System and Electronic Medical Records in Hospital

By

Chandani Kumawat

*Dissertation submitted for the partial fulfillment of the
MBA Hospital and Health Management*

Academic year, 2015-2017



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TO WHOMSOEVER IT MAY CONCERN

This is to certify that **Chandani Kumawat** student of MBA Hospital and Health Management from The IIHMR University, Jaipur has undergone internship training at NTT Data Services from **February 06, 2017 to May 05, 2017.**

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

The Internship is in fulfillment of the course requirements.

I wish her all success in all her future endeavors.



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To whomsoever it may concern

This is to certify that **Chandani Kumawat** of **The IIMR University, Jaipur** has been working with NTT DATA Services for her summer project.

Project Details:

Project Name : Evaluation of barriers in the adoption of hospital information system and electronic medical records in hospitals
Duration : 90 days
Location : Bangalore
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She has successfully completed her project and her performance during the tenure of the internship has been found to be satisfactory.

Her findings in course of the project has been found to be practical and relevant and some of the recommendations will be incorporated on the floor on approval from the business.

Thanking You,

Regards,



Dilipkumar Santhanam
Business Partner Director, Services HRBP Team
NTT DATA Services

CERTIFICATE BY SCHOLAR

This is to certify that the dissertation titled Evaluation of Barriers in the Adoption of Hospital Information System and Electronic Medical Record in Hospitals submitted by **Chandani Kumawat** Enrollment No. **IIHMR-U/01/2015-17/0269** under the supervision of **(Col.) Dr. Ashok Kaushik** for award of MBA in Hospital and Health of the University carried out during the period from **February 06, 2017** to **May 05, 2017** embodies my original work and has not formed the basis for the award of any degree, diploma associate ship, fellowship, titles in this or any other institute or other similar institution of higher learning.

Chandani Kumawat
Signature

THE IIHMR UNIVERSITY, JAIPUR

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This is to certify that all ethical issues have been considered while collecting data for my dissertation titled "Evaluation of Barriers in the Adoption of Hospital Information System and Electronic Medical Record in Hospitals".

Chandni Kumawat

Signature of student

ABSTRACT

By: Chandani Kumawat

Introduction: HIS is a comprehensive computer based system that establishes an orderly and systematic method of managing hospital operations, financial, administrative and clinical patient records more effectively and efficiently for both out patients and inpatients. EMR is a part of hospital information system that contains all the patient medical history. It is basically electronic version of paper records and more beneficial than paper records. Despite of these benefits still after successful implementation of HIS, the hospital staff may face some barriers in adoption of the hospital information system. In this study the dimensions and barriers of HIS and EMR adoption will be analyzed, prioritized and also provided some suggestion to address those barriers.

Objectives: To identify and categorize the barriers that different healthcare providers are facing in adoption of hospital information system and electronic medical record and to suggest remedial actions to address those barriers.

Methodology: It was a descriptive cross sectional study and a survey was designed and conducted to identify major barriers in adoption of HIS and EMR by healthcare professionals. A sample size of 150 respondents was taken. The study was conducted amongst various users of HIS and EMR working in different departments in various hospitals in Bangalore.

Results: The barriers identified in this study as per clinical staff were difficulty in information exchange from one department to another department, technical support for hardware and network, hospital staff including doctors, nurses etc. are not trained enough to use HIS, workflow of various department not meeting with the software, software not providing any value add in terms of CDSS, MIS reports, BCMA etc.

And as per the administrative staff major barriers were financial barriers including lack of capital resources in HIS implementation as HIS and EMR have high initial cost, high operational and maintenance cost, uncertainty about the return on investment, lack of proper training, IT support system, software not providing any value to their tasks such as CDSS, MIS reports, BCMA, data safety issues with HIS implementation. Other barriers were support and loyalty from vendor and no enhancement in productivity,

graphical user interface of HIS software, no reduction in turnaround time, and customization of software according to the requirements.

Conclusion: The results of study basically emphasized the prioritized barriers in using HIS. It was aimed to shed light on barriers in the adoption of HIS and EMR to make effective efforts in the relevant area of HIS challenges. This will help hospital information system developers and implementers to address important challenges first, which would support successful implementation of such systems in hospitals which lead to efficiency and safety of hospitals in providing high quality services to the patients.

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3. Abbreviations

HIS	Hospital Information System
IT	Information Technology
EMR	Electronic Medical Record
CDSS	Clinical Decision Support System
OT	Operation Theatre
ICU	Intensive Care Unit
CSSD	Central Sterile Supply Department
BMW	Bio Medical Waste
MIS Reports	Management Information System Reports
BCMA	Bar Code Medication Administration

4. Introduction

In our society healthcare is a very important part in everyone's life and it is compulsory for healthcare providers to do their jobs in an efficient and effective manner. Every day number of patients visits the healthcare facilities for their physical or mental problems. The medical and administrative staffs have to manage and integrate clinical, financial, operational and administrative information. A hospital information system (HIS) is basically a computer system that is used to manage all the information related to hospital to allow healthcare providers and administrative staff to do their job effectively.

A hospital information system is one of the important applications of information and communication technology. It provides support to the healthcare providers in managing variety of information that is generated on day to day basis in a hospital. It is a comprehensive and integrated information system designed to collect, retrieve, manipulate and use of information to support all the administrative and clinical activities of a hospital. These hospital information systems have been first introduced in the 1960s and evolved with time and modernization of healthcare facilities.

Initially hospital information systems were used only in the financial and accounting areas. But now with the advancement in computer technology, it is used in every activity and in entire flow of information within the hospital. Currently, hospitals are becoming more independent on these information systems in carrying out all the clinical, administrative, financial, and operational functions. Improving patient safety, increase quality of medical care and decrease healthcare cost to the community are the objectives of HIS technology.

Benefits of Hospital Information System:

- It improves the quality of healthcare delivery.
- It improves clinical care and patient safety.
- It reduces the administrative paper work
- It reduces the scope of error.
- Helps the decision makers to detect and control emerging health problems, monitor progress towards health goals.
- It provides a common source of information about a patient's health history.

- HIS keeps patients' information related to treatment in a secure place.

For improving the communication among various providers within and between the organizations, EMRs are developed which serve by automating the collection, use and storage of patient information and facilitates clinical decision support and guidelines compliance. Evidence from various studies prove that various multiple functionalities of EMR such as Clinical Decision Support System, Clinical Data Repository and Computerized Physician Order Entry helps in improving the quality by reducing medical errors. Analysis have also revealed that improved patient safety, high quality care and cost reduction based on the overall spending of health information technology has encouraged the adoption of electronic medical records. Electronic medical record (EMR) is a part of hospital information system that contains all the patient medical history. It is basically electronic version of paper records and more beneficial then paper records.

India is the fastest growing healthcare information technology market in Asia after China. Throughout the world, in the healthcare industry, the widespread utilization of technology becomes common, with plan to utilize both present and future HIS applications. An efficient and future proof hospital information system is a key of a viable health system as healthcare business models are evolving rapidly.

Today, there are some processes that govern these sectors. There is a need to control these processes as costs rise and there is a requirement to manage the information that health professionals needed. The HIS has the functionality to handle various types of patients: in-patients, out-patients, accidents and emergencies, daycare and referred patients as it is a patient centric approach. Despite of these benefits still after successful implementation of HIS, the hospital staff may face some barriers in using the hospital information system.

Numerous studies show that a significant number of large scale information system projects have been failed because of many reasons. Each year tens of billions dollars spends on failed project but there have been reported improvement also in the project management and software. According to the research findings of the Standish Group International Inc., 49 percent of very large projects that cost over 10 million dollars,

rejected before the end and only 51 percent have been implemented, which spend more time and money.¹

Some studies show that the common scenarios of HIS implementation failures are- an implementation start well but never be completed because of the inflexibility of the HIS software and inexperienced implementation teams and another is the HIS implementation has been completed but only part of HIS functionality has been implemented and one more is that the after successful implementation of HIS, the hospital staff have stopped using software. For this there might be two reasons either the software was not user friendly or the workflows were not well planned and configured.

In this study the dimensions and barriers of HIS and EMR adoption will be analyzed, prioritized.

5. Review of Literature

A literature search was performed to identify published studies related to the factors that are influencing the adoption and use of hospital information system and electronic medical record. The search was limited to full paper articles published in English. However, this review gives a broad reflection of substantial research performed across different countries, with a limited contribution from Indian studies.

In a study by Ranjeeta Basra Korgaonkar et al. (2014)² on adoption of information system by Indian hospitals; challenges and roadmap. According to this study HIS is a computer system that provides support to healthcare providers in managing variety of information system that is generated on day to day basis in a hospital. In today's scenario, the use of information technology has become vital for hospitals with an aim to automate the core processes of healthcare delivery system, data inaccuracy minimization, data collection redundancy, on the basis of structured evidence based knowledge making clinical decision, improvement in health outcome, medical error reduction and lower cost.

A number of hospitals in India are still using the traditional paper based system and find difficulty in large volumes data management. IT has been a late entrant in the field of hospital administration and most hospitals started with small systems that were developed in house only. HIS was first introduced in 1960s. Initially it was used only in financial and accounting areas.

The evolution of hospital information systems:-

1960 - Shared hospital accounting system

1970 - Expanded financial and administrative systems, results review, clinical department automation

1980 - Integrated financial and clinical (limited) systems, managed care, financial and administrative systems, departmental imaging (limited systems)

1990 - Expanded clinical departmental solutions, increased IDN like integration, emergence of integrated EMR offerings

2000 - Emerging, broad-based clinical decision support, broad operational departmental systems with integration, emerging data warehousing and analytics solutions

With time and enhancement in computer technology, now HIS is used for every activity and in the clinical, administrative, financial, and operational all aspects of hospital. The modern HIS includes many applications addressing the needs of various departments in a hospital.

HIS for different departments are:

- **Nursing information system (NIS):-** These systems are designed to help nurses in order to provide better patient care. A NIS can perform variety of functions and provide benefits such as improve staff schedules, improvement in clinical data integration and in patient charting. They can have better managed work force in order to help managers to handle absence and overtime. This can also be used in the monitoring of staffing levels and making it cost-effective. It can also be helpful in admission information, patient charting. By this application all clinical data can be stored securely and retrieved when required. By the integration of clinical data nurses can collect, retrieve and analyze the clinical information and also integrate it in designing patient care plans.
- **Physician's information system (PIS):-** The aim of PIS systems are to improve physicians practice and it is recommended by government for deployment. Popular application of PIS is electronic medical records (EMRs), electronic health records (EHRs) etc. An EMR basically contains all of the patient's medical history in

digitalized version. It is mainly used by healthcare providers for diagnosis and treatment. An EHR contains the information from all the providers that are involved in patient care and also it allows sharing of information. The data in EHR can be created, managed and consulted only the authorized staff from across all the healthcare organizations.

- **Radiology information system (RIS):-** These systems are used for radiology billing services, scheduling of appointment, reports and storage of patient database. With the advancement in technology this RIS practice has become more complex.
- **Laboratory information system (LIS):-** These systems are used for laboratory orders management, billing services etc.
- **Pharmacy information system (PIS):-** It is basically designed to address various functions of pharmacy department. It helps pharmacist to monitor the use of medication in hospital, to supervise medication allergies, adverse drug reactions, and other drug related complications. It also helpful in order to detect drug interactions and helps in administering proper drug based on patients psychological factors.

Steps of HIS implementation

Step 1: HIS Orientation

HIS orientation is conducted on an as needed basis to hospital IT teams to provide an overview of HIS, as well as benefits and requirements participation.

Step 2: HIS Technical Assessment and Installation

After orientation, IT service providers interested in implementing HIS will sign the memorandum of agreement and will be provided with a copy of HIS policies and procedures including materials for posting and other forms. Hospital IT staff visits the service provider for site inspection.

Step 3: Outcome Management Training (Establishing Milestones and Performance Targets)

This training is conducted with the program manager or case manager to identify milestones and performance targets. This includes services provided to hospitals IT team with a detailed description of how those services assist participants to achieve the milestones and ultimately complete the program. This milestone/performance is customized for each participating department.

Step 4: User training

User training is conducted on an as needed basis. All the HIS users are required to attend this training before utilizing HIS. After the training, participants are given certificate of completion, user name and password.

Step 5: Go Live! And Technical Support

With the completion of steps one to four, the hospital is now ready to “Go Live” or start using the system.

Electronic Medical Record (EMR)

In India this EMR adoption started somewhere around 2008 when an investment in patient portal and EMR software is made by a handful technology of savvy entrepreneurs in order to enhance connectivity and communication between doctors and patients. In India there are 35 domestic EMR vendors with multiple product portfolios.

Several recommendations regarding EMR standards were presented in a committee constituted by an order of “mohfw.gov”. Some recommendations are:

Name	Class
UHID	Unique Health Identifier
XML	For Data Capture
HL7	Clinical Data for Inter Department Documents

Key Driver of EMR in Indian Market:

- Increased healthcare awareness
- Changing lifestyle
- Demand of quality
- Competition between hospitals

- Cheap and quality will encourage to international patient

EMR in India

EMR Providers	Hospitals Using EMR
IBA Health	AIMS, Coimbatore
Vepro	Apollo Hospital, Chennai
Siemens	Artemis Healthsciences, Gurgaon
Karishma Software	Christian Medical College, Vellore
Sobha Renaissance IT Pvt. Ltd.	Fortis Hospital, Mohali and Delhi
21 st Century Healthcare Solutions	Manipal Hospital, Bangalore
Soft Link International	Max Devki Devi Hospital, Delhi
Prognosys	P D Hinduja Hospital, Mumbai
Srishti Software	Ruby Hall Clinical, Pune
CDAC	PGIMER, Chandigarh
GE Healthcare	Sri Sathya Institute of Higher Medical Sciences, Bangalore

The challenges of HIS implementation that were addressed in this study:

- Poor infrastructure. Application and organization of the implementation processes
- End user contribution management
- Different information systems, external systems and independent physician groups integration
- Lack of coordination among different departments, end users and stakeholders
- Redundant, inaccurate, confusing master data
- Data definitions, representation and vocabulary standardization problem
- Lack of technical requirements planning
- Resistance by end users
- Lack of end user training
- Immaturity of software
- After implementation support
- Lack of information about HIS implementation

- Hospital's administrative needs ignorance

In Sakhi John and Dr. Mohd Vaseem Ismail et al. (2015)³ study, overall healthcare market in India was reached to almost USD 70 billion in 2015 but health IT market was only USD 3 billion. There are various factors such as cost, implementation issue, and interoperability of various modules, security and confidentiality due to which healthcare sector; especially hospitals have been lagging behind adoption of information system.

Indian healthcare industry expected to become US \$280 billion industry by 2020. Health IT market in India is expected to reach \$1.45 billion in 2018 from the present \$381.3 million. EMR has highest penetration in India. It is growing by 13.5% in the last five years and it is expected to have same rate of increase due to improving uptake and upcoming hospital projects.

In a study by Haux et al. (2006) Healthcare information systems refers to such systems that are used to process data, information and knowledge in healthcare environments (Haux, Winter, Ammenwerth, & Brigl, 2004). While healthcare information systems and health information systems are often used today to refer to the same concept, a series of terms have been used in the evolution of this phenomenon from its early foundations in the 1960s. And this study mainly focuses on major evolutionary developments in the primitive hospital information systems.

Important trends in hospital information system:

- **Trend 1: From Paper-Based Systems to Computer-Based Systems:** Meanwhile health data and information in the past have been created and stored mainly on paper, there has been a clear migration from paper to computer-based systems (Haux et al., 2002). This ability means that more data can be processed and stored through the use of modern information technologies to yield better knowledge. The future of healthcare information systems looks towards a near “paperless” era.
- **Trend 2: From Local to Global Information Systems:** While earlier healthcare information systems were limited to departmental units (e.g. radiology, or laboratory) or just within a healthcare practice system (e.g. hospital or clinic) (Linberg, 1968), modern healthcare systems target regional, national and even a global reach.

- **Trend 3: From Healthcare Professionals to Patients and Consumers:** Originally, healthcare information systems were designed to be used by mainly physicians and administrative staff (Ball, 1971; Ball et al., 1994), but it was later passed on to be used by nurses. Since then, the trend has shifted to involve more patient input.
- **Trend 4: From Using Data for Patient Care to Research:** Over the years, patient data has been used beyond patient care management to a more general use involving research in healthcare (Leiner, Haus, Haux, & Knaup, 2002; Kuhn & Guise, 2001) and even education.
- **Trend 5: From Technical to Strategic Information Management Orientation:** Haux (2006) has noted that while computer supported information systems from the 1960s to the 1990s focused on problems resulting from the technical aspects of the systems, concerns about the organizational problems, social issues and change management aspects became more relevant at the turn of the millennium.
- **Trend 6: From Numeric Data to More Complex Forms of Data:** Not only has the technology that support health information systems advanced in technological complexity, the data that is being received and processed has also become complex. From numeric data through alphanumeric data to imaging and even molecular data (Maojo & Martin-Sanchez, 2004).

A study by Mohamed Khalifa, MD et al., (2013)⁴ done in Saudi Arabia to identify, categorize and analyze barriers perceived by different healthcare professionals in order to provide suggestions on beneficial actions and options in the adoption of EMRs.

According to this study EMR is a component of HIS. In theory, any information which can be placed in a paper record can also be placed in an electronic record. However, many institutions that are migrating toward an electronic record system are facing some challenges such as difficulty in converting unstructured text, data, and images into a standard format.

Different types of patient data that can be included in an EMR system:

- Medical history of patient

- Physical examination
- Diagnosis
- Activities related to clinical work
- Diagnostic assessment
- Therapeutic efficacy (drugs, devices, procedures, rehabilitation programs)
- Data related to administration (Claims, billings, outcomes)

EMR Adoption Model

The HIMSS Analytics Electronic Medical Record Adoption Model (EMRAM) incorporates methodology and algorithms to automatically score hospitals around the world relative to their Electronic Medical Records (EMR) capabilities. This eight-stage (0-7) model measures the adoption and utilization of electronic medical record (EMR) functions.

In this century the widespread adoption of EMR systems is an important step in delivering the promise of longer lives and better health outcomes. In the past decade, in United States there has been increasing movement toward adoption of EMR for the storage of patient health information and more recently toward personal health records (PHRs).

Basically EMR is a generic term used to describe computer-based patient medical records. For the most part, the development of EMRs is being promoted as a necessary step to improve care.

The recognition of the vast benefits EMR systems will provide in the healthcare delivery enterprise continues to grow. Benefits are expected to include:

- fewer medical errors, which are estimated to be responsible for as many as 44,000 to 98,000 deaths a year
- The provision of more efficient healthcare services
- reduced utilization
- improved ability to manage chronic disease
- improved health status
- streamlined work processes and
- More accurate and complete medical records.

Stages of EMR Adoption Model

EMR Adoption Model SM	
Stage	Cumulative Capabilities
Stage 7	Complete EMR; CCD transactions to share data; Data warehousing; Data continuity with ED, ambulatory, OP
Stage 6	Physician documentation (structured templates), full CDSS (variance & compliance), Closed Loop Medication Administration
Stage 5	Full complement of Radiology PACS
Stage 4	CPOE, Clinical Decision Support (clinical protocols)
Stage 3	Nursing/clinical documentation (flow sheets), CDSS (error checking), PACS available outside Radiology
Stage 2	CDR, Controlled Medical Vocabulary, CDS, may have Document Imaging; HIE capable
Stage 1	Ancillaries – Lab, Rad, Pharmacy - All Installed
Stage 0	All Three Ancillaries Not Installed

HIS and EMR



Study identified that there are six main barriers and ranked them according to their importance, these are: Human Barriers (3.73), related to beliefs, behaviors and attitudes, Financial Barriers (3.50), related to money and funding, Legal and Regulatory Barriers (3.32), related to laws, regulations and legislations, Organizational Barriers (3.16), related to the hospital management, Technical Barriers (3.04), related to computers and IT and Professional Barriers (3.00), related to the nature of healthcare jobs. Among these barriers they have identified that human barriers, those are related to healthcare professionals and their beliefs, plus the financial barriers, related to money and funding are two major barriers and challenges in the way of successful implementation of EMRs and human factors are even more important. After identifying barriers solutions were also provided such as improving the awareness of the importance and benefits of using EMRs, developing teaching and training on EMRs, Proper planning of hospital resources and allocating the proper funding and enough capitals investments, developing rules and regulations for the use of EMRs by Ministry of Health, redesign medical and administrative work flow to match with EMRs specifications, implementing new innovations in both software and hardware, designing system interface more user friendly and understandable, conducting training programs and motivating healthcare professionals to learn and train on using EMRs by providing direct or indirect incentives.

In a case study of an EMR system at Sankara Nethralaya Hospital in India by Jeremiah Scholl, Shabbir Syed Abdul, Luai Awad Ahmed et al. (2011)⁵ previous computer or EMR experience was noted as a critical issue for successful EMR implementation. Health staff in developing countries will often have less experience using computers than the developed countries.

In Ali Ahani, Mehrbaksh Nilashi, Hossein Ahmadi et al., (2016)⁶ study, dimensions and barriers of HIS implementation have been analyzed and prioritized. The major barriers of HIS implementations were technical problem related to system design, lack of organizational training, lack of powerful information networks, dissatisfaction of users about the content of system, concern related to privacy and no incentives to use system. HIS design and performance was one of the largest issues, related to the level of user friendliness and inability of the system to meet unexpected situations.

Issues related to technical aspects of HIS were infrastructure as there is a lack of hardware and maintenance problem, some departments have old computers, software issues etc. According to Jahanbaksh et al. (2014), the challenges of e-Health utilization relate to some fundamental issues primarily improper privacy and security mechanisms.

A study by Ahmadian et al. (2014) have discovered the lack of powerful information networks to be the highest factors that make it difficult for hospitals to implement the HIS technology. Developing countries access to internet and public networks and home-made internet protocols are limited. Lack of required technological infrastructure to establish national health information system, is a prevalent problem in developing countries. Limited resources and capability that can affect promotion of health IT in private and public hospitals. (Anwar, Shamim et al., 2014)

Robert H. Miller and Ida Sim et al.⁷ conducted a study on Physicians use of Electronic Medical Records and identified that the high initial financial costs, slow and uncertain financial payoffs, high initial physician time costs, difficulties with technology, complementary changes and support, electronic data exchange, financial incentives and physicians' attitudes were the key surface barriers to EMR use. And three major barriers difficulties with technology, complementary changes, support and electronic data exchange are – physicians' initial time costs increases and reduces physicians' EMR use, financial benefits and quality improvement.

A study by Sima Ajami and Tayyebi Bagheri Tadi et al. (2013)⁸ showed that time is the most important barrier such as physicians are very busy, they don't have time to properly become familiar with the various products, after that to select best EMR as per their requirement, then implement it and then train to use it etc. Then cost such as purchase price, costs of coordination, monitoring costs, negotiating costs, upgrade costs and governance costs are included cost. Physicians have to weigh the costs against the benefits and their prime concern was high upfront financial costs of implementing EMRs followed by uncertainty over any financial benefits that may accrue over time.

After that absence of computer skills that is needed because they have to perform various functions at the same time such as listen to patients complaints, assess medical relevance and simultaneously type notes and all these functions they can perform if they

have adequate typing skills, concentration, familiarity with the application's user interface etc.

Another barriers were workflow disruption, concern about security and privacy because non users believe that there are more risks of patient data security and confidentiality involved with EMR than paper records, lack of incentives, complexity of software such as multidisciplinary of screens, too many navigational aids, physical space such as not having sufficient private rooms for extra computers, communication among users, concern about the ability to select an effectively install EMR system, technical support, interoperability, reliability, inadequate data exchange, concern about data entry were the major barriers for adopting EMR by physicians.

In a study by Dr. Rajesh Kumar Sinha and Susanna Kurian et al. (2014)⁹, the satisfaction level of end users of hospital information system were assessed. HIS acceptability and sustainability mainly depends on satisfaction of end users with the HIS design and also inclusion of them during HIS implementation.

The major concerns with the end users were to have regular induction and training and customization of HIS according to them so that they can perform their daily routine activities effectively. Reasons for dissatisfaction among users are- not addressing their requirements and at the time of design and implementation no involvement of users.

Mehrdad Farzandipur, Fatemeh Rangraz Jeddi and Esmaeil Azimi et al. (2016)¹⁰ conducted a study on factors affecting successful implementation of hospital information systems. The study showed that mainly human factors such as basic knowledge of using computer, ease of using HIS, and ease of learning how to use HIS. According to this paper there is a relationship between motivation to use computers and having experience in using computers. The persons with more experience in using computers are more motivated to perform computational processes and are supportive of hospital information system implementation and the persons with less experience of using computers have negative perception for hospital information system. Various studies shows that the systems that are user friendly and easy data retrieval will be more accepted and their implementation will be successful.

Then technological factors such as HIS future development, reliability of system in information safety. Amongst them the system development capability and HIS reliability keeping information safe were the most important. In some studies technical

factors such as ability to communicate systems are the biggest obstacle and the biggest benefits are electronic interchange and communication facilities. Then after human and technological factors, organizational factors and managerial factors such as training of users, management of project and confidentiality of information have an important role in the adoption and successful implementation of HIS. These factors resulted in inability of design and implementation of many of these HIS systems and also problems in the use of these systems.

According to Kimiafar et al. the primary cause of low quality of hospital information system were the lack of related and sufficient education. In the study by Minal el al., the biggest barriers in the adoption of EMR are reported as the cost of software, hardware and physician participation.

The adoption of IT in healthcare has been faced many challenges, hence the HIS implementation is very slow and lagging behind due to the resistance by the healthcare professionals to the use of technology.

These challenges majorly ranges from issues related to technology itself, regulatory environment, low adoption rates by doctors and hospitals due to associated costs, as the cost of acquisition, running and maintenance is very high and uncertainty about the return on investment, and concerns on privacy and security, issues related to human factors. (Madison N. Ngafeeson et al., 2014)¹¹

In a study by Banayat, Garcia, Kesinger, McCook, and Schollossman et al.¹² the barriers to EMR adoption were identified. Electronic medical records have been used as a tool that will enhance the patient care coordination, reduces medical errors, increase efficiency and effectiveness, improve safety of patient and improve quality of healthcare delivery services by incorporating clinical decision support tool. According to Walker et al. a fully standardized electronic health care information exchange and interoperability system fully implemented among multiple classes of providers could yield a net value \$77.4 billion per year. As per the CDC in 2010 office based physicians who had access to basic EMR system were only 24.9% and only 10.1% had access to fully functional EMR. There were various barriers exist due to which the EMR adoption rate was very low. According to this paper not only the technical and financial considerations that were the most widely identified barriers to EMR adoption but also the user specific-social, psychological and organizational factors may be as important. These factors

basically include poor interfaces, clinical work flows not meeting with software, interoperability issues, poor change management, negative impact on physician patient relationships.

As per Boonstra and Broekhuis et al., 2010 and Castillo et al. 2010 financial factors such as high startup costs, high ongoing costs, return on investment uncertainty and lack of financial resources and technical factors such as complexity of system including multitude of screens, options, menus, pop ups and drop downs, lack of technical knowledge, customization problem, lack of interconnectivity, hardware maintenance were identified as most frequently cited barriers to adoption of EMR by physicians.

Change management plays an important role in the successful implementation and adoption of EMR. It needs to begin at very start of the initiative. Effective change management processes, tools and resources need to be in place both pre and post implementation. There were two major factors that result in low adoption of EMR- lack of user buy-in and accountability at the outset. The main area of change management that most powerfully affects the EMR adoption is skillful training.

Psychological barriers include physician skepticism and social barriers such as negative perceptions, lack of support from colleagues and work processes that divert attention and organizational barriers such as not having leadership skills, lack of management commitment, non-supportive organizational culture were considered as important challenges in EMR adoption.

Ayodele Cole Benson et al. (2011)¹³ conducted a study on assessing barriers to adoption of hospital information systems in Nigeria. The study shows that the main problem was that there is not any robust health care policy in implementation of hospital information system. According to Williams and Boren (2008) the poor technological base and lack of funding support may be responsible for poor implementation of electronic medical records in developing countries.

Non adoption of hospital information system leads to various consequences such as laboratory results mix up, error in diagnosis, errors in medication orders, patient's mismanagement. As per this study the major barriers of HIS implementation were unclear healthcare policy on hospital information system, no healthcare outcome implications, dependence on imported finished products, and resistance by the clinicians to the use of technology, significant technological bias in the provision of healthcare,

unavailability of financial aids to healthcare providers, lack of funding support, high cost of hospital information system, poor infrastructural base of the country, inadequate human capital, problem associated with poor internet access.

A study by Ozge Sagiroglu and Meltem Ozturan et al. conducted on implementation difficulties of hospital information system. According to this study HIS is a computer system designed to make effective management of all the information of hospital's medical and administrative work. HIS is a hospital wide system that is used to support the flow of administrative and clinical information. As per the definitions HIS should work with the integration of all non-medical systems such as human resources, accounting, and inventory besides medical systems. Introduction of HIS in the hospitals leads to patient care improvement as well as management of hospital, accurate and correct medical information collection and retrieval, low operational and treatment costs, easy access to patient medical data, for exceptional cases clinical data and warnings interpretation such as drug-drug interaction checking, duplicate checking, error checking etc. Most of the early 1960s and 1970s HIS did not succeed to make these expectations actual.

Study shows that the sources of HIS implementation difficulties were majorly related to organizational issues, infrastructure, application and organization of the implementation processes, end user contribution management, profile of end users, different system, external systems and independent physician groups integration, inconsistency among various workflows of different departments, lack of master data management, technical requirement planning, software immaturity, after implementation support, ignorance of administrative needs of HIS implementation, training issues, problems related to hardware, software, planning, support, and security.

6. Rationale

With the increase in the demand of high-quality healthcare services, the need for HIS has become essential. A number of international studies indicated the challenges have been faced by healthcare providers in the adoption of HIS and EMR. Few studies also demonstrate the positive perception with respect to the adaptability of HIS and EMR by healthcare providers owing to various factors such as efficiency, quality, safety etc. The values of HIS and EMR could be assessed by identifying multiple benefits generated from its use and comparing this with the old paper based information system.

On the other hand there are various barriers associated with the adoption of HIS and EMR. Considering the Indian scenario, only few studies have been conducted on hospital information system and focused on the barriers in the adoption of HIS and EMR. To shed light on these barriers, this study was conducted.

7. Research Question

- What are the barriers that the healthcare providers are facing in the adoption of hospital information system and electronic medical record?

8. Objectives

- To identify the barriers that the different healthcare providers are facing in the adoption of hospital information system and electronic medical record.
- To evaluate the feedback given by the healthcare providers.
- To suggest remedial actions to address those barriers.

9. Research Methodology

9.1 Study Design

Descriptive cross sectional quantitative study

Quantitative component of study includes data collection through semi structured questionnaire to identify and evaluate the barriers in the adoption of HIS and EMR. Cross sectional study involve data collection from a subset of population at a defined time.

9.2 Study Area

The study was conducted amongst various users of HIS and EMR working in different departments in various hospitals in Bangalore.

9.3 Sampling Method

For quantitative analysis Non probability convenience sampling was utilized in which the questionnaires were distributed to the respondents (Clinical staff and administrative staff) in the various hospitals in Bangalore.

9.4 Study Includes

Sampling targeted the users of HIS and EMR both clinical staff and administrative staff in hospital.

Clinical Staff- Physicians, Nurses, Radiologist, Lab technicians, Pathologist, Radiology technician.

Administrative staff– IT personnel's, other admin staff including Head of departments, CFO, senior managers and managers from finance department.

9.5 Study Excludes

Sampling excluded the following departments- Pharmacy, Front office, ICU, OT, CSSD, Housekeeping, Linen & Laundry, Material management, Security department, BMW, Engineering.

9.6 Sample Size

150

9.7 Duration of Study

Three months (February 2017- April 2017)

9.8 Sources of Data

Primary data through questionnaire

9.9 Data Collection Tool

For quantitative data collection, semi structured questionnaire tool for both clinical staff and administrative staff were prepared. The questionnaire includes demographic factors like name of the organization, department, designation, age, gender and years of experience and other factors related to the hospital information system. Both the questionnaire contains nine close ended structured questions and one open ended question.

9.10 Data Collection

For data collection, schedule based survey were conducted using the above mentioned tool in which the questionnaire were distributed to different respondents working in various private hospitals in Bangalore. Their responses were collected and analyzed to

describe the major barriers in hospital information system and electronic medical record adoption and also the effort was made to prioritize and rank the barriers.

9.11 Data Analysis Procedure

All the analysis and graphical depictions were done with the help of MS-Excel and results were presented in the form of pie charts, bar graphs and column graphs.

10. Data Analysis and Interpretation

10.1 Characteristics of respondents

Based on findings, 62% of sample population was female and 38% of sample was male.

Gender wise distribution

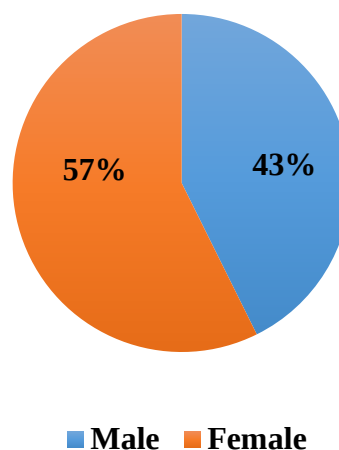


Figure: 11.1

The average age of sample was 31.95 years and among them 33% was in the age group of 26-30 years, 20% in 31-35 years, 18% in 21-25 years, 14% in 36-40 years, 11% in 41-45 years, 2% in 46-50 years, 1% in 51-55 years and 1% in the age group of 56-60 years.

Age was the most important parameter in this study because the older people have more resistance towards the digitalization of information system in hospitals as they are less technology addict. They face many types of difficulties such as typing problem, less experience of computer technology and most important is that they are used to of their

usual practice. And on the other hand younger people in the age group of 21-35 years have less resistance towards hospital information system and electronic medical record as they are more familiar with technology, they have computer skills also and most important they enjoy working with technology.

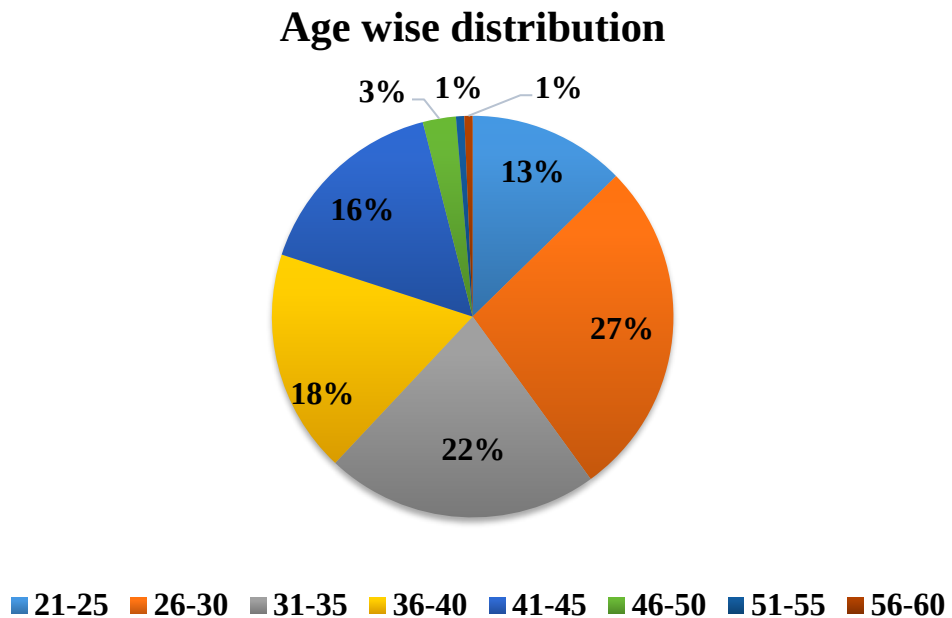


Figure:11.2

Among 150 respondents 36% were nurses, 27% technicians, 19% doctors, 11% IT staff, 7% other administrative staff including CFO-Chief financial officer, senior managers, managers.

Designation wise distribution of respondents

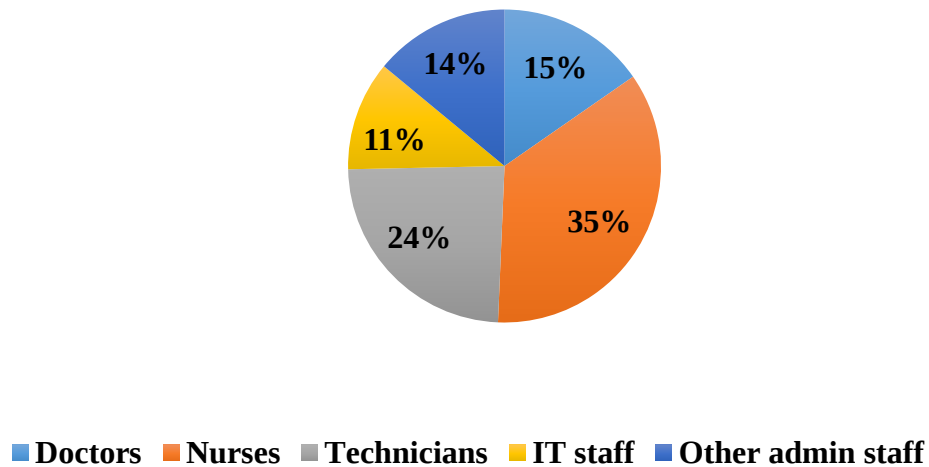


Figure: 11.3

About 88% had an experience of 0-10 years, 10% with 11-20 years, 1% had 21-30 years of experience and 1% with 31-40 years of experience.

Years of experience also plays an important role in this study as in questionnaire for administrative staff few questions were related to the financial aspects of hospital information system and these questions only answered by the people who have an experience of more than 10 years. Basically in this study maximum people from administrative staff have an experience between 11-20 years and they have answered those questions.

Years of experience wise distribution

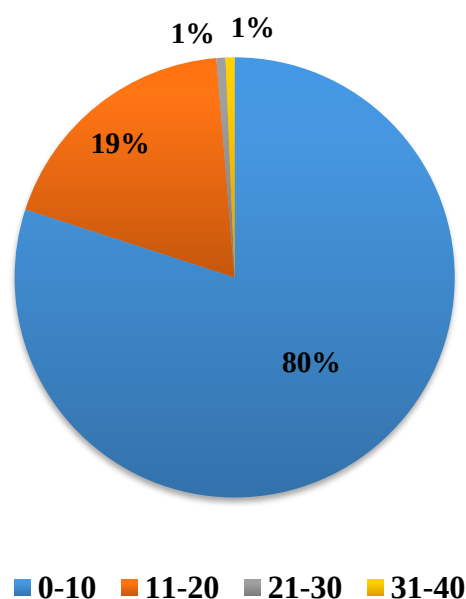


Figure: 11.4

10.2 Analysis on clinical barriers

➤ Responses of clinical staff on various parameters (Table: 11.1)

S. No.	Parameters	Yes	No
1	Software meeting departmental workflow	70%	30%
2	Difficulty in information exchange between different departments	79%	21%
3	Reduction on TAT using HIS	56%	44%
4	Lack of proper training and unavailability of guidelines and manuals	73%	27%
5	Not proper maintenance and technical support for hardware and network	74%	26%
6	Software providing value add in terms of CDSS, MIS reports	60%	40%

➤ **Assessment of barriers**

○ **Percentage analysis**

Out of 112 respondents (clinical staff) every individual has been given different rating for each factor on 0- not a barrier, 1- minimum barrier, 2- moderate barrier, 3- major barrier scale.

Software not meeting departmental work flow

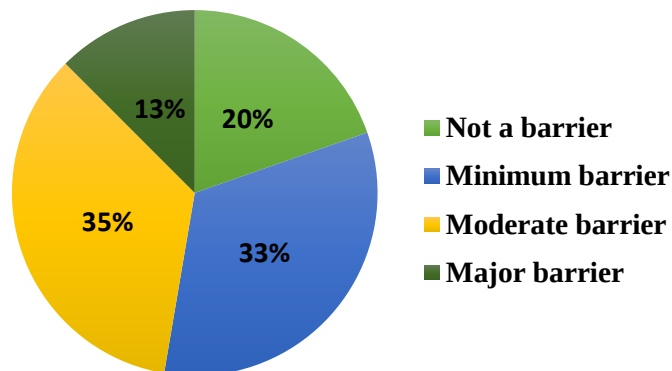


Figure: 11.5

As per this analysis only 13% respondents consider software not meeting departmental workflow as major barrier, 35% considers it as moderate barrier, 33% consider as minimum barrier and 20% consider it as not a barrier. As per this maximum respondents put it as moderate and minimum barrier if their software not meeting with their departmental workflow or business requirements.

Difficulty in information exchange b/w departments

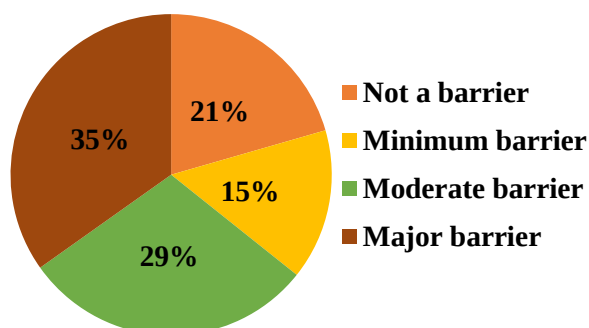


Figure: 11.6

For difficulty in information exchange between various departments of hospital 35% respondents consider it as major barrier (mainly specialized doctors and nurses), 29% as moderate barrier, 15% consider as minimum barrier and 21% consider it as not a barrier.

No Reduction on TAT

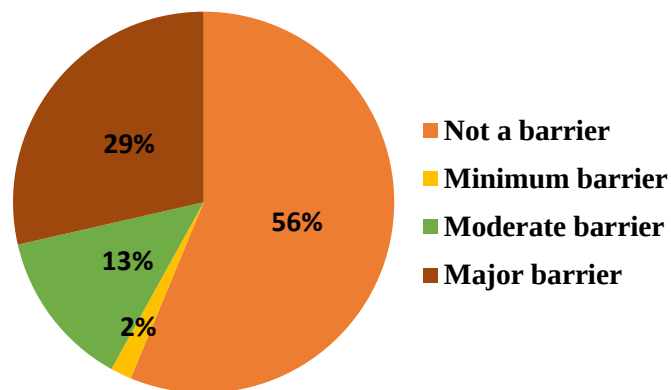


Figure: 11.7

29% respondents consider it as major barrier if there is no reduction on turnaround time by using HIS (mainly nurses), similarly 13% consider it as moderate barrier, 2% as minimum barrier and 56% consider it as not a barrier.

Lack of proper training and unavailability of guidelines and manuals

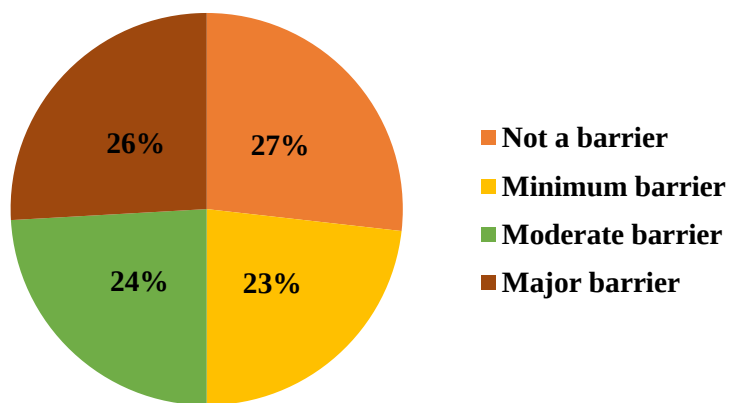


Figure: 11.8

Lack of proper training and unavailability of guidelines and manuals is the most important barrier faced by maximum doctors, technicians and nurses. According to this

analysis 26% respondents consider it as major barrier, 24% as moderate barrier, 23% as minimum barrier and 27% as not a barrier.

Not proper maintenance and technical support for hardware and network

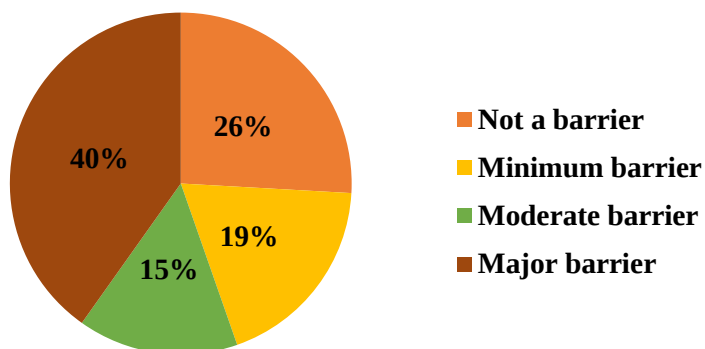


Figure: 11.9

For hardware maintenance and network issues 40% respondents consider it as major barrier, 15% as moderate barrier, 19% as minimum barrier and 26% as not a barrier.

Screen interface

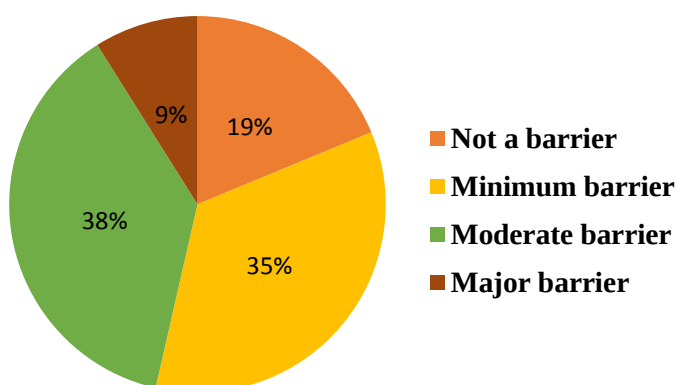


Figure: 11.10

Only 9% respondents consider screen interface as major barrier, 38% consider it as moderate barrier, 35% as minimum barrier and 19% as not a barrier.

Screen interface includes various parameters such as screen colour, layouts, information, charts, graphics, and customization option.

Value add in terms of CDSS, matrix

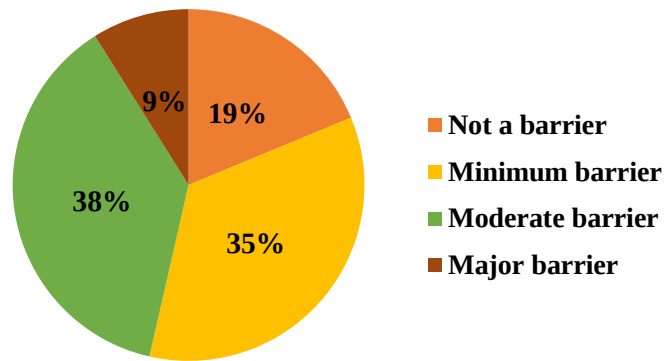


Figure: 11.11

Software providing value add in terms of CDSS, MIS reports etc.- 9% respondents consider it as major barrier, 38% as moderate barrier, 35% as minimum barrier and 19% as not a barrier.

➤ **Satisfaction of clinical staff with IT support system in the use of HIS**

Among 112 respondents 40% were moderately satisfied with the IT support system, 38% were very satisfied, 14% were extremely satisfied, 6% were slightly satisfied and only 1% were not satisfied. This indicates that IT support system is not a barrier for clinical staff as maximum respondents are very satisfied or moderately satisfied with the IT support system in the use of HIS.

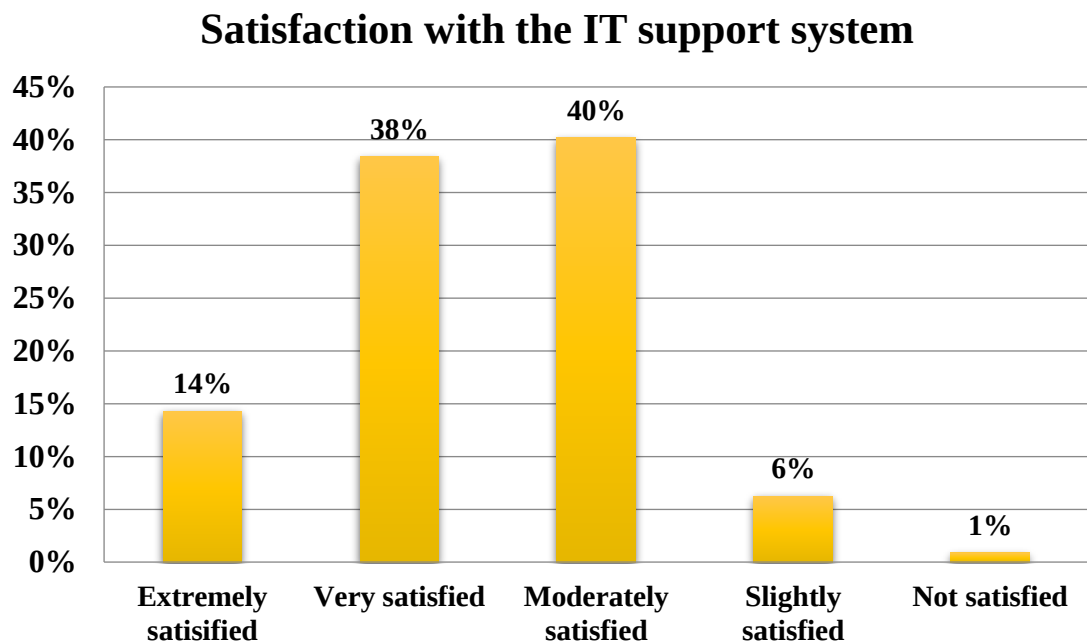


Figure: 11.12

10.3 Analysis on administrative barriers

➤ Responses of administrative staff on various parameters (Table: 11.4)

S. No	Parameters	Yes	No
1	Lack of sufficient capital resources is a barrier	100%	0%
3	Receive Support and loyalty from vendors	55%	45%
4	IT support system is a barrier	55%	45%
5	Enhancement in productivity with HIS	89%	11%
6	Lack of proper training is a barrier	92%	8%
7	Data safety	21%	79%
9	Providing Value add in terms of CDSS, MIS reports	42%	58%

➤ Assessment of Barriers

○ Percentage analysis

Out of 38 respondents every individual has been given different rating for each factors on 0- not a barrier, 1- minimum barrier, 2- moderate barrier, 3- major barrier scale.

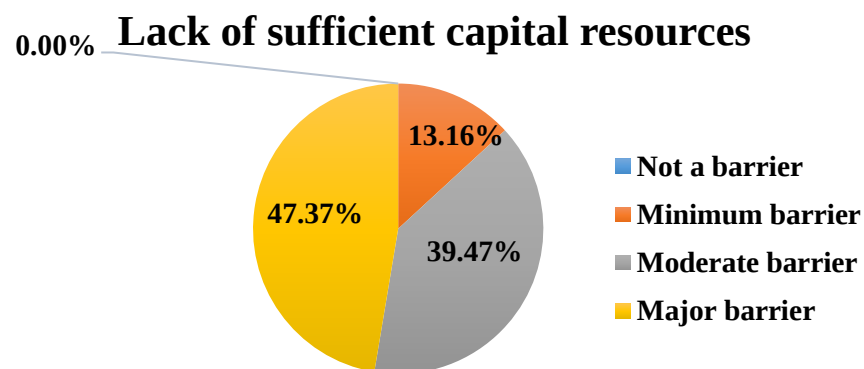


Figure: 11.13

47.37% respondents consider lack of sufficient capital resources as major barrier, 39.47% consider it as moderate barrier, and 13.16% as minimum barrier and no one consider it as not a barrier. The initial cost of HIS implementation is very high and

along with the initial cost operational and maintenance cost is also very high so that hospitals are lagging behind the adoption of HIS as cost is the major issue for administrative staff.

Uncertainty about ROI

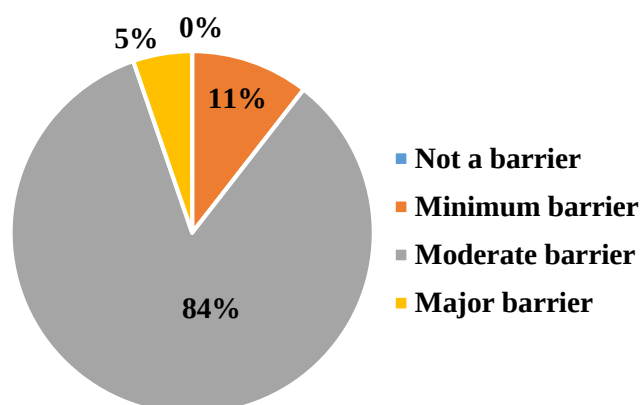


Figure: 11.14

There is always an uncertainty about the return on investment as 5% respondents consider it as major barrier, 84% consider it as moderate barrier and 11% consider it as minimum barrier.

Support and loyalty from vendors

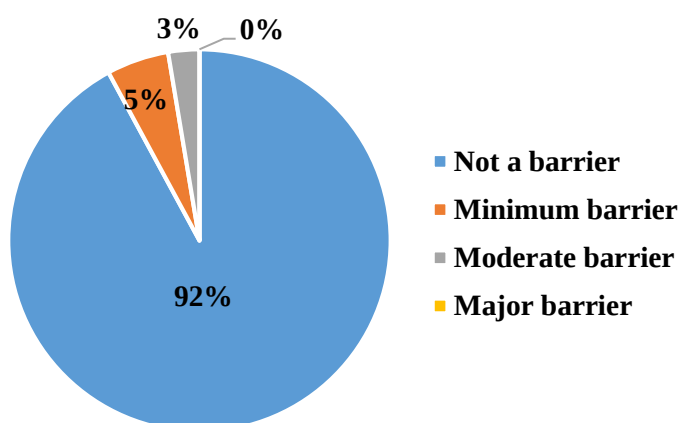


Figure: 11.15

For support and loyalty from vendors no one consider it as major barrier, 3% consider it as moderate barrier, 5% as minimum barrier and 92% consider it a not a barrier.

IT support system

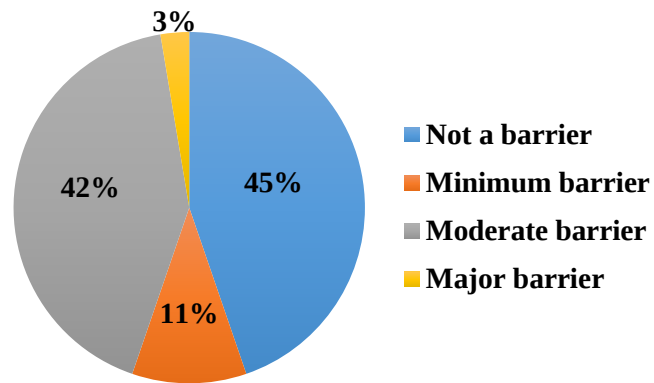


Figure: 11.16

3% respondents consider IT support system as major barrier, 42% consider it as moderate barrier, 11% consider it as minimum barrier and 45% consider it as not a barrier (mainly IT staff).

No enhancement in productivity

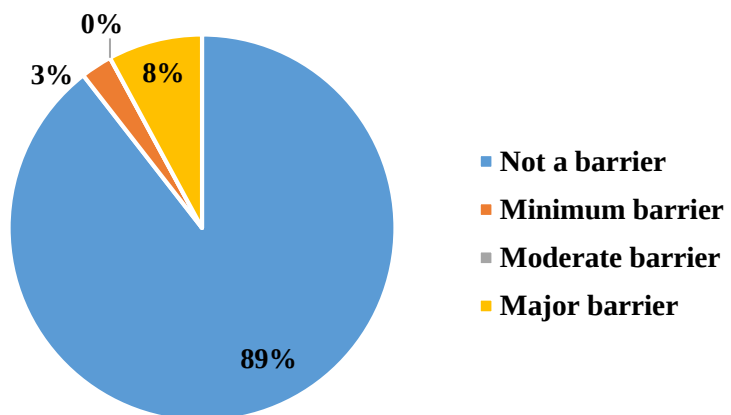


Figure: 11.17

8% respondents consider no enhancement in productivity as major barrier, 3% as minimum barrier, and 89% consider it as not a barrier.

Lack of proper training

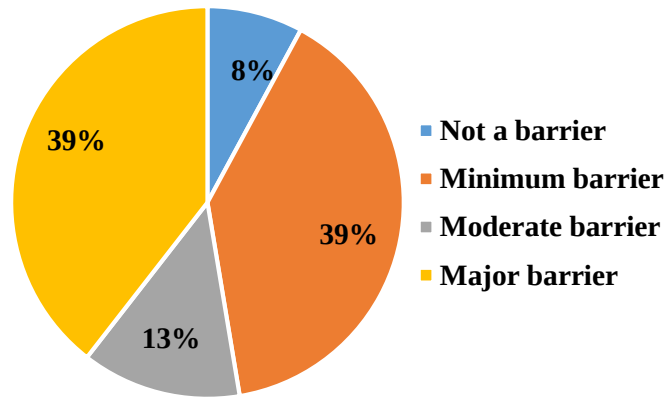


Figure: 11.18

For lack of proper training and unavailability of guidelines and manuals 39% respondents consider it as major barrier, 13% as moderate barrier, 39% as minimum barrier, and 8% as not a barrier.

Data safety

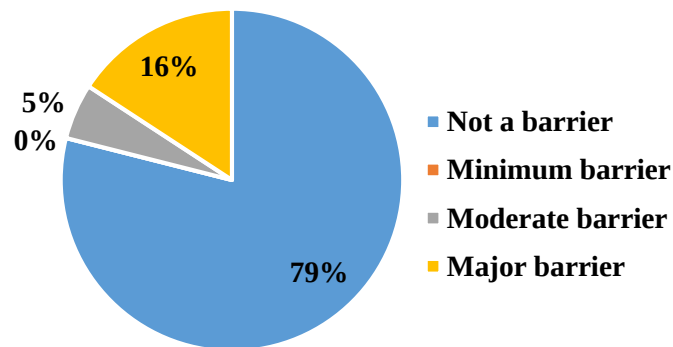


Figure: 11.19

16% respondents consider major barrier if there is any data safety issue with HIS implementation, 5% as moderate barrier, and 79% consider it as not a barrier.

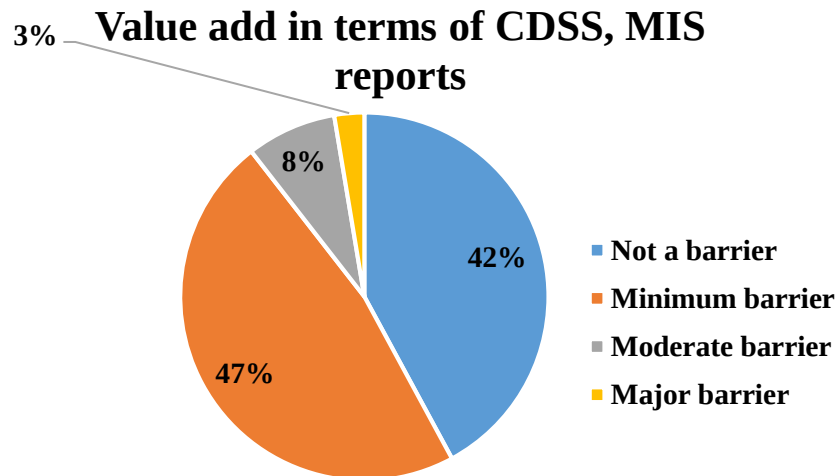


Figure: 11.20

Software providing value add in terms of CDSS, MIS reports 3% respondents consider it as major barrier, 8% as moderate barrier, 47% as minimum barrier, and 42% consider it as not a barrier.

➤ **Suggestions for HIS to adapt, learn and implement in a facility to enhance and improve the quality of health care services**

Both the clinical staff and administrative staff were provided some suggestions for improvement in the HIS implementation and use. According to them following are the areas of improvement in HIS implementation:-

- User friendliness
- Speed of network
- Safety of Data
- Waiting time
- Training
- Customization of software
- Graphical user interface
- Enhancement in productivity

Observational Learnings

The study conducted shows the list of healthcare providers using EMR software-

Hospital Name	Software Name
Hospital A	Track care
Hospital B	Soft bee
Hospital C	Health object
Hospital D	Med mantra
Hospital E	Wipro

Analysis of the data collected inferred that majority of the participant hospitals are operating on HIS but only some parts such as billing module, clinical order entry electronically using computers, order duplication, error checking and patient notes.

The use of HIS as fully functional operating system in any healthcare provider facility is of utmost importance since partially operational health information systems not only effects the process flow but also decreases the efficiency because of the mixing of paper based and electronic work pattern.

In addition, the study infers that all end users of laboratory, radiology, blood bank, dietary services, bedside procedures, operation theatre, outpatient department, inpatient department/nursing unit, Cath labs, dialysis, chemotherapy, ICU department not have access to clinical orders placed through computers, metrics and dashboard reports.

The fact that users are not using EMR as a major part of their HIS capability imposes a major burden to reduce medical errors, improve the quality and efficiency of patient care.

11. Discussion

The results of this study presented the importance of main factors and challenges affecting adoption of HIS and EMR in hospitals from point of view of clinical staff (doctors, nurses, technicians) and administrative staff (IT staff, other admin staff- finance department senior manager, manager, CFO, HODs). Prioritization of barriers helps healthcare authorities to decide on their main area of focus and importance of that particular area.

11.1 For clinical staff

As per the clinical staff the main barriers in the adoption of HIS and EMR were:-

- **Difficulty in information exchange between various departments of hospital through HIS:** - Difficulty in information exchange between various departments were realized as major barrier in this study as this problem would occur due to the incompatibility of computer system, staff was not trained enough that they don't know how to share information, problem with the server and interfaces, inconsistency among different workflows of different departments etc.
- **Not proper maintenance and technical support for hardware and network:** - This was more related to system slowness, computer crashing making records inaccessible, speed of the network, electricity failure, and technical limitations related to hardware, printers were not in working condition, computer nodes were old in some departments etc.
- **No reduction on turnaround time (TAT):** - Most of the nurses said that there is no reduction on turnaround time by using HIS because they have to do duplicate work such as same work they are doing in paper and in system also, for example: implementation of some functionality and not all, results in duplication of work as both the computerized and manual work flow were exist side by side and staff have to perform duplicate data entry and it will put an extra load on them.
- **Lack of training and unavailability of guidelines and manuals:** - Another area of focus was proper training and unavailability of guidelines and manuals in using HIS as staff is not having extra time for training due to their busy schedule and problem with doctor is that they like traditional paperwork more convenient than software because they are used to of it.
- **Software not meeting with business requirements:** - Another important factor addressed by respondents was software not meeting with departmental workflow, for example: implementation of some functionality but not of others can cause both computerized as well as manual workflow to exist side by side that will require staff to perform duplicate data entry and this will put an extra workload on them.
- **Screen Interface:** - The screen interface is basically the graphical user interface (GUI) that includes screen layout, screen colors, readable information, charts,

graphics, and customization option etc. This problem majorly address by technicians and nurses as they were not that much familiar with the system and also there were too many options, too many navigational adds, multiple screens in the software that creates confusion.

- **Software not providing value add in terms of CDSS, MIS reports:-** Then another factor such as software not providing value add in terms of CDSS, MIS reports, BCMA etc. This factor was majorly addressed by doctors as in their thinking HIS is not providing any value to their task.
- **IT support system:** - As per the rating of clinical staff on satisfaction with the IT support system in the use of HIS 14% were extremely satisfied, 38% very satisfied, 40% were moderately satisfied, 6% slightly satisfied and only 1% were not satisfied, so as per this rating maximum people were very satisfied and moderately satisfied, hence IT support system was not a major barrier for them.

11.2For Administrative staff

As per administrative staff the main barriers in the adoption of HIS were:

- **Lack of sufficient capital resources and uncertainty about the return on investment:** - Lack of sufficient capital resources, uncertainty about the return on investment was identified as major barrier because initial investment is very high. And also the operational and maintenance of HIS and EMR requires high cost. The return on investment uncertainty barrier is the worry that specifically financial gains to the practice of HIS and EMR may not be seen for years, if ever, and may not balance the investment risk. All these factors were included in financial barrier as it is considered in terms of money. Due to these financial barriers, there was problem to do things up to the optimum level, all tasks were done in accordance with the budget.
- **Lack of proper training and unavailability of guidelines and manuals:** - Training was the major issue in HIS and EMR adoption. Skillful training allows users to see how the new system integrates with and may even improve their current workflow

caring for patients. Growing proficiency removes the temptation to revert back to their old familiar processes and procedures. No system is ever implemented perfectly the first time around and there will always be “bugs” to fix. When users encounter system issues, internal IT staff, super users, or the vendor need to be readily available to respond and address the issues. Long waits for response to a problem will negatively impact both user learning and user satisfaction.

- **IT support system:-** In the implementation of hospital information system IT team of hospital plays an important role.
- **Value add in terms of CDSS, MIS reports:** - Another factors addressed by respondents were software not providing value add in terms of CDSS, MIS reports, BCMA, matrix etc. Major problem in generating management information system reports in order to measure the performance of various departments of hospital.
- **Data safety issues:** - Using HIS may threaten confidentiality of patient health information. It may lead to information loss, corruption or hacking.
- **Support and loyalty from vendors**
- **No enhancement in productivity:** - There were no enhancement in productivity by using HIS and EMR basically no improvement in quality indicators such as registration time, waiting time, discharge time etc. as per the administrative staff.

According to the respondents of this study the main areas of improvement in HIS and EMR implementation was user friendliness of the system, speed of the network, training of staff, customization of software as per their requirement, improvement in waiting time etc.

The results of this study basically emphasized the prioritized barriers in adoption of HIS and EMR. This study aimed to shed light on barriers of using HIS and EMR to make effective efforts in the relevant area of HIS challenges. This will help to foster the trends of HIS and EMR implementation and utilization in private hospitals which lead to efficiency and safety of hospitals in providing high quality services to the patients. But still the study cannot assist in generalization as there were some limitations.

12. Limitations

- Sample size- less responses from hospital staff due to their busy schedule
- Hospital staff excluded from the study
- Non availability of resources
- Time constraints

13. Conclusion

Hospital information system is useless, if the users that interacting daily with these systems are dissatisfied with their functionality, faced many challenges in using these systems and reject them. The major purpose of this study was to address those challenges that associated with the HIS and EMR adoption and giving priority to them in order to clarify that on which factor main focus should be required.

The barriers identified in this study as per clinical staff were difficulty in information exchange from one department to another department, technical support for hardware and network, hospital staff including doctors, nurses etc. are not trained enough to use HIS, workflow of various department not meeting with the software, software not providing any value add in terms of CDSS, MIS reports, BCMA etc.

And as per the administrative staff major barriers were financial barriers including lack of capital resources in HIS implementation as HIS and EMR have high initial cost, high operational and maintenance cost, uncertainty about the return on investment, lack of proper training, IT support system, software not providing any value to their tasks such as CDSS, MIS reports, BCMA, data safety issues with HIS implementation.

Other barriers were support and loyalty from vendor and no enhancement in productivity, graphical user interface of HIS software, no reduction in turnaround time, and customization of software according to the requirements.

So basically overcoming the hurdles to IT adoption in hospitals requires a combination of change management and system design that properly incorporates concerns of healthcare providers into technical form and functional form. People make mistakes, get distracted by subsidiary tasks, get bored with complex training routines, and resent work flow disruptions that increase their overall workload. Successful systems should be intuitive and there is a need to incorporate the requirements of healthcare providers in

software, system should be usable with minimal learning curve, provide error correction (or at least providing notification), should be easily integrated into clinical workflow and administrative workflow, incorporate clinical decision support system, and capable of some visible improvement (even if modest) early on, so as to reinforce the change process. In short, the easy thing will be the right thing, at least most of the time.

14. Recommendations

Relied on the results of study recommendations were as follows:

1. Policies for short term and long term need to be established to deal with these barriers.
2. Software should meet business requirement of hospital and this can be achieved by analyzing the requirement thoroughly before starting the implementation phase and customization of software as per the workflows of hospitals.
3. For hardware maintenance, network issues upgrade machines (computers, printers) and network to new versions and update their operating system to enhance performance.
4. Providing continuous training to hospital staff for improving the knowledge of using HIS and EMR.
5. Ensure that software vendors should supply proper system documentation, user manual and guidelines for using and troubleshooting.
6. Ensure that software vendor should integrate other health IT system such as CDSS, MIS reports etc. so as to gain best benefits to provide value add.
7. Proper planning of fund allocation and enough capital investments for the implementation of HIS and EMR.
8. Conduct feasibility studies on benefits versus costs and that study could draw forecasting on return on investment of implementing and using HIS and EMR.

Basically HIS implementation requires proper planning, considerable investments and time. These must be done in order to minimize the failure of HIS and EMR implementation.

15. References

1. Farzandipur Mehrdad, Jeddi Rangraz Fatemeh and Azimi Esmaeil. "Factors Affecting Successful Implementation of Hospital Information System".2016.Available from:-
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4789654/>
2. Korgaonkar Basra Ranjeeta. "Adoption of Information systems by Indian Hospitals; Challenges and Roadmap".2014.volume-5.
Available from: <http://www.ijser.org/researchpaper/Adoption-of-Information-System-by-Indian-Hospitals.pdf>
3. Mr. John Sakhi, Dr. Ismail Vaseem Mohd. "Information Technology Challenges and Issues in Health and Hospital Sector-Critical Evaluation".2015.Volume-11.Available from: <http://ijetee.org/Docs/Volume%2011/Issue%205/15.pdf>
4. MD Khalifa Mohamed. "Barriers to Health Information Systems and Electronic Medical Records Implementation-A Field Study of Saudi Arabian Hospitals".2013.Available from:
<http://www.sciencedirect.com/science/article/pii/S1877050913008375>
5. Scholl Jeremiah, Abdul Syed Shabbir, Ahmed Awad Luai. "A Case Study of an EMR System at a Large Hospital in India: Challenges and Strategies for Successful Adoption".2011.Available from:
<http://www.sciencedirect.com/science/article/pii/S1532046411001262>
6. Ahani Ali, Nilashi Mehrbakhsh, and Ahmadi Hossein. "Evaluating the Barriers of Hospital Information System Implementation Analytical Network Processes (ANP) Method.August 2016.Available from:-
<https://www.researchgate.net/publication/308898382>
7. Miller H. Robert, Sim Ida. "Physicians use of Electronic Medical Records: Barriers and Solutions". Available from:
<http://content.healthaffairs.org/content/23/2/116.full.pdf+html>
8. Ajami Sima, Tadi Bagheri Tayyeb. "Barriers for Adopting Electronic Health Record (EHRs) by Physicians".2013.Available from:
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3766548/pdf/aim-21-2-13.pdf>
9. Sinha Kumar Dr. Rajesh, Kurian Susanna. "Assessment of End User Satisfaction of Hospital Information system".2014.Available from:
<http://journal.managementinhealth.com/index.php/rms/article/viewFile/328/980>

10. Ngafeeson Madison. "Healthcare Information Systems: Opportunities and Challenges".2014.Available from:
http://commons.nmu.edu/cgi/viewcontent.cgi?article=1012&context=facwork_book_chapters
11. Banayat, Garcia, Kesinger, McCook, and Scholossman. "Barriers to EMR Adoption". Available from:
http://www.medinfodoc.net/uploads/1/4/0/8/14081633/med_inf_403_barriers_to_emr_adoption.pdf
12. Benson Cole Ayodele. "Assessing Barriers to Adoption of Hospital Information Systems in Nigeria". The Journal of Global Health Care System.
13. Sagioglu Ozge, Ozturan Meltem. "Implementation Difficulties of Hospital Information Systems".2006.Information Technology Journal.volume-5.
14. Hamborg Kai-Christoph, Vehse Brigitte, Bludau Bernd Hans. "Questionnaire Based Usability Evaluation of Hospital Information System". Available from:-
www.ejise.com/issue/download.html?idArticle=625
15. E Nabovati, H Arki Vakili, S Eslami, R Khajouei. "Usability Evaluation of Laboratory and Radiology Information Systems Integrated into a Hospital Information System". April 2014. Available from:-
<https://www.ncbi.nlm.nih.gov/pubmed/24682671>
16. Jurickova Ivana, Hejmova Pavla. "Barriers to Implementation of a Clinical Information System in an Emergency Department". April 2014. Available from:
http://iwbbio.ugr.es/2014/papers/IWBBIO_2014_paper_145.pdf
17. Sharma Meenakshi and Aggarwal Himanshu."EHR Adoption in India: Potential and the Challenges".2016. Vol 9(34).Available from: Indian Journal of Science and Technology, DOI: 10.17485/ijst/2016/v9i34/100211
18. Herrick M Devon, Gorman Linda and Goodman C John. " Health Information technology: Benefits and Problems".2010.Available from:
<http://www.ncpa.org/pdfs/st327.pdf>
19. Ravindra S. Swaran, Chandra Rohitash and Dhenesh S. Virallikattur."A Study of Management of Electronic Medical Records in Fijian Hospitals".Available from:
<https://arxiv.org/ftp/arxiv/papers/1507/1507.03659.pdf>
20. Sarwar Naveed Raja, Bughio Ali Imdad, Arain Ahmed Shakeel, Tunio Nawaz Muhammad. "The Adoption of Hospital Information System in Private Sector

Hospitals: A Case Study of Hyderabad”.2015.Availablefrom:https://www.researchgate.net/profile/Shakeel_Arain/publication/281203115_The_Adoption_of_Hospital_Information_System_in_Private_Sector_Hospitals_A_Case_Study_of_Hyderabad/links/55e4364308aecb1a7cc9f62f.pdf

21. Amin Mohd Indah, Hussein Sumarni Surya. ”Assessing User Satisfaction of Using Hospital Information System (HIS) in Malaysia”.2011.vol-5.Available from:<http://www.ipedr.com/vol5/no1/45-H00097.pdf>
22. Acharyulu G.V.R.K. “Assessment of Hospital Information System Quality in Multi-Specialty Hospitals”.2012.vol-3.Available from:<http://ijimt.org/papers/252-CM221.pdf>
23. Chatzoglou D. Prodromos, Fragidis L. Leonidas, Doumpa Triantafyllia, Aggelidis P. Vassilios. “Hospital Information System Evaluation”.2012.Available from:http://infoman.teikav.edu.gr/~fragidis/papers/2012_Hospital_Information_System_Evaluation.pdf
24. Al-Mamary Hasan Yaser, Shamsuddin alina, Aziati Nor. “Factors Affecting Successful Adoption of Management Information System in Organizations towards Enhancing Organizational Performance”.2014.Volume-2.Available from:<http://pubs.sciepub.com/ajss/2/5/2/>
25. Sadoughi Farahnaz, Sarsarshahi Aida, Eerfannia Ieila, Firouzabad Khatami Ali S. M. “Ranking Evaluation Factors in Hospital Information System”.2016.Volume-8.Human and Veterinary Medicine International Journal of the Bioflux Society

16. Annexure

16.1 Data collection tool- Clinical staff

GENERAL QUESTIONNAIRE

Name of the organization:	
Department:	Designation:
Gender:	Age:
Years of experience:	

1. Do you know hospital information system (HIS)?
Yes/No
2. Does the current software meeting your department workflow/Business requirement?
Yes/No (0 / 1 / 2 / 3)
3. Is there any difficulty in information exchange between different departments through HIS?
Yes/No (0 / 1 / 2 / 3)
4. Do you think there is reduction on TAT (Turnaround time) by using HIS in daily operations?
Yes/No (0 / 1 / 2 / 3)
5. How satisfied are you with the IT support system in the use of HIS?

1-Extremely satisfied	2-Very satisfied	3-Moderately satisfied	4-Slightly satisfied	5-Not satisfied
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6. Lack of proper training and unavailability of manuals or guidelines for using HIS is a barrier?
Yes/No (0 / 1 / 2 / 3)
7. Not proper maintenance and technical support for hardware and network is a barrier in the use of HIS? (Such as electricity failure, computer crashing, system downtime, system slowness, not working printer etc.)
Yes/No (0 / 1 / 2 / 3)

8. What do you think about the screen interface you used to display and enter data in the HIS? (0 / 1 / 2 / 3)
- *Screen layout are:* Well designed/Poorly designed
 - *Screen colours are:* Pleasant /Unpleasant
 - *Information is:* Readable /Confusing
 - *Graphics are:* Pertinent /Uninteresting
 - *Charts are:* Concise / Diffused
 - *Screen interface is:* Easy to customize /Rigid
9. Does your software provide relevant information across the hospital and gives you value add? (Value add in terms of CDSS, matrix)
Yes/No (0 / 1 / 2 / 3)
10. What would you suggest as a recommendation for HIS to adapt, learn and implement in a facility to enhance and improve the quality of health care services?

0	Not a barrier
1	Minimum barrier
2	Moderate barrier
3	Major barrier

16.2 Data collection tool- Administrative staff

ADMIN QUESTIONNAIRE

Name of the organization:	
Department:	Designation:
Gender:	Age:
Years of experience:	

1. Do you know hospital information system (HIS)?
Yes/No
2. Do you think that lack of sufficient capital resource is a major barrier in HIS implementation?
Yes/No (0 / 1 / 2 / 3)
3. Uncertainty about the return on investment (ROI) after implementing and using HIS?
(0 / 1 / 2 / 3)
4. Did you receive support and loyalty from your vendor?
Yes/No (0 / 1 / 2 / 3)
5. Is IT support system a major barrier in the implementation of HIS in the hospital?
Yes/No (0 / 1 / 2 / 3)
6. Does the installation of HIS software enhanced the productivity (quality indicators) of hospitals?
Yes/No (0 / 1 / 2 / 3)
7. Lack of proper training and unavailability of manuals or guidelines for using HIS is a barrier?
Yes/No (0 / 1 / 2 / 3)
8. Do you think implementation of HIS leads to data safety issues?
Yes/No (0 / 1 / 2 / 3)

9. Do you feel that implementation of HIS will give value add (MIS Reports, CDSS, BCMA etc.) to the organization?

Yes/No (0 / 1 / 2 / 3)

10. What would you suggest as a recommendation for HIS to adapt, learn and implement in a facility to enhance and improve the quality of health care services?

0	Not a barrier
1	Minimum barrier
2	Moderate barrier
3	Major barrier

16.3 Tables

- **Frequency analysis (for clinical staff)- Table 16.1**

S. No.	Factors	0-Not a barrier	1-Minimum barrier	2-Moderate barrier	3-Major barrier
1	Software not meeting departmental work flow	22	37	39	14
2	Difficulty in information exchange b/w departments	23	17	33	39
3	No Reduction on TAT	63	2	15	32
4	Lack of proper training and unavailability of guidelines and manuals	30	26	27	29
5	Not proper maintenance and technical support for hardware and network	29	21	17	45
6	Screen interface	88	12	10	2
7	Value add in terms of CDSS, MIS reports	21	39	42	10

- **Percentage analysis (for clinical staff)-Table 16.2**

S. No.	Factors	0-Not a barrier	1-Minimum barrier	2-Moderate barrier	3-Major barrier
1	Software not meeting departmental work flow	19.64%	33.04%	34.82%	12.50%
2	Difficulty in information exchange b/w departments	20.54%	15.18%	29.46%	34.82%
3	No Reduction on TAT	56.25%	1.79%	13.39%	28.57%
4	Lack of proper training and unavailability of guidelines and manuals	26.79%	23.21%	24.11%	25.89%
5	Not proper maintenance and technical support for hardware and network	25.89%	18.75%	15.18%	40.18%
6	Screen interface	18.75%	34.82%	37.50%	8.93%
7	Value add in terms of CDSS, MIS reports	18.75%	34.82%	37.50%	8.93%

- **Frequency analysis (for administrative staff)- Table 16.3**

S. No	Factors	0-Not a barrier	1-Minimum barrier	2-Moderate barrier	3-Major barrier
1	Lack of sufficient capital resources	0	5	15	18
2	Uncertainty about ROI	0	4	32	2
3	Support and loyalty from vendors	35	2	1	0
4	IT support system	17	4	16	1
5	No enhancement in productivity	34	1	0	3
6	Lack of proper training	3	15	5	15
7	Data safety issues	30	0	2	6
8	Value add in terms of CDSS, MIS reports	16	18	3	1

- **Percentage analysis (for administrative staff)- Table 16.4**

S. No	Factors	0-Not a barrier	1-Minimum barrier	2-Moderate barrier	3-Major barrier
1	Lack of sufficient capital resources	0.00%	13.16%	39.47%	47.37%
2	Uncertainty about ROI	0.00%	10.53%	84.21%	5.26%
3	Support and loyalty from vendors	92.11%	5.26%	2.63%	0.00%
4	IT support system	44.74%	10.53%	42.11%	2.63%
5	No enhancement in productivity	89.47%	2.63%	0.00%	7.89%
6	Lack of proper training	7.89%	39.47%	13.16%	39.47%
7	Data safety issues	78.95%	0.00%	5.26%	15.79%
8	Value add in terms of CDSS, MIS reports	42.11%	47.37%	7.89%	2.63%