Internship Training

At

Frost and Sullivan

Evaluationof IT adoption in the 25 chain hospitals of India focused on HIS, EMR and PACS

By

Dr. Sonal

PG/13/065

Under the guidance of

Dr. Anandhi Ramachandran

Post Graduate Diploma in Hospital and Health Management

2013-15

International Institute of Health Management Research

New Delhi

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Abstract

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Background behind the study: Healthcare industry has always faced immense need for cutting edge technology for patient treatments, monitoring and healthcare informatics. However, the industry has been slow in adopting IT technologies in their workflow. The scenario is nevertheless changing now, with greater need to cut healthcare costs, immense demand for faster, better healthcare delivery along with reduced operating costs and improves the efficiency of healthcare delivery. The rate at which information technology (IT) systems are being ordered and deployed by healthcare providers around the world has far outpaced the growth of the evidence base of clinical and operational benefits associated with such systems. Literature confirms that implementation of ITreduce medical errors and also helped improve the management of health related information. All users (Doctors, Nurses, Patients and insurers etc.) access data in real time and make quick clinical decisions. The study majorly focuses on the IT adoption in the 25 chain hospital groups and key HIS, PACS & EMR vendors operating in the healthcare IT market in India. The study has also tried to understand the overall trend on the evolution of healthcare delivery market and the current state of healthcare Information Technology market Size in India and its growth trends.

Objectives of the study: The general objective of this dissertation is**Evaluation of IT adoption in 25 chain hospitals of India focused on HIS, EMR and PACS.**

Specific objectives are as follows:

1) To understand the overall trend on the evolution of healthcare delivery market of India

2) To assess the current state of healthcare Information Technology market Size in India and its growth trends.
3) To identify the major HIS, EMR and PACS present in the chain hospitals of India.
4) To determine the key vendors operating in the healthcare IT market in India.

Research Design/ Methodology

The dissertation study is a descriptive cross-sectional study.

Sample Size: Study has been conducted among the 25 chain hospitals of India

N=25

Sampling Technique used: Convenient Sampling

Primary Data Sources:a) Telephonic discussion with CIO and managers of the hospitals.

Secondary data sources: a) Hospital websites, b) Published literature, c) Online Magazines, d) Annual Reports, e) IT specific Magazines etc.

Results: The results shows that HIS and PACS implementation rate in 25 chain hospital groups is quite high 100% and 96% respectively. EMR adoption in sample hospitals are in nascent stage with only 56% are using EMR. ICT Health, CSC, Impulse Technologies are key HIS and EMR vendor whereas Meddiff Technologies, Med Synaptic, GE, ICT Health and Agfa Healthcare are top PACS vendor as evident from the study result. Also the SWOT analysis of the system has shown a positive side as a whole.

Conclusion: The healthcare IT market has been witnessing many developments with the introduction of information technology in the hospitals. IT implementation has streamlined hospital procedures such as billing, medical imaging, and diagnostic information.Hence, rate of adoption of newer technologies is high in hospitals. There are various national and international vendors prevailing in Indian healthcare market.

Most of the Indian companies have market share not only in India but also in other countries.

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Date: 30.04.2015

TO WHOM IT MAY CONCERN

This is to certify that **Ms. Sonal** was working with **Frost & Sullivan India Pvt. Limited** as an **Intern** from 02.02.2015 and was a part of the HealthCare team based out of Bengaluru.

She has been relieved from the services on 30.04.2015 at end of Business hours. She was eligible for a stipend of Rs. 10,000/- per month

Yours truly,

For Frost & Sullivan

Julaina Mohamed
Senior Manager - Human Resources,
Frost & Sullivan India Pvt. Ltd

TO WHOMSOEVER IT MAY CONCERN

This is to certify that **Dr.Sonal** student of Post Graduate Diploma in Hospital and Health Management (PGDHM) from International Institute of Health Management Research, New Delhi has undergone internship training at **Frost and Sullivan, Bangalore** from **February2015** to **May2015**

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

The Internship is in fulfillment of the course requirements.

I wish him all success in all his future endeavors.

Dr. A.K. Agarwal
Dean, Academics and Student Affairs
IIHMR, New Delhi

Dr.Anandhi Ramachandran

IIHMR, New Delhi

Completion of Dissertation from Frost & Sullivan (India) Private Limited

The certificate is awarded to

Dr. Sonal

In recognition of having successfully completed her Internship in the department of

Healthcare Consulting & Research- MENASA

And has successfully completed her Project on

Evaluation of IT Adoption in 25 Chain Hospitals of India

From

February 1st 2015 to April 30th 2015

At

Frost & Sullivan (India) Private Limited

She comes across as a committed, sincere & diligent person who has a strong drive & zeal for learning.

We wish her all the best for future endeavors.

FROST & SULLIVAN INDIA PVT LTD BANGALORE

Julaina Mohamed
Senior HR – India
Frost & Sullivan(I) Pvt Ltd

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Certificate of Approval

The following dissertation titled **Evaluation of IT Adoption in 25 Chain Hospitals of India** at **Frost & Sullivan (India) Private Limited** is hereby approved as a certified study in management carried out and presented in a manner satisfactorily to warrant its acceptance as a prerequisite for the award of **Post Graduate Diploma in Health and Hospital Management** for which it has been submitted. It is understood that by this approval the undersigned do not necessarily endorse or approve any statement made, opinion expressed or conclusion drawn therein but approve the dissertation only for the purpose it is submitted.

Dissertation Examination Committee for evaluation of dissertation.

Name	Signature
Dr. Anandhi Ramachandran	
Manav Chaudhary.	

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Certificate from Dissertation Advisory Committee

This is to certify that **Dr. Sonal** a post-graduate student of the **Post- Graduate Diploma in Health and Hospital Management** has worked under our guidance and supervision. She is submitting this dissertation titled "Evaluation of IT Adoption in 25 Chain Hospitals of India" at Frost & Sullivan (India) Private Limited in partial fulfillment of the requirements for the award of the **Post- Graduate Diploma in Health and Hospital Management.**

This dissertation has the requisite standard and to the best of our knowledge no part of it has been reproduced from any other dissertation, monograph, report or book.

Dr.Anandhi Ramachandran,
Associate Professor
IIHMR- Delhi

Bipul Jha
Senior Consultant-HealthCare
Frost & Sullivan (India) Private Limited

FEEDBACK FORM

Name of the Student: Dr. Sonal

Dissertation Organisation: Frost & Sullivan

Area of Dissertation: Market Research

Attendance: Good

Objectives achieved: Dr. Sonal has a good acumen to understand the topic under study. Understand the healthcare IT adoption scenario in hospitals of India, Key healthcare IT Systems, Key vendors and their presence, Drivers & challenges for HIT

Deliverables: All deliverables required for the study completed on time. Evaluation of IT adoption (HIS, EMR, PACS) in 25 chain Hospitals of India, Top Vendors and brands, various systems deployed.

Strengths: flexibility to understand & adopt to the Scenarios, Positive attitude and ability to prioritize, highly committed to work.

Suggestions for Improvement: needs to work more on the presentation skills & outcome derivation, which could come more from industry expertise. I wish her good luck for all future endeavours

Signature of the Officer-in-Charge/ Organisation Mentor (Dissertation)

FROST & SULLIVAN INDIA PVT. LTD. BANGALORE

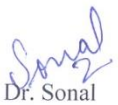
Date:
Place:

iv

INTERNATIONAL INSTITUTE OF HEALTH MANAGEMENT RESEARCH, NEW DELHI

CERTIFICATE BY SCHOLAR

This is to certify that the dissertation titled **Evaluation of IT Adoption in 25 Chain Hospitals of India** and submitted by **Dr. Sonal** Enrollment No. PG/13/065 under the supervision of **Dr. Anandhi Ramachandran** & **Mr. Bipul Kumar Jha** for award of Postgraduate Diploma in Hospital and Health Management of the Institute carried out during the period from **February 1st 2015 to April 30th 2015** 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.



Dr. Sonal

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Acknowledgment

Apart from the personal efforts and steadfastness to work, constant inspiration and encouragement given by a number of individuals served as the driving force that enabled me to submit my dissertation in the present format.

A formal statement of acknowledgement is hardly sufficient to express my gratitude towards the personalities who have helped me undertake this dissertation project. I hereby convey my thankfulness and obligation to all those who have rendered their valuable time, help, support and guidance to meet this project completion. A special thanks to the Almighty and My Parents for the completion of my project.

First of all a special gratitude to Frost & Sullivan, Bengaluru for giving me the opportunity to work on the project during the three months internship cum dissertation as a part of course curriculum for the partial fulfillment of Post Graduate Diploma in Health and Hospital Management.

No work can be perfect, without the ample guidance. I owe my sincere gratitude to my Organizational Dissertation advisor **Mr. Bipul Kumar Jha,Senior Consultant-HealthCare, Frost & Sullivan**. Without his ample guidance, regular encouragement, inspiration and intelligent criticism; it would have not been possible to carry out this work. His unfailing constant help and support was a source of motivation & inspiration for me.

I am also highly thankful to **Mr. Piyush Kumar Verma, Industry Analyst-HealthCare, Frost& Sullivan**for his constant facilitation in completion of this project.

A sincere token of thanks to **Dr. Anandhi Ramachandran, IIHMR, New Delhi** for her valuable time as a mentor for completion of this study. Her continuous guidance and support at crucial juncture helped me complete the assigned project on time.

Dr. Sonal

PG/13/065

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List of Abbreviations

MENASA	Middle East, North Africa and South Asia
GCC	Gulf Cooperation Council
IT	Information Technology
HIT	Health Information Technology
CPOE	Computerized Physician Order Entry
EMR	Electronic Medical Record
PACS	Picture Archiving and Communication System
PDA	Personal Digital Assistant
ANM	Auxiliary Nurse Midwifed
HIS	Hospital Information System
LIS	Laboratory Information System
RIS	Radiology Information System
CT	Computed Tomography
MRI	Magnetic Resonance Imaging
ADL	Automated Optical Disk Library
PCEHR	Personally Controlled Electronic Health Record
SWOT	Strength, Weakness, Opportunity & Threat

PART- 1

INTERNSHIP REPORT

1.1 Organization Profile

FROST & SULLIVAN

Frost & Sullivan is founded by Dan L. Sullivan and Lore A. Frost in New York in 1961. Its headquarters are located in Mountain View, California.

It is the Growth Partnership Company, enables clients to accelerate growth and achieve best in class positions in growth, innovation and leadership. The company's Growth Partnership Service provides the CEO and the CEO's Growth Team with disciplined research and best practice models to drive the generation, evaluation and implementation of powerful growth strategies.

Frost & Sullivanhas more than 40 global offices with more than 1,800 industry consultants, market research analysts, technology analysts and economists. They offer a seamless integration of their global offices and personnel, and are committed to this worldwide network, as it forms the basis of their ability to identify, research, analyze, and present timely global growth opportunities in the market.

They provide two critical services to their "partners" that support their growth strategies: Growth Partnership Services and Growth Consulting. The Growth Partnership Services represent a subscription-based program that provides their clients with disciplined research to support the generation and evaluation of growth opportunities, and career-focused best practices to help implement growth strategies at best practice levels.

Their growth consulting program provides clients with customized consulting that supports a visionary understanding of the market, the development of growth strategies, and diagnostics to validate growth strategies.

• **Exclusively Focused on Growth** - Actively engaged in identifying, researching, and developing opportunities, growth models, and strategies that enable clients to accelerate growth.

• **Industry Breadth** - Cover the broadest spectrum of markets and technologies to provide clients with the ability to look outside the box and discover new and innovative ideas.

• **Global Perspective** - 40 global offices ensure that clients receive global coverage and perspective based on regional expertise.

• **Continuous Monitoring** - Continuously monitoring markets, technologies, careers, and geographies for growth opportunities.

• **CEO's 360 Degree Perspective** - Disciplined research integrates all critical research methodologies to significantly enhance the accuracy of decision-making and lower the risk of implementing growth strategies.

• **Trusted Partner** - Work closely with the clients' Growth Teams, helping them generate new growth initiatives and leverage all of Frost & Sullivan's assets to accelerate their growth.

1.2 Mission & Vision

Mission: To research and analyze new market opportunities for corporate growth.

Frost & Sullivan are the world leader in growth consulting and the integrated areas of technology research, market research, economic research, corporate best practices, training, customer research, competitive intelligence, and corporate strategy.

1.3 Services Provided

- Growth Partnership Services
- Growth Consulting
- GIL Global Community
- GIL University
- Events

1.4 Industry Coverage

- Aerospace & Defense
- Measurement & Instrumentation
- Consumer Technologies
- Information &Communication Technologies
- Automotive Transportation & Logistics
- Environment &Building Technologies
- Energy& Power Systems
- Healthcare
- Metals & Minerals

- Chemicals, Materials & Food
- Electronics & Security
- Industrial Automation & Process Control

1.5 Healthcare 360° Research& Consulting

Frost & Sullivan's Healthcare consultants and industry experts give clients the market-competitive research and strategic analyses they need to navigate this heavily regulated and globalizing industry.

Frost & Sullivan’s Healthcare team monitors global and regional perspectives across market segments such as medical devices, life sciences, healthcare information technology, and clinical diagnostics.

Figure1: 360° Research & Consulting

Guided by the 360° perspective and focus on Mega Trends, as well as ability to identify areas of cross-industry convergence, Healthcare consulting services keep clients ahead in an ever-changing environment.

Key Topics of Expertise:

- Advanced medical technologies
    - Medical devices
    - Medical imaging
- Connected health
    - Provider Information Technology
    - Analytics
    - Health Information Exchange
    - Telehealth
    - Remote Monitoring
    - Video Telemedicine
    - mHealth
- Life sciences
    - Biotechnology
    - Clinical diagnostics
    - Drug discovery technology
    - In-vitro diagnostics
    - Life science research tools
    - Pharmaceuticals

1.6 Department Visited

The department of working in the organization during the internship was the Healthcare Research & Consulting- MENASA region. The healthcare industry is undergoing rapid change, dynamic discoveries and pressures driving business decisions and corporate growth. Business models are being forced to evolve as healthcare continues to shift from a treatment focus to points of wellness, prediction, personalization, and prevention. Their core program areas are Connected Health, Life Sciences and

Advanced Medical Technologies.I worked closely with the team in Bengaluru, Delhi, Chennai and Dubai and helped the research managers & analysts in their primary research, secondaryresearch, data mining activities and other responsibilities that I have been assigned to. I worked on several projects in connected health and advanced medical technologies in India, GCC countries and Nepal.

1.7 Reflective Learning's

Frost & Sullivan as an organization provides an individual with the platform to learn in the tasks they are involved with. During the entire duration of internship, there has been a lot of individual learning's from both Customer and the organization. Also the experience of the mentor has been very useful for knowledge transfer.

Some of the key learning's during the internship are as follows:

1) Finer appreciation of secondary research on the industry to understand its dynamics, market players and existing trends.
2) Good grip to do primary research through personal interviews of senior management, opinion leaders, and end users by travelling to the respective locations.
3) Better understanding of buyer-seller dynamics as the healthcare system transitions to digital information.
4) Overview of health systems of India, Nepal and GCC countries.
5) Advance understanding of HIT market in India.

PART- 2

DISSERTATION REPORT

CHAPTER- 1

DISSERTATION OVERVIEW

1.1 Background

Healthcare IT refers to the use of IT services, products, software and solutions by healthcare organizations to integrate and streamline various processes. In healthcare, IT is used to develop a secure environment and maintain a uniform flow of information. It improves the quality and efficiency of the services delivered and helps in reducing errors in the healthcare industry.

Healthcare industry has always faced immense need for cutting edge technology for patient treatments, monitoring and healthcare informatics. However, the industry has been slow in adopting IT technologies in their workflow. The scenario is nevertheless changing now, with greater need to cut healthcare costs, immense demand for faster, better healthcare delivery along with reduced operating costs and improves the efficiency of healthcare delivery.The rate at which information technology (IT) systems are being ordered and deployed by healthcare providers around the world has far outpaced the growth of the evidence base of clinical and operational benefits associated with such systems. This is particularly so for the installation of large scale commercial systems in hospitals that provide acute care and outpatient services across a wide range of clinical specialties.

The significant increase in demand for medical care has increased the chances of error in diagnosis and treatment Plan. This has led to the introduction of systems such as CPOE (computerized physician order entry system), integrated systems such as enterprise-wide PACS (picture archive and communication systems), EMR (electronic medical record). The burgeoning cost of treatment in India, makes insurance an undivided part of the care system, IT has enabled efficient claim addressing and

settlement process. These not only reduce medical errors, but also helped improve the management of health related information. All users (Doctors, Nurses, Patients and insurers etc.) access data in real time and make quick clinical decisions.

1.2 Objective of the Study

The **general objective** of this dissertation is **Evaluation of IT adoption in 25 chain hospitals of India focused on HIS, EMR and PACS.**

Specific Objective:

Specific objectives are as follows:

5) To understand the overall trend on the evolution of healthcare delivery market of India
6) To assess the current state of healthcare Information Technology market Size in India and its growth trends.
7) To identify the major HIS, EMR and PACS present in the chain hospitals of India.
8) To determine the key vendors operating in the healthcare IT market in India.

1.3 Scope of the Project

This study includes the evaluation of the current state of Healthcare IT adoptions in India in particular to chain of hospital groups focused on HIS, EMR and PACS. It highlights the key vendors present in HIT market and future potential of HIT market and also projected HIT market size till 2019 using simple excel based analysis tool.

1.4 Need of the Study

HIT greatly improves the quality, safety and efficiency of the care patients receive. It give the doctors, nurses and other members of healthcare team the tools they need to

keep important information instantly available. It helps doctors to diagnose health problems sooner, reduce the possibility for medical errors, and provide safer, more cost-efficient care. Therefore, the study would help us to know:

- The current state of HIT adoptions in India in particular to chain of hospital groups.
- The category in which Indian hospitals falls as per HIMSS 7 stage HIT adoption scale.
- Type of HIS, EMR and PACS used among the Indian hospitals.
- Future potential of HIT market in India.

1.5 Data Sources

Primary data sources: a)Telephonic discussion with CIO and managers of the hospitals.

Secondary data sources: a) Hospital websites, b) Published literature, c) Online Magazines, d) Annual Reports, e) IT specific Magazines etc.

1.6 Work Plan

It includes the activity table and the Gantt chart for the overall project.

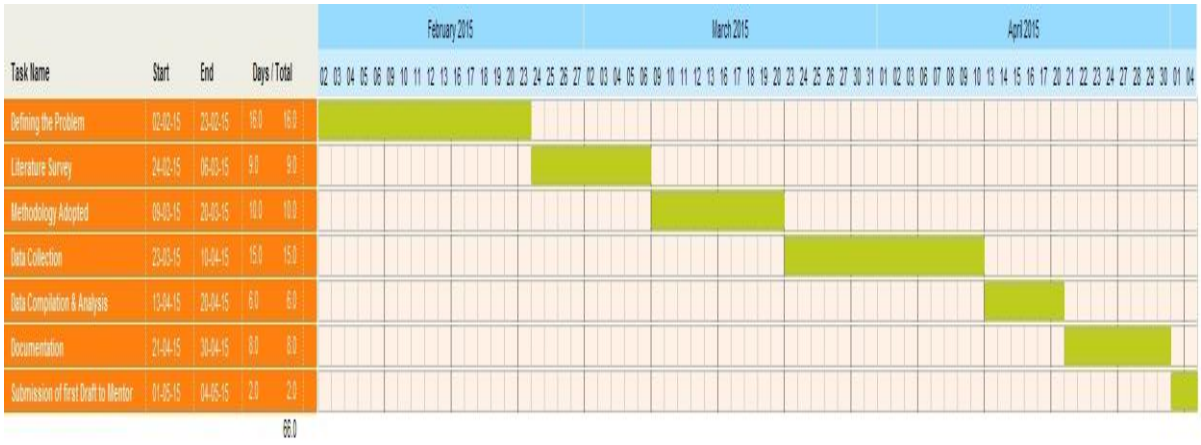


Figure 2: Gantt chart representing the dissertation project plan

Activity	Estimated Time Taken	Expected Outcome

Defining the Problem	16 days	Problem Defined and Proposal
Literature Survey	09 days	Final Draft of the Proposal
Methodology Adopted	10 days	Finalization of Tools to collect data
Data Collection	15 days	Filled up excel sheet for HIS, PACS & EMR
Data Compilation & Analysis	06 days	Bar graphs, pie charts, tables, workflows etc.
Documentation	08 days	Preparation for the final report
Submission of first draft to Mentor	By May 4th 2015	First draft ready

Table 1: Activity table for the project plan

CHAPTER- 2

PROJECT OVERVIEW

2.1Evolution of Healthcare IT in India

Health informatics is a judicious integration of Information Technology and Health, and other allied disciplines of biomedicine.It is as much a result of evolution as planned philosophy, having its roots in the histories of information technology and medicine [1]. Indian HIT market evolution has been vibrant with many hospitals adapting to newer technologies. Although, the adoption to newer technologies may be restricted to big groups of private hospitals and few government hospitals. Many hospitals and health care organizations are still dependent on manual processing.

Use of IT in health care sector roots back to 1957 in India, the neurosurgery department of King Edward Memorial Hospital in Mumbai used to keep electronic patient records during that period [2]. But it is only after nineties the use of informatics felt clearly when a project called Indian health care project begun in 1994 in collaboration with Govt. of India, Apple computers and CMC in the state of Rajasthan. The project combined an IT device- the Personal Digital Assistance (PDA) - and support tools intended to reduce the time spent by an ANM (Auxiliary Nurse Midwife) in paper work, increase the accuracy of data collected and supplied by ANMs, ensure the availability of village level health care data in an electronic form, and provide ANMs with information that would help them to improve the effectiveness of the service [3][4]. Prior to that in 1993, a professional society called Indian Association of Medical Informatics (IAMI) was formed with an intention to promote and further the application of informatics in to the field of health, bioscience, and medicine in India. C-DAC (Center for development of Advanced Computing) an autonomous body first developed a total HIS (Health Information System) package in collaboration with Sanjay Gandhi Post Graduate Institute of Medical Sciences in 1997. Apollo is a pioneer in the field of Telemedicine

in India and is credited with being the first to set up a Rural Telemedicine Centre in the village of Aragonda in the

state of Andhra Pradesh. Even though the first Telemedicine site was launched in 1999, Apollo's initiatives with Telemedicine (including Tele cardiology Clinic) started well before that. Similarly a Tele Medicine center was started in 1999 at Sanjay Gandhi Post Graduate Institute Medical Sciences with connection to three Govt. medical colleges of Odisha [5].

Since the 1990s, many large hospital in India have adopted hospital information systems, this systems are mainly built in-house or source from local vendors. On the other hand, many small hospitals have some kind of back office applications and recently begin to adopt clinical applications.Now-a- days the IT penetration is increasing day by day with more and more corporate hospitals setting up centers in II tier cities in India requiring IT automation in them. States governments are also trying to interconnect various hospitals in their state. Organizations like ISRO, IIT, Kharagpuretc.; corporate firms like WIPRO, TCS, and SISL etc. are instrumental in developing IT solutions in health care in India [5].

2.2 Current state of HIT- Value, Market size, growth

2.2.1 The Indian HIT market overview

TheHIT market has been witnessing many developments with the introduction of healthcare reforms in developed and developing nations [6]. But despite India's recent ascendancy as the hub of the IT and IT-enabled services industry powered by a vast pool

of skilled manpower, it has lagged tremendously behind other countries in HIT adoption. Looking at the health scenario of India, the GDP spend on health is 0.9%,

whereas the WHO recommends a 5% of GDP for health. The scale of e-health services in India has been very small so far considering its size, mostly limited to medical transcription, health awareness through portals, telemedicine and hospital management system. In today's time, it is basically the private sector that is driving and paying for HIT [7].Large

Corporate hospitals in India spend under 1% of their operating budget on IT, while spending is closer to 3% in the West. Barring a few preliminary attempts to computerize basic hospital administrative and some clinical functions, there has been little appreciation or impetus given to HIT adoption [8].

2.2.2Current Market State

In the last 4 to 5 years many positive developments have set the tone for potentially much greater HIT adoption in India. With a maturing private healthcare sector, the private hospital chains have become the primary consumers and financiers of HIT. The aggressive IT sector in India is slowly managing to move large government hospitals toward HIT adoption [8]. Hence IT deployment has gained paramount importance in the Indian healthcare delivery segment, especially in medium- to large-segment hospitals. It is being implemented in various departments of the hospitals, ranging from billing and finance to administration and even patient care, thereby simplifying the operations to a great extent.Thus, the growing cognizance of information technologies' importance in healthcare has been instrumental in improving the efficiency of services offered at the hospitals as well as saving precious time, effort, and money considerably in the long run.

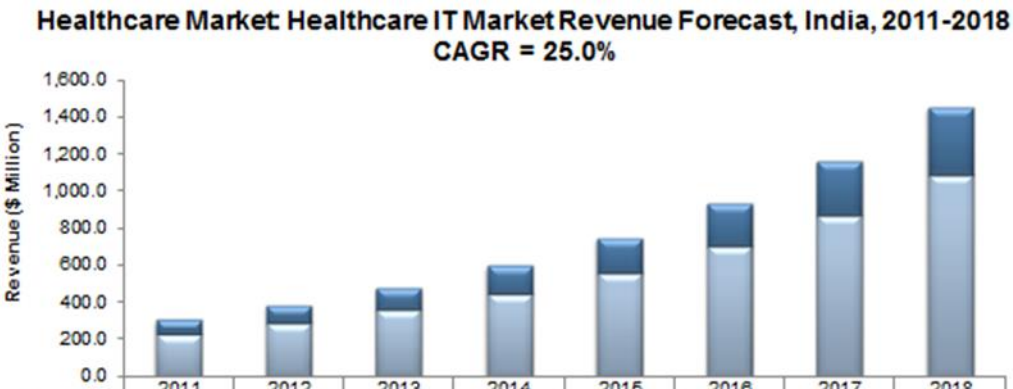
India is at par with other Asian market in being a highly price-sensitive market. Local participants are dominant; however, this trend is slowly changing as more international companies have ventured through partnerships and strategic alliances.

2.2.3 Current HIT Market Size & Growth

Indian healthcare is experiencing a transformation, with the application of newer, better IT systems and applications. Adoption of IT has become one of the top priorities for the Indian healthcare companies. But most big healthcare organizations allocate only 2–3% of their annual budget to IT expenditure. These percentages when calculated on a lower basis seem insignificant as compared to U.S. IT spending in actual dollars. However, this has changed nowadays and some HIT players spend touching as much as six to seven per cent of operating budgets.

Healthcare IT spending in India is expected to grow from $274.2 million in 2009 to $744.0 million in 2015, growing at a compounded annual growth rate of 25.0% from 2011 to 2018. This creates a lot of opportunities for IT vendors, as more and more hospitals are adopting information technology apart from medical technology. Moreover, with new and upcoming applications such as telemedicine and e-prescriptions penetrating the healthcare vertical in India, IT investments on software would further increase with a focus on integrated billing and online availability of patient records across hospitals.

The market earned revenue of more than $381.3 million in 2012 and forecasts this to reach $1,454.7 million in 2018.The top three states with highest number of hospitals with HIS installed in India are Maharashtra, Delhi and Andhra Pradesh.Electronic health records market has conventionally contributed the largest share in the market [9].



	2011	2012	2013	2014	2015	2016	2017	2018
Software Licensing Revenue	76.3	95.3	119.2	149.0	186.2	232.8	291.0	363.8
Revenue (Apart from Software Licensing Revenue)	228.8	286.0	357.5	446.9	558.6	698.2	872.8	1,090.9
Total	305.1	381.3	476.7	595.9	744.8	931.0	1163.8	1454.7

Figure 3: Healthcare IT market revenue forecast, India 2011-2018

2.3 Current Market Offerings:

The Indian HCIT market is broadly divided into two categories, clinical and non-clinical systems; this division is based on their areas of utilization in health facilities. However, there are many functions that a system does in a health organization that deal with both clinical as well as non-clinical kinds of data. Therefore, a third type of system is defined as those that utilize a mix of both clinical and non-clinicaldata; these systems are more linked to patient data management. There are many systems that have cross-functional dynamics.

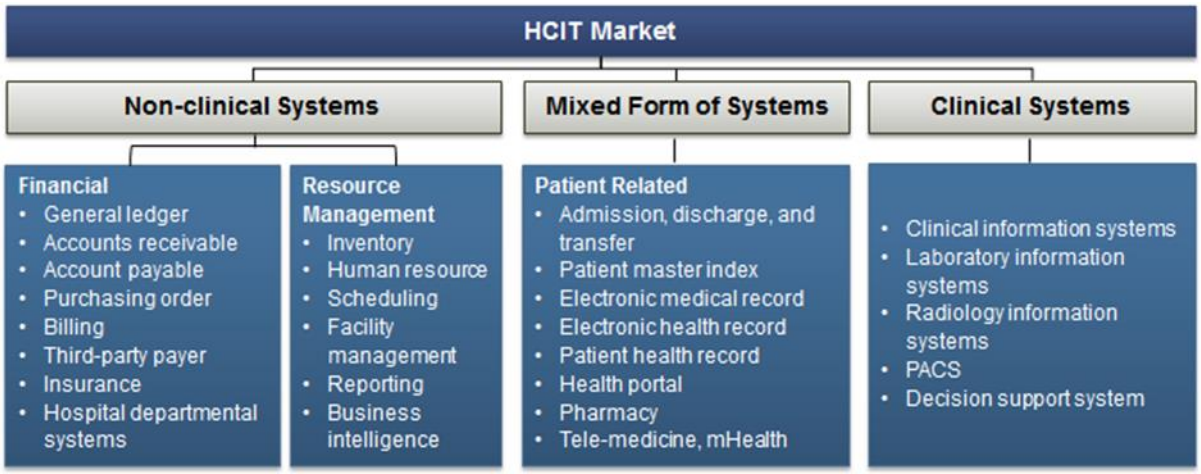


Figure 4: Healthcare IT market offerings

Being a hub for IT, India has a number of local, large end-to-end solution providers and product vendors. Wipro Infotech, Tata Consulting Services Limited, and Mahindra Satyam have had significant roles to play in hospital information systems (HIS) implementation, establishment of nationwide emergency systems, and growth of telemedicine.

2.4 IT Adoption Levels in Indian Hospitals:

The Indian market scenario on the adoption of IT systems throws light on two major systems: hospital information systems and laboratory information systems.

With increasing IT applications and insurance penetration, the demand for EMR is anticipated to increase robustly in the next few years. However, initially the scope of the services will be limited to the metro and Tier I cities only.

With increasing emphasis on the implementation of HIS in the country, the market of instruments such as PACS will grow rapidly. However, the success of these factors will largely depend upon various factors including technology adoption and cost.

For hospitals below 50 beds in size, there is always a budget constraint for support facilities, which includes IT/ITes as well. Highest adoption seen is for HIS and LIS, and the least is for clinical systems and enterprise-wide systems.

For hospitals having bed sizes of 50 to 250 and above, the highest to least adopted systems are HIS, LIS, RIS, telemedicine, clinical systems, and EMR.

Overall, the HIS and LIS adoption levels are high in Indian hospitals. Adoption of clinical systems is at a very nascent stage in hospitals below 100 beds. RIS and PACS adoption is also high in above-100-bed hospitals, and it is fast catching up in the market for 50- to 100-bed hospitals.

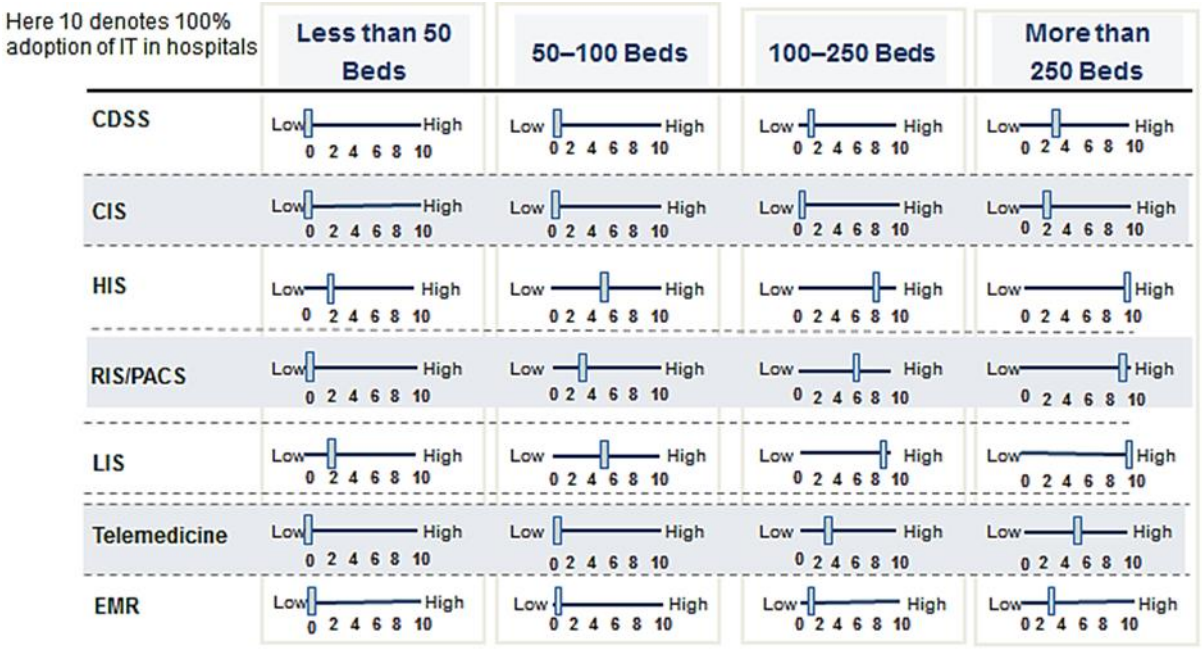


Figure 5: Current level of IT adoption in Indian hospitals I

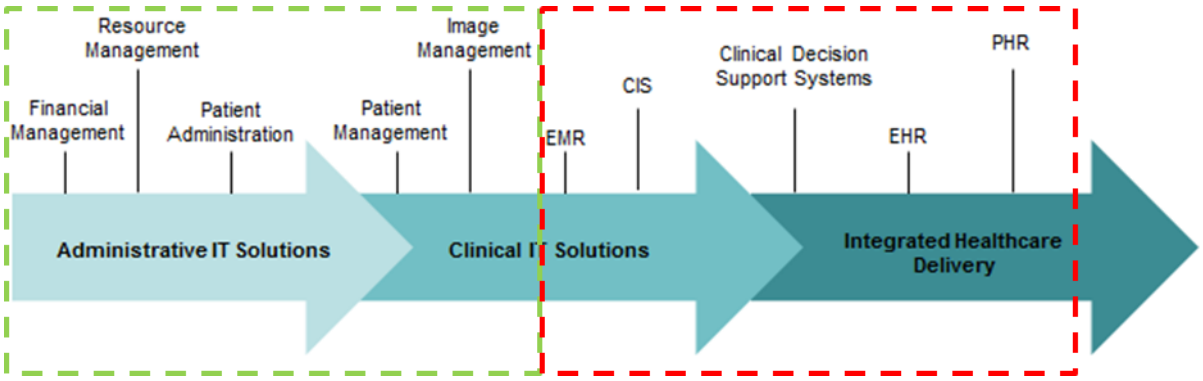


Figure 6: Current level of IT adoption in Indian hospitals II

The technologies marked in red box have witnessed very low adoption levels in Indian healthcare facilities.

2.5 Major IT products/ systems

2.5.1 HIS

A hospital information system (HIS) is essentially a computer system that can manage all the information to allow healthcare providers to do their jobs effectively and efficiently.

According to Paul R. Vegoda HIS is defined as, an integrated information system which improves patient care by increasing the user‘s knowledge and reducing uncertainty allowing rational decisions to be made from the information provided [10.Haux, Schmücker and Winter view the hospital information system as the entire information processing and information storage subsystem of a hospital, whereby it is not just about computer systems and networks and the computer-based application systems that are installed on them, but it is about the information in a hospital as a whole [11].

HIS consist of different software’s that are integrated in order to capture data in specific sections of the hospital[12] andfocus on the integration of all clinical, financial and administrative applications including financial, patient-related, and strategic management data, patient accounts, patient tracking, payroll, reimbursements, taxes, and statistics.

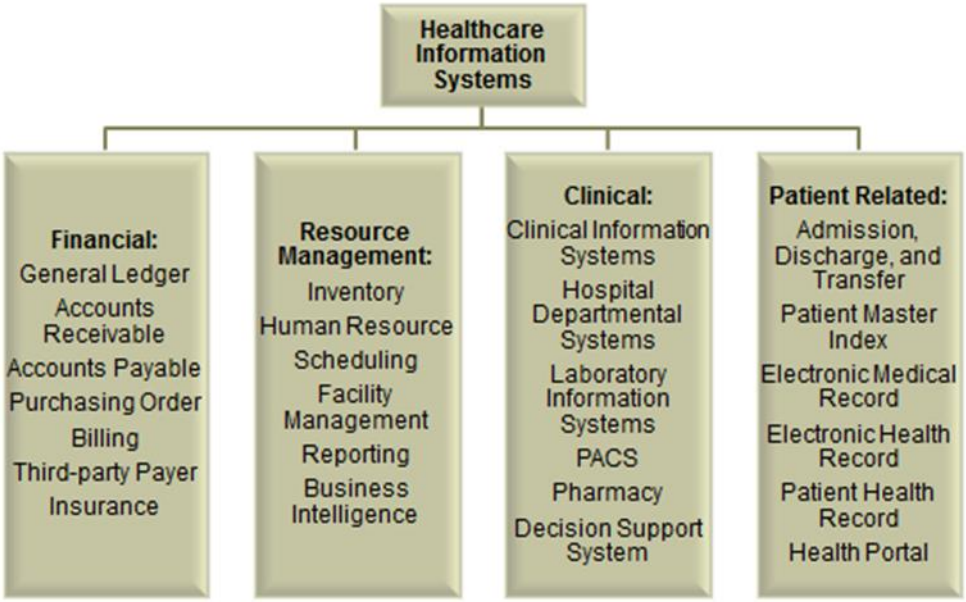


Figure 7: Hospital Integrated Systems Components I

Components of a hospital information system consist of two or more of the following:

- Clinical Information System
- Financial Information System
- Laboratory Information System (LIS)
- Nursing Information Systems
- Pharmacy Information System
- Picture Archiving Communication System (PACS)
- Radiology Information System (RIS)

HIS Modules:

HIS - Basic Modules

1. **Patient Registration and Appointment Scheduling Module** - The Registration module is an integrated patient management system, which captures complete and relevant patient information. The system automates the patient administration functions to have better and efficient patient care process.
2. **Outpatient Management Module** - The Outpatient module serves as an entry point to schedule an appointment with the Hospital Resident Doctor or Consultant Doctor

for Medical Consultations and diagnosis. This module supports doctors to take better and timely consultation decisions by providing instant access to comprehensive patient information.

3. **Patient Billing & Insurance Module** - The Patient Billing module handles all types of billing for long-term care. This module facilitates cashier and billing operations for different categories of patients like Outpatient, Inpatient and Referral. It provides automatic posting of charges related to different services like bed charges, lab tests conducted, medicines issued, consultant's fee, food, beverage and telephone charges etc.This module provides for credit partly billing and can be seamlessly integrated with the Financial Accounting Module.
4. **Services Module** - The service module provides for effectively managing all the services available in the hospital and the charges for each of these services are securely entered and handled.
5. **User Manager Module (security workflow)** - The User Manager module basically deals with security through controlling the access to the information available in the application. Any user associated with a user group can access only those screens for which the user group has rights. It also deals with the System Related Activity like User Monitor, Creating User Group Master, User Master and view the User Group Lookup of employee database, Maintenance of company documents, User defined error message, Generating Daily Statistical Summary.

HIS - Optional Modules

1. **Pharmacy Module** - Pharmacy module deals with the automation of general workflow and administration management process of a pharmacy. The pharmacy module is equipped with bar coding facility, which makes the delivery of medical items to the patient more efficient.

2. **Laboratory Information System** - The Laboratory module automates the investigation request and the process involved in delivering the results to the concerned department/doctor of the hospital. Laboratory module starts with receiving the online request from doctors and also allows laboratory personnel to generate requests. The Laboratory module supports to perform various tests under the following disciplines:Biochemistry, Cytology, Hematology, Microbiology, Serology, Neurology and Radiology.
3. **Radiology Management Module** - Radiology module caters to services such as X-ray, Scanning, Ultra sound etc. Scheduling of Radiology resources is possible. The system stores all the result details of various tests andmakes a Report based on the Test Results.
4. **Electronic Medical Record (EMR)** - The EMR Module is a fully integrated knowledge repository that caters to Medical and clinical records of patients in the hospital. The system supports medical professionals of various departments of the hospital with relevant information like medical examinations, diagnoses, treatment histories, test results and so on. The module provides access to critical and complete patient data that leads to high quality cost effective and efficient patient care. The EMR has the following features.
5. **Dietary Module** - The dietary module in the hospital management system software is designed to assist the hospital kitchen in providing meals to inpatients as per the instructions of the dietician.
6. **House Keeping Module** - Housekeeping in any hospital is defined as the provision for a clean, comfortable and safe environment in the hospital for patients and general public. Housekeeping in the hospital management system software involves the maintenance of beds in wards, rooms, cubicles. The various housekeeping tasks can be planned, assigned and tracked in the module.

7. **Nursing Module** - Nursing module is a tool provided in the hospital management system software to the nurses to manage their routine tasks with the objective of improving patient care. It is tightly integrated with the Inpatient module and other clinical modules for smooth flow of information.
8. **Emergency Management** - Emergency module in the hospital management system software allows fast registration of patients by the capture of key and very specific registration details such as demographic information, keeping in mind the critically of this function. This module also collects information related to Medico Legal Cases (MLC) which is subsequently used for reporting to local authorities.
9. **Machine Maintenance** - The machine or equipment maintenance module in the hospital management system software facilitates breakdown processing and preventive maintenance scheduling and recording.
10. **CSSD** - CSSD, or Central Sterile Supply Department is an important and crucial function of most of the mid-size and large hospitals. In certain countries, CSSD is even mandatory to meet with the government stipulations for hospital license etc.
11. **Blood Bank** - This module in the E-Hospital Management System hospital Management Software is quite comprehensive in its nature, maintaining all information regarding the blood donation. The details about the donors and recipients are maintained.
12. **Financial Accounting Module** - The Financial Accounting Module deals with Cash/Bank, Receipt/Payments, Journal Voucher and General Ledger etc. Books like Cashbook, Bankbook and Ledger book can be generated. This module generates reports like Trail Balance, Balance Sheet and Profit and Loss statement.
13. **Fixed Asset module** - The Fixed Assets Module deals with all the activities that are related to the Fixed Asset Part of Financial Accounting of any hospital management system software.

14. **Payroll Module** - The Payroll & Personnel module deals with Pay (and deduction) calculation, printing of salary slip, salary certificates, and PF statements, Gratuity Statement and provides a monthly analysis.
15. **MIS Dashboard** - The dashboard presented in the hospital management system software is a summary of key parameters values covering all areas of the hospital that are generally monitored by the top management on a regular basis. Some of the parameters could be current bed occupancy, revenue for a period, etc. [13].

Figure 8: Hospital Integrated Systems Components II

HIS Tasks & Features

The most important tasks in hospital information systems can be summarized as follows:

1. Storage and monitoring of patient‘s condition:
    - Accurate and electronically stored medical records of patients (e.g. drug allergies) are provided
    - Visual and auditory warning systems are generated in the event of abnormal test results or other important data
    - Time intervals and / or testing periods for tests on patients to be specified

- Data Processing and analysis for statistical purposes and research oriented purposes

2. Management and Data Flow:
    - Support automated patient data transfers between departments and institutions
    - Enable graphic or digitized diagnostic images from the hospital database based on the integrated retrieval system
    - Digital signatures, in order to create internal orders electronically
    - Communication by Laboratory Information System
    - Registration of human resources and their properties
3. Financial Aspects:
    - Efficient administration of finances
    - Use and monitoring of medicines and effectivity of the ordering process
    - Expected and actual treatment costs are listed and reported
    - Automated representation of the needs of the nursing staff
    - Status analysis of bed occupancy and overall performance in the hospital information system [14]

2.5.2 Picture Archiving and Communication System (PACS):

This is a medical imaging technology that provides economical storage of and convenient access to images from multiple modalities (e.g., source machine types such as computed tomography (CT), magnetic resonance imaging (MRI), ultrasound, and digital projection radiography). Electronic images and reports are transmitted digitally via PACS; this eliminates the need to manually file, retrieve, or transport film jackets.

With the development of integrated health care systems supported by the appropriate information infrastructures, PACS can be implemented over distant networks to provide

remote access to patient information and to support one of the most promising forms of telemedicine, tele radiology [15].

The introduction of a PACS offers a means of transmitting, displaying, storing, and viewing images such that interpretation of images may be changing from the conventional hard-copy images to soft-copy studies viewed on PACS workstations. Whereas images included in hard-copy studies were often cropped to the region of interest and included only limited or no images from the localizer series, soft-copy studies on PACS usually include all uncropped and unaltered images from the study, including the localizer series and any series that previously may have been discarded, such as repeated series for artifact or motion. This system yields potentially more information for review and interpretation.

Since localizer images have a large field of view, including anatomic regions outside the region of interest for a specific examination, visualization of structures outside the region of clinical concern may result in more incidental findings [16].

The data management computer is the core of the PACS and is functionally equivalent to the administration office in a film-based system. It has four major functions:

- Acquiring images from the capture computer
- Archiving images
- Distributing images to the display workstation
- Processing image retrieval requests [17]

An automated optical disk library (ADL) is used as a long-term image archival and retrieval device [18].The image data and pertinent information are transmitted to other and possibly remote locations over networks, where they may be displayed on computer workstations for soft copy viewing in multiple locations, thus permitting simultaneous consultations and almost instant reporting from radiologists at a distance.Close integration with the hospital information system (HIS)--radiology information system

(RIS) is critical for system functionality. Medical image management systems are maturing, providing access outside of the radiology department to images throughout the hospital via the Ethernet, at different hospitals, or from a home workstation if tele radiology has been implemented [19].

Uses

PACS has four main uses:

1. **Hard copy replacement:** PACS replaces hard-copy based means of managing medical images, such as film archives. With the decreasing price of digital storage, PACSs provide a growing cost and space advantage over film archives in addition to the instant access to prior images at the same institution. Digital copies are referred to as Soft-copy.
2. **Remote access:** It expands on the possibilities of conventional systems by providing capabilities of off-site viewing and reporting (distance education, telediagnosis). It enables practitioners in different physical locations to access the same information simultaneously for teleradiology.
3. **Electronic image integration platform:** PACS provides the electronic platform for radiology images interfacing with other medical automation systems such as Hospital Information System (HIS), Electronic Medical Record (EMR), Practice Management Software, and Radiology Information System (RIS).
4. **Radiology Workflow Management:** PACS is used by radiology personnel to manage the workflow of patient exams.

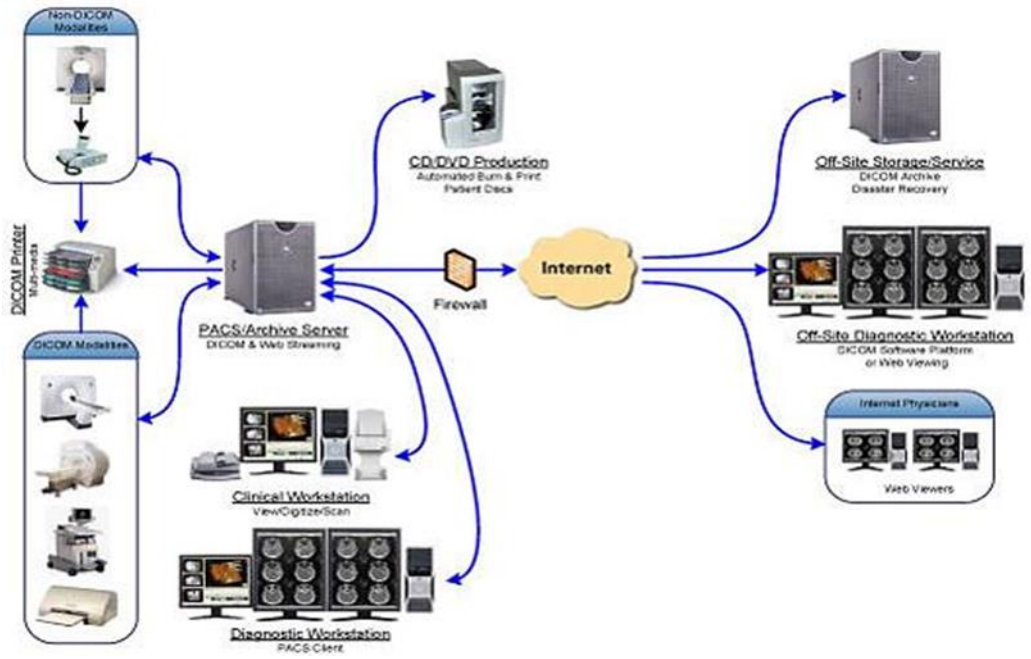


Figure 9: PACS

2.5.3 EMR.

According to the National Alliance for Health Information Technology (NAHIT) an EMR is "an electronic record of health-related information on an individual that can be created, gathered, managed, and consulted by authorized clinicians and staff within one health care organization," or simply "medical records in an electric format."

An EMR has become one of the most important new technologies in healthcare. The use of the EMR in a clinical setting is increasing throughout all fields of medicine and in clinical practices, private or academic, large or small [20]. It is an enabling technology that allows physician practices to pursue more powerful quality improvement programs than is possible with paper-based records [21]. EMR stores various types of medical data. The data ranges from medical history, prescriptions, drug allergies to the patients hospital service bills and more. The currently used paper based system is insufficient, ineffective and involves high cost of maintenance. On the contrary, EMR has several advantages like easy data recovery, portability, collaboration etc.

EMR assists doctors in making effective medical decisions with ease. In addition, EMR helps the service providers to effectively gather, maintain and recover patient's medical

information with the help of HIS. Along with managing the medical data, EMR assists in hospital order management, hospital workflow management and security of the medical data. It assists the entire healthcare delivery process in reducing cost and maximizes the profit.

These EMRs have the following key features:

- Patients' clinical information: medical history, prescriptions, allergies, diagnosis, reports.
- Clinical decision-support databases: databases that help in making decisions during prescription writing.
- Workflow management: managing processes such as appointment viewing, check-in patients, and review.
- Security features: for maintaining the security and confidentiality of critical information.
- Electronic prescription tool: for writing and managing prescriptions.
- Patients' financial records: service bills and receipts.

Potential Benefits of EMR

These benefits include:

- **Evidence-based clinical processes** – development of precise clinical processes using evidence based medicine driven by the need to provide expertise at the point of care.
- **Clinically focused business drivers** – adoption of business models based on clinical processes and measured by clinical quality indicators by supporting business workflows to automate and streamline processes.
- **Clinically relevant information at the point of care** – access to consolidated data, information and medical expertise that allow clinical decisions to be made

independent of location, time and context, where the EMR replaces the traditional paper medical record.

- **Improved patient safety** – preserves healthcare professionals' implicit knowledge of patient safety and offers tools that provide decision support such as alerts for infectious diseases or allergies An EMR enables:
  - Reduction of human errors in prescribing treatment
  - Reduction of errors by providing active decision support to clinicians
  - Reduction of errors in primary source data, as it is entered immediately at the point of care by the health professional, or automatically by clinical monitoring tools
  - Reduction of poor quality data from hospital services due to reporting through provision of primary source data, eliminating need for potentially adapted aggregated data
- **Processes focusing on error prevention** – adoption of clinical protocols based on key risk-prone processes.
- **Coordinated processes** – coordination of processes across the patient journey at the clinical, administrative and management levels.
- **Cost-effective access to data at the point of care** – accessibility to consolidated data, information and medical expertise at the point of care through better use of inexpensive technologies such as mobile devices. This reduces healthcare cost by preventing duplication of data, and encourages local accountability through down-up performance measurement.
- **Efficiency tool** – provides a tool for managers, executives, and auditors to measure hospital performance based on primary source data by giving access to atomic structured information in real time (as opposed to, for example, scanned documents). This dramatically reduces the time between the collection of data and

the analysis of key performance indicators and offers unparalleled richness and visibility of operational activities from the point of care.

- **E-health tool** – the EMR places the patient at the center of care delivery and underpins a Personally Controlled Electronic Health Record (PCEHR). The resulting outcomes from an EMR as a key eHealth tool include:
    - Providing a central repository for clinically relevant information
    - Supporting data collection used for secondary uses (for example, research)
    - Supporting effective implementation of public health strategies
    - Improved ability to respond to major incident/disaster needs in the community.

Figure 10: A Typical EMR Graphical User Interface

Types of EMR—Technology Benchmarking:

1. Web-based EMR Solution:

- A Web-based EMR solution is a remotely hosted electronic medical system, which can be accessed over an Internet Web browser.
- The initial investment is comparatively much lower when compared to the client server-based solution. However, considering long-term expenditure, it turns out to be much more expensive.
- All technical aspects of the server, such as maintenance and backups, are maintained by a professional IT company.
- Another major advantage is that since most of the computing is done on the remote server, the requirements of "onsite hardware" by the enterprise are greatly reduced.
- This allows the physician to access all information at any time from any place with Internet access.

2. **Client Server-based EMR Solution:**
    - Client server-based solutions allow a fast response time, as data from the server to the client are transferred much faster, usually at 100 Mbits/second.
    - These solutions also allow an enterprise to have complete control over its data. This allows the enterprise to directly make arrangements for backup without having to get in touch with a vendor.
    - The disadvantages are the initial costs, which are quite high, as "onsite hardware" requirements are greater.
    - The initial costs of the application are also high. Maintenance of the server has to be carried out by the enterprise, and this adds to the resource requirements and their costs.

CHAPTER- 3

RESEARCH METHODOLOGY

The study was conducted in chain of hospital groups in India.

3.1 Research Design

The dissertation study involve collection of data without changing or manipulating the environment and simultaneously involves one-time interaction with groups of people. Therefore it is a descriptive cross-sectional study.

Descriptive cross-sectional study: It is a study in which a condition and potentially related factors are measured at a specific point in time or over a short period for a defined population. They are usually conducted to estimate the prevalence of the outcome of interest for a given population. In this way cross-sectional studies provide a 'snapshot' of the outcome and the characteristics associated with it, at a specific point in time.

3.2 Type of Data

The data were collected by the following methods:

1. Primary data collection: Primary data has been obtained from telephonic discussion with CIO and managers of the hospitals.
2. Secondary data collection: Secondary data is the data that has been already collected by someone else for a different purpose. Here we have to extract the required data from the available resources. The tools used for secondary data were:
    a) Hospital websites
    b) Published literature
    c) Online Magazines
    d) Annual Reports
    e) IT specific Magazines etc.

3.3 Sample

Sample Size: Study has been conducted among the 25 chain hospitals of India

N=25 (Annexure 1)

Sampling Technique used: Convenient Sampling

Other Tools used for the study: Microsoft Office Excel 2010; Microsoft Office Visio 2007; Microsoft Project 2007

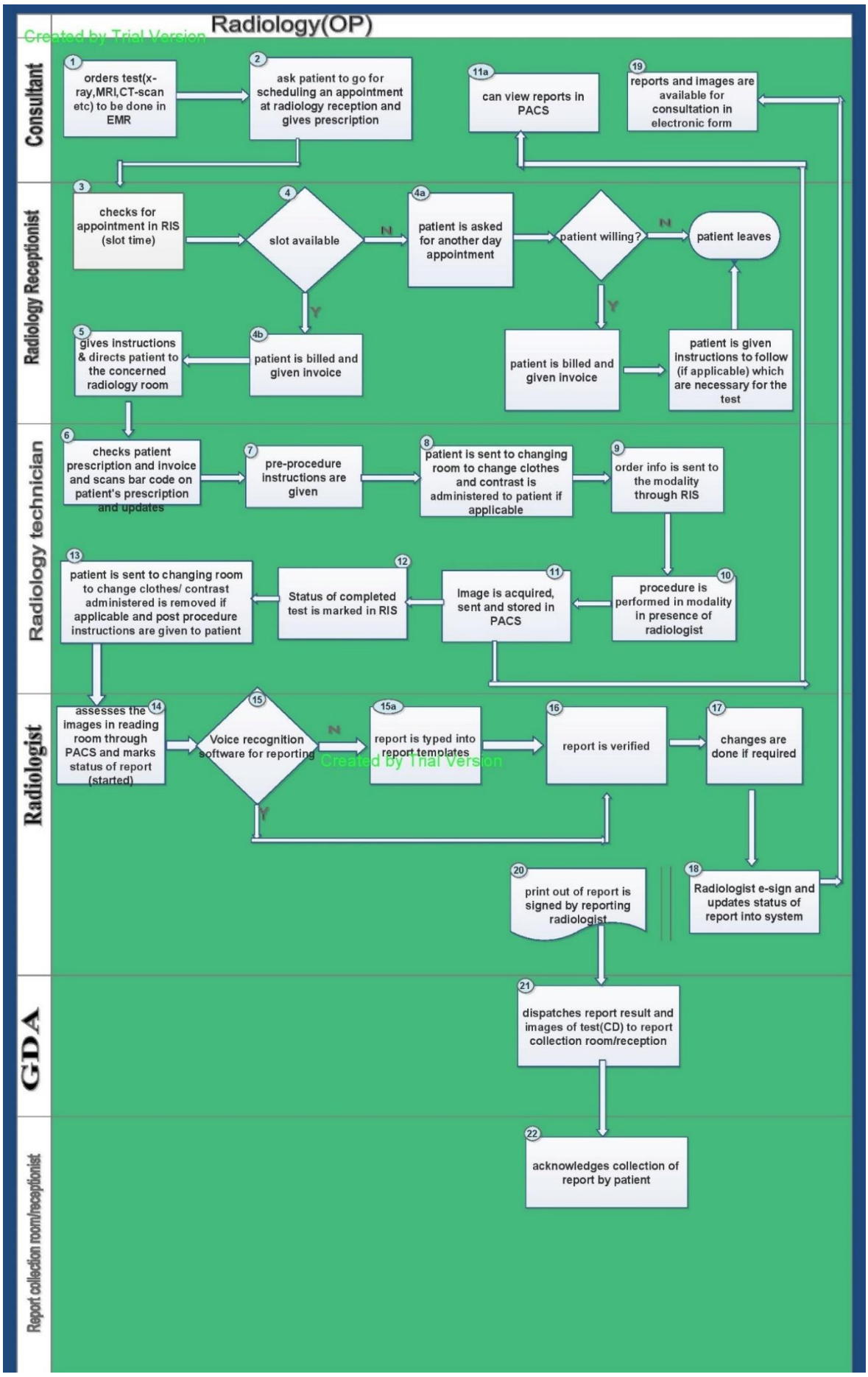

Radiology(OP)
Created by Trial Version
Consultant
Radiology Receptionist
Radiology technician
Radiologist
GDA
Report collection room/receptionist
1 orders test(x-ray,MRI,CT-scan etc) to be done in EMR
2 ask patient to go for scheduling an appointment at radiology reception and gives prescription
11a can view reports in PACS
19 reports and images are available for consultation in electronic form
3 checks for appointment in RIS (slot time)
4 slot available
N
4a patient is asked for another day appointment
patient willing?
N
patient leaves
Y
5 gives instructions & directs patient to the concerned radiology room
4b patient is billed and given invoice
patient is billed and given invoice
patient is given instructions to follow (if applicable) which are necessary for the test
6 checks patient prescription and invoice and scans bar code on patient's prescription and updates
7 pre-procedure instructions are given
8 patient is sent to changing room to change clothes and contrast is administered to patient if applicable
9 order info is sent to the modality through RIS
13 patient is sent to changing room to change clothes/ contrast administered is removed if applicable and post procedure instructions are given to patient
12 Status of completed test is marked in RIS
11 Image is acquired, sent and stored in PACS
10 procedure is performed in modality in presence of radiologist
14 assesses the images in reading room through PACS and marks status of report (started)
15 Voice recognition software for reporting
N
15a report is typed into report templates
16 report is verified
17 changes are done if required
Y
Created By Trial Version
20 print out of report is signed by reporting radiologist
18 Radiologist e-sign and updates status of report into system
21 dispatches report result and images of test(CD) to report collection room/reception
22 acknowledges collection of report by patient

Figure 11: Workflow in radiology department with PACS when receives order from OPD

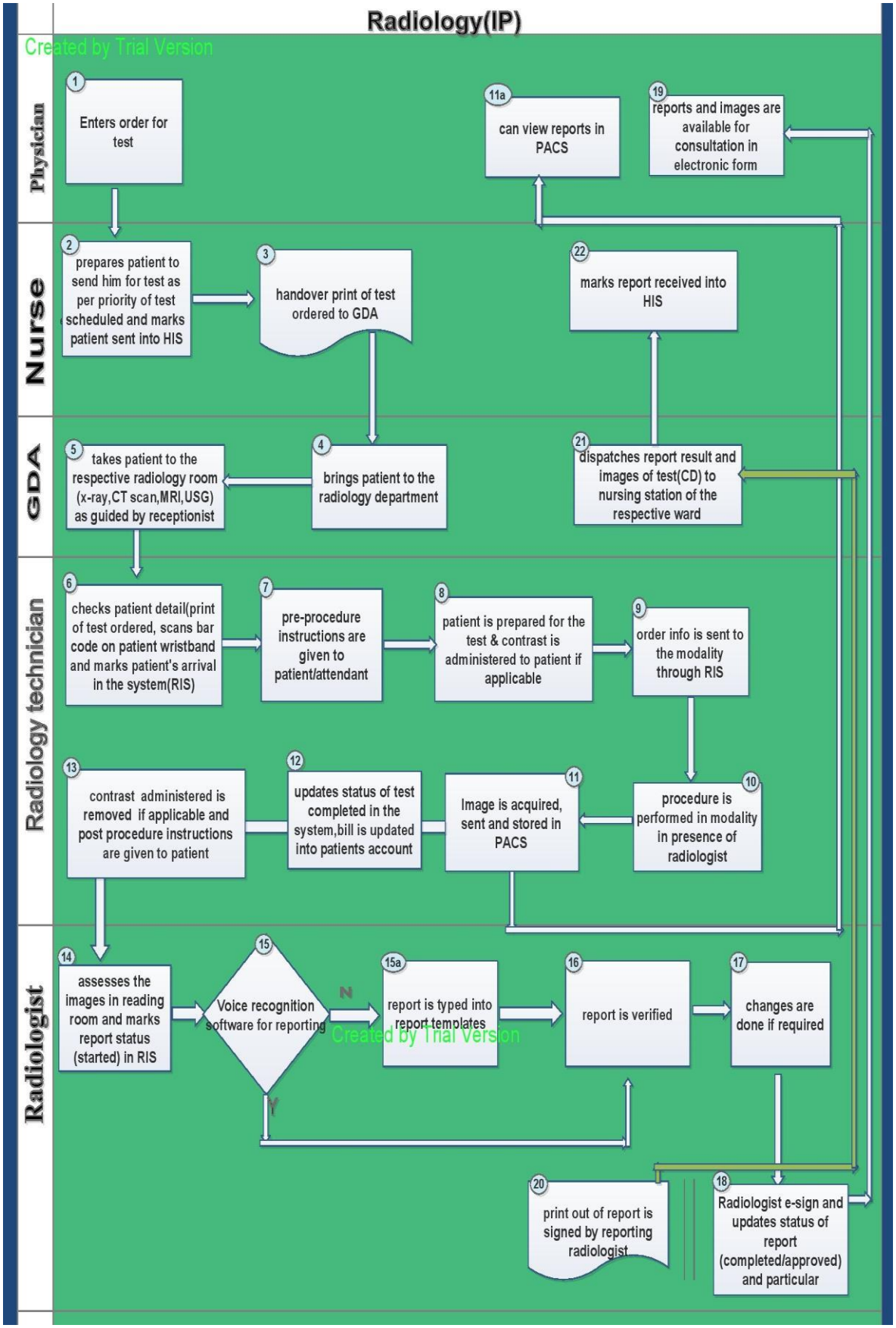


Figure 12: Workflow in radiology department with PACS when receive test order from IPD

CHAPTER- 4

RESULTS& ANALYSIS

4.1 HIS

4.1.1 Number of hospitals using HIS

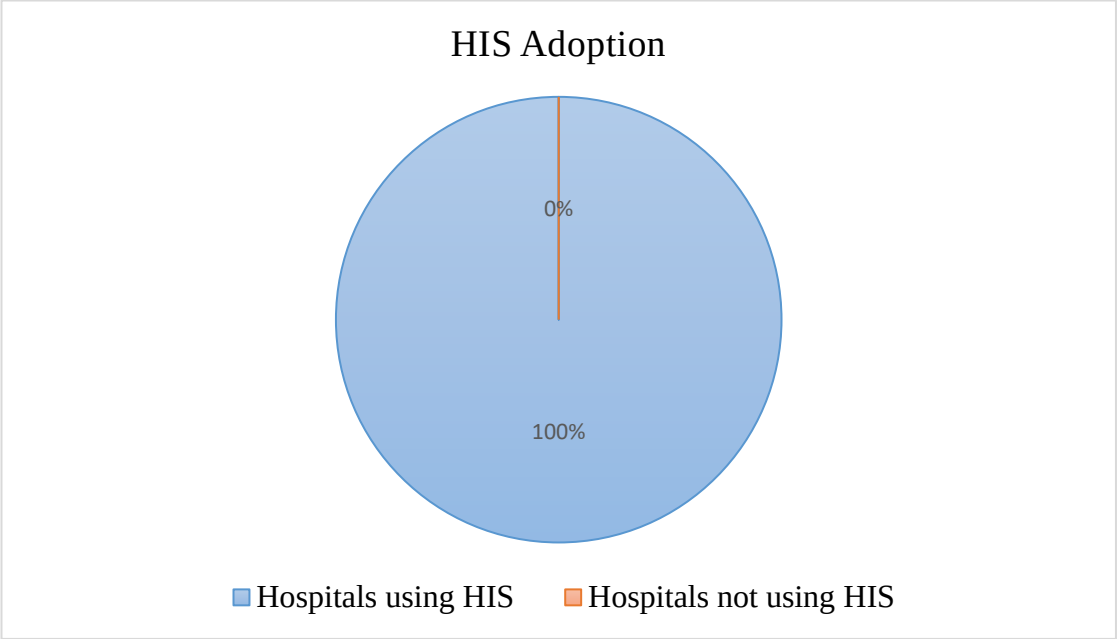


Fig 13: Pie chart showing adoption of HIS by the hospitals

Among the chosen 25 group of chain hospitals all the hospitals are using HIS.

The result shows that HIS have become indispensable modern hospital infrastructure and operations technical support environment. Digital hospital management is needed for social development is the development trend of hospital management all over world including India. The results exhibit that Indian hospitals are doing their utmost to become super-efficient at using resources — doctors, equipment and facilities — and are working incessantly to improve every process.

4.1.2 Key HIS vendors

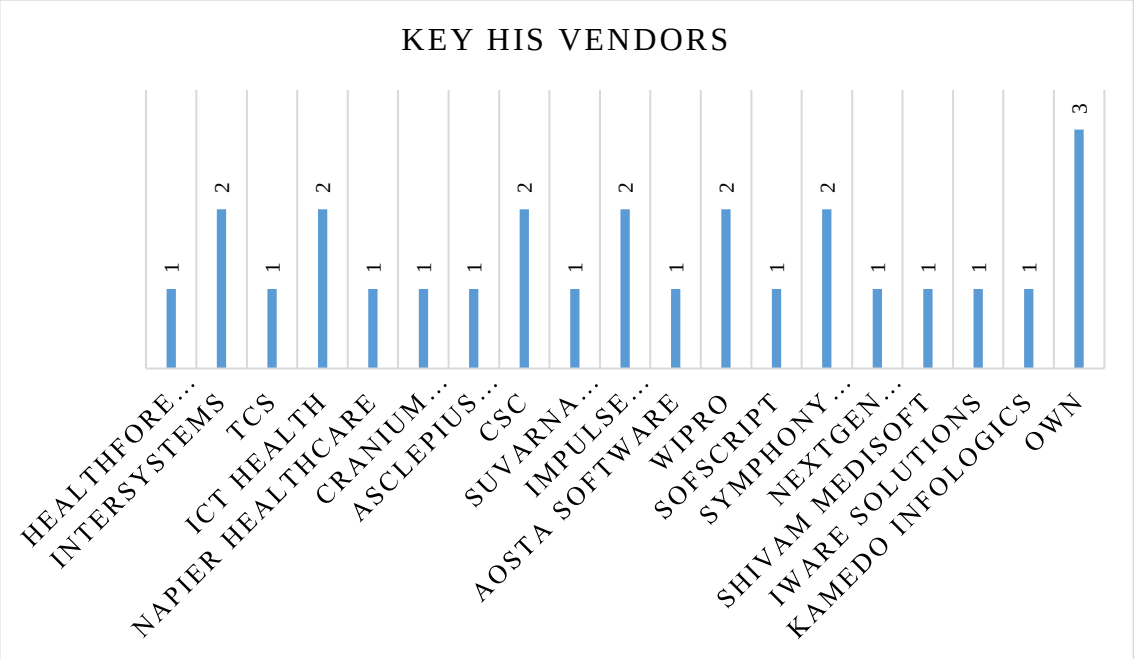


Fig 14: Graph showing key HIS vendors

Among the 25 chain hospitals in India, three chain hospitals have their own home grown HIS, whereas remaining have purchased it from vendors.

Key HIS vendors evident from the result are:

1. Intersystem
2. ICT Health
3. CSC
4. Impulse Technologies
5. Wipro
6. Symphony Corporation

4.2 PACS

4.2.1 Number of Hospitals using PACS

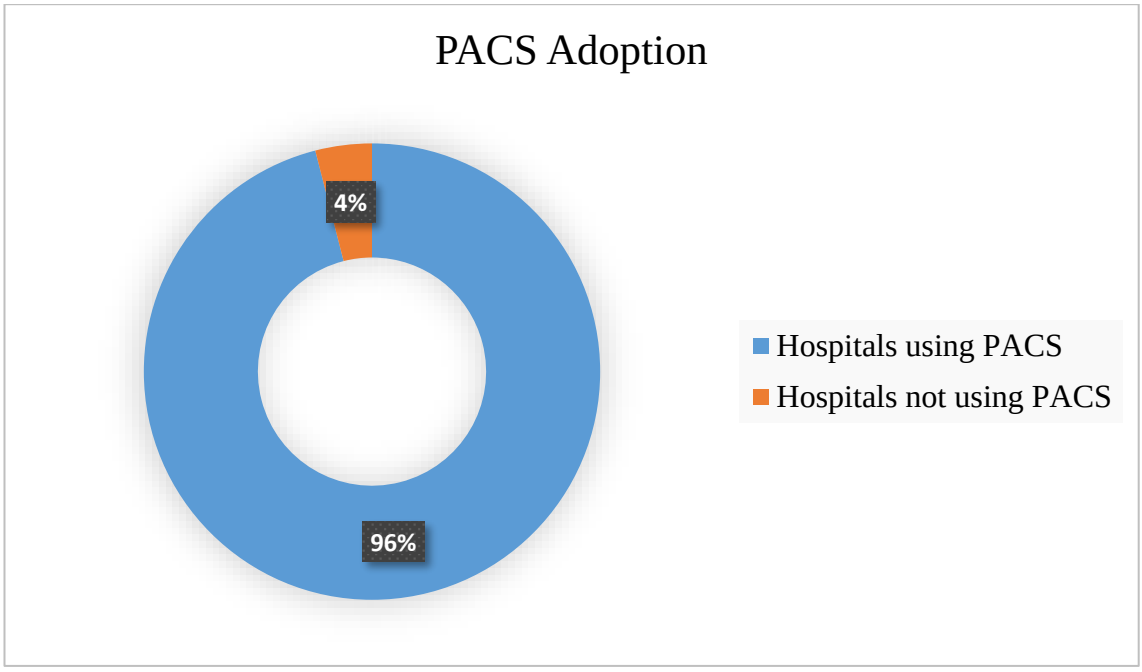


Fig 15: Pie chart showing PACS adoption by the hospitals

As far as PACS usage is concerned, it allows hospitals to capture, store, view and share all types of images internally and externally. It is evident from the results that hospitals have seen a lot of interest in PACS because of the ability to make information instantly available to high numbers of users in a larger enterprise, sharing storage devices in the process.Therefore, out of 25 chain hospitals 24 have already adopted PACS in their system and only one hospital has not implemented PACS in their hospital which corresponds to about 4%.

4.2.2 Key PACS Vendors

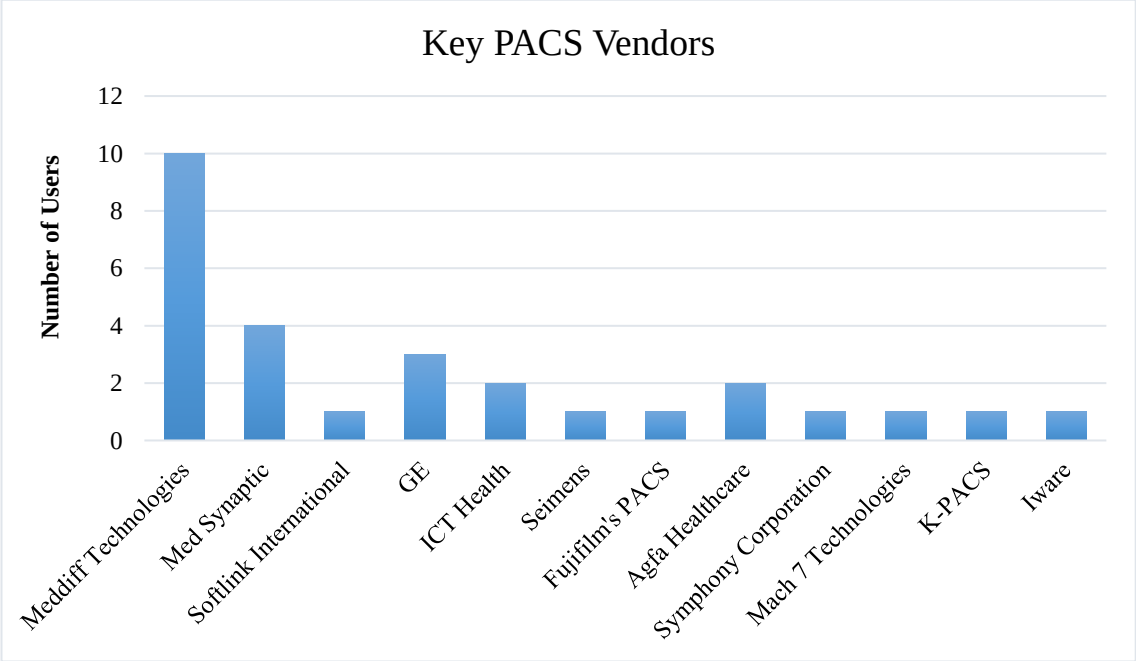


Figure 16: Graph showing key PACS vendors

In India PACS Vendors range from nearly all the major medical imaging equipment manufacturers, medical IT companies and many independent software companies.From the results that we obtained from the study, Meddiff Technologies has the largest market share in India as a PACS vendor, as chain of ten hospitals out of 25 have come down in favor of implementing PACS from Meddiff Technologies.

Key PACS vendors in major hospitals of India are:

1. Meddiff Technologies
2. Med Synaptic
3. GE
4. ICT Health
5. Agfa Healthcare

4.3 EMR

4.3.1 Number of Hospitals using EMR

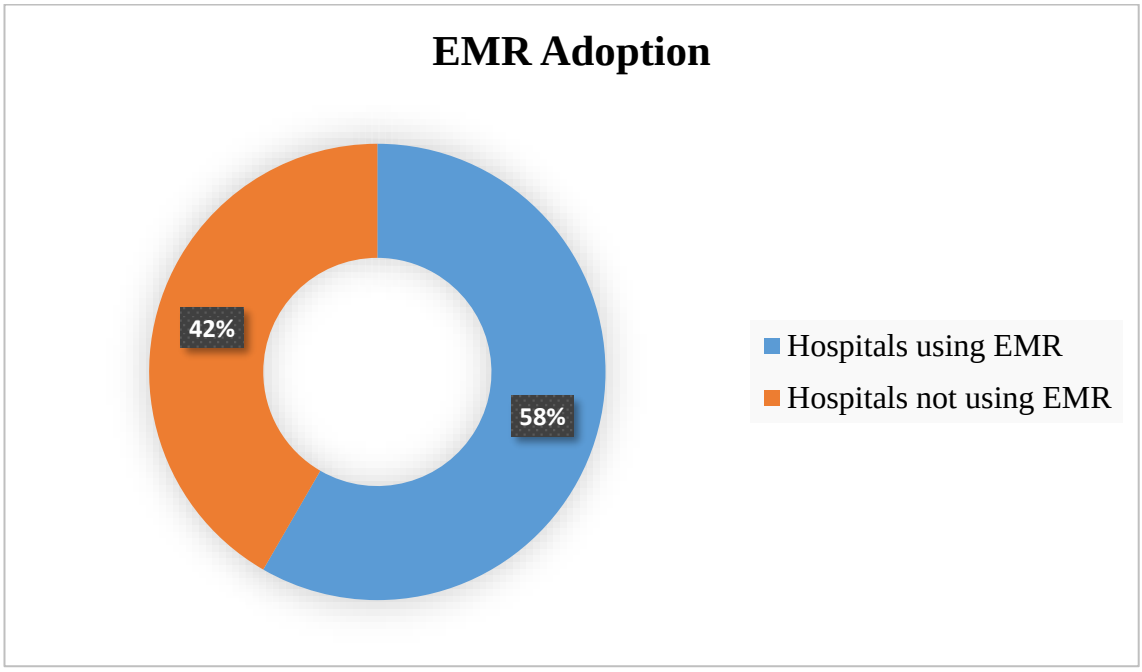


Figure 17: Pie chart showing EMR adoption by the hospitals

Though HIT adoption by Indian hospitals have increased significantly and things too go quite satisfactorily in the direction of HIS adoption and PACS adoption by the Indian hospitals, EMR adoption in India is disappointing.

Although EMR has tangible positive outcomes, the adoption rate has been low. Among the chain of 25 big corporate hospitals nearly 14 out of 25 (58%) have adopted EMR and about 42% have still not adopted EMR in their hospitals. The low adoption rate is due to several gaps existing from the doctors to EMR vendors.

4.2.2 Key EMR Vendors

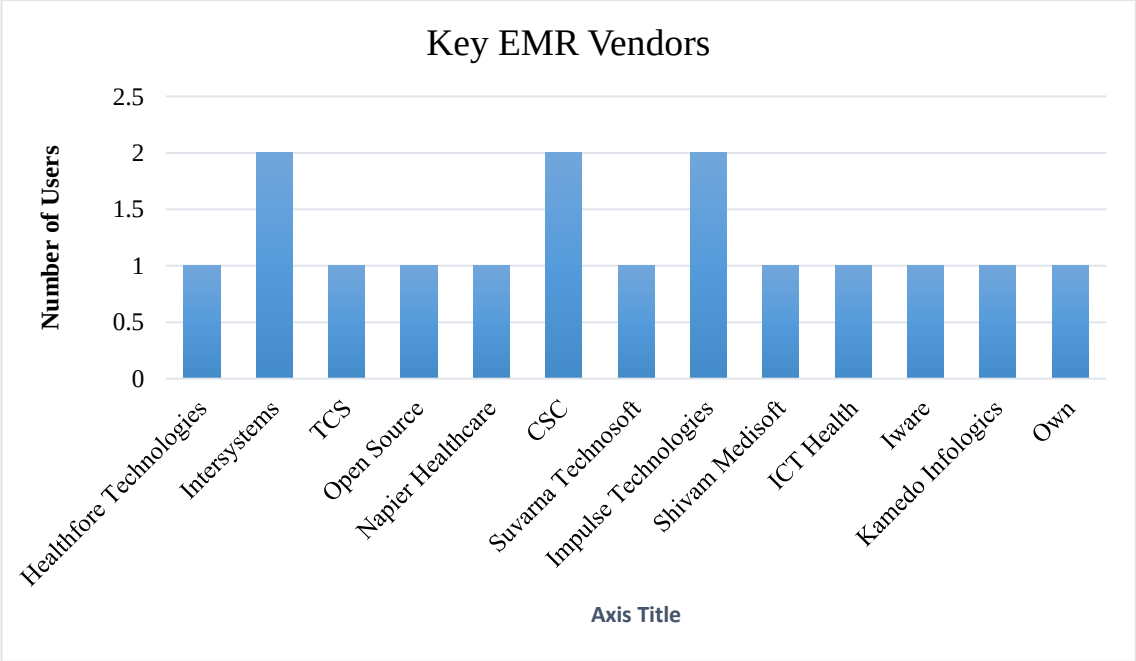


Figure 18: Graph showing key EMR vendors

There are various Indian and International EMR vendors in Indian HIT market place. EMR vendors have strong market incentives for developing EMRs. They are evolving at a greater rate in the product development. Since there are many options out in the marketplace to purchase the EMR or to customize hospitals preference, hospitals are obtaining EMR from different vendors. Top three vendors perceptible from the study are Intersystems, CSC and Impluse technologies each being adopted by two hospitals.

Key EMR vendors in India are:

1. Intersystems
2. CSC
3. Impulse Technologies

4.4 Trends ofIT Adoption in 25 Chain Hospitals

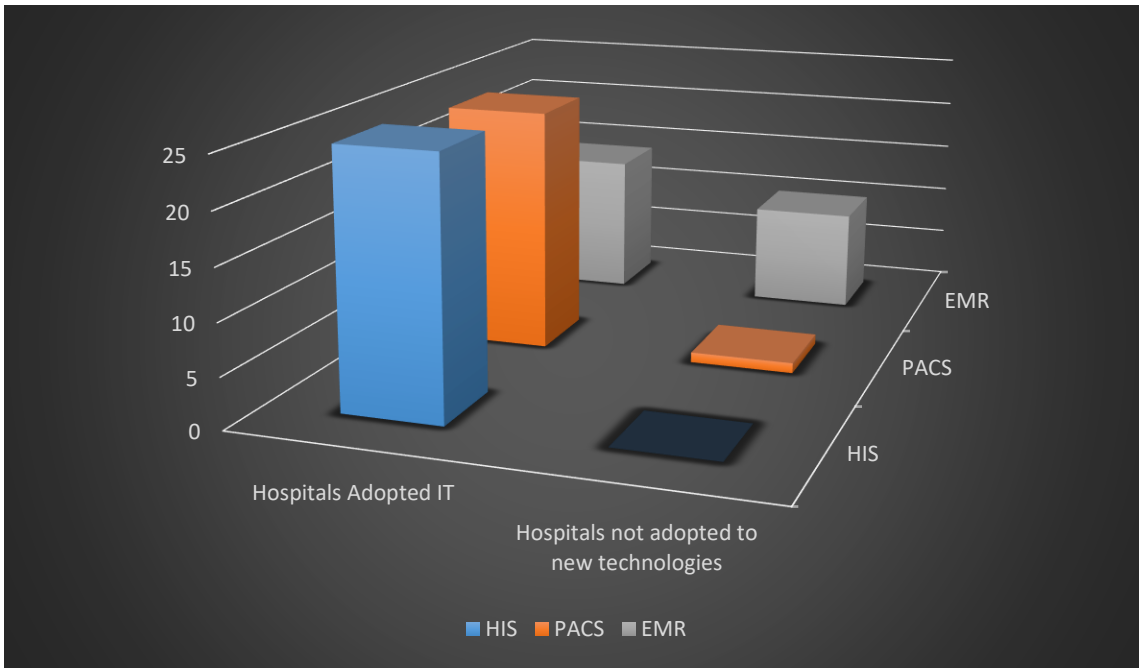


Figure 19: Graph showing overall trend of IT adoption viz. HIS, PACS & EMR in 25 chain hospitals

For every hospital however big or small it is, HIT has become a vital part of it. It is also apparent from the results that all the 25 chain hospitalgroups (100%) have HIS implemented in their hospitals. PACS adoption rate is also quite admirable and out of 25, 24 hospitals have put it into practice which corresponds to 96%. These remarkable outcome from the study is due to consciousness of hospitals to the fact that incorporation of IT in hospitals results in improved team work, faster delivery of diagnosis related information, earlier identification of drug interactions and allergies etc. Though Indian hospitals have embraced HIS and PACS but EMR has to go long way. Only 56% hospitals are utilizing EMR services and 42% hospitals has not turned up for EMR.

CHAPTER-5

SWOT ANALYSIS

SWOT ANALYSIS OF IT ADOPTION IN THE HOSPITAL

SWOT is an acronym for Strengths, Weaknesses, Opportunities and Threats. Strengths and Weaknesses are considered to be internal factors and Opportunities and Threats are considered to be external factors. It is the foundation for evaluating the internal potential and limitations and the probable/likely opportunities and threats from the external environment. It views all positive and negative factors inside and outside the firm that affect the success.

Strengths

1. **Improved patient safety:** Introduction of information technology in hospitals improve patient safety by enhancing the quality of care. Due to readily availability of comprehensive data, doctors can make better decisions about patients care, thereby reducing medical errors and improving quality of healthcare.
2. **Efficient hospital operations:** As information technology delivers information faster, smarter and cheaper, hospitals are too benefitted from it. In hospitals, IT has improved operational efficiency and increased productivity by reducing paperwork, automating routine processes and eliminating waste and duplication. For example, PACS saves costs for file room, storage space and film supplies and also decreases time spent reporting, filing and retrieving records. Web access enables physicians to view radiological images from their homes, offices remote facilities etc.
3. **Improve in data storage:** Storing records digitally in computers requires a small percentage of space as compared with the traditional system of keeping

huge files of patients in physical storage space. Also, storing medical records digitally increases storage capability for longer periods of time.

4. **Improve communication between departments:** HIS, PACS, EMR etc. improves interdepartmental communication. It allows multiple access to document at one time thus integrate communications from different department within a hospital.

Weakness

1. **Limitation on interoperability:** A patient's treatment involves receiving services from multiple units in a hospital, therefore system integration must exist within a single hospital to improve operations and decision making. System integration must also exist between other healthcare agencies present in the healthcare network as patients usually involves receiving services from multiple providers and interacting with various other health related entities. However, most hospitals are not linked and thus hospitals are not yet maximizing their IT potential.
2. **User resistance:** Staff resistance to change, staff adaptation to IT and workflow changes is the key barrier to HIT adoption in the hospital. Among staff, Physicians are person responsible for resistance to adoption to newer technologies.
3. **Require comprehensive training:** HIT implementation requires hospital staff to be trained related to utilization of newer technologies. Thus, extensive training programs including planning for training and coordination across the hospital staff are necessary during HIT implementation.

4. **Slow IT adoption:** Hospitals have been slow to adopt IT and has lagged significantly behind other industries in the usage of IT, which has now contributed to the list of problems now associated with the hospitals.

Opportunities

1. **Encourage proactive healthcare practices:** HIT solutions like HIS, PACS & EMR can integrate evidence –based recommendations for preventive services with patient data to identify patients needing specific services. For example EMR can remind doctor to offer the services during routine visits and remind patient to schedule care.
2. **Fulfil patient's satisfaction:** The personal health record (PHR) allows people to maintain and access their own medical information. This could generate positive attitude towards managing their own information. Therefore, it improves the quality; efficiency of care thus satisfies the patient
3. **Social:** With the use of data from HIS, PACS & EMR the disease registries and databases of various diseases may be created, and keyword searches may produce lists of patients with specific diagnoses. Thus it can be significant step towards a comprehensive research database for various diseases.

Threats

1. **Cost:** One of the most immediate barriers to widespread adoption of HIT is the high cost of implementation. HIT continues to be a financial burden on hospitals. There are significant yearly maintenance costs, including software, hardware, training, and hiring additional IT staffing. Furthermore, as hospitals

upgrade software, capital must be continually invested to maintain, upgrade and build necessary interfaces for the systems.

2. **Loss of patient trust:** Implementation of HIS, EMR etc. might turn the doctor-patient relationship, as implication of these technologies can diminish human touch between doctor and patient. Thus this in turn results in loss of patient trust in doctor.
3. **Privacy and security:** The implementation of basic health IT functionalities creates a range of privacy and securityconcerns including configuring secure wireless networks, establishing role-based accesscontrols, setting strong individual passwords, and auditing enabled functionality. Also, IT system is vulnerable to the hackers and virus threat, thus it makes public fear surrounding privacy. They could even endanger security of patient information.

CHAPTER- 6

CONCLUSION

The rapid growth in Information & Communication Technology (ICT), and the power of Internet has strongly impacted the business and service delivery models of today's global environment. This study majorly focuses on the IT adoption in the 25 chain hospital groups and key HIS, PACS & EMR vendors operating in the healthcare IT market in India. The study has also tried to understand the overall trend on the evolution of healthcare delivery market and the current state of healthcare Information Technology market Size in India and its growth trends.

- After analyzing the data from the sample size of 25 chain hospital groups, it is found that almost every big corporate hospital has incorporated HIS in their curriculum.
- Results from the study revealed that PACS too have higher rate of adoption by the hospital groups (96%). Similar findings have been observed in a recent survey of hospital executives, 49 percent indicated that they had PACS or were implementing it [22]. Also the survey of 460 hospital and system chief financial officers showed that 72 percent anticipate investing in PACS [23].
- EMR adoption by the hospitals are still in nascent stage. Study results shows that only 56% hospitals have EMR implemented in their settings. Our study results are consistent with a recent survey by Modern Physician/Pricewaterhouse Coopers which suggests that only 41% of respondents indicated that their organizations have invested in an EMR [24].The current perceived adoption level of electronic medical records in India lies at 4.43 out of 10. Where 1 is the highest and 10 the lowest

level; part or full modules implemented majorly cover the Tier I and II cities of India.

Capability Composition	Levels
No composite IT initiative	Level -1
All three ancillary modules not installed	Level 0
Ancillary modules—laboratory, radiology, pharmacy—all installed	Level 1
Clinical data repository, clinical data support system, may have document imaging	Level 2
Clinical documentation (flow sheets), CDSS, (error checking), PACS available outside radiology	Level 3
CPOE, CDSS (clinical protocols)	Level 4
Closed-loop medication administration	Level 5
Physician documentation (with templates); full CDSS, full PACS	Level 6
Paperless hospital (medical records fully electronic)	Level 7

Figure 20: Levels of EMR adoption in India

- The departments that have been prime focus for the hospital for the usage of IT systems are billing section, front office registration, and laboratory and radiology department.A variety of studies have indicated that Physicians reported using computers more for administrative functions than for clinical functions. The most common uses included billing or claims submission and scheduling or patient appointment reminders [24].
- The key HIS vendors pronounced from the results that are operating in Indian market are Intersystem ICT Health, CSC, Impulse Technologies, Wipro and Symphony Corporation.
- Top PACS vendors in 25 chain hospital groups are Meddiff Technologies, Med Synaptic, GE, ICT Health and Agfa Healthcare.
- Study outcome also disclose Intersystems, CSC and Impulse Technologies as the major EMR vendors in the market.
- The HIT market in India is still in the early growth stage. It is a small market dominated by in-house implementations and customized solutions developed by small local software developers. In terms of technology adoption, the Indian market

is far behind its Asia Pacific counterparts such as Australia, Japan, South Korea, Singapore, and Malaysia.

- Most of the IT vendors in India have their head offices or corporate offices in the south and west regions. Karnataka, Maharashtra, and NCR are the states with most of the IT vendor presence.
- Approximately 47% of the vendors have multiple product offerings. Most of the IT vendors having presence in India have HIS as their main product/service offering, around 72.0%. Vendors only dealing with single products have the highest percentage in HIS and PACS, then for physician management systems and EMR systems.
- Some of the vendors profile themselves as core HIS and EMR companies. Few project themselves as physician/clinic management and EMR providers. The top 10 companies have their product offerings in HIS, EMR, and CIS.

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CHAPTER- 7

RECOMMENDATIONS

1. **IT department should be seen as an area of revenue center:** Hospitals generally considers IT department as financial burden. Although there might be high initial cost of implementation and yearly maintenance but they should consider both financial return on investment and nonfinancial benefits when making IT investment decisions. As return on investment (ROI) varies by the type of IT. For example, pharmacy department and radiology department has more ROI.

2. **Diligence of top management:**Top management plays a crucial role in any organization. Decisions taken up by the top management is generally followed down the organization ladder. Therefore,installation and adoption of newer information technology in hospitals demands careful and persistent effort by the top management.

3. **Well organized training plan:** Proper and periodic training of hospital personnel is required for enhancement of the skill set of employees. Trained employees will be better equipped to handle HIT products. The regular training sessions will resolve their everyday issues and will also update them about the latest technologies available in the market which in turn keep their zeal alive to adopt newer information technologies.

4. **Regular feedback:** Regular feedback from the end users such as nurses, doctors etc. as well as from the patients should be taken by the management. Feedback

will help in analyzing the need of the hospital whether existing workflow is efficient or there is need of introduction of new HIT solutions for better efficacy. Any issues apparent from the feedback must be resolved either by training the staff or if requires customization of software's by the vendor as per the hospital workflow.

5. **Need analysis:** As there are many international HIT vendors in Indian HIT market. Hence there is need to do complete need analysis of Indian market and what features are hospitals expecting in the products. Then software's should develop according to need of Indian hospitals.

CHAPTER- 8

APPENDIX

Appendix 1

The chains of hospitals under the scan in delimitations of this study are (N=25):

S. No.	Healthcare Groups
1	Fortis Healthcare
2	Apollo Hospitals
3	Manipal Health Systems
4	Max Healthcare
5	Narayana Hrudayalaya
6	Care Hospital
7	Columbia Asia
8	Global Hospital
9	Healthcare Global
10	MedantaMedicity
11	Krishna Institute of Medical Sciences Limited
12	Sahyadri Hospitals Limited
13	Artemis Hospitals Limited
14	Kovai Medical Hospitals Ltd.
15	Sagar Hospital
16	Sterling Hospitals
17	Yashoda Hospitals
18	PD Hinduja Hospital
19	Lilavati Hospital

20	**Metro Hospital**
21	**Bhagirathi Neotia Woman & Child Care Centre**
22	**Medica Super specialty Hospital**
23	**Rockland Hospital**
24	**Sunrise Hospitals**
25	**Kerala Institute of Medical Sciences**

Appendix 2

S. No.	Healthcare Groups	HIS Vendor	PACS Vendor	EMR Vendor
1	Fortis Healthcare	Healthfore, fortisggn- trakcare	Meddiff Technologies & Med Synaptic	Healthfore, fortisggn- trakcare
2	Apollo Hospitals	TCS	Med Synaptic, Softlink International &Meddiff Technologies	med mantra by TCS
3	Manipal Health Systems	Bnglr- TrakCare by Intersystems, remaining ol branches uses wipro HIS	Meddiff Technologies including bnglrhosp& Med Synaptic	TrakCare
4	Max Healthcare	own	GE	vista CPRS implemented by dell
5	Narayana Hrudayalaya	Hinai	Hinai	not using emr
6	Care Hospital	Napier Healthcare	own	napier healthcare
7	Columbia Asia	own	Meddiff Technologies	own
8	Global Hospital	cranium technologies	GE	not using emr
9	Healthcare Global	charak HIS by asclepius consulting	Meddiff Technologies	not using emr
10	MedantaMedicity	CSC	Seimens	CSC
11	Krishna Institute of Medical Sciences Limited	SuvarnaTechnosoft	Meddiff Technologies	SuvarnaTechnosoft

12	Sahyadri Hospitals Limited	Impulse Technologies	Med Synaptic	Impulse Technologies
13	Artemis Hospitals Limited	CSC	Meddiff Technologies	CSC
14	Kovai Medical Hospitals Ltd.	Aosta Software	GE Healthcare	not using emr
15	Sagar Hospital	Wipro	Fujifilm's Synapse PACS	not using emr
16	Sterling Hospitals	Sofscript	Agfa	not using emr
17	Yashoda Hospitals	Symphony	Symphony, meddiff-3 branches	not using emr
18	PD Hinduja Hospital	e-Symphony	IMPAX 6 by agfa healthcare	not using emr
19	Lilavati Hospital	own	Mach7 Technologies	not using emr
20	Metro Hospital	next gen e solutions	not using	not using emr
21	Bhagirathi Neotia Woman & Child Care Centre	Neosoft by Shivammedisoft	K-PACS	Neosoft by Shivammedisoft
22	Medica Super specialty Hospital	Impulse Technologies	Meddiff Technologies	Impulse Technologies
23	Rockland Hospital	Hinai	Hinai	Hinai
24	Sunrise Hospitals	iWARE	iWARE	iWARE
25	Kerala Institute of Medical Sciences	yasasii software from kamedoinfologics	Meddiff Technologies	yasasii software from kamedoinfologics

CHAPTER- 9

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