



TLM 3901

**MASTER OF SCIENCE IN TELEMEDICINE  
AND e-HEALTH**

---

THE CHALLENGES, PROBLEMS AND STRATEGIES OF ELECTRONIC  
MEDICAL RECORD IMPLEMENTATION: A CASE STUDY OF AN EYE  
HOSPITAL FROM INDIA

---

SHABBIR SYED ABDUL

MAY 2008

FACULTY OF MEDICINE  
Department of Clinical Medicine  
University of Tromsø  
Norway



THE CHALLENGES, PROBLEMS AND STRATEGIES OF ELECTRONIC  
MEDICAL RECORD IMPLEMENTATION: A CASE STUDY OF AN EYE  
HOSPITAL FROM INDIA



By

SHABBIR SYED ABDUL

May 2008

This thesis is submitted as partial fulfilment of the requirements of the degree of  
Master of Science in Telemedicine and e-Health

FACULTY OF MEDICINE  
Department of Clinical Medicine  
University of Tromsø  
Norway



## Abstract

The increasing number of publications in scientific journals indicates the acceptance of Electronic Medical Record (EMR) systems and their potential to improve safety, quality, and efficiency in medicine. However, these studies are mainly from developed countries. The available literature does not yet seem to adequately describe the factors facilitating and hindering implementation of EMR systems in developing countries. Indeed more research is needed to understand challenges and problems of managers and health staff (end-users) in hospitals from developing countries. To do so an interpretive research study was designed to answer the following research questions: 1) *what are the different interests and expectations of managers and health staff and how they should be aligned in order to adopt an EMR system?* 2) *What are the challenges of the managers and problems faced by the end-users while transitioning their practice from paper to PC?* 3) *What are the strategies adopted by managers to overcome the problems faced by end-users?*

**Method:** Interpretive research study was conducted in an eye hospital in India from 12<sup>th</sup> Nov 2007 to 4<sup>th</sup> Jan 2008. Forty two hours of observation were done and thirty one interviews were conducted from twenty one stakeholders (managers, health staff and IT professionals). In addition photographs were taken to strengthen the interpretive analysis.

**Results:** Different important organizational issues came into picture. Managers' interests were to save time, space and resources while maintaining the medical records. They were focusing on challenges like changing the mindset of end-users, providing various options of training and creating understanding between IT and Health staffs. Health staff was interested in an EMR system, as it provides accessibility to patient information instantly and acts as a good source for research. However they were struggling to spare extra time to get trained after their routine work, they had problems with data entry, and some were not used to computers. Creating an IT environment, involving health staff in an EMR software development team and adopting a slow and steady approach were some of the relevant strategies from managers.

**Conclusion:** This study reveals that different actors seem to be interested in the EMR system for different reasons, which are related to their current work priorities. It also highlights 14 different essential issues which should be addressed during implementing EMR system. This study can be a starting point of reference for hospital managers, health staff and vendors helping them in increasing the level of awareness about the issues crucial for successful implementation of EMR system. For researchers it provides an overview of different issues for future research towards finding sustainable solutions for these challenges and problems.

Keywords: Electronic medical/patient records, Hospital Information system, Implementation, Challenges/problems, India



## Table of contents

Abstract.....	ii
Table of contents .....	v
Figures and Pictures.....	vii
Tables and Flow charts .....	vii
Acknowledgements.....	vii
1. Introduction.....	2
1.1 Purpose of the study .....	2
1.2 Research Questions .....	3
1.3 The study context and methodology .....	3
1.4 Expected contribution.....	4
1.5 Personal motivation.....	4
1.6 Structure of the thesis.....	5
2. Electronic Medical Record system .....	2
2.1 Summary.....	5
3. Introduction to India.....	6
3.1 Indian healthcare system .....	8
3.1.1 Information Technology Infrastructure for Health (ITI)H .....	9
3.1.2 Different healthcare providers.....	10
3.1.3 The Present Scenario of Paper Medical Records .....	11
3.2 Summary.....	11
4. Theory .....	13
4.1 Information Infrastructure (II) .....	14
4.1.1 Enabling function .....	15
4.1.2 Shared function .....	15
4.1.3 Openness.....	15
4.1.4 Heterogeneity .....	15
4.1.5 Socio-technical networks.....	16
4.1.6 Enduring.....	16
4.1.7 Scaling Up.....	16
4.1.8 Installed base.....	17
4.2 Actor-Network Theory (ANT).....	18
4.2.1 Translation .....	19
4.2.2 Inscription .....	20
4.3 Criticism .....	22
5. Method.....	23
5.1 Research Strategy.....	23
5.2 Quantitative research methodology.....	24
5.3 Qualitative research methodology.....	25
5.4 Interpretive research methodology.....	26
5.4.1 Evaluating criteria applicable to interpretive research: .....	29
5.4.2 Positioning of the researcher in research: .....	32
6. Material collection .....	33
6.1 Observation.....	33
6.2 Semi-Structured interviews.....	36
6.3 Quantitative study .....	37

6.4	Limitation .....	38
6.5	Summary.....	39
7.	The Case .....	41
7.1	Introduction to the hospital where research was conducted .....	41
7.2	Project: Implementation of EMR system in an Eye hospital in India .....	42
7.3	Description of creation and flow of information within hospital.....	45
7.4	Introduction to EMR system and its interface .....	48
7.5	Interests and expectation of different actors is as follows:.....	53
7.6	Practical problems of end-users .....	59
8.	Discussion.....	63
8.1	Factors important for implementing EMR system.....	63
8.2	How to evaluate the Implementation of new technology? .....	65
8.3	The challenges and problems faced by end-users while transitioning health care practice from paper to PC and relevant strategies adopted by managers.....	67
8.3.1	Enrolment of actors by manager .....	67
8.3.2	Change of mindset and attitude.....	69
8.3.3	Creating understanding between health staff and IT staff.....	70
8.3.4	Re-organizing practice and interdependencies among actors.....	71
8.3.5	Users satisfaction.....	73
8.3.6	Time factor.....	74
8.3.7	Training.....	75
8.3.8	Encouragement and motivation.....	76
8.3.9	Dealing with predefined templates.....	77
8.3.10	Doctor-Patient relation.....	79
8.3.11	Creating IT environment and providing technical assistance .....	80
8.3.12	Slow and steady approach.....	81
8.3.13	Security and confidentiality .....	82
8.3.14	Standardization.....	82
9.	Conclusion .....	83
9.1	Practical Implications .....	86
10.	References .....	89
	Appendix.....	91

## Figures and Pictures

Figure 2-1 Model of EMR.....	3
Figure 3-1 Political map of India.....	6
Figure 3-2 National Flag of Republic of India .....	6
Figure 10-1 Letter of acceptance from SN .....	92
Picture 7-1 Chart of policy and Objectives of this hospital .....	41
Picture 7-2 Patients at reception .....	45
Picture 7-3 Patients waiting at Optometrist cabin.....	45
Picture 7-4 Optometrist checking sight of patient .....	46
Picture 7-5 Optometrist doing slit-lamp examination.....	46
Picture 7-6 Patients waiting at Consultant cabin.....	46
Picture 7-7 screen shot of EMR template.....	49
Picture 7-8 Screen shot of History template.....	49
Picture 7-9 screen shot showing allergy and medical history .....	50
Picture 7-10 Screen shot of drawing template .....	51
Picture 7-11 Drawings on paper record.....	51
Picture 7-12 Screen shot of medication interface of EMR .....	52
Picture 7-13 Screen shot of Investigation ordering interface of EMR.....	52
Picture 7-14 Archive of paper records.....	55
Picture 7-15 Server EMR database.....	55
Picture 7-16 MRD staff transferring paper records.....	56
Picture 7-17 EMR interface for researcher.....	59
Picture 8-1 Screen shot showing predefined template.....	73
Picture 8-2 Top 10 users of EMR system among Optometrist .....	76
Picture 8-3 Template pointing allergy .....	77
Picture 8-4 Consultant_1 sitting back to author at IT help desk .....	81

## Tables and Flow charts

Table 3-1 Economic indicators .....	7
Table 3-2 Major demographic and key health status indicators .....	8
Table 3-3 Healthcare Infrastructure.....	10
Table 3-4 Percentage of hospitals by size .....	10
Table 6-1 Actors and number of interviews conducted.....	36
Table 6-2 Comparisons between electronic and paper records.....	38
Table 8-1 Factors taken from study of Ovreteit, Scott et al. 2007.....	64
Table 9-1 showing interests of actors to adopt EMR.....	84
Table 9-2 challenges, problems and strategies .....	86
Flow chart 3-1 Role of ITIH .....	47
Flow chart 7-1 Schematic presentation of the flow of information within hospital.....	47
Flow chart 8-1 The shift in interdependencies among actors .....	72

## Acknowledgements

First and foremost I am thankful to University of Tromsø, more precisely the organizing committee of this master degree in Telemedicine and eHealth and the Norwegian Government for granting a scholarship, given this great chance to gain knowledge and international experience in this field.

This thesis is submitted as partial fulfilment of the requirements of the degree of Master of Science in Telemedicine and e-Health, and it is a result of all knowledge gained during this course. Therefore I would like to express my gratefulness to all the lecturers and professors who taught me different modules or subjects in this course.

I appreciate the guidance, valuable support and feedback received from my supervisor Prof. Gunnar Ellingsen. My special thanks to my co-supervisor Prof. Serrano Artur for proof reading this thesis and giving his suggestions and advice.

I would like to express my gratitude to staff of Sankara Nethralaya for their hospitality and co-operation during my material collection. This thesis would not have been possible without their help.

I am very much thankful to RLN Murthy and LS Satyamurthy from Indian Space Research Organization (ISRO), Dr. Lipika Nanda, SP Sood, Torkel Snellingen, and Jeremiah Scholl for their support and recommendations.

I gratefully acknowledge suggestions and moral support from my friends Olav Nilsen, Gloria Enerlan-Aas, Luis Fernandez Luque, Jaya Kumari and Aamir Rehman Jarral. Although I could not list the names of all the persons who helped and contributed in this thesis, it does not mean I have forgotten them. Thank you very much all of you!



# 1. Introduction

This chapter is organized into six sections to give a brief overview of this study. Section 1.1 provides the purpose of the study. Section 1.2 discloses the research questions guiding this case study. Section 1.3 introduces briefly the study context and methodology used. Section 1.4 presents the brief summary of expected contributions of the study. Section 1.5 describes the author's personal motivation for conducting this study and the last section 1.6 provides an outline of the remaining parts of the thesis.

## **1.1 Purpose of the study**

Information Technology revolution has provided added value to all sectors and health care system is no exception, however, the degree of ICT (Information and Communication Technology) penetration in other sectors like banking and transportation, is deeper than in the health sector. Though hospital managers and policy makers are very much aware of advantages and potential benefits of ICT, to say in one sentence better access to health care and access to better health care, ICT in healthcare sector still lacks behind. One of the reasons can be as Van Bommel and Musen claims

*Clinicians would be unwise to use any system unless it has been shown to be safe and effective (Van Bommel and Musen 1997)*

Proponents of Information Technology have been arguing for the last few decades about potential benefits such as improve efficiency and quality of healthcare with reduced costs. More research is needed to prove safety and effectiveness of ICT tools in healthcare and it is also needed to study the complexity of the factors influencing the implementation process of this new technology; only thereafter actual benefits can be documented. The technology chosen in this study is the Electronic Medical Record system. The factors influencing the implementation process are the interests challenges and problems of hospital managers and health staff.

This study does not reflect on economical issues or on the public healthcare system. Rather it aims on understanding hitches of implementation in private sector. In this study a Trust hospital (charity funded) is focused. Once this system is proven to be cost effective and efficient then can be presented as a model for government healthcare authorities.

## **1.2 Research Questions**

The main objective of this study is to understand the major factors influencing the adaptation and implementation of an Electronic Medical Record system in a hospital setting. The major research questions for which this study went to find out appropriate answers are the following:

- 1) What are the different interests and expectations of managers and health staff and how they should be aligned in order to adopt EMR system?
- 2) What are the challenges of the managers and problems faced by the end-users while transitioning their practice from paper to PC?
- 3) What are the strategies adopted by managers to overcome the problems faced by end-users?

## **1.3 The study context and methodology**

This study was conducted in an eye hospital called Sankara Nethralaya (SN). It is located at one of the Indian metropolitan cities, Chennai in State Tamil Nadu. Sankara Nethralaya is a 260 bed, Vision care Institution providing world class eye care for the past 29 years. It is a trust institution (charity funded), operating with the efficiency and commitment of a private organization, non-profit making and a non-commercial organization. This hospital is under a process of implementation of an EMR system since the last eight years; therefore it was a perfect subject (case) for conducting a study to understand the factors influencing the adoption and implementation of new technology in the hospital setup.

A case study approach with interpretative research methodology was adopted to provide rich quality of description and analyses of complex socio-technological issues tangled in adopting ICT in healthcare, more precisely EMR system in hospitals. This study used multiple techniques like observation, semi-structured interviews and informal conversations with different actors, for collecting material. Field work was conducted in the same hospital in India from 12<sup>th</sup> Nov 2007 to 4<sup>th</sup> Jan 2008. Forty two hours of observation were done; thirty one interviews were conducted from twenty one stakeholders. In addition photographs and screen shots were taken to strengthen the interpretive analysis.

#### ***1.4 Expected contribution***

This collected empirical material will contribute to the expanding literature and discussion on development and implementation of sustainable EMR systems in hospital setup in India as well as in other developing countries. There is limited empirical research conducted on this topic especially in hospitals in India. This material has highlighted the views and experiences of different stakeholders/actors involved directly in the implementation process in this hospital and this can be utilized for better understanding the factors influencing the implementation process and improving future EMR systems.

This study is expected to serve as a starting point for hospital managers, health professionals and Information systems professionals interested and involved in implementing EMR systems in hospitals. For students and researchers of health informatics it provides an overview of different issues to carry out future research on the EMR systems.

#### ***1.5 Personal motivation***

I am a medical doctor having international experience in working as a general practitioner for about 5 years in India and in Maldives. Over the past several years I have been specifically interested in eHealth as a solution to several issues relating to lack of medical history available to support clinical practice. I am aware that physicians can deliver better and fast when they have better information about the patient's condition and clinical history. I believe, from my own experience, that PHR's (Personal Health Records) and EMRs (Electronic Medical Records) are emerging as key tools for efficient practicing in modern medicine. However, lack of good models of EMRs fitting in complex healthcare system, adequate evidence proving its effectiveness, efficiency and reliability hinders its use in mainstream clinical practice.

During my participation in the eHealth India conference in New Delhi, in August 2007, it surprised me that, in spite of the highly developed ICT sector in India, the utilization of ICT in health sector is lacking behind. Only very few hospitals out of hundreds of tertiary hospitals in India have adopted Electronic Patients Record systems. The increasing number of publications in scientific journals indicates that the acceptance of EMR system is largely from developed countries. Indeed more research is needed to know about the situation in developing countries. Therefore I got interested to know the challenges and problems of the implementation process of EMR system in developing countries and more precisely in India.

I am committed to actively get involved as a researcher in the field of my interest such as EMRs, linking them to Hospital Information Systems, especially on management and flow of medical information within and among health care providers. Courses taught in my first year of master's degree familiarised me with the various problems in healthcare setups while adopting ICT (Information and Communications Technology) in clinical practice. This program has also provided me the necessary skills and expertise to understand the complexities tangled within the healthcare system when implementing new technology. All these knowledge and skill gained during my study motivated me to take my first step as researcher.

## **1.6 Structure of the thesis**

This thesis is composed of eight chapters. After this introduction the following chapters are :

Chapter 2: Introduces the topic of this study that is Electronic Medical Records; briefs its pros and cons.

Chapter 3: briefly introduces India and Indian healthcare system and talks about the role of Information Technology in healthcare, it describes different healthcare providers and present status and problems of paper medical records.

Chapter 4: outlines the Actor Network and Information Infrastructure theories. Moreover, describe how the different issues in this study can be understood better by adopting these theories. That deals with important concepts fit within the context of this study.

Chapter 5: describes the research strategy, introduces the qualitative and quantitative research methodology; provides insight on factors influencing the choice of research methodology and evaluating criteria applicable to interpretative research within the context to this study. Thereafter, the set of principles for conducting and evaluating interpretive field research in Information systems proposed by Klein and Myers are explained and discussed in the context of this study. Finally data collection methods techniques used and modes of analysis adopted will be described.

Chapter 6: Introduces the case of the hospital where the study was conducted and it illustrates the workflow in this hospital. The background to the project from its inception phase to the present status are described. Practical problems of the health staff are presented in the form of episodes.

Chapter 7: the empirical material collected revealed 14 different issues influencing implementation process; they are about challenges, problem and strategies of actors of this hospital. Discussion and analyzes of these issues was done with the support of ANT and II theory.

Chapter 8: summarizes the discussion done and answers to the research questions of this study. In addition, the author proposes some recommendations and need for future research. References and appendix follow this chapter.



## 2. Electronic Medical Record system

Imagine yourself to be a physician at an emergency department and an unconscious man of age 43 years has been brought by his wife. As patient is unconscious you cannot get any information from him, his wife is so nervous, and in panic that she has neither carried past medical records nor knows diagnoses of her husband. All the information you could get from her is that patient had underwent some heart surgery with balloon and he is on anti-hypertensive (blood pressure) pills of red colour and one white colour pill for diabetics. In addition she says the patient is under treatment in this hospital since last 2 years and surgery was done 6 months ago, the patient had been reviewed by the consultant last month.

Does this sound far-fetched? Unfortunately these types of scenarios are common in emergency rooms and in doctors' offices everyday in hospitals. In the same situation, this is how it should be: just by entering the name and address of the patient in the computer you could found he is a case of Coronary artery disease (atherosclerosis caused by the gradual build-up of fatty deposits in coronary artery). He underwent balloon dilatation and stent placement and the medications prescribed to him in last visit. Just by examining normal ECG of patients the doctor can confirm that presently the patient does not have any heart problem and patient unconsciousness can be due to misbalance of his sugar level in the blood. The lack of availability or accessibility of current and past medical history of patients delays the initiation of accurate treatment. Furthermore, it may lead to duplication of examination, misdiagnoses and creates room for medical error.

Available Information and Communication Technologies (ICT) if used appropriately can serve as good tools for leveraging efficiency and effectiveness of the healthcare system. This section will introduce to Electronic Medical Record (EMR) system, one of the ICT tools which has potential to solve many concerns and problems that the healthcare system struggling with. Some other terms are also used to designate EMR. For example few other terms listed here are:

- Electronic Medical/Patient Record (EMR/EPR)
- Electronic Health Record (EHR)
- Computerised Medical Record (CMR)
- Computerised Patient Record (CPR)
- Computer-Based Patient Record (CPR)

- Electronic Health Care Record (EHCR)

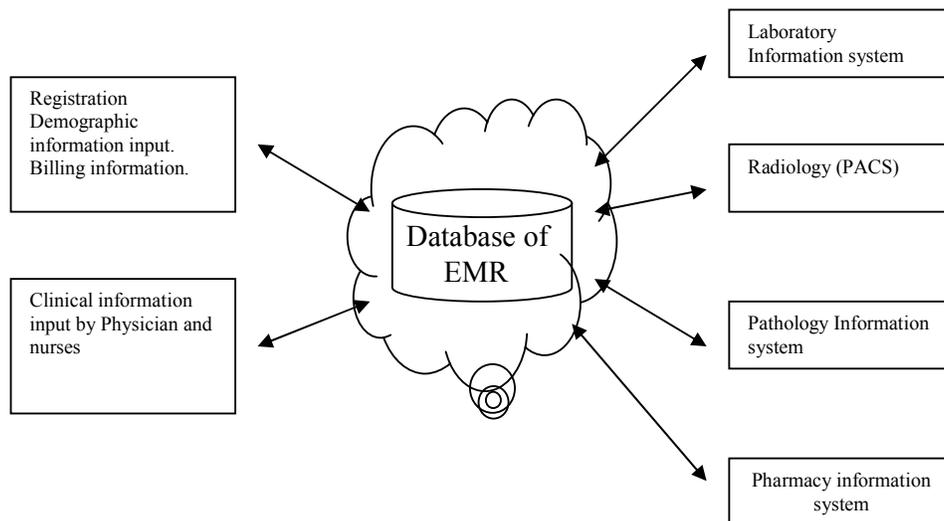
The EHR is different from an EPR/EMR in that it is longitudinal and not site specific. In other words EHR is patient centric and EPR/EMR is provider centric. Although there are different definitions for these terms, the following definition of EHR is well accepted:

*“An electronic health record is any information relating to the past, present or future physical and mental health, or condition of an individual which resides in electronic system(s) used to capture, transmit, receive, store, retrieve, link, and manipulate multimedia data for the primary purpose of providing health care and health-related services.” (Murphy 1999)*

An EPR/EMR is defined as:

*The record of the periodic care provided mainly by one institution. Typically this will relate to the health care provided to a patient by an acute hospital. Electronic Patient/Medical Records may also be held by other health care providers, for example, specialist units or mental health NHS Trusts. (Royal College of General Practitioners Health Informatics Task force, (RCGP 1998).*

Schematic presentation of EMR



**Figure 2-1 Model of EMR**

The advantages of EMR can be broadly classified into 4 categories: Clinical, Workflow, Administrative and Cost effectiveness (Mildon and Cohen 2001).

Clinically, the most important feature of EMR is the accessibility to patient's information from any department and at any time within the network. EMR system saves time of doctors to access information and money of patients by avoiding duplication of the examination. It assist physician to diagnose fast and to quick initiate accurate treatment. It supports clinical research, assists with clinical audit, and helps in medical education. If this system used appropriately for a period of time, can support as Evidence based Medicine and serves as Decision Support System for young doctors. If information about communicable diseases is reported to government bodies, it can assist to take prophylactic measures at the earlier stages of disease.

Workflow benefits from EMR system are many (Essex 2000). Enables record transfer, supports continuing collaborative care and case management within the hospital, allows automatic reports, supports selective retrieval of information and by automation possibilities of misplacement and loss of records are eliminated. Reduces clerical staff and eliminates transcription staff. Thus EMR system provide efficient and cost-effective healthcare.

Administrative benefits include to know when a patients was admitted, in which type of ward (general, semi-private or private room) and under which consultant, how many different laboratory examination were done, how many cross consultations were done, in short to tracking the patient which again reduce errors by making flow of information automated. Staff from finance department can handle insurance and financial aspects more efficiently.

An EMR system acts both as an efficient and cost effective system by contributing to the reduction of medical errors. Utilizing EMR system appropriately professional efficiency, patient care will improve, and the cost of providing healthcare will decline. Improving efficiency and patient safety benefits the financial position of healthcare organizations (Charles, Jason et al. 2005).

Obstacles and problems for EMR implementation seem to be hesitance from management to invest in IT hardware and software. Since vendors are not familiar with the workflow and exact requirements of different actors in hospitals, management cannot find the product that exactly fulfils their requirements. Reluctance to adopt new technology and to change their practice from paper records to electronic systems by health staff is another problem. In addition, other problems are like to setup training courses on how to use software due to lack of computer literacy and also to consider the costs to maintain the server and software updates. Standardisation is also a concern specially when integrating systems and equipments from different departments. Unclear legislations regarding EMR systems from government is also a matter of concern. Nevertheless, with the declining in the cost of IT equipment, documented benefits of improved quality of healthcare, efficient use of time, space and recourses are attracting health providers towards EMR system.

## **2.1 Summary**

This chapter starts with narration of scenario that gives emphasis on need of electronic medical record system in hospital setup. The concept of Electronic Medical Record system, and different terms used for electronic record were introduced. Definition and schematic presentation of EMR was illustrated. Advantageous were highlighted under sub headings of clinical, workflow, administrative and cost-effectiveness of EMR system. Obstacles like hesitance to invest in IT sector by hospital managers, reluctance to adopt new technology, as it requires learning and training from end-users were mentioned.

### 3. Introduction to India

The republic of India is a sub-continent comprising of 28 states and 8 union territories with more than 22 official languages, New Delhi as its capital. The non-violent resistance to British colonialism led by Mohandas Gandhi and Jawaharlal Nehru brought independence on 15<sup>th</sup> august 1947. Pictures 3.1, 3.2 are political map and national flag of India. With its billion plus inhabitant India is second largest country after China. India is said to be melting point of faiths and religions, the diverse culture makes India a unique country in the world. ‘Customs’ specifies the Indian way of life and ‘Traditions’ specify the boundaries of the religion. There are many religions followed in India like Hinduism, Islamism, Christianity, Sikhism, Buddhism and many more. As India was ruled by many kings, there are many Architectural Heritages in India. The fine arts, especially architecture made tremendous progress during the Islamic rule in India. The Mughal Architecture occupies a most significant place in the history of Indian Architecture. King Shah Jahan of Mughal Empire builds ‘Taj-Mahal’ in city Agra as symbol of ‘love’ which is one of the seven Man-made wonders.



Figure 3-1 Political map of India



Figure 3-2 National Flag of Republic of India

Although India is a developing country on one hand struggling with over population, poverty and illiteracy, on other hand the IT revolution contributes to a vastly improved image of India's prowess. India, along with China is seen as an economic powerhouse and one of the two fastest growing economies of the world. India is the best place to invest and establish company or business, as all the resources are available in low price. Many foreign companies are being established in India, four among top ten rich people of the world are from India. The monthly income of a person in India can vary from 1000 rupees (20 EURO) to millions (20,000 EURO).

Indians have great contribution towards global progress. The founder and creator of Hotmail (Sabeer Bhatia), the creator of the Pentium chip (needs no introduction as 90% of the today's computers run on it) is Vinod Dham, and the co-founder of Sun Microsystems (Vinod Khosla). All these great people have Indian origin (Stephen 2000). The great scientist has said following about India.

*“We owe a lot to the Indians, who taught us how to count, without which no worthwhile scientific discovery could have been made”. -Albert Einstein.*

Table 3-1 indicate some of the latest economic indicators of India taken from CIA world fact book 2007. The real growth rate indicates the booming economic development of any country. For example, it is 2.2% in USA where as 8.5% for India.

GDP	2.965	in USD trillion
Per Capita (PPP)	2,700	in USD
Real Growth rate	8.5	in percentage
Indian Rupee (INR)	41.32	1 USD

**Table 3-1 Economic indicators**

*(Source: CIA World fact Book, 2007)*

### 3.1 Indian healthcare system

Indian health care system is very complex, for it has to serve more than one billion populations. It has diversity not only in culture and traditions, but likewise in its geographic setting. In India, there are mountains, desert, thick forest and islands in the Indian Ocean. Table 3-2 displays some of the indicators which reflect the health status of Indians. These indicators warn still there is long way to go to achieve the target of ‘health to all’.

Indicator	Value	Unit
Population	1,129	in million
Population growth	1.578	in percent
Life expectancy	69.25	years
Male	66.87	
Female	71.9	
Birth rate	22.22	per 1000
Death rate	6.4	per 1000
Infant mortality rate	32.31	per 1000

**Table 3-2 Major demographic and key health status indicators**

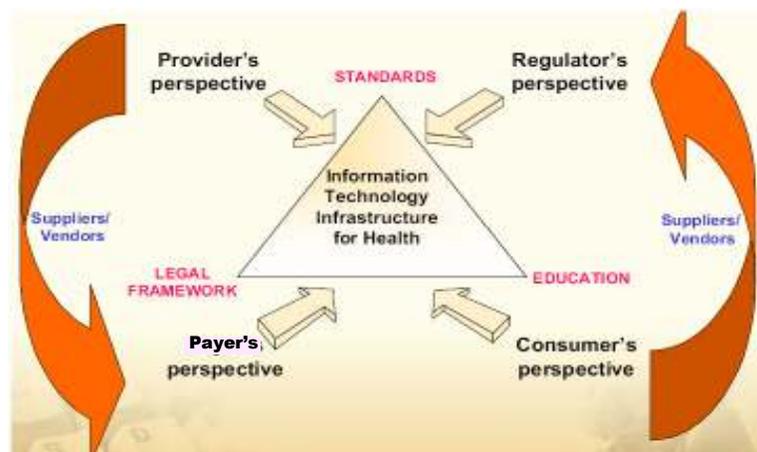
Government has recognized the potential benefits of ICT like cost effectiveness; efficiency and accessibility to rural population is attracting policy makers and health authorities. The Ministry of Health is interested to adopt ICT to possible extent. Now the agenda is ‘How?’ not ‘Why?’ to apply this ICT in effective and efficient manner considering the present minimal infrastructure, socio-economical context and limited human resources (Sahay 2001). India is currently undergoing lots of changes through an embarked Health sector reform program in several states and is ready for transitioning to a model of Health Information system that is sustainable and practical in local setting.

The diversity of Interests among different types of stakeholders in the healthcare industry has created the complexity within their relationships and this has hindering the voluntary adoption of information technology and standards. In order to create better understanding, the government felt the need to educate and empower different groups and players about the importance of standards to get the stakeholders on a common platform. The formation of the ‘Information Technology Infrastructure for Health (ITIHI)’ committee is a step towards bringing stakeholders on a common health network. Next section focuses on aims and objectives of ITIH.

### 3.1.1 Information Technology Infrastructure for Health (ITIHI)

The Ministry of Health and Family Welfare (MoHFW) and the Ministry of Communications and Information Technology (MCIT) along with Indian Space Research Organization (ISRO), Medical Council of India (MCI), Indian Council of Medical Research (ICMR), Indian Medical Association (IMA), premier institutes like the All India Institute of Medical Sciences (AIIMS) and other International key players in health sector like WHO and private sectors like the Apollo Health Street Ltd. (AHSL) are working together with the objectives of creating an Information Technology Infrastructure for Health (ITIHI) is to deal problems of different stakeholders (government, hospitals, insurance companies, patients, vendors and others) in the healthcare sector in order to create an Integrated Healthcare Information Network for India.

According to the committee members *Information Technology Infrastructure for Health is a set of standards, guidelines and legislation that provide easy and secured Information transactions between various healthcare entities (ITIHI 2005)*. The ITIH framework focuses on improving the Indian healthcare information system from information gathering to data processing and knowledge management to improved decision making and finally, prepares the ground for implementing an integrated healthcare delivery network in India. Flow chart 3-1 illustrates the role of ITIH to integrate different perspectives of stakeholders and to connect distributed health data in the framework of a secure network. It is an initiative to bring isolated healthcare providers to work together in order to achieve common goal of ‘health for all’ for all billion Indians.



**Flow chart 3-1 Role of ITIH**  
(Source: Framework for ITIH in India Vol II 2005)

### 3.1.2 Different healthcare providers

Indian Health care system follows a three tier hierarchy starting from Periphery Health centres (PHC) in remote areas, which provides basic health assistance. However, if the patients need some examination he / she will be referred to District hospital. It is located in every district of a state, and if the case is more complicated that needs some thorough investigations and diagnosis, then patients will be referred to Tertiary hospital that are located in capital cities of each state. This pattern of three tier hierarchy is followed by both public and private sector. With the only difference that, in public sector only single hospital is available but in private sector there are varieties of choices available depending on paying capacity of the patient. There are disparate systems of healthcare delivery such as the government, charity, missionary & corporate hospitals and numerous clinics. Currently, all health providers work in isolation from one another providing no means for continuum care to the patients. There is desperate need for network or communication among health providers in both sectors public and private to share or transfer patients information. Table 3-3 and 3-4 shows the healthcare infrastructure and percentage of hospitals by its size. This gives an approximate picture of number of different healthcare providers.

Hospitals	15,393
Public	4,049
Private	11,344
Hospital beds	875,000

**Table 3-3 Healthcare Infrastructure**  
(Source: Ministry of Health report February 2005)

Less the 30 beds	84 %
31 to 100 beds	10%
101 to 200 beds	5%
More than 201 beds	1%

**Table 3-4 Percentage of hospitals by size**  
(Source: Ministry of Health report February 2005)

The only information a physician gets is what a patient carries with him, the paper records, many times incomplete, with illegible handwriting, and sometimes bills paid for the previous investigation instead of results or reports of investigations done earlier. Unfortunately in India, the Electronic Medical Record (EMR) systems in healthcare system are not yet implemented. Each time the patient visits or is admitted in a hospital, a new patient record is created for that same patient, and this creates redundancy of paperwork, repetition of examination done previously leading to over-consumption of manpower and other resources. The next section sketches out the current situation of paper medical records in public hospitals and the need for Electronic Medical Record systems.

### **3.1.3 The Present Scenario of Paper Medical Records**

The medical record usually called as 'Case Sheet' is an official and legal document where healthcare staff writes all the medical information of a patient. It includes past medical history, present complains, results of examination done, diagnosis and treatment. Unfortunately the condition of these medical records, especially in public hospitals is quite unsatisfactory. This situation is neither due to reluctant hospital administration nor inefficient medical record staff. It is due to limited space allocated decades ago and year by year a constantly increasing patient load.

Another issue to be focus is that in paper record information written is of free style, all clinician write patients information according to his/her own style and there are good chances to miss or forget some important information, this might lead to serious consequences on patient's treatment and care. Even if all information is written, illegibility is also a matter of concern. Paper record is a hard copy that can be accessed only by one person at a time and in a given place; it needs physical transfer if required by another person to access at other place. Retrieving requested record from the archive will be a matter of luck, missing a record in such archive is not surprising. In addition, with time information in paper record gets diminished because of ageing of paper and ink. Sometime fire accidents or natural catastrophe like floods and earthquakes can completely ruin the archive of paper records. All above mentioned issues can be over-come by adopting an EMR system. It not only solves present problems but also improves efficiency of healthcare by increasing accessibility, needs no extra space and resources subsequently for maintaining records. An EMR can act as a good resource for researchers, if used appropriately can be used as a tool for disease surveillance purpose that can be used for public health prophylactic initiatives and can be used for practicing Evidence based medicine.

### **3.2 Summary**

This chapter starts with introducing economical status of India and brief background of Indian history. Then Indian healthcare system is discussed by pointing our some important health status indicators, three tire hierarchy in public and private sector was explained. As Government has realized the potential benefits of ICT, now the agenda is 'how' not 'why' to apply ICT in healthcare sector. Very important step has been taken by Indian government by

creating ITIH, which plays a vital role to integrate disparate healthcare providers. Finally the present status of paper record archive was displayed and various pitfalls of paper records were highlighted and the need and advantages of EMR system was explained.

## 4. Theory

In order to evaluate the effectiveness of Information technology interventions in healthcare a deeper understanding of the characteristics and properties of this technology is essential. Furthermore, one should know the nature and complexity of the problems where this technology has been adopted as solution (Johanna, Westbrook et al. 2007). By using iterative process, moving back and forth through material collected, I have selected Information Infrastructure (II) theory to address technological issues during implementation in this study. In addition this study points out dependencies and interoperability among heterogeneous elements involving human, non-human, technological and non-technological actors. To provide a strong theoretical basis about these heterogeneous elements from which to analyze and interpret findings from material collected Actor Network Theory (ANT) has been adopted. Properties and characteristic features of these two theories (II and ANT) are discussed below.

The theories presented here are worked out on the basis of the evidence suggesting they are well established approaches to Information Systems (IS) development and software engineering. They are implicitly built upon the concept of IS which, maybe, was appropriate when the IS field was established. However, they are not so with regards to the kind of IS solutions we are building today and that is widely believed to be in focus in the years to come. This change in the nature of (IS) is reflected in public discourses about technology where the term IS has been replaced by ICT to reflect the so-called convergence between information and communication technologies (Hughes 1994). This convergence process is an extension and enhancement of change processes related to the nature of information systems. From the times when organizations developed and implemented their first systems, the number and types of systems in use have increased. We are now developing solutions to support communication, collaboration and information exchange between any units (people, organizations, information systems) globally. In parallel, as the number of systems grows, so does also their integration. The technological changes reflected in the substitution of "IT" with "ICT" also should be reflected in the way we see our "information systems" and our approaches to their design.

Ole Hanseth (Hanseth and Monteiro 1996) argues that the technological changes within II are so profound, one has to anticipate and prepare for changes, even substantial ones. Such changes can be in some of the most fundamental concepts - in many cases we should give up the notion of Information System and replace it with Information Infrastructure. This change also implies that we need new methodologies -that are appropriate for the design of infrastructures rather than systems (and at the same time account for what is specific for information infrastructures compared to other infrastructures). A key characteristic of infrastructures is that they evolve over long time where the existing infrastructure - the *installed base* - strongly influences how it can be improved. The concept of the installed base is important for the II theory that will be presented. The design approach will reflect this, seeing the installed base both as a material to be shaped (improved and extended) at the same time as it is an actor that often appears to live a life of its own outside the control of designers and users. The larger the installed base grows, the more powerful it becomes. Hughes explain in “Technological Momentum,” that Technology shapes and gets shaped by society (users, actors) to achieve its momentum with the time (Hughes 1994). The important components for information infrastructure in this study are EMR system software, Internet connectivity, Computers, Networking, Telecommunication and Organizational aspects (process of dependencies and interaction between different actors). These components of information infrastructure are discussed below.

#### **4.1 Information Infrastructure (II)**

The term “infrastructure” has been used in relation to information technology to denote basic support systems like operating systems, record servers, communication protocols, computer networks, interorganizational systems and distributed information systems (Hanseth and Monteiro 1998). These concepts are larger, more complex and more diversified. For better and deeper understanding different aspects of Information Infrastructure functionalities are discussed in context of this study.

### **4.1.1 Enabling function**

Hospitals usually have an abundance of information processing by different systems isolated at different departments. II support a wide range of activities, not only by improving of automating something existing, but also by opening up fields of new activities enabling new technologies and integrating information systems from different departments. In this study EMR systems are capable of integrating patient administrative systems, laboratory systems, a range of sensory/graphical input devices such as X-ray, ultrasound, ECG and many other electronic equipments used for diagnostic and treatment purpose in a hospital at distinct departments.

### **4.1.2 Shared function**

An infrastructure shares information anytime and anywhere among its network members. This functionality of II plays important role especially in healthcare sector by sharing patient's information which is very crucial for health staff to deliver their service. Infrastructure is irreducible; they cannot be split into separate parts though they are being shared by different groups independently (Hanseth and Monteiro 1998). In this study patient electronic records are such shared irreducible unit. Standardization plays vital role in sharing and integrating different components of II.

### **4.1.3 Openness**

It means II can include and can get operated by any number of Users, Stakeholders, human, non-human actors, technical and non-technical actors (Hanseth 2002). Furthermore, one cannot draw a strict border to II, because if not always they often interact with outer environment and other II's as well very open to include new technologies and organisational changes (Hanseth and Monteiro 1998).

### **4.1.4 Heterogeneity**

As components of II are consisting of human, non-human, Technical, Non-Technical this makes the system heterogeneous (Hanseth 2002). For example: the II involves different types of professionals who create the information, develop applications and services, design the workflow, and train others such as health staff, managers, software programmers, patients and few other actors who are directly or indirectly involved in creating, storing and retrieving

medical information in this study. At the same time II is consist of different equipments such as computers, telephones, cables, optical fibre lines, servers and many more technological and non-technological actors. Applications and software that allow users to access, manipulate, share, store, and organize data within II. The network Standards and transmission codes that facilitate interconnection and interoperation between networks.

#### **4.1.5 Socio-technical networks**

This aspect of II is important especially in large organizations like hospitals, where workflow is interdependent on different actors with different mind set towards adopting technology for changing their work practice. The earlier we understand that new technology is tangled with socio-technical networks, just not 'pure' technology, the easier we can implement II's projects in practice (Hanseth and Monteiro 1998). Technology and society influence each other, Technology shapes society and gets shaped by it, till it gains its Momentum with the time (Hughes 1994). Socio-technical networks consider objects as social or technological those are linked together into networks. The "development organization" as well as the "product" being developed is considered unified socio-technical networks (Hanseth 2002).

#### **4.1.6 Enduring**

This is an important characteristic of successful II's. The project must be capable of lasting for an extensive period of time, it should have capability of changing incrementally and in an economically feasible to meet the slight changes of the environment, but must be consistent with its goals. In addition it must change in a fashion that is transparent to the users. In order to gain durability II should make users work fast and easy, it should be user-friendly and should gain user satisfaction.

#### **4.1.7 Scaling Up**

Scalability refers to quantity of expanding, capability to change its size and function. Information Infrastructure technology with limited users if function well and satisfy its users will be expanded and implemented into bigger networks, this quality of II's expanding and adding any number of users and performing well enough shows potentiality and efficiency of

the II's. It depends not only on piece of 'good' technology. It includes many other socio-technical aspects, political will-power, mind set and interest from users as well as economical feasibility in a given context. In this study managers adopted a slow and steady approach, first they wanted to test EMR system with few users in the evening clinic, once they were satisfied with the performance then wanted to expand it and implement in the day and evening clinic and then in the complete hospital.

#### **4.1.8 Installed base**

This aspect implies that infrastructures are considered as always existing, they are never developed from scratch. So when designing a 'new' component of infrastructure, it should be always kept in mind that this new component will be accepted only and only if it can be integrated, or substitute a part of existing infrastructure (Hanseth 2002). The installed base is on one hand the capability of being incrementally changed to meet new needs, and that this change must be transparent to the users, and on other hand understanding of II makes clearer the nature of the installed base and how to cultivate it. The notion of installed based does to a large extent includes all aspects of the infrastructure mentioned above- an infrastructure is an evolving, shared, open, and heterogeneous installed base.

For example in this study, the present EMR system was developed from the system which was attempted by in house IT staff, and was tested. Since health staff found that system to be very slow and required many clicks to accomplish the task, gradually it was out of use. Managers were interested to have faster and user friendly system, hence they engaged a software developer company (Tata consultancy services) to provide software for electronic record system. The present EMR system was build on the older system. Thus the Installed base provided the capacity of II to change incrementally in order to meet new needs of the users needs.

## 4.2 Actor-Network Theory (ANT)

The Actor-Network Theory is a sociological theory developed in early 1980's by the French Science and Technology Study scholars, Michel Callon, Bruno Latour and their colleagues at the Ecole des Mines in Paris. The basic concept of this theory is that any network is heterogeneous in nature consisting of human, non-human, technical, non-technical, society, surrounded by environment and other networks; they named all these participants of this network as "actor" or "actant". It claims that any actor human or non-human (artefacts, computers, software's, cables, organizations...) are equally important to a social network. It tries to relate relations between 'Material' (things) and 'Semiotic' (concepts), explains how material-semiotic networks come together to act as a network (Hanseth 2002). The empirical focus of this theory is to explain how the successful networks of aligned interests are created through the enrolment of a sufficient body of allies, and the translation of their interests so that they are willing to participate in particular ways of thinking and acting which maintain the network.

ANT facilitates a systemic approach to understand the complex dependencies and interoperability among heterogeneous elements human non-human, technological and non-technological that contribute to understanding the complex healthcare system in the context of this study.

*"An actor network consists of and links together both technical and non-technical elements. Not only the car's motor capacity, but also your driving training, influences your driving. Hence, ANT talks about the heterogeneous nature of actor networks"* (Hanseth and Monteiro 1998).

As Law and Callon argue ANT map the way in which actors define and distribute role, and mobilize or invent others to play these roles, Such roles may be social, political, technical or bureaucratic in nature; the object that are mobilized to fill them are also heterogeneous and may take the form of people, organizations and machines. The network metaphor is thus a way of underlying the simultaneously social and technical character of a system (Law and Callon 1988).

Speciality of ANT in contrast to other social theories is both a theory and methodology combined. It not only provides theoretical concepts as ways of viewing elements in the real world, it also suggests that exactly these elements which need to be traced in empirical work. This theory offers new concepts and ideas for the understanding of the ‘socio-technical’ nature of information systems.

One more important concept taken into consideration in this theory is what makes different (heterogeneous) actors to form ‘*Network*’ and how the process of ‘*Inscribing*’ our (innovators) interests on actors and enrolling them by ‘*Translating*’ their interest, and making them aligned to maintain the network. Fundamental processes within ANT are translation and inscription.

#### 4.2.1 Translation

*“Nothing is by itself knowable or unknowable, sayable or unsayable, near or far. Everything is translated” (Latour 1988)*

According to Latour’s above statement, nothing can be predicted; everything comes on its course of time by translation. In this study managers (innovator) create a network in which all the actors agree that the network is worth building and defending. With the concept of translation, ANT explains the inevitable change in actors, technologies and networks. It describes that there is neither single ‘right’ way for a network to get stable nor there is single network. Instead, there are a multiplicity of networks making up a technological actors and different visions of how this actor network should function (Williams-Jones and Janice 2003). Michel Callon has defined 4 moments of translation (Walsham 1997).

*1. Problematization:* Innovator knows the problem and solution for it, but the problem is he can’t solve it alone by himself, he need many other actors. He acts as obligatory passage point (OPP) between the other actors and network, so that his interest or goal becomes indispensable. Ex: In the case of this study managers are innovator, they wanted faster, transparent and easy work flow in the hospital. They understood that problem of increasing space for archiving patient records, time and resources to maintain these records, moreover difficulties of health staff for assessing patient information when and

where required as problem. Managers were sure that EMR system will be appropriate solution for these problems, and know unless they create a network they can solve problem themselves hence build a network of Doctors – Optometrist – IT staff – Computers - Internet Providers - server – cables – Software.....

2. *Interessement (commerce/profit sharing)*: Here innovator approaches and convince the actors for enrolment by negotiating the terms of their involvement. Ultimately the innovator is inscribing his interests and showing profit for actors out of it. Ex: In this study managers were aware of their own profits and enrolled healthcare staff by showing advantages of this system and their role in this network.

3. *Enrolment*: Actors convinced with the profits, and if they feel this network is of their interest, they accept the roles that have been defined for them during interessement. To achieve maximum benefit from system for which network is created, it is necessary all actors are involved in the network.

4. *Mobilisation of allies*: Here working place of the actors are decided, Thought it is not necessary that all actors have to be mobilize. Actors will be informed from where, how and what to work (role). Ex. IT staff from IT Dept have to visit consultants or optometrist working place (if needed), in order to sought out technical problems.

#### **4.2.2 Inscription**

Inscription refers to programs of action for the users (actor), and it defines roles to be played by them and the system. By inscribing programs of action into a piece of technology, the technology becomes an actor imposing its inscribed program of action on its users. In other words the process of creating technical artifacts that would ensure the protection of an actor's interests (Latour, 1992). The notion of inscription refers to the way technical artefacts embody patterns of use:

*"Technical objects thus simultaneously embody and measure a set of relations between heterogeneous elements"* (Akrich 1992).

The designer (vendor) works out a scenario with his anticipations about how the system will be used. This anticipation is inscribed into the system. The inscription includes programs of action for the users, and it defines roles to be played by users and the system. In doing this the designer is making implicit or explicit assumptions about what competencies are required by the users as well as the system. In ANT terminology he delegates roles and competencies to the components of the socio-technical network, including users as well as the competent of the system (Latour 1991). Ex. Health staff is enrolled in creating information and EMR system to store, sort and made assessable when and where ever needed within network.

The problem starts when actual use of system deviates from the inscribed patterns. When user uses the system in an unanticipated way instead of following its assigned program of action, the used may follow an anti-program (Latour 1991). When understanding the technical artifacts one necessarily shifts back and forth between designer's anticipations about users and the real use (Akrich 1992). The process of translation is pivotal to understand how different actors of a system interact (Masys 2005). The idea behind translation is how an actor tries to enrol the other actor into position that suit his/her purposes. In simple words to organize other actors to work for (his/her) own benefits, it can be said to have translated them.

Few other concepts of ANT are:

*Irreversibility:* When mobilization succeeds, the actor network can be said to move towards a state of irreversibility. The irreversibility is a degree or stage from which it is subsequently impossible to return to a point where alternative possibilities exit (Walsham, 1997). At the moment, Internet appears to be approaching a state of irreversibility.

*Black Box:* According to Akrich arguments the challenge of simplifying actor-networks has been addressed by the idea of creation of 'black boxes' (Akrich 1992). The concept of black box provides better understanding about the complex networks among different actors. For example if EMR system is viewed as a black box, this box contains plethora of different boxes or modules and systems such as administrative module, Optometrist, consultant and so forth. One needs to understand each of these boxes (modules) to understand the whole system.

*Immutable mobile*: Latour explained the concept of 'immutable mobile' which has characteristics like optically consistent, mobile that can be transferable from one space to other immutable (retain its shape and internal proportions even when moved, transposed or translated elsewhere). It has dimensions that can be scaled up or down making it large or small, it can be reproduced (Latour 1990). For example these are Standards, maps, templates which help in designing, interoperability of intra-network and inter-network with strong properties of irreversibility, and not effected with transcend time and place. Ex. Maps of territory, photographs, finger prints, brain scans etc.

However, there are few critics done by different researchers on the concept of ANT, few of them are as follows.

### **4.3 Criticism**

The Problem of Generalized Symmetry: the major criticism is that ANT advocate's radical symmetry between human and non-humans (Lee and brown 1994), many researchers are of the opinion that humans must have different (superior) moral status from machines and computers.

Another criticism is that ANT fails to explain the effects that technology can have on those who are not part of the network that produces it, and that it therefore fails to support value judgements on the desirability or undesirability of such effects.

Limited Analysis of Social Structures: ANT has been accused of ignoring the larger social and political context, and therefore creating the possibility of effective social, ethical and political critiques.

## 5. Method

### 5.1 *Research Strategy*

Research strategy should depend upon the objectives and aims of study, it should assist researcher to find the most appropriate answers to the research question for which the study initiated. Table 1 shows overview of ICT prospectus in eHealth. Since the field of ICT is so vast so as its evaluation; the types of questions that can be asked and methods that can be used seem infinite and badly demarcated (Stoop and Berg 2003). This study was guided by the following research questions:

- 1) What are the different interests and expectations of the managers and the health staff, and how they should be aligned in order to adopt EMR system?
- 2) What are the challenges of the managers and problems faced by the end-users while transitioning their practice from paper to PC?
- 3) What are the strategies adopted by managers to overcome the problems faced by end-users?

As these research questions are focused on perspectives of organizational decision-makers and problems confronted by end-users during implementing process of electronic medical record system. It is necessary to understand heterogeneity of organization. It is important not only to know different actors (human; non-human) but also socio-cultural context where these actors are working and how they are inter-related among themselves and with technology. During studying human behaviour it is found increasing difficult in explaining human behaviour in quantifiable, measurable terms (Hancock B. 2007). In order to enrich the findings of this study and to get answers up to the point for the proposed questions, in this study both qualitative and quantitative research methodologies are used.

Before describing how empirical material was collected, a brief introduction is given about quantitative, qualitative and more about interpretive methodologies in next section.

## **5.2 Quantitative research methodology**

Colin Robson argues in his book “Real World Research” that the task of carrying out enquiry is complicated by the fact that there is no overall consensus about how to conceptualize the doing of research. Different methods and different views exist. One strategy says that you collect all the material before starting to analyse it. Another strategy has material collection and analysis intertwined. These differences fall within two main traditions of research methodologies. One is variously labelled as positivistic, natural science based, hypothetico-deductive, quantitative or even simply ‘scientific’; the other as interpretative, ethnographic or qualitative.

A theory is a general statement that summarizes and organizes knowledge by proposing a general relationship between events – if it is good one, it will cover a large number of events and predict events that have not yet occurred or been observed. This ‘theoretic’ approach is commonly involved by following five sequential steps:

1. Deducing a hypothesis from the theory.
2. Expressing the hypothesis in operational terms, which propose a relationship between two specific variables.
3. Testing this operational hypothesis. This will involve an experiment or some other form of empirical enquiry.
4. Examining the specific outcome of the enquiry. It will either tend to confirm the theory or indicate the need for its modification.
5. If necessary, modify the theory in the light of the findings.

Quantitative method such as time motion study measurements were combined with qualitative techniques like interview and observation. This multi-method approach gives multitude of results and improved the robustness of its results (Kaplan 1995). In discussion section results of quantitatively conducted study will be used as in put for discussing qualitatively collected material that is from interviews and observation.

### **5.3 Qualitative research methodology**

Qualitative research attempts to deepen our understanding of how things working in our social world. It helps to explore how people experience something which is new to them, explains a new area where issues are not yet understood (Hancock B. 2007). Through this study I want to explore the experiences of health staff using computers in their practice. According to (Schwandt 2001) qualitative research is a diverse term covering an array technique seeking to describe, decode, translate, and somehow come to terms with the measurement or frequency of phenomena in the social world. In other words, qualitative research tends to work with text rather than numbers. In this study I am working with the experiences and views of actors who want to change (managers) and who are changing (health staff) work practice from paper records to electronic records using computers.

Qualitative research may be or may not be interpretive, depending upon the underlying philosophical assumptions of the researcher ((Myers 1997). Interpretive studies assume that people create and associate their own subjective and inter-subjective meanings as they interact with the world around them. Interpretive researchers' attempts' to understand phenomena through accessing the meanings participants assign to them (Klein and Myers 1999).

*'Interpretive methods of research start from the position that our knowledge of reality, including the domain of human action, is a social construction by human actors and that this applies equally to researchers. Thus there is no objective reality which can be discovered by researchers and replicated by others, in contrast to the assumptions of positivist science'*(Walsham 1993)

Next section will focus on interpretive research, which is one type of qualitative research strategy which assumes, knowledge of reality is obtained only through social constructions such as language, conscious shared meanings, documents, tools and other artifacts (Klein and Myer, 1999). This study is interpretive case study from an eye hospital in India.

#### **5.4 Interpretive research methodology**

Interpretive methods of research in IS are “aimed at producing an understanding of the *context* of the information system, and the *process* whereby the information system influences and is influenced by the context”(Myers 1997). Through this study approach is made to understand the influence of information system in hospital *context* and how its influence on the work flow *process* of hospital and on practice of health staff. It starts from the position that our knowledge of reality, including the domain of human action, is a social construction by human actors and that this applies equally to researchers. Thus there is no objective reality which can be discovered by researchers and replicated by others, in contrast to the assumptions of positivist science (Walsham 1993). As well according to Walsham (1993) ‘Interpretive research is the knowledge that is gained, or at least filtered, through social constructions such as language, consciousness, and shared meanings’. In addition to the emphasis on the socially constructed nature of reality, interpretive research acknowledges the intimate relationship between the researchers’ and what is being explored, and the situational constraints shaping this process’ (Klein and Myers 1999).

In interpretative approach the theories and concepts tend to arise from the enquiry. They come during material collection rather than before it. Material collection and analysis are not rigidly separated. An initial bout of data collection is followed by analysis, the results of which are then used to decide what material should next be collected. The cycle is then repeated several times. Exactly same happened with me, at the start It was not so clear what exactly I want to do, though I had vague idea that I wanted to find how easy or hard to change work practice in hospitals. When I did my observation and done first interview, reflecting on the observations and interview it interested me to know experiences and opinion of end-users who are changing or transitioning their practice from traditional paper to PC.

As the “Interpretive” is a term of epistemology, with no single standard definition. Since unlike positivist research, there is no accepted general model to carry out interpretive research, except few guidelines for conducting the inductive process central to interpretive research (Rowlands 2005). I was not very sure which qualitative methods to use in this study. However I wanted to use interpretive methods, to make myself surer, I was interested to know the factors influencing the choice of interpretive methods; and what are evaluating criteria applicable to interpretive research?

Here are the five factors (Trauth 2001) suggested, which can influence the choice of research methods, they are discussed with the context of this study.

**i. The nature of the research problem or question**

Trauth argues that the nature of the research problem has most significant influence on the choice of a research methodology. “That is *what* one wants to learn determines *how* one should go about learning it” (Trauth 2001). Obviously, what we want to learn will help us to pose our research question, and the question posed will depend on the stage of knowledge accrual about the phenomenon. These two factors may be distinct but they are nevertheless interrelated (Rowlands 2005). In my case, with my personal experience as physician I am aware that doctors have a desperate need for better information about the patient’s condition and previous treatment. I am also aware that Electronic Medical Record system is very good tool for accessing patients information. During my participation in ‘eHealth India’ Conference in New Delhi, in August 2007, I was surprised to know in spite of very well developed IT sector in India, diffusion of ICT in health sector is very minimum. Why only very few hospitals have gone for implementing EMR. According to Trauth’s phrase ‘what I wanted to learn’ was expressed as wanting to know challenges of hospital management and problems of health staff during implementing EMR. As the proposed research questions in this study involves exploring what is happening or being experienced, rather than measuring how much of something is happening, or disclosing the way changing one thing produces a change in another, which is why I feel interpretive approach is appropriate in this study.

**ii. The researcher’s theoretical lens**

Theoretical lens means the way researcher see, understand and explain the phenomenon which he is studying to his readers by the support of a theory which he thinks support to explore the phenomenon explicitly. By using theory researcher explains his/her observations, analyze empirical material and makes conclusions. Especially in interpretive research one has flexibility to choose the theory after collecting some part of the material. At the beginning of this study I only had rough idea to use Latour’s Actor network Theory (ANT) with theory of Information Infrastructure (II), however after getting familiar with finding made by observation and interviews done, I feel ANT and II theory support me to explain the functions of enabling, sharing, Openness, heterogeneity of the EPR system, as well the process of

implementation of EPR where managers needs to create interest among different stakeholders (actors) to get alliance with each other. Details about these theories were discussed in the chapter 4.

**iii. The degree of uncertainty surrounding the phenomenon**

In this study uncertainty is on both sides. On one side neither standard framework for implementing EMR system in hospital is available nor guidelines from Government health authorities (Medical Council of India) clarifying the legal aspects of EMR. On the other side neither recommended methods for evaluating implementation process nor a standard protocol to carry out such research. Therefore It was important to observe carefully how managers where anticipating and adopting strategies and how hand health staff reaction to the strategies taken by management. On other side I was trying my best to acquire more information and deeper insight about complexity of the situation, time to time I have changed my tactics and interview questions.

**iv. The researcher's skill**

As (Forsythe 1999) argues, skill of researcher play great role on the way he / She does the work, and this will reflects on material collected, analyzed and ultimately on the results of study. I have medical background and I am not an expert in qualitative research. Nevertheless I have experience of qualitative study, as I have worked on evaluating a telemedicine project from Norwegian Centre for Telemedicine, for one of my course in last semester. This study is about understanding the actors behaviour in context of adopting new technology, changing work practice and it involves evaluating innovative technology, therefore I feel qualitative methods are much suitable.

## **v. Academic politics**

There was no specific preference shown towards any particular method by the faculty here at University of Tromsø. The methods chosen in this study were merely on nature of raised research questions with the aim to find appropriate answers to them.

However, each researcher's circumstances are different depending upon the nature of research questions and context where and when the research is planned to be conducted. I have reflected on above mentioned factors before choosing my research methods.

### **5.4.1 Evaluating criteria applicable to interpretive research:**

As there are no standard methods or protocol to carry out interpretive research, similarly no standard rules or principle to evaluate interpretive research methods. Klein and Myers (1999) proposed the set of principles derived primarily from anthropology, phenomenology and hermeneutics. They argue that having a type of some principles is better than having none at all, since the absence of any criteria increases the risk that interpretive work will be judged inappropriately (Klein and Myers 1999). These principles can be used as guidelines for new researchers to carry out study as well as to evaluate research methods used after it is completed. I would like to discuss each of these principles, and to see how much these principles are applicable in context of this research study.

The set of principles for conducting and evaluating interpretive field research in Information systems proposed by Klein and Myers (Klein and Myers 1999) are as follows:

#### **i. The Fundamental principle of Hermeneutic Circle**

This principle is most fundamental to all interpretive work of a hermeneutic nature and act as meta-principle for the following six principles. The concept of this principle is that we understand a complex whole from preconceptions about the meanings of its parts and their relationships. The process of interpretation takes place by understanding each part or section of the whole phenomenon which we want to understand. Thus the movement of understanding is constantly from the whole to the part and back to the whole. This principle of Hermeneutic Circle applies in the context of this study in a way that the aim is to understand the nature of change which is taking in hospital as a whole by adopting new EMR system, in

order to understand this one needs to focus on different groups and actors how they are changing their practice, thus understanding these changes from each group illustrate us the total change in hospital work flow system as a whole.

**ii. The principle of Contextualization**

According to this principle, it is very important to know the social, technological and historical background of the research setting, so that the intended audience can see how the current situation under investigation emerged. This principle helps to make the context of the research clear; it helps to understand where the research is carried out and why? In short this principle places the object of study in context. Therefore in case chapter background of project I have discussed how-by whom-when this project was started, history of it and current status.

**iii. The principle of interaction between the Researcher and the Subjects.**

This principle is relevant to this chapter as it reflects on how the research materials (material collected) were socially constructed through the interaction between the researchers and participants (informants). Interpretivism suggests that the facts are produced as part of the social interaction of the researchers with the participants. This principle guided me in my material collection method. First thing what I did was I developed good social relation, my medical background made me easy to find common language with them, in additional travelling from Norway to India made my informant to think about seriousness of study. I will be discussing in detail about how I collected material in next section of this chapter.

**iv. The principle of Abstraction and Generalization**

This principle requires relating the idiographic details revealed by the material interpretation through the application of principles one and two to theoretical, general concepts that describe the nature of human understanding and social action. By this principle the authors argues that, it is important that theoretical abstractions and generalizations should be carefully related to the field study details as they were experienced and/or collected by the researcher. This is so readers can follow how the researcher arrived at his / her theoretical insight. According to Walsham's argument that the validity of the inferences drawn from one or more cases does not depend on the representativeness of cases in a statistical sense, "but on the plausibility

and cogency of the logical reasoning used in describing the results from the cases, and in drawing conclusions from them” (Lee 1989; Walsham 1993). In the next chapter theory supporting this study and reason for selecting ANT and Information Infrastructure theory will be discussed.

**v. The principle of Dialogical Reasoning**

This principle talks about sensitivity to possible contradictions between the theoretical preconceptions (prejudice) guiding the research design and actual findings (“the story which the material tell”) with subsequent cycles of revision. The most fundamental point is that the researcher should make the historical intellectual basis of the research (philosophical assumptions) as transparent as possible to the readers and to himself. The researcher should identify its philosophical roots, and relate the particulars strengths and weakness of the preferred philosophical direction to the purpose of the work. Hermeneutics recognize that prejudice is the necessary starting point of our understanding the phenomenon. The critical task of hermeneutics then becomes one of distinguishing between “true prejudice, by which we understand, from the false ones by which we misunderstand” (Klein and Myers 1999).

**vi. The principle of Multiple Interpretations.**

This principle deals with the sensitivity to possible differences in interpretations among the participant as are typically expressed in multiple narrative or stories of the same sequence of events under study. Similar to multiple witness accounts differently even if all tell it as they seen it. This principle requires the researcher to examine the influences that the social context has upon the actions under study by seeking out and documenting multiple viewpoints along with the reasons for them, because questions about work-related problems and their organizational contexts extend into the realm of the social (Forsythe 1999). The analysis of reasons may include understanding conflict related to power, work-load, economics, or values.

**vii. The principle of Suspicion**

This principle alerts about the sensitivity to possible “biases” and systemic “distortions” in the narratives collected from the participants. This principle is more concerned with the interpretation of meanings than with the discovery of “false preconceptions”.

### 5.4.2 Positioning of the researcher in research:

Sl. No	Principle	In this study
1.	Hermeneutic Circle	This principle suggest to achieve understanding of over all change in workflow, it is necessary to understand changes done by different actors and iterating between the changes of different actors and whole system. By this principle I understood the need to focus on all actors from managers to end-users and to observe change in work style by each actor and compare to over all change in hospital work flow after adopting EMR system. As Ottino argues, “complex systems cannot be understood by studying parts in isolation. The very essence of the system lies in the interaction between parts and the overall behaviour that emerges form the interactions” (Ottino 2003).
2.	Contextualisation	This principle helps to make the context of the research clear; it helps to understand where the research is carried out and why? In my study this principle clear the purpose of this study by giving the background, where, how and why this study was planned.
3.	Interaction between researcher and subjects	First I did observation, of hospital, understand who is who, work flow. Then introduced myself with different stakeholders, my medical background help me to mingle with them easily. They were very open to share their experiences and views. I have received interesting information from them. This helped to understand their concerns toward use of EMR system.
4.	Abstraction and generalisation	This principle guided me to choose theory, Though I had some theoretical prejudices in my mind, when I started to collect material, after doing my observation and after conducting first two interviews, it was getting clear that in this study ANT and II theory are appropriate as they involve different actors, heterogeneity and interaction among themselves and technology.
5.	Dialogical reasoning	In this study, I did not find contradictions between theoretical prejudices and material gathered, which once again witnesses right theories are chosen.
6.	Multiple interpretations	This principle helped me a lot to understand the reasons given by different stakeholders depended upon their background, position, sex, experience etc. In addition, about how researcher understand this narration and interpret it in his writing. Finally how readers interpret after reading what researcher has written. Therefore one should be careful not to loose main essence of the fact, in these multiple interpretations.
7.	Suspicion	This principle alerts researcher to understand the statements given by participant depends upon their mutual interests, benefit or lose by implementing EPR. Therefore, analyzing the reasons givens by stakeholders should be done carefully.

**Table 5.1 principles of interpretive methods applicable in this study**

## 6. Material collection

### Qualitative techniques:

I would like to start with Geertz notion about material collection that,

*'What we call our data (material) are really our own constructions of other people's constructions of what they and their compatriots are up to' (Geertz 1973)*

I started in Chennai, India, for collecting research material and doing observation on site during my stay of 53 days from 12<sup>th</sup> Nov 2007 to 4<sup>th</sup> Jan 2008. Various techniques like observation, semi-structured interviews, and informal conversations were used. I have done about forty two hours of observation on site observing how optometrist and consultant accomplish their routine tasks, how they handle paper records and electronic records, what do they do if they face problem with EMR system and I also observed patients reaction when health staff were using computers instead of paper record. In chapter 6, I have illustrated all my observation in the form of episodes. Here I would like to share my experiences, how I started observation what were the reactions from different actors.

### 6.1 Observation

Observations yields best results when conducted by outsider with considerable inside experience (Forsythe 1999). I having experience of working in hospital as physician, to do observation as outsider in this study was easy and I felt comfortable. First week of my present in the hospital I got acquainted by different departments of the hospital, from reception desk to consultant cabin and at the same time I noticed how patient record is created and by whom the information is added in EMR or paper record. Then I followed each step that patient has to go through from reception desk of hospital till he receives consultation from Ophthalmologist and goes out of hospital. This made me familiar with the work flow of the hospital as well with the type of work different actors' performs. As a result of my first week of observation I came to know that in this hospital around 30 optometrists work in day clinic and check around 400 patients every day on average of 12 to 15 patients each. In evening clinic, 10 optometrists check around 50 to 60 patients on average of 5 to 6 patients for each optometrist. Check-up by optometrist comprises of collecting information from patients such as; present complains,

medication in use, past medical history, allergies and to perform routine examination such as testing sight, noting the power of lenses, measuring intra-ocular pressure, doing slit-lamp examination and entering all gathered information along with findings from examination done into the patient medical record (paper or electronic). Competence among optometrist using EMR system was mixed, some were using the system for one year, few were beginners using this system less than 3 months and fewer were under training.

According to my observation about 60 to 70% of patients' information is entered by optometrist in medical record of patient. Therefore I wanted to focus on how optometrists perform their routine work, so I wanted to do on site observation, till now I was observing from outside the cabin; I got permission from head of department for Optometrist to get in the cabin. Now next task was to create social contact with the optometrist, it is very natural when some stranger comes and watch your work, the first question arises in your mind is who is this person? What he wants? If optometrists are not comfortable, then they do not behave as they used to. That is why I asked Head of Optometrist to introduce me to them but I requested him not to say that I am going to observe how they use computers, because I was afraid this may bias their actual method of working. I even did not disclose that I am medical doctor for same reason. I tried my best not to influence their practice by my presents. Once I started observing slowly I tried to ask about workload, and I even asked to few of optometrist why they have computer in their cabin, for what they will use computer? Then I used to know what exactly they are thinking about this EMR system. Most frequent problem they face used to say was about time.

I used to take snaps of what I felt interesting and a note book to write when optometrist says something interesting and my impressions during observation. I was following the words of Eisenhardt, K.

*“one key to useful field notes is to write down whatever impressions occur”*  
(Eisenhardt 1989)

I used to note time taken by optometrist when they use EMR or paper record and this actually gave me idea to conduct time-motion study comparing time effectiveness of documentation done by optometrist using paper Vs PC. First of all, optometrists have hectic workload with many patients waiting for their turn for check up. Optometrist in order to under go training and to get well versed with the system they needed to spare personal time after their routine

work. Moreover, when they become perfect in using software this made their work easy and faster. Approximately I have done thirty hours of observation with twelve different optometrists. Though observational periods may be much shorter in design context, they are still extremely useful when conducted appropriately (Forsythe 1999).

Next group of actors I did observation were consultant (Ophthalmologists). Once again my medical background helped me to get mingle with them easily. At first they exactly did not understand what I exactly want to observe, once they understood that I am there to observe their problems while using EMR system not their competence of treating patients, they were open and interested to discuss their struggles with EMR. They were so interested, even if I was in other cabin, the consultant with problem used to search me and show me his problem. I have done about ten hours of observation with 5 different consultants. My observation revealed that consultant pay first attention on diagnosis and treatment, then only on using technology. This is tertiary hospital, majority of patients will be having complicated diseases, because patients approach this hospital from different cities and states only after if it is not treated else where (in their home city). So it's very important that system should work fast, should not slow work process because consultant do not want to waste even few seconds if system is slow.

I have done observation at reception desk for 2 hours (an hour in the day and the evening clinic). The electronic record is created for all the patients visiting in the evening clinic for the first time. Demographic information is filled by the receptionist and a consultant and an Optometrist is allocated and the patient is asked to wait till his/her turn comes at the Optometrist cabin. In day clinic still health staff are working with the paper record, but if patient who visited last time in the evening clinic and comes for review in the day clinic same electronic record is continued.

In total I have done forty two hours of observation mostly with end-users (health-staff). Other technique which I used in material collection in this study is Semi-Structured interviews.

## 6.2 Semi-Structured interviews

Apart from observation I conducted semi-structured interviews and informal talks, details of interviews done are shown in Table 6-1. My Informants were five managers; five consultants; ten optometrists and the vendor (former-employee of this hospital) who is developing software of EMR system.

Sl.No	Actor	No. of interviews	Technique used
1	Managers (5)	11	
i.	Chairman	1	Semi-structure interview
ii.	Medical Superintendent	2	Semi-structure interview
iii.	Medical Record Department	3	Semi-structure interview
iv.	IT Director of Hospital	2	Semi-structure interview
v.	Head of Optometrist Department	3	Semi-structure interview
2	Consultants (5)	7	Semi-structure interview
3	Optometrist (10)	10	Semi-structure interview
4	Vendor (1)	2	Semi-structure interview
Total	21	31	

**Table 6-1 Actors and number of interviews conducted**

Thirty one interviews were conducted with twenty one different actors, which include managers, IT staff, Health staff and vendor. With some informants I have taken twice or even thrice if I felt that better to ask something more. All interviews were recorded except one interview with consultant (That consultant refused for recoding). Duration of interviews lasted from 20 to 60 minutes on an average of 40 minutes per interview. Questions asked in interview are listed in appendix; slight changes were done depending on job of informant. For example managers' questions were mainly pertaining to strategies, how they handled problems of end-users.

I did not conducted interview at first meet with informant. In first meeting I introduced myself and explain purpose of study, explained that this study would help to understand the problems and challenges of different actors during implementation process so that possible solutions can be found and can create better understanding among different actors. I have ensured that confidentiality will not be breached. After making clear the objectives of study took appointment for conducting the interview.

All the interviews were transcribed by the professional transcriptionist and were verified by cross checking. About 83 pages of transcribed material were produced from recorded interviews. Transcribed material was read thoroughly back and forth. Issues which are in favour or hindering (which creating problem) implementation process of EMR systems were differentiated. Most common topics or concerns expressed my informants were given priority and reflected in discussion. Apart from semi-structured interviews informal talks/conversations especially at lunchtime or tea break were done. Such informal talks also seem to be more informative, because informant is relaxed and more open. I have collected good enough information to highlight the views and experiences of different actors. In addition to these materials, various photographs were taken after gaining prior approval from hospital management and participants to strengthen the interpretive analysis.

### **6.3 Quantitative study**

This study explored time effectiveness of an Electronic Medical Record system compared with traditional paper based documentation by Optometrists at an Eye hospital in India. The data was collected in one week between 24<sup>th</sup> and 29<sup>th</sup> of December 2007. Ten optometrists were randomly selected among those that were attending the evening clinic during the week when the study was conducted. The time spent was recorded in a total of 300 records, out of which 200 records were selected (n1 =100; n2=100) where the time mentioned by optometrist and time shown by automated system matched. There was no statistically significant difference in the time spent between electronic and paper records. Table 6-2 displays the mean time spent for documentation in paper records (19.7 min) and electronic records (20.4 min). That means electronic records took only 0.64 minute longer than in paper records. Details on this comparative study are to be given in a publication, at the moment being

prepared, which will soon be submitted to a scientific journal. However results are herein used for discussion.

	Electronic records	Paper records
No. of subjects	100	100
Gender		
Males	66	72
Females	34	28
Age* (years)	45.6 (17.5)	43.6 (22.1)
Time* (minutes)	20.4 (6.6)	19.7 (7.5)

\*mean (standard deviation)

**Table 6-2 Comparisons between electronic and paper records**

#### **6.4 Limitation**

This study was conducted approximately for two months of an eight years implementation process (still ongoing). The study addresses some challenges of this hospital at a certain point of time in a specific part of India. I have interviewed only twenty one actors out of hundreds of staff working and using the EMR system in this hospital. Although this study had direct relevance for this hospital, it has highlighted issues of more general relevance. Namely, it presents challenges and problems of different stakeholders involved in the implementation process of an EMR system. Financial/economical issues and cost effectiveness of the EMR system were not studied. As the study was carried out in a trust hospital, the observations cannot be generalised to the situation of public hospitals. In fact, public hospitals face serious constraints regarding economical resources which are not felt by the hospital targeted in this study.

## **6.5 Summary**

This chapter was focused on research material collecting strategies, explained different research methodologies like quantitative and qualitative methods, factors (Trauth 2001) suggested, which can influence the choice of research methods were discussed. The set of principles for conducting and evaluating interpretive field research in Information systems proposed by Klein and Myers were made explicit in context of this study. Details of how material was collected during observation and how semi-structured interviews were performed and analyzed along with interview questions were listed in the appendix. A quantitative study was conducted to know impact of time effectiveness on documentation by comparing electronic and paper records.



## 7. The Case

### 7.1 Introduction to the hospital where research was conducted

Sankara Nethralaya (SN) is located at one of the Indian metropolitan city, Chennai in State Tamil Nadu. It was named Sankara Nethralaya, which means "The Temple of the Eye". The long journey for vision with a mission began since 6<sup>th</sup> September 1978. Every employee of this hospital considers hospital as temple and work as worship. Sankara Nethralaya is a Vision care Institution providing world class eye care for the past 29 years. It is a public institution, operating with the efficiency and commitment of a private organization. It is a non-profit making and a non-commercial organization. In 29 years, the hospital has gained international excellence and is acclaimed for its quality care and compassion. It is a tertiary referral hospital with super speciality in ophthalmology. In picture 1 you can see snapshot of the chart of policies and objectives of this hospital, you can find this chart on every wall of the hospital.



Picture 7-1 Chart of policy and Objectives of this hospital

Sankara Nethralaya has been adjudged “The Best Eye Hospital in India”, by a survey conducted by The Week Magazine (May 2007). On an average, 1000 patients visit hospital for consulting and 125 surgeries are performed every day. In addition, it is the pioneer for introducing teleophthalmology mobile units’ project in India. There are seven mobile units going around village to village in four different states. All Mobile units are connected to Main Hospital at Chennai via SATCOM (Satellite Communication Technology) provided by ISRO. These mobile units have completed 1,546 camps and treated 151,028 poor patients free of charge while visiting each village from October 2006 to August 2007. They also organize awareness meeting in the evening at the camp location to educate the rural populace on the importance of the eye care and hygiene. They also introduced a spectacle dispensing unit in the rear of the vehicle to dispense spectacles at a very reasonable cost.

This hospital was selected for conducting the study after doing internet survey and exchanging emails explaining the purpose of the study with the medical director of this hospital. It was found to be good subject as this hospital is under process of implementing EMR system, they have already started in their out patient clinic, and next phase will be implementing in rest of the departments in the hospital. Moreover, this has given a greater advantage for in-dept understanding the implementation process, to illustrate the problems and struggling faced by end-users while transitioning their practice from paper to PC and to understand the strategy adopted by management to over come the struggling of health staff.

## **7.2 Project: Implementation of EMR system in an Eye hospital in India**

### ***Background:***

In this section precise description was done on how the idea of implementation of EMR was initiated and how it was developed and what is its present status and who are the people involved in its implementation in this hospital.

Dr. S. S. Badrinath is the Chairman of Sankara Nethralaya and the president of Telemedicine Society of India. He is also founder of Medical and Vision Research Foundation at Chennai and the recipient of 'Padma Sri' Award in 1983. He is the recipient of 'Padma Bhushan and Dhanvantari' Awards in 1999. Actually it was his idea to start EMR in SN. In 2000 SN was already using computers for administrative purpose (billing) and scheduling appointments. Dr. S.S. Badrinath wanted to include patient information too. He

asked this hospital IT staff to develop software which assists optometrist to feed and store patients information and which can help Ophthalmologist (consultants) to retrieve patient info. The IT staff did not had complete idea of requirement and specification, they attempted to create a system by which optometrist can enter patient's information and consultant can retrieve that info and can add his/her treatment and advice on the same electronic record and can store this record in a hospital server.

Due to various reasons this system could not work, such as the IT staff did not had experience in developing EMR, Optometrist and consultant were not satisfied with the system, as they did not found all fields they need to fill, this system took lot of time for data entry, they found this system is disturbing their flow of work, and gradually they stopped using this software. Once again Dr. S.S. Badrinath conducted a meeting with IT staff, medical record department and health professionals. Members where selected from each department and were send to short trip to the hospitals in UK and USA to have survey of the hospitals which are using EMR system. So that they can get general idea of how EMR works. These member visited different hospitals in UK and USA, observed those hospitals working with EMR system. They enquired how the system was developed, how it was implemented and at the end they returned with many new ideas and strategies. Once again they had meeting together and decided to hire some software solution company for developing EMR software for them. Therefore, they started to search software developers, out of many they selected Tata Consultancy Services (TCS), as this consultancy is renowned and added to this, they have involved in developing EMR system for National Health Services in UK.

Head of different departments had given TCS staff requirements and specification for developing EMR system. Within few months TCS developed a good looking, and attractive EMR system, once again optometrists and consultants were not satisfied, they did not liked the interface, system was too slow, many clicks were required with totally new interface then what they used to work by the paper records. In short they requested to change the whole EMR system.

Again starting from scratch was neither an easy job nor a good idea for TCS, at the same time they were not sure, that the system they will develop again would be accepted by health staff. So TCS had adopted following strategy.

1. TCS requested if any consultant, wants to get involved in developing new EMR system, fortunately Dr. R.R. Sudhir who is Head of Dept of Preventive Ophthalmology, Consultant Cornea Services came forward to help TCS in 2005.
2. TCS has also hired few senior members of IT staff of SN, This made the work easy, as these people were working in SN for 10 to 15 years, they had good enough idea of workflow in the hospital, added to this, these people can friends of many health staff and it was easy to know exactly what problems health staff are facing with the system and how they want it to be.

Dr. R.R. Sudhir (hereafter referred as consultant\_1) is playing a major role in developing and implementing the present EMR system at SN. He is a consultant and knows a consultant's requirements added to this, he also knows very well what information he needs from optometrists. He has done a great job by designing interfaces very similar to the paper records they used to. He tried his level best not only to make is similar to paper record but also to make work easier, in many fields optometrist need not type, just they can click by choosing one of the possible variants. For example in the field of SEX, they can just click on MALE or FEMALE, and need not to spell it. Consultant\_1 trying not only to make practical work easy, but also efficient, he is developing alert engine to assist consultant in case they prescribe incompatible drugs or allergic drug for patient. This EMR system creates discharge summery just with one click, now management need not spend resources for transcription of medical record of the patients.

All modules of EMR system were ready by end of 2006 and actual challenges of implementation started. Once again meeting was conducted gathering members from different departments and came out with implementation strategy. It was decided they would go for phase/step wise implementation, and gradually increasing to full fledge. Training and awareness programmes were carried out among health staff and administrative staff, Demo-CDs were distributed to everyone so that they can practice in their house, as well option was provided to practice online on the hospitals web page, so that they can get adopted to interface and templates used in the EMR system. After all these efforts SN has launched EMR system for its evening Out Patient clinic from January 2007.

### **7.3 Description of creation and flow of information within hospital**

In this section the creation and flow of information within hospital will be explain with the help of snapshots taken in the hospital. Detail description will be done from the time patient enters hospital till s/he leaves the hospital after consultation. Along with patient how information is created will be told. Thereafter how more information is added into the patient's record and what happens with the record when patient is discharged will be narrated.

The first point of contact for the patients to the hospital is Reception counter. Patient can call and take appointment in advance or can come directly and wait for their turn. Here the Pictures 7-2, 7-3 shows patient contacting reception and waiting for their turn to Optometrist.



**Picture 7-2 Patients at reception**



**Picture 7-3 Patients waiting at Optometrist cabin**

Receptionist is the person who creates patient record, fills demographic information and assign patient to the particular Optometrist and a Consultant, cabin number will be told to patients and patient record will be forwards to that optometrist cabin. If patient had taken prior appointment, he will know time of appointment and need not wait for long before optometrist cabin.

An optometrist receives patient's record assign to them on their computer if it is paper record, a secretary brings manually. An optometrist collects all past medical history, present complains and does routine procedures; maximum information about patient is added to record by them. Picture 6-5 and 6-6 shows optometrist performing sight test, measuring IOP and doing Slit-lamp examination.



**Picture 7-4 Optometrist checking sight of patient**



**Picture 7-5 Optometrist doing slit-lamp examination**

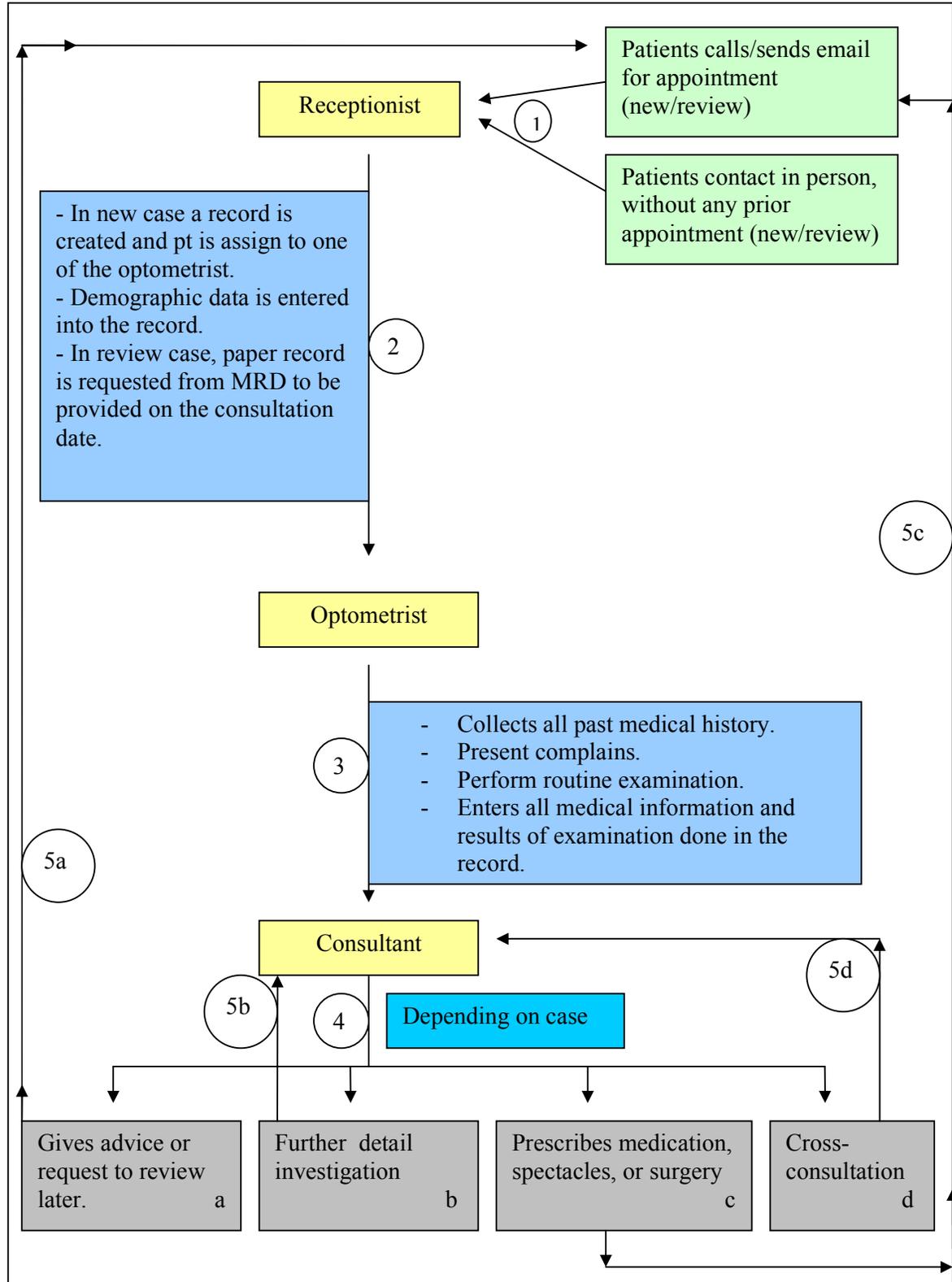
Once optometrist completes examination, patient is asked to wait before consultant cabin. Optometrist enters all the information about the patient and results of examination done and forward the record to consultant's computer, if it is paper record again secretary comes and take it to the consultant cabin. Picture 7-6 shows patients waiting at consultant cabin.



**Picture 7-6 Patients waiting at Consultant cabin**

The consultant reviews information written/entered by the optometrist. He performs additional examination if necessary, depending up on severity of the case. He may just explain the problem to the patient and ask to review later, or prescribing spectacles or medication or advice surgery or cross consultation (referring to another consultant). Consultant add his findings and advice to the record print out summary and hand over to patient, if it is paper record then consultant dictate summary with voice recorder, later his secretary make the transcription, send the discharge summary to patient by post/email or

patient comes back to collect it personally. Flowchart 7-1 will illustrate information flow.



Explanation to flow chart 7-1.

1. First contact point of patient to receptionist.
2. Work done by receptionist
3. Work done by Optometrist
4. Decision taken by consultant depending upon the case
5. 5a, 5b, 5c and 5d are 4 different possibilities for the patient.
  - 5a. Consultant explains the problem and ask to come in later stages (Ex. If patient comes at early stages of cataract, consultant ask to come after few weeks or months)
  - 5b. Ordering future investigation and patient consulting back with results of investigation requested by the consultant.
  - 5c. Prescribing medication or spectacles, patient coming for review as advised by consultant.
  - 5d. Referring to another consultant of other department.

#### **7.4 Introduction to EMR system and its interface**

This section introduces to the EMR system used in this hospital. With the help of screen shots of interfaces description about how creation of patient information will be done, to give a clearer idea about this system.

Optometrist starts gathering patients information, starting from purpose of visit or present complain, then they fill the history, sight test (VA/Refraction), external examination will be done. Once the optometrist finish writing history they have to save it, then click other option and fill is and save it, thus all medical information is stored in and at last when summary is clicked all info about the patient can be viewed.



Picture 7-7 screen shot of EMR template

Picture 7-9 display screen shot of first screen (interface) once optometrist open the record. As seen in 7-9 different names of templates are shown on left side of the screen. For example if optometrist wants to enter medical history of the patient, they click on history icon and next screen is displayed. Picture 7-10 display screen shot of interface of the history collection template. The colour of the fields of Medical Record Department Number, Patients name and age is written is in light brown in Picture 7-9. In case if the patient has allergy to any drug, food or dust, the colour of that row will be changed to light blue as in Picture 7-11. In the same way if the patient is known case of HIV/AIDS the colour of that row will be changed.



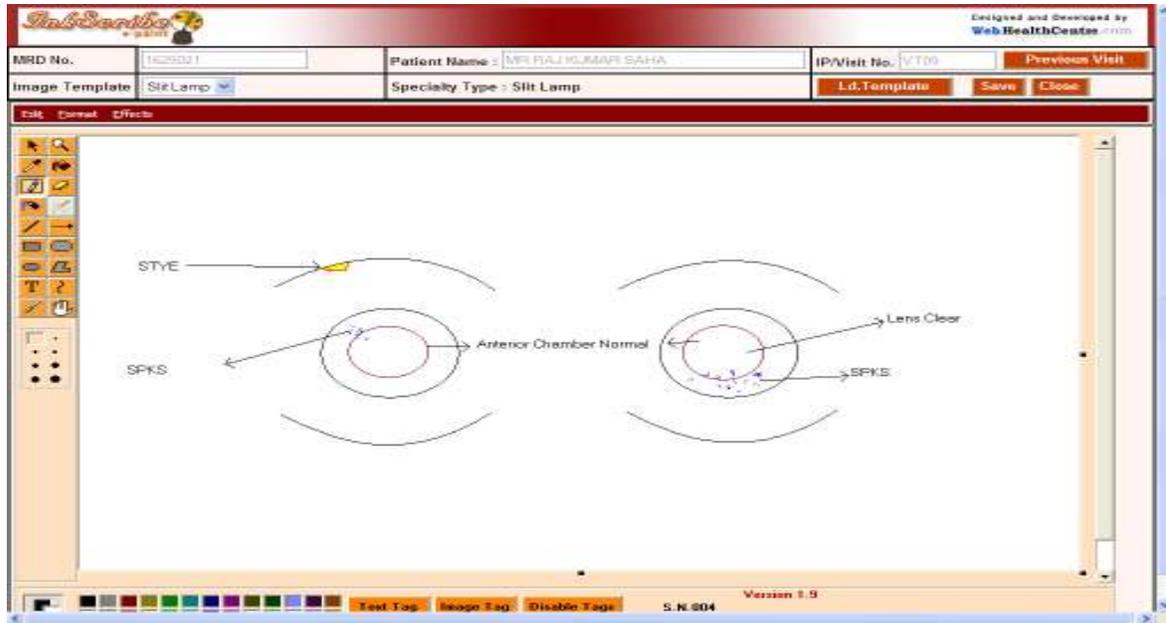
Picture 7-8 Screen shot of History template

Once optometrist finishes all routine examinations and enters findings in the EMR system. The record is forwarded to consultant PC. Where consultant can have quick view on case summary, perform additional examination if needed. Picture 7-11 shows the case summary of the patient, here the colour of the row is changed to blue as this patient has allergy to wheat.

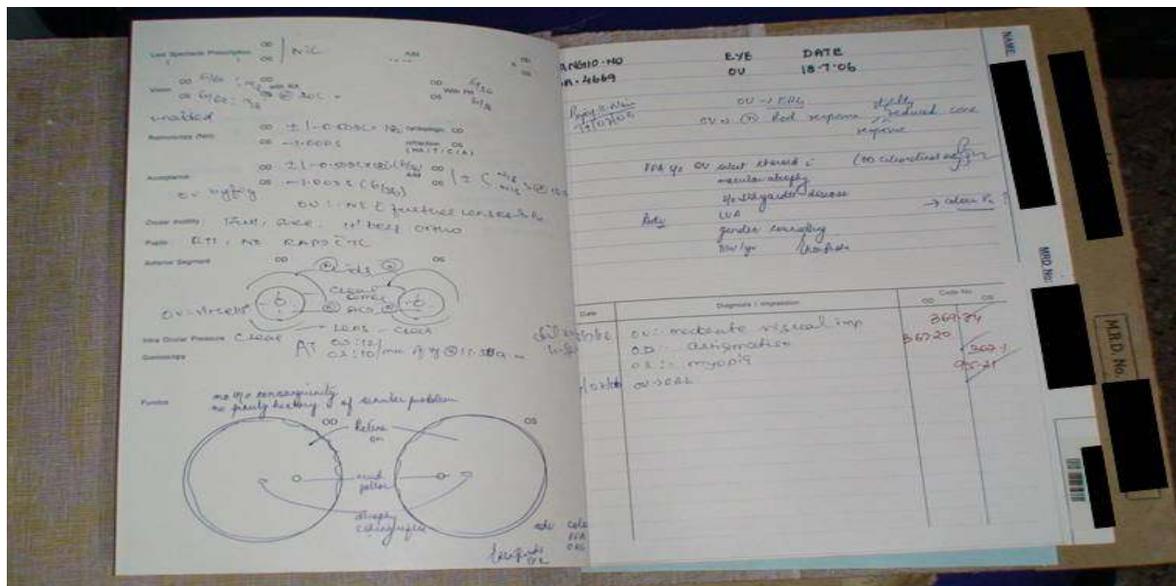


Picture 7-9 screen shot showing allergy and medical history

This EMR system has drawing facility, it uses electronic pen-pad technology; the consultant can draw just as they draw with pen on paper record. The consultant wants to draw what he has seen in the eye of the patient during his examination. If next time a consultant does same examination, he can compare present situation with the previous. Picture 7-12 shows the drawings of consultant.

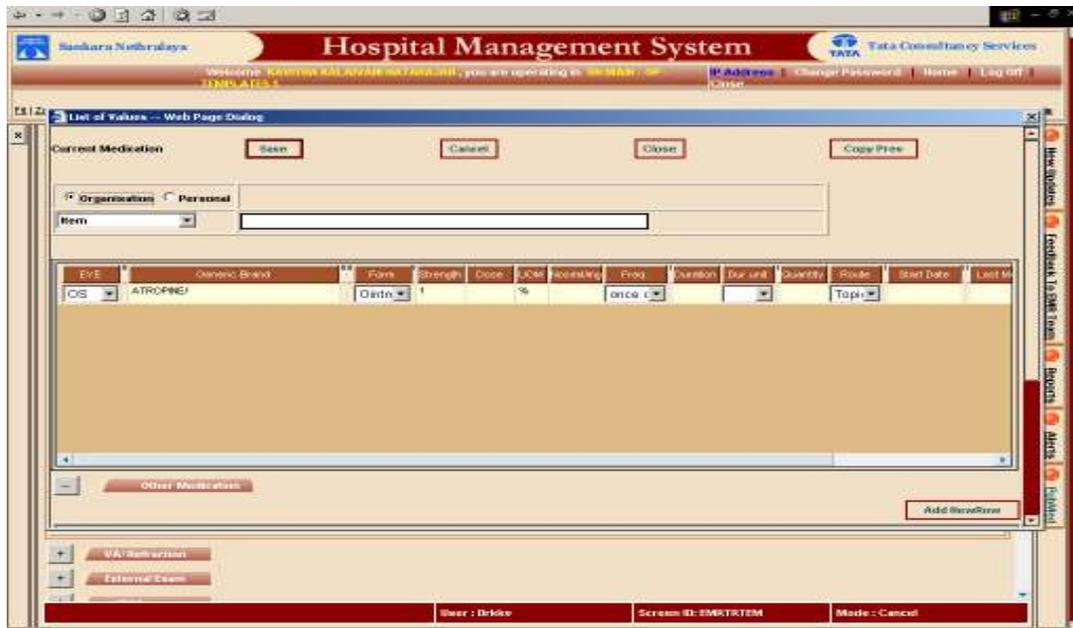


Picture 7-10 Screen shot of drawing template



Picture 7-11 Drawings on paper record

Picture 7-12 and 7-13 show similarity of the interface developed to make health staff easy to adopt new system. When the consultant is finished with his examination, depending on the case he gives his advice either to come after few weeks or months or put on treatment or may prescribe spectacles / lens, or may order future investigation or can refer the patient to another consultant. Picture 7-14 and 7-15 shows medication and ordering investigation interface.



Picture 7-12 Screen shot of medication interface of EMR



Picture 7-13 Screen shot of Investigation ordering interface of EMR

The next section will focus on interest and expectations of different actors. These actors have been divided into three categories namely Managers, Developers and Users in order to understand the interests, expectations of each group.

## **7.5 Interests and expectation of different actors is as follows:**

### **Managers**

The chairmen of this hospital wants to establishing the Hi-Tech Eye Research Centre, and he is fully confident that creating medical information data-base is the best option to store, retrieve and analyze medical information, which is very crucial for any research. He says,

*“We want to use the information and communication technology advances to the best advantage in this institution. EMR system will be very helpful to us for doing research either prospective or retrospective studies”*(Manager\_1 Dec 2007).

As the hospital is developing constantly, presently SN have already 5 different branches in this city (Chennai) and one in another city ‘Kolkutta’, he has plans to open more branches as patient flow is increasing day by day. Once again EMR system gives him facility to monitor work flow of all branches sitting in his own office.

During interview with medical director of this hospital, He says

*“I want to make work flow fast, easy and transparent”. And he adds “waiting time for patients is grossly reduce, because manual transport time for the records is completely eliminated by this EMR system, investigation reports Etc..Etc can be viewed at a click of a button, without waiting for results to be brought by someone”*.(Manager 2 Nov 2007)

He wants to monitor workflow such as how many patients visited hospital, how many surgeries were done; even he can monitor how many patients were seen by each optometrist, consultant and so on. Without EMR system he had to request secretary to get report from the department of his interest. He is interested to use EMR system as Decision Support System (DSS) and practicing Evidence Base Medicine (EBM) as he is very sure that after a period of time this EMR system can assist younger consultant. He told,

*“At present doctors may go by approximation or sometimes ask for help with colleagues for calculating dosage of the drug, all this calculations we would like to put in EMR. With the weight of the patient the dose of the drug is calculated by EMR. And it will be connected with drug data so that we can get name of the drug with correct dosage by just giving first few alphabets.”*  
(Manager\_2 Nov 2007.)

He is satisfied with the Alert engine created within EMR system, as this can reduce human error and increase efficiency of the treatment. He says that now they need not spend any resource for transcription of case summery, just by a click complete summery can be print out.

Head of Medical Record Department (MRD) is very enthusiastic about EMR system as it makes MRD work very easy, fast and efficient. He says.

*“Each year approximately 300,000 records are added to the archive, constantly we had to increase space for storing these records, but with creating electronic data-base, space problem is solved for ever”.*(Manager\_3Dec 2007)

Picture 7-14 and 7-15 shows the paper archive and EMR system server. The number of manpower used and financial resources can not only be reduced but also contribute to reduction of medical errors which again increase the efficiency of treatment.



**Picture 7-14 Archive of paper records**



**Picture 7-15 Server EMR database**

Human-resources for maintaining (storing and retrieving when needed) paper records can be utilized for other useful purpose. The primary responsibility of the MRD is to supply request record to consultant and store it back once patient is discharged from hospital. He says

*“In Chennai itself we have 5 clinics in different locations. The major problem is to transfer requested records from one location to another. Either manually or by transfer faxed copy or we have to scan and send in attached record and it takes lot of time and resource. With this EMR system record transfer is made easy and record loss is avoided” (Manager 3 Dec 2007).*

Picture 7-16 show the transfer of paper records from hospital to archive done by MRD staff. In case if patient visit hospital without prior appointment, it will take some hours to fetch the record from the archive.



**Picture 7-16 MRD staff transferring paper records**

The manager of MRD also says EMR system has solved the problem of accessibility to patient information for any time any day (24x7), Before when patient approach hospital in emergency in nights or in holidays, The MRD will be closed and consultant doesn't had any means to access past history of patient, but now just by entering record No. required record can be accessed.

The vendor for this hospital is TCS, their only interest is to provide seamless connectivity and speed up the flow of information, to provide user friendly interface, to provide secured and reliable server. Actually TCS wants to use this hospital as a model, so that similar EMR system can be implemented in other hospitals. He tells,

*“Sankara Nethralaya always provides the quality care, this will be upgraded in a better level by using EMR system, flow of information will be faster and easier”(Vendor Dec 2007).*

Regarding resources he say's *“approximately there are staff of 40 people in medical record department, to store, distribute and to recollect the records. About 4 to 5 manpower is used to tag the record and store in order each day. These activities can be eliminated totally and these staff can be utilized effectively for other purpose.”*

Health professional as developer: As mentioned earlier one of the consultant is involved very much in developing the EMR. Moreover, he was acting as a bridge between IT staff and Health staff. His main goal was to speed up the implementation process.

**End-users:**

Administrating staff:

- i. Receptionist: They are the first contact for the patients in the hospital, if patient is visiting second time they will fix appointment depending on the schedule of the consultant and send request to MRD to bring the record of that particular patient. If patient is contacting first time they will create patient record, enter the demographic information, and ask patient to wait for their turn at optometrist cabin. With the EMR system receptionist need not send request to MRD for record, nor cross check whether record reached to the right place (cabin) at the right time.
- ii. Billing Dept: Now they need not go through each page of patient record in order to know what all investigations done, how many consultants treated and number of days patient stayed and in which ward... so on. Just by entering record number all details can be viewed. EMR system made their work also fast and easy.

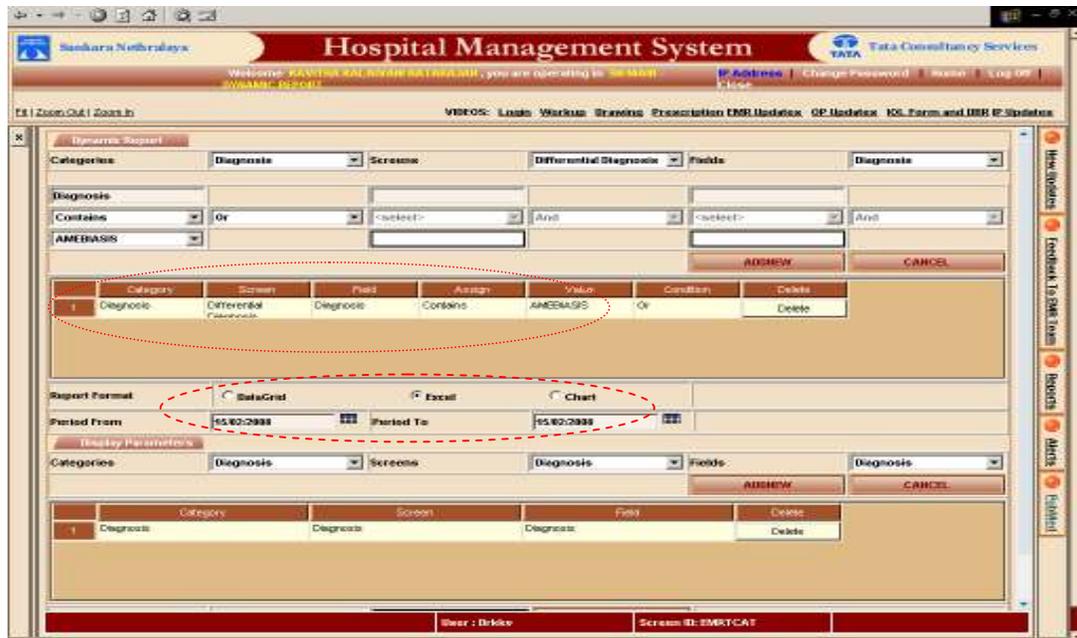
Health Professionals:

- i. Optometrist: They are technicians, which do initial work up with the patient. They record the past medical history, present complains, they test sight, measure Intra Ocular pressure (IOP), does [slit-lamp examination](#) of the eyes and dilate the pupils. In addition educate patients about eye hygiene and correct methods of using spectacles or lenses. About 60 to 70 % of medical information is filled by optometrist. Only final examination and advice is left for consultants. They are interested in EMR, as they can view all past history with one click; need not to ask same questions to patients each time they visit hospital. One of the optometrist said,  
*“Sometimes patient visit without prior appointments even after few years of their last visit, then it takes 1 or 2 hour to find that record. However by EMR system this waiting time is saved, doesn't matter after how much period a patient is visiting”*(Optometrist\_1 Nov 2007)

- ii. Consultants (Ophthalmologists): They are interested in EMR system because patient medical information can be accessed with just few clicks any time. Need not to ask questions about past medical records. Some surgeons access to medical record from home, for thorough planning of surgery next they have to do as well to see the examination reports (many times decision of going for surgery or not depends on examination reports). One of the consultant said,

*“Actually this EMR system made my work easy and fast, now I can workup with patient faster” (Consultant\_2 Dec 2007).*

- iii. Researchers: They are the once getting maximum benefit of EMR system. Medical information data-base is like treasure for them. The larger the data-base the greater the power of their study becomes. Lot of time is saved for accessing and sorting the patient’s records with this EMR.
- iv. Younger consultant or Graduates under training are also going to get benefit with EMR system. With effective and long term use of EMR a huge amount of data is accumulated and this can be used as Evidence Based Medicine and assist them as decision support system.



Picture 7-17 EMR interface for researcher

## 7.6 Practical problems of end-users

During the observation, the different problems faced by my end-users in day to day practice are narrated in the form of episode. This gives a clear picture of the situation, how the problem arises and is solved in this hospital setup. (Names used in these episodes are imaginary).

Episode 1.

Ms. Deepika is an Optometrist working in this hospital since last 3 years. She underwent training and using the EMR system from last one year. As usual, she came to her job by 8 am and noticed that patients are waiting for her and rushed into her cabin, logged into the EMR system and noticed that 3 new and 2 review patients are on her list and called the first patient. She recalls that yesterday there was a notice from the head of department stating that at least 4 cases should be done in electronic records in the morning clinic. She decided to start her day with EMR. The first patient she got is Mr. Anil, 53-year-old gentleman from another city and state, it's good both can

communicate in Hindi (Indian language). This gentleman is known case of diabetic retinopathy from last 10 yrs. He undergone surgery of left eye for cataract in the hospital in his town 2 years ago and now presented with dimness in his right eye. He is under treatment at his home town from last 10 years for diabetics and for his eye problem from last 6 months, since he did not regain his vision, he was asked to consult SN for future evaluation and treatment. As well he had few investigations done at his home town. Deepika collects all past medical history, present complains and medication in use, she is entering information as much as possible while listening to patient. Then she performs her routine procedures like testing sight, measuring intra ocular pressure, and examining eye with slit-lamp. After that she enters all information collected and results of examinations done into system. Then she ask patient to wait at the consultant cabin. After patient is out, she told the observer,

*“Typing long history and medications takes much time”, especially when we are not used to type writing and she wishes, “along with training of EMR system, we should also be train in type-writing, because typing takes more time even though we know the system perfectly”.*

After waiting for a while, the secretary of consultant asks Mr. Anil to get in to the consultant cabin. The consultant greets and show chair to sit, asks is Hindi ok? Both agree to communicate in Hindi. Then consultant asks the purpose of the visit, while patient is saying his complains he starts viewing the medical record on monitor. Consultant explains that he is reading patients past medical information, results of examination done by optometrist, then he ask patient to lie down on the examination table, switch off the light and check thoroughly the eyes with ophthalmoscope and ask patient to look at different directions so that he can see the different parts of retina. Then he switches on the lights and asks to sit on the chair, while explaining the condition of eye, he starts drawing his findings from examination on patient’s medical record so that in next visit he or any other consultant can compare the severity of the pathology. Suddenly he see that drawing template is not working, he calls to Technical help desk gives the IP number of his computer, IT staff on other side take control over this computer and rectify the problem, within a minute the problem was solved. The consultant finishes his drawing and advices Laser treatment (Photocoagulation) to be done. As patient is from another city, he request to undergo treatment as soon as possible, consultant give him appointment for the next day and patient comes out of the cabin satisfied.

## Episode 2.

Ms Priya is working in this hospital as optometrist since last 6 months. She has undergone training of EMR system and she is very enthusiastic to use computers and new technology in her daily practice. Today her schedule is for evening clinic, so she arrives at her cabin by 4 pm and sees patients already waiting for her. Usually to the evening clinic local people (patients from Chennai) visit after completing their day jobs. On the other side, workload is not as much as in the day clinic and that is why management decided to implement EMR system first at evening clinic. Ms Priya logs in the system and calls her first patient to the cabin. One gentleman with his mother enters; actually both of them wanted to get checked. The lady was named Mrs Rukmani, 58 yrs old; by profession she was a teacher in a school. She is known to have a case of Hypertension since 8 yrs and has been under treatment for Glaucoma for last 5 yrs in this hospital. As she already has a paper record since last 5 yrs and she had a prior appointment, her record was ready at the optometrist cabin. However, in few cases if a review patient comes without a prior appointment, it takes time to fetch the record from the medical record department; sometimes it happens that patients have to wait for hours just for the record to come.

Ms Priya continued to write in the same paper record. Because management wanted to continue the paper record if it was created earlier in order to avoid confusion of using both records at a time (paper and electronic record) of the same patient. After performing her routine examinations, she writes all her findings into the paper record and keeps it on the other corner of the table for the secretary to take the record to the consultant's cabin. After completing work out with the lady, Ms Priya starts examining Mr. Raju, 27 yrs son of that lady.

Mr. Raju is a software programmer, complains of burning and watering of both eyes since one and a half months, as he is consulting for the first time at evening clinic an electronic record was created. When Ms Priya was entering the complaints she noticed that to indicate a period she has to choose a number from the list and click on one or two, and there was no option to indicate an exact period. Therefore, she had to choose two months, in the same way she told the observer

*“when we have to choose allergens from a given variants sometimes it happens that patients have something not in the list, and we are not provided with space to write, this has to be changed, we need space to write remarks, we have complained about it to IT staff.”*

After performing routine examination to Mr. Raju, she asks both of them to wait in the hall, secretary will take them to consultant cabin.

After waiting a while, secretary calls out the name of Mrs. Rukmani and takes them to consultant cabin. The consultant greets and show the chair to sit, and finds yet paper record has not been brought, so he calls secretary and request to get the record of Mrs Rukmani. The consultant takes same time as optometrist to go through old reports. While asking patient about her present complains, consultant saw the findings of the examination done by optometrist. After doing some additional examination, consultant advices her to continue same treatment and he added two more pills and asks to review after 1 month. One disadvantage of having paper record is that she cannot get her case summary now, but to collect it next week, once it is ready after transcription. Next comes Mr.Raju, in his case it was easy for consultant, just with one click he could see complains and results of examination done by optometrist on the monitor by opening electronic record. Consultant does examination of the both eyes and he wants Ultra-sound scanning of the both eyes has to be done. Unfortunately the radiology department is not yet integrated with EMR system. Therefore the consultant had to convert electronic record to paper record by printing it out. Then he asks Mr Raju to review him post ultra-sound examination and meanwhile advised him to consult at community health care centre, a branch of this hospital where computer professionals are taught how to sit and work with PC.

The above two episodes illustrates the practical problems. The next section deals with the discussion of the above mentioned problems along with appropriate strategies adopted by the management of this hospital.

## 8. Discussion

This section has been broadly divided into two halves. In first half, this study is compared with another similar study done before. To know whether this project has important factors for successful implementation as suggested by other researchers. Comparison was done with theory of EMR implementation proposed by Øvretveit (Ovretveit, Scott et al. 2007). Then discussion will be focused on time motion study and about appropriate methods to evaluate implementation of new technology.

In the second half, under umbrella of II and ANT discussions will be focused on organizational challenges of managers, regarding problems of end-users; then on some relevant strategies of managers to overcome these challenges.

### **8.1 Factors important for implementing EMR system**

Most health care providers needed more information about how to implement IT successfully (Ovretveit, Scott et al. 2007). The research reported in this study used observation and documentation from different studies done but relied largely on self collected material by a limited sample of informants and time. The EMR system itself and its Implementation strategy will differ from hospital to hospital depending upon the size of hospital whether it is huge, medium or small, private or public, the commitment of managers and health staff involve in implementation and so forth.

By reviewing literature and research done, important factors contributing to successful implementation were found. By comparing findings of this study with those factors were found to be important, as the best 'evidence-based theory of EMR implementation'. This can be a good approach for contributing scientific knowledge in this field. Although, this study is supported by II and ANT; it will become clearer if its findings are compared with different theories and studies done earlier. In the table below are the factors important for successful implementation shown by previous research.

<b>Factors important for implementation</b>	<b>Karolinska EMR Implementation</b>	<b>Sankara Nethralaya EMR Implementation</b>
<b><i>The EMR system</i></b>		
User friendly, efficiency in use and accessibility	Yes	Yes
Health staff acceptance and implementers responsiveness to concerns	Yes	Yes
System failures	No	No (occasionally yes)*
No conflicting suitability (managerial/clinical)	Yes	Yes
<b><i>Implementation process</i></b>		
User involvement in selection and development	Yes	Yes
Training and education provided at the right times, amount and quality	Yes	Yes
Previous computer or EMR experience	Yes	No (not with this EMR system)**
<b><i>Leadership</i></b>		
Strong management support	Yes	Yes
Physician champion	Yes	Yes
<b><i>Resources</i></b>		
Adequate people and financial resources	Yes	Yes
<b><i>Organizational culture and climate</i></b>		
Medical centre more change ready	Yes	Yes

**Table 8-1 Factors taken from study of Ovretveit, Scott et al. 2007**

\*In SN health staff faced some system failure rarely like sometimes navigation was slow for few minutes, server was down and some times computers used to hang up.

\*\*In karolinska hospital five different EMR systems existed and health staff had experience of using those different systems, the new implementation was to integrate five systems and to make a single system. Where as in Sankara Nethralaya the case was different, health staff did not had any experience of using computer, although there was some attempts made earlier, that EMR system was very slow and the performance of that system was unsatisfactory so had to abandon with in few months. Therefore, in SN EMR system implementation health staff had to shift their practice from paper based to computers.

Comparison done here is not for using previous research as evidence based, however, to see which important factors for successful implementation are present or absent in this implementation. This newer EMR system was design by the consultant\_1 and he says

*“I have tried to design a user friendly screen similar to paper records which we are using for the data entry in the form of predetermined templates and provided option to modify the data wherever required. This has reduced the data entry time drastically compare to interface of earlier EMR system. Most of the health staff is satisfied with present interface.”(Consultant\_1 Dec 2007)*

## **8.2 How to evaluate the Implementation of new technology?**

The field of ICT evaluation is very scattered; the types of questions that can be asked and methods that can be used seem infinite and badly demarcated (Stoop and Berg 2003). Moreover, any good evaluation should be constructive and provide direction or guidance for developing better system further (Kaplan 1997). For doing so one must point out and understand the exact problems which should be tackled. In order to gain deeper insight of problems merged within complex socio-technical network both qualitative and quantitative techniques were applied in this study, material and results from these techniques were used for evaluation of this implementation of new technology or EMR system in this context.

Actually my medical background has tempted me to conduct quantitative study and then to compare its pros and cons with qualitative techniques adopted in this study. Focus of this quantitative study was to explore time effectiveness of documentation done by the optometrist using EMR system and paper record. The result reveals no significant difference in time taken for documentation between electronic and paper records. Time motion study was particularly chosen because there were conflicting opinions and assumptions among health staff regarding consumption of time while using EMR system.

Following are the contradicting opinions of the consultant and Optometrist:

*“I think it takes longer time when I work with EMR system, it is easy for me to write on paper records.”(Consultant\_4 Dec 2007)*

However, one of the optometrist thinks opposite. She told

*“As this EMR system is provided with templates, we need not write every detail, just by click we can fill out many fields and this will save our time, the more we use the faster we can work with this system ” (Optometrist\_6 Dec 2007)*

Advantages of quantitative studies are; the result is expressed in numbers, and we can measure the difference and it does not depend on opinions, views and assumptions. However, there might be some pitfalls, for example in this study the measurement reflects only on a segment of time out of total time required from patient entering to going out of hospital. They do not reflect on other factors like interdependencies with other actors, organizational aspects and user satisfaction. Where as qualitative studies cover many aspects, as the material collected is from observation and interviews, they highlight not only technical problems but also social problems. The results of qualitative study are expressed in statements and suggestions to the problem actors facing in real time practice. As Burkle argues these valuable statements and suggestions would surely not have been uncovered through a pure laboratory study or quantitative study (Burkle, Ammenwerth et al. 2001).

Usually quantitative techniques are applied in clinical set ups, for example to know effectiveness of a drug. Therefore, the aim of study will be focused only on how fast and for how many patients this particular drug has cured. However, researchers don't consider if the patient likes the taste of this drug, if the patient can afford the cost of the drug and so forth. Here come qualitative techniques which not only see the number of patients cured and how fast they where cured but also it study did patient liked the drug, does he can afford the cost and availability of drug in local pharmacy and so forth. In order to have a complete picture it is better to combine both these techniques if possible.

This time motion study was conducted with the consultant as co-author, who was involved in the software development team. After seeing the results he says

*“Implementation of EMR is very challenging and the mind set which some have is it takes more time in entering data. From the results of the study it is very clear that there is no difference in the time between both the systems. Now I got proof to convince health staff.”(Consultant\_1 Jan 2008)*

For evaluating implementation of new technologies, especially in complex environment like hospital setup qualitative techniques suits well as they cover broader aspects and different perspectives of actors. At the same time it will be better if combined with quantitative techniques; as a result we will have solid numbers which can be compared with the suggestions and opinion to get deeper insight of the system or technology under evaluation.

### **8.3 The challenges and problems faced by end-users while transitioning health care practice from paper to PC and relevant strategies adopted by managers**

There are different meanings for these words ‘challenge’ and ‘problem’; challenge means a call to engage in a contest or mission; problem means any question or matter involving doubt, uncertainty or difficulty. In this study, challenges are nothing but efforts for achieving the goal to make the EMR system into the mainstream of practices in a sustainable and workable way; these challenges pertain to managers. Problems are the difficulties or uncertainty while using EMR system commonly pertaining to end-users. In this section organizational challenges of managers will be highlight first and then problems of different actors will be discussed. Thereafter, focus will be on the strategies adapted to overcome these challenges and problems. In this study utilizing the concepts from ANT and II the discussion will disclose challenges, problems and some relevant approaches of the management.

#### **8.3.1 Enrolment of actors by manager**

Successful EMR system implementation is not merely about introducing new technologies but also managing the organizational change processes that surrounds it (Webster 1995). As Orlikowski cites the arguments of Wagner and Newell, which claims that participant need to build the social network necessary to build a workable system and such network can be

created either through common aims or through reciprocity or mutual benefit (Orlikowski and JoAnne 2006). As one of the managers says

*“Implementing EMR system is not just purchasing computers and starting to work on it. We need to merge the advantages and functionalities of EMR system into our system or practice..... we want sustainable and workable system to be used by all health staff” (Manager\_2 Dec 2007).*

From the above statement of manager it is clear that managers of this hospital want to make all health staff to use the system. Creating awareness is first challenge for any manager who wants to bring changes in routine practice. He needs to make clear the benefits of the new system and the advantages to them. As in this study managers have explained the power of IT and its benefits in every departmental meeting. They made users understand how EMR system will make their work easy, flow of information fast, and advantages of such information data base. Unless users are satisfied with the concept of this new system, managers will not implement it. In accordance to ANT, it looks like manager is ‘enrolling’ other actors by creating ‘*Interessement (commerce/profit sharing)*’ which is one of the moment of translation proposed by (Walsham 1997).

Latour describe the concept of enrolment very well by giving example of rugby, how different players (actors) aligned with the common aim of making a goal (Latour 1987). The ANT explains how these sets of actants (human and technological) with diverse interest allies to create relatively stable sociotechnical network (Law 1999). According to McLoughlin arguments, Actor-networks are the consequences of an alignment of otherwise diverse interests. Alignment is dependent upon the enrolment different actors into the network (McLoughlin 1999). Enrolment is not just a matter of negotiation and power play, but also a matter of redefining the technology, including and excluding different network elements (Jonathan 2004). About getting enrolled actors an optometrist and consultant have said.

*“Sometime patients come for review without appointment, in such cases we need to wait for secretary to bring medical record from MRD, but by using EMR, we can retrieve patients past medical information just by one click, this system is useful for us” (Optometrist\_4 Nov 2007).*

*“EMR system will create database which will be good resource for research”  
(Consultant\_3 Dec 2007).*

*“I am interested because this EMR system is very good tool for accessing patients information in daily practice as well as data stored will be a good resource to carry research”(consultant\_5 Dec 2007).*

### **8.3.2 Change of mindset and attitude**

‘Installed base’ concept of Information infrastructure is directly related to acceptance of new system or technology. Hanseth argues that new component will be accepted if only it can be integrated or substitute a part of existing system (Hanseth 2002). In this study, managers found the need to change mindset and attitude, particularly of senior staff those who have experience of working with paper records since last 15 to 20 years. Nevertheless, this new EMR system was accepted by them gradually, as it is based on older versions and this new system did not altered their practice, users accepted it after getting convinced that this new EMR system is a useful tool. One of the managers told

*“It is natural that human being reluctant to change as it required learning and training. However, when this new system proves itself to be easy safe and fast, the interest will be increasing gradually. It takes some time.” (Manager\_1 Dec 2007).*

The consultant who was in software developing team of EMR system was very much concern about mind set and attitude of all health staff and he says

*“We have mixed generations of staff; it is easier with younger and newly employed staff, it was not easy to convince senior consultant to train and make them to use system. They are used to paper based practice since last 20 to 30 years....However, gradually we managed to train all of our health staff ”  
(Consultant\_1 Dec 2007) .*

### 8.3.3 Creating understanding between health staff and IT staff

To create understanding between IT staff and Health staff is very necessary. The EMR system is developed and managed by IT staff but used by Health staff. One of the managers say's

*“I am involved in bringing these parties together. IT staff should know requirements of Health staff and Health staff should know the limitations of the software programmes. At first vendor created something that looked good on screen, but actually it was useless to doctors. If something need 100 clicks before it can be filled is useless. Doctors' want fast and easy system” (manager\_3 Dec 2007).*

According to ANT, the IT staff (software programmer) inscribes roles to the system as well to the users. They inscribe programs of action into piece of technology delegates' roles to its actors forming socio-technical network, including humans and non-humans (Latour 1991). IT manager of this hospital says

*“It is not so easy for me to make health staff understand, every time I try to explain them that we are not taking their powers, rather helping them to make their work fast and easy. Next when new system is implemented they compare with old system for each and everything. One more thing is, they had freedom with paper records, they can postpone if they want, but with EMR system they have to complete all work in same day and have to follow all steps as system requires” (Manager\_4 Dec 2007).*

To have a successful implementation of technology the understanding between different groups of actors is necessary. As Hanseth argues that Information Infrastructure cannot work without supporting its actors and actors using it (Hanseth and Monteiro 1998). That is actors and technology is important to form stable socio-technical network concept of Information Infrastructure. According to Masys arguments new patterns of system failure can evolve from misunderstanding between two actors or incompatibility between designer's anticipation and real use by the user. These types of failure occur when technology is introduced into a system without thorough and pre-planned implementation strategies (Masys 2005).

Hospital managers and vendor of this EMR system have solved this challenge of creating understanding between IT and Health staff very wisely: First consultant\_1 and head of optometrist department from health staff were involved in software developing team of EMR system. Next the vendor of this EMR system hired senior IT staff of this hospital. It was a very clever idea of vendor to utilize IT staff from same hospital, as they are very familiar with the workflow and health staff. IT staff (former employee of this hospital) says

*“I am working here from last 15 years, I am aware of workflow and many people from health staff are my good friends. Dr. Sudhir’s (consultant\_1) contribution is enormous; he designs interfaces and explain how he want system to perform and we make software based on his requirements. Though my employer has changed still I am working for this hospital” (Vendor Dec 2007).*

#### **8.3.4 Re-organizing practice and interdependencies among actors**

Implementing new system means re-organizing and giving new shape to the practice. If it is seen through lens of ANT it is about ‘mobilisation of allies’. Management is responsible for all organizational issues, such as distribution of responsibility and workload. Disagreement from actors may be a threat to stability of the network (Williams-Jones and Janice 2003). Regarding distribution of workload one of the Optometrists said

*“Before implementation if any patient needed to visit hospital, hel used to take appointment from receptionist and secretaries from MRD department used to take care of transferring of records from archive to us (optometrist), then from us to consultant and then the record was taken back to archive. But now all secretary work is eliminated, thus saving time and chances of missing or misplacing the records” (Optometrist\_6 Nov 2007).*

Both ANT and II theories explain explicitly the concept of socio-technical network and interdependencies among its heterogeneous actors. Actually complexities arise from the

interdependencies among actors within networks and vary with the type of linkage and frequencies of interactions (Bruno Piotti, Baltazar et al. 2006).

Before EMR system:
Patient → Receptionist → MRD → secretary → Optometrist → secretary → Consultant → secretary → archive (MRD).
After EMR system:
Patient → Receptionist → Optometrist → Consultant → database (server).

**Flow chart 8-1 The shift in interdependencies among actors**

Before EMR system was implemented the workflow depended on secretaries and papers records. Transferring of records was done manually, secretaries used to supply medical records requested at the right time and the right place, stored them back to MRD once workup with the record was over. If more examination or investigations were ordered by consultant, again secretaries used to take these medical records manually and returned back to consultant with results of examinations. All departments used to work independently from each other with their own work style and own information system.

EMR system has made this workflow automated and transparent. A complexity arises not by automation of workflow, but also when we attempt to integrate different departments that belong to different groups of people with different backgrounds. Their integration also implies integrating work procedures and institutional arrangements (Bruno Piotti, Baltazar et al. 2006). In this project IT staff makes the EMR software and health staff uses it. First and foremost IT staff depends upon health staff to know detail requirements and then health staff depend on IT staff for assistance whenever technical problem arises.

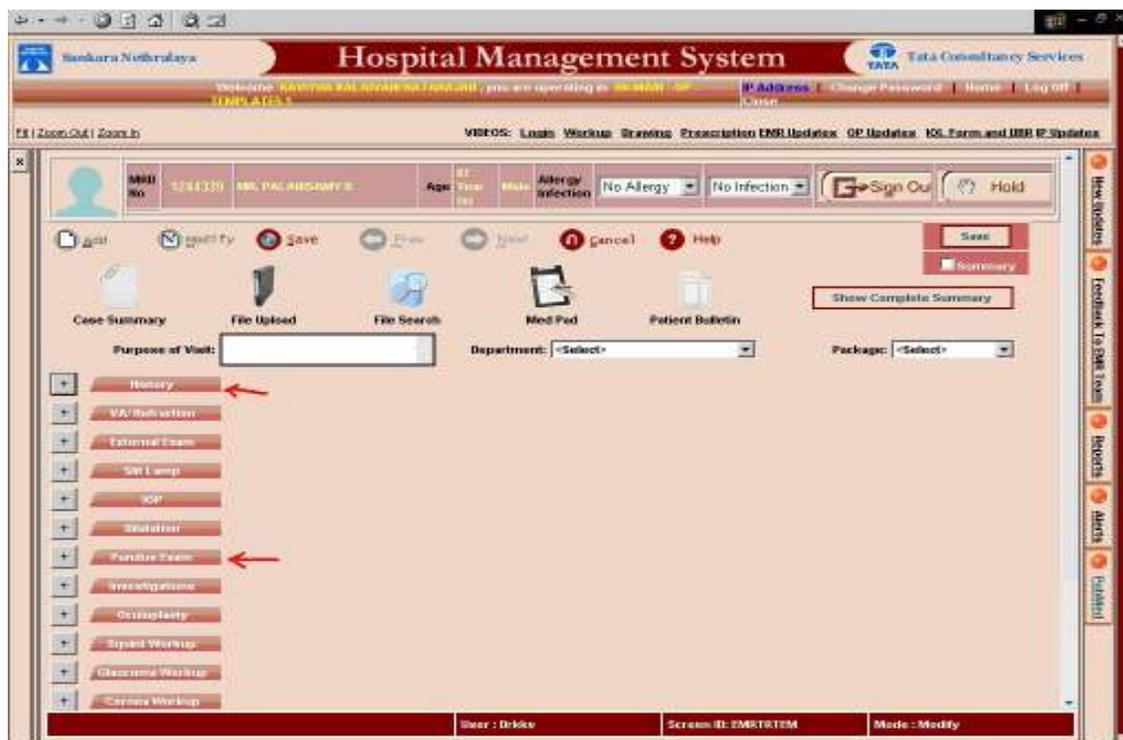
Sometimes technical problems arises like server may go down or works very slow this creates interruption in the practice of health staff, in such cases health staff has no other choice other than just printing out as much data they have entered and then continue with paper record. As well whenever they need to order investigation, they have to convert electronic record to paper record by printing out, then only they can refer patient to laboratory or radiology department for investigation. This is because when the study was conducted, vendor was still working on integrating different departments.

### 8.3.5 Users satisfaction

Management trying their best to implemented in a way, that all actors are satisfied, and to satisfy all at a time is not at all an easy task. User satisfaction with system and new model of practice are key factors to either make a project successful or a flop. However, if user finds over burdened by the workload they simply stop using the new system. If the concept of ‘interestment’ is considered from ANT as proposed by Callon (Walsham 1997), users will be satisfied if only the new system profits them in terms of saving time or decreasing workload. The consultant who designs the interface for this system told:

*“The main challenge in the development of EMR was designing a user friendly screen for the data entry in the form of predetermined templates and to provide options to modify data if required.” (Consultant\_1 Nov 2007).*

The Picture 8-2 shows the templates provided; Just by clicking on history all necessary fields required to fill will be displaced, units of all biometric measurement will be readily available, for example every time when health staff wants to write blood pressure or ocular pressure need not write ‘Hg mm’. If fundus examination is clicked, all fields to be filled as well past results if the patient had already undergone this examination earlier will be displayed. Thus this system makes practice fast and efficient.



Picture 8-1 Screen shot showing predefined template

Information Infrastructure's concepts of 'enduring' and 'scalability' underscore importance of 'User satisfaction' for long run and scaling up of project that is nothing but making successful and adoptable system.

### 8.3.6 Time factor

Time is an important factor which must be dealt seriously. Material collected reveals in real time practice the primary concern of all health staff will be to accomplishing their task faster and reduce waiting time of patient. If the practice gets slow due to any reason (technical or incompetence to use EMR) the user has to shift to paper record. In order to get competence over the system users need to give enough time to receive training and to get well versed with it. This time factor is tangled with other key factors like user satisfaction, enrolling actors and these factors in turn are linked with 'enduring' and 'scaling up' concepts from Information Infrastructure. One of the optometrist told

*“This is a tertiary hospital we usually have complicated cases and long list of patients to check up. In spite of hectic work we need to take time for training after our work time” (Optometrist\_7 Nov 2007).*

My observation revealed that health staffs were having contradicting opinions concerning the time of computerized documentation compare to paper base records. In order to study the difference in time, myself along with the consultant involved in developing software for EMR system conducted simple and straightforward study to explore the potential impact on time effectiveness of Electronic Medical Record system compared with traditional paper based documentation done by Optometrist.

The results of this study confirm no statistically significant difference in the time-spent between electronic and paper records. The mean time spent in electronic records was only 0.64 minute longer than in paper records, average time was 20 minutes per patients?????. The actual problem related to time is not that the system needs extra time to accomplish given task, but with to spare extra time for getting trained and at the same time do the routine work. Health staff had to work overtime to be able to do all that was expected of them from management. Therefore, considering this problem of health staff, management has provided various options to train them.

### 8.3.7 Training

Providing good enough training to all users will be a great task. It is utmost important to make users interested and spare some time in learning the system, getting familiar with different interfaces and templates used in the system. Providing different options of training from management side and giving sufficient time to learn and practice the system from user side can only be the best way to speed up the implementation process. The more the users get well verse the lesser time they need to accomplish task with the system. One of the consultant says

*“At first I was reluctant to learn, it took some time but once I got well versed of the system, it made my work fast, now I can dispose patient sooner then with paper record system” (Consultant\_2 Dec 2007).*

Management distributed Demo CD’s so that they can understand different interfaces and templates in it. There was a software programme in CD by which health staff can get practice how to enter information; as well online practice facility was provided for those who don’t have computer at home. One of the managers said,

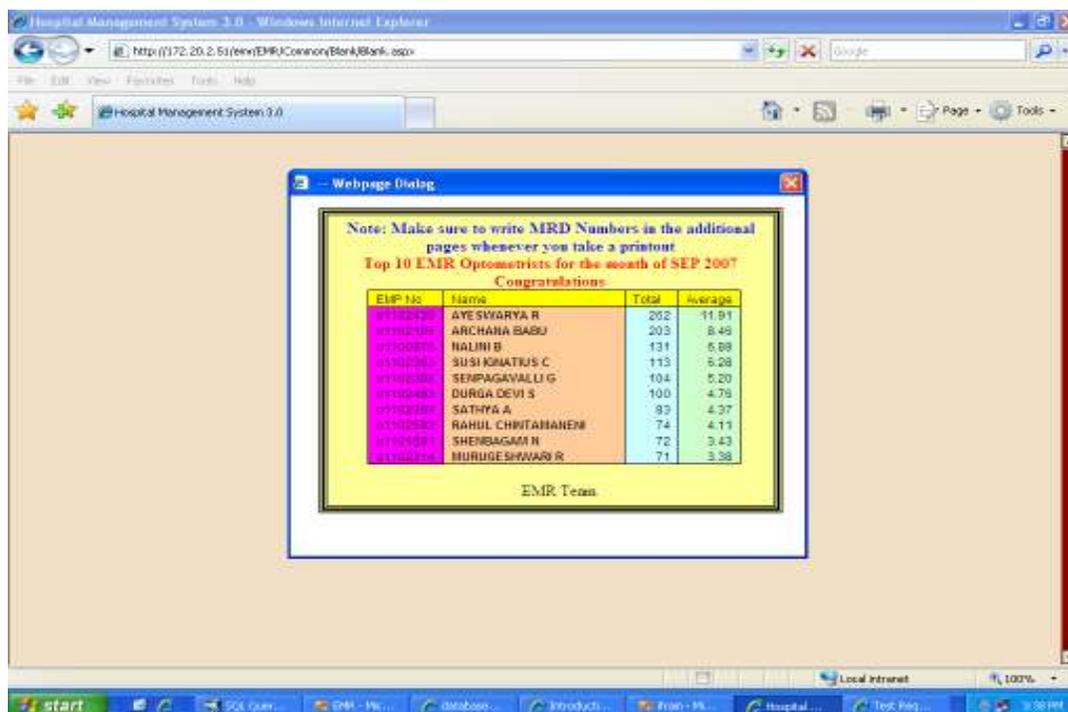
*“First we selected a group of users who are found of technology, and uses computers more often, we trained them first, they learn the system very fast and were trainers for other people”. For changing mindset one of the manager say’s “we don’t try to bring a change suddenly in the work; instead we are trying to go slow but steadily.” In addition, he say’s, “It is not just like purchasing a computer and start using it, here we are changing our way of practice, and we want all staff to change not only a group of people. With time I feel, everything will be in its place.”(Manager 1 Nov 2007.)*

Over ownership issue, one of the manager say’s that though it is patient’s information, it is created by hospital for smooth work flow and research purpose of the hospital. The manager told that the patient information created and stored is owned by hospital. Furthermore, he says,

*“We give paper summary to all patients at discharge; we give those full details what they want. However we don’t provide access to our data base for the outsiders. Its dangerous and also it’s the question of confidentiality” (Manager\_2 Nov 2007).*

### 8.3.8 Encouragement and motivation

Management had constantly adopted different ways to encourage and motivate users to learn and use the system. They were giving economical incentives as well as moral motivation. Before this EMR system, all optometrist were given economical incentive for every extra patient checked after 12 patients per day. However, after implementing EMR system, management decided to give an incentive for the extra patients checked by electronic record thus attracting optometrist to use EMR system. The Picture 16 shows the top 10 users (optometrists) of EMR system in the month of September 2007. This screen is seen by every user of this system each time they enters the system, it is a type of appreciation for these top 10 users and a kind of motivate for rest of the optometrists. However, the time spent for training or practicing to get well versed with the EMR software was not paid, health staff had to spare time after their routine work.



Note: Make sure to write MRD Numbers in the additional pages whenever you take a printout

**Top 10 EMR Optometrists for the month of SEP 2007**

Congratulations:

EMP ID	Name	Total	Average
01102420	AYE SWARYA R	202	11.81
01102408	ARCHANA BABU	203	8.46
01100870	NALINI B	131	5.88
01102383	SUSH KRNATIUS C	113	5.28
01102384	SEMPAGAVALLI G	104	5.20
01102483	DURGA DEVI S	100	4.75
01102388	SATHYA A	83	4.37
01102520	RAHUL CHINTANEN#	74	4.11
01101454	SHEEBAGAM N	72	3.43
01102354	MURUGESHWARI R	71	3.38

EMR Team

Picture 8-2 Top 10 users of EMR system among Optometrist

### 8.3.9 Dealing with predefined templates

Though almost everyone is satisfied over all with this new EMR system, still some feels it needs some changes. For example some wants templates preloaded and some wants just to click on right word from a given list rather than typing; some want a space to be provided in order to write remarks. Because one of the optometrist says,

*“When we want to write period we can click only on 1 or 2 day/month/year, but if a patient says 1.5 months we have to choose from 1 or 2, we want space to be provided so that we can write exact period. In the same way there is list of allergens, still if patient says something new which is not in that list we need to write it manually” (Optometrist\_4 Nov 2007)*

In the picture red arrow shows this patient has allergy to ‘Wheat’, and fortunately this allergen is in the list. In case if it was not listed, then optometrist don’t have any space to write.

The screenshot displays the Hospital Management System interface. At the top, it shows the user's name 'KAVITHA KAL RIVANI NATARAJAN' and the system name 'Hospital Management System'. The main content area is divided into several sections:

- BirthHistory:** Normal
- Personal History:** Includes Occupation, Physical Activity, No of Children, Diet (Non Vegetarian), and Travel To (AFGHANISTAN).
- SocialProblem:** Tobacco Chewing.
- Allergy History:** A table with columns for Allergy Type, Allergen, and Allergy Reaction. The entry shows 'Food.' as the Allergy Type, 'Wheat.' as the Allergen, and 'Blisters on the skin.' as the Allergy Reaction.
- Current Medication:** Nil
- External Lab Investigation:** A table with columns for Test Date, Test Name, and Remarks. The entry shows '06/03/2007.' as the Test Date, 'ECG.' as the Test Name, and 'nil.' as the Remarks.

A red arrow points to the 'Allergy Infection' dropdown menu, which is currently set to 'Wheat'. The interface also includes a navigation bar with 'VIDEOS: Login Workup Drawing Prescription EMR Updates OP Updates IOL Form and DBR IP Updates' and a footer with 'User : Drkkv' and 'Screen ID: EMRCASSU'.

Picture 8-3 Template pointing allergy

Another optometrist also expressing concerns about some changes to be made, and she says

*“Still little changes have to be done though many changes have been done since EMR system got implemented” (Optometrist\_3 Nov 2007).*

In fact health staff needs a system which will help them in their work not add on some extra work. On this one of the optometrist comments

*“We need templates at least of common diseases preloaded, so that we can fill out the field relevant to that disease and rest of the fields should be shown normal by default, but in present system, we have to fill information regarding present disease and in additional to this we have to fill other fields which are not relevant to disease. And typing takes time” (Optometrist\_1 Nov 2007).*

Another issue to be focused is about converting electronic record to paper records. As for now during the period of this study there was no integration with other departments like radiology or laboratory, therefore whenever more investigation was needed the optometrist or consultant used to convert electronic record to paper record and this patient will be continued with paper record thereafter. One of the consultant was expressing concern over this and said

*“Still laboratory department is not integrated with EMR system, therefore we need to convert EMR to paper whenever investigation is required and thereafter this patient will be continued with paper record.....IT staff is working on this issue and hope soon this will be integrated ” (Consultant\_5 Dec2007).*

The Consultant\_1 who was designing the interface for this system has given importance to make interface similar to paper record format which are in use now. The concept of ‘Install base’ is applied here, this goes with the argument of Hanseth and Monteiro that new technology has to be connected to existing Install base (Hanseth and Monteiro 1998). The acceptance rate will be high if new system is similar to present paper based system.

He says

*“I have tried to keep the interfaces as similar as paper records, so that Users need not search for required field to fill up, in addition I have design template with relevant fields for example if optometrist click on fundus examination, only the field relevant to this examination is displayed they need just to fill the fields with the finding after examination” (consultant\_1 Dec 2007).*

It was interesting to find that though this consultant\_1 was of the opinion he is helping optometrist by displaying all the relevant fields, actually the optometrist were not very much satisfied with this, they wanted something else. One of the optometrists says

*“When we use paper record we write what is necessary for the problem the patient has, where as EMR system displays all fields and we need to fill all the fields, instead we want all field to display NA (not applicable ) by default and we can fill only those field which are required” (Optometrist\_7 Nov 2007)*

As this system is still under development, these types of back and forth changes are very usual and this is what Hughes stated long ago that people get shaped and shapes technology before completely accepting it (Hughes 1994).

### **8.3.10 Doctor-Patient relation**

Patients are one of the key actors in this network, it is important to consider their concerns. Patient care and patient satisfaction will be given priority in any healthcare system. Few optometrists told that they felt some patients were unhappy, when optometrists were entering data while listening to patient. Especially seniors or not well educated patient felt that optometrist is busy with her/his work on computer and not showing attention towards patient. Regarding how to gain confidence from patients, one of the senior optometrist says,

*“Eye to eye contact is very important to make patients feel that we are listening to them and understanding their problems. At the same time we can do entry of the information if we are perfect in typing, we need not look at key board for each letter” (Optometrist\_2 Nov 2007).*

One of the consultant also told me the same, usually when patients enters cabin consultant open the electronic record and read the findings and past medical history from EMR system, since patients are used to consultant asking them their problem and past medical history, now they are feeling that consultant are reluctant. And he says

*“Patients are used to doctors asking them their problems, with this new system we don’t need to ask problems or past history we can read it from their electronic records, this makes them feel that we are reluctant or not showing attention, in order to avoid this misunderstanding I ask patients about their problem while doing my examination” (consultant\_5 Dec 2007).*

ANT focuses on how the actors are connected and influenced by its surrounding environment, in this context by new technology (Monteiro 2000). As argued by Giuse and Kuhn healthcare system is complex and consist of heterogeneous actors (humans and technology), therefore social factors has to be considered as important as technological factors (Giuse and Kuhn 2003). Therefore each and every link is equally important. In fact a chain is as strong as its weakest link.

### **8.3.11 Creating IT environment and providing technical assistance**

More computers are required to create IT environment in addition to just run EMR system. Management felt this need and provided computers in reading room, resting rooms of health staff so that they can use for their personal use, like checking emails, reading news and article of their interest. This was an approach to make health staffs get used to computers. Some initiatives were taken from IT manager of this hospital regarding this matter and he say’s

*“We are trying our best, helping health staff at personal level. Hospital management has decided that if any health staff wants to purchase computer, one of our staff will do counselling and help in installation and provide technical assistance ” (manager\_4 Dec 2007).*

Gaining confidence creating good impression was taken seriously by management and vendor, before health staff develops any negative impression about this system. Therefore technical assistance help desk was provided.

One of the consultants says

*“Whenever we get any sort of technical problem we call to IT staff and say IP number of computer we are using, on other side IT staff take control over our system and usually they solve the problem within minutes but rarely if they take much time we have to continue with paper record” (Consultant\_3 Dec 2007).*



Picture 8-4 Consultant\_1 sitting back to author at IT help desk

Technical failure arises from “design-reality” gaps (Bruno Piotti, Baltazar et al. 2006). This means usually technical problem are mismatch of designer (software programmer) assumptions and in reality how it is used by user. Management is solving this problem by providing enough training and technical assistance via help desk whenever needed.

### **8.3.12 Slow and steady approach**

Management wants to take slow and steady approach that is why first they implemented in evening out patient clinic, and then they started with 2 records per day in Day clinic by the time I was conducting study all health staff were asked to work with 4 records per say, thus they were gradually trying to shift from paper to computers.

Manager of this hospital say's

*“We first provided enough training then asked health staff to use EMR for 2 cases per day then 4 cases and now all patients that visits the evening clinic an electronic record is created. In order to avoid confusion we do not want both an electronic and paper record to exist for the same patient. Patients that revisit the clinic are continued to be served by the record, either electronic or paper, that was created during their first visit” (Manager\_2 Dec 2007)*

### **8.3.13 Security and confidentiality**

Management will be solely responsible for the security and confidentiality of the patient information stored in the server of the hospital. Management of this hospital has taken high level security precautions available. Even though the data-base is used for research purpose confidentiality of the patient is respected and precautions are taken not be breach. Back up options of the information were foreseen. Regarding legal issues the managers told, that unfortunately government of India yet don't have clear legislation concerning EMR system, so there is still uncertainty regarding this and managers hope soon it will be finalize by government.

### **8.3.14 Standardization**

Regarding standardization managers and vendor are very much concern to adopt standardization like HL7, ICD-10, because it will be easy for them to integrate with other equipments and other networks in future. As Lenz argues, standards are fundamental for integration (Lenz, Elstner et al. 2002). By applying the concept of 'openness' from Information Infrastructure, one can realize that this system is open to integrate different equipments from different departments by adopting standardization. Vendor (former employee of this hospital) told

*“TCS has QAG (Quality Assurance Group) who monitor standardization, all the development we make here are documented and follow ISO standards. Actually it is for our benefits, we can integrate our system with the equipments as now we are in process to integrate with laboratory department” (Vendor Dec 2007)*

## 9. Conclusion

Conclusions made here are the interpretations done by the author of this study from empirical material and discussions done with the support of an ANT and Information Infrastructure theories. This study was designed to answer the following research questions: 1) *what are the different interests and expectations of managers and health staff and how they should be aligned in order to adopt EMR system.* 2) *What are the challenges of the managers and problems faced by the end-users while transitioning their practice from paper to PC?* 3) *What are the strategies adopted by managers to overcome the problems faced by end-users?*

Regarding interests and expectations, this study reveals that different actors seem to be interested in the EMR system for different reasons, which are related to their current work priorities. Eight different reasons were emphasized which attracted managers and health staff to adopt the EMR system. The fundamental reason was that the chairman wants to make this hospital an advanced eye research centre of India, as he is also president of the telemedicine society of India, he is fully confident on potential benefits of the EMR system. Manager\_2 was interested to make work flow fast and transparent, he wants to monitor all work flow right from his computer, to know how many patients visited, how many surgeries were done and so on. The medical director is expecting to use the database created by this system for practicing Evidence Based Medicine. The medical record department manager was attracted as this system saves lot of space, resources and time in transferring back and forth to the archive. No need to spend resources for transcription, summary can be made just by a click, thus benefiting both management and patients as well.

The greatest functionality that attracted the interest of clinicians towards the EMR system is that it allows accessibility to patients' medical information instantly which is crucial for making diagnosis and initiating treatment. Researchers need not spend days for getting records from archive and sorting them according to their needs. Both administrative staff and health staff expressed interest as this system make their work faster. One interesting fact which this study revealed is that, five out of eight reasons which attracted interest is directly related to time. All actors agree EMR system saves time and makes workflow fast. However, the commonest problem reported by the users while adopting this system is surprisingly again related to 'time'. The actual problem related to time is not that the system needs extra time to

accomplish a given task, but it is with to find extra time for getting trained and at the same time do the routine work.

- |   |
|---|
| <ul style="list-style-type: none"> <li>• To establish research centre</li> <li>• Workflow fast easy &amp; transparent</li> <li>• To use as EBM</li> <li>• To save space time &amp; Resources</li> <li>• Easy accessibility to patient information</li> <li>• Makes work fast for health staff</li> <li>• Useful tool and resource for researchers</li> <li>• Save time of administration and billing staff</li> </ul> |
|---|

**Table 9-1 showing interests of actors to adopt EMR**

By analyzing empirical data 14 different essential issues came into picture if they are addressed appropriately would be helpful for successful implementation of the EMR system in hospital setups.

Enrolling health staff by creating awareness will be the starting point for managers, usually health staff in any hospital consists of mixed generation with senior consultant who are used to paper based practice since the last few decades and young doctor who are used to computers, it takes time to change the mindset and attitude which is important to get them enrolled. To bring health staff to get used to computers, it is necessary to create an IT environment within the hospital to providing computers in reading room and rest room for personal use. It is also worth to install more computers and this should be done much earlier then implementing the EMR system.

The implementation process in this hospital lasts since eight years and it is still not yet completely implemented. In the first attempt the IT staff of this hospital built an EMR system which was very slow, in the second attempt it was done by an IT vendor. This vendor created very good looking interfaces, yet that couldn't satisfy health staff as it required many clicks, and no options were provided to enter required information. Once again, the vendor with the help of the consultant and IT staff of this hospital developed a system, which seems to be successful and it is running in this hospital since last year. This points out that the manager should regard this process as a long term with flexible slow and steady approaches. The management should aim to bring revolution by evolution; this means developing the system step by step as reported in this study, rather than directly jumping towards revolution.

This implementation process will be a long iterative process between design – reality – re-design. In this study the consultant design is as similar as possible to paper format and gives the option to fill the fields just by clicking, however, in reality it was found not appropriate, so he had to re-design. Creating understanding between health and IT staff will speed up the process of implementation in reference to this study, different approaches were tried from last eight years, but earlier systems were not successful as and when vendor hired IT staff and consultant doctor of this hospital in the software developing team. The system was ready within a year and got implemented in the evening clinic.

Various training options must be made available because health staff needs to work over time to be able to accomplish routine work and to get training. With computerization data entry will be through typewriting and my observations revealed that it would be helpful to provide training in typewriting as well. Moreover, this skill of typewriting will be useful to avoid misunderstanding between doctor-patient relationships; as found in this study some patients were feeling health staff are reluctant towards them, not seeing them when they are talking and saying their problems. Gaining patient satisfaction will be a high priority concern for health staff as well as for hospital management. A simple typewriting skill can be very much helpful.

Another challenge for managers seen in this study is to achieve durability. Improving ‘user satisfaction’ towards this system was also found out to be crucial. The end-users will be satisfied if only this system helps them in terms of saving time or reducing work load. As noticed from the study with implementation of the EMR system, interdependencies changes automatically, health staff need not depend on secretaries for transferring of records, instead they will need to depend on IT staff in case of any trouble with the system. Here comes one more challenge for managers that is to provide technical help desk so that technical problem can be dealt at the earliest specially in the implementation stages where health staff is still testing the system. Creating good impression is important because ‘first impression is the best impression’.

Health staff were uncomfortable with converting electronic records back to paper records by printing out whenever they needed more examination to be done from laboratory or radiology department, the was due to lack of integration among the departments. Managers were aware of it and the process of integration was in progress when this study was conducted. IT staffs

knew very well that only standardization can solve this problem to integrate with different departments and equipments, hence they were very particular of adopting ISO standards in their software. Management is responsible to provide higher level of security and confidentiality to the database stored, no personal information should be breached without appropriate consent from patient even though for research purposes. Legal and ethical issues should be considered without reluctant.

Challenges and problems	Some relevant Strategies
<ul style="list-style-type: none"> <li>• To enrol actors</li> <li>• To change mindset and attitude</li> <li>• To create understanding between Health and IT staff</li> <li>• To re-organize practice and interdependencies</li> <li>• To satisfy all actors</li> <li>• To deal with time factor</li> <li>• To provide training</li> <li>• To deal with templates</li> <li>• To build doctor-patient relationship</li> <li>• To create IT environment</li> <li>• To provide security &amp; confidentiality for patients information</li> <li>• To demand standardization from vendors</li> </ul>	<ul style="list-style-type: none"> <li>• Involving health staff in software developing team</li> <li>• Creating awareness</li> <li>• Providing various training options</li> <li>• Encouraging &amp; motivating</li> <li>• Designing interface similar to paper format</li> <li>• Providing technical assistance to health staff</li> <li>• Slow and steady approach</li> <li>• Adopting standardization</li> </ul>

**Table 9-2 challenges, problems and strategies**

## **9.1 Practical Implications**

This study is expected to raise the level of awareness about the essential issues for successful implementation of EMR systems. It also serves as a starting point for hospital managers on the issues of EMR implementation and for researchers providing an overview of different issues for future research. Based on the experience gained from this study and the knowledge obtained from the empirical material, the author concludes with a proposal of some recommendations and issues for future research:

- From problem to solution approach: Management must first recognize actual problems in their local setups and only then technology should be applied to solve them. Studies revealed that the commonest reason for unsuccessful ICT project in health sector is attempting to change work routine according to technology.

- Selecting a suitable EMR system: while developing or selecting an EMR system, a crucial step is to consider the 'design-reality' concept. Designing of a system should be done based on the real situation of that local work setup.
- Researches on economical issues are of utmost importance for the development and maintenance of the EMR system. This is especially important for small and average size hospitals as they occupy more than 95% of healthcare providers in India and many other developing countries.
- Future research is needed towards developing standards and consensus for integrating disparate healthcare providers in order to maximize the advantages of ICT in healthcare system, both for the patients and other stakeholders like government health authorities or insurance companies.



## 10. References

- Akrich, M. (1992). The De-Description of Technical Objects. Cambridge, Mass, MIT Press.
- Bruno Piotti, C. Baltazar, et al. (2006). "An Institutional Perspective on Health Sector Reforms and the Process of Reframing Health Information Systems: Case study From Mozambique." The Journal of Applied Behavioral Science **42**(91-109).
- Burkle, T., E. Ammenwerth, et al. (2001). "Evaluation of clinical information systems. WHAT can be evaluated and what cannot?" Journal of Evaluation in Clinical Practice **7**(4): 373-385.
- Charles, B. H., C. H. Jason, et al. (2005). "Virtual health/electronic medical record: current status and perspective." Int J HealthCare Technology and Management **6**(3): 257-275.
- Eisenhardt, K., M. (1989). "Building theories from Case Study Research." The academy of Management Review **14**(4): 532 - 550.
- Essex, D. (2000). "The many layers of workflow automation." healthcare Informatics **17**: 121-130.
- Forsythe, D. E. (1999). "It's Just a Matter of Common Sence": Ethnography as Invisible Work. Computer Supported Cooperative Work. **8**: 127-145.
- Geertz, C. (1973). Thick Description. THE INTERPRETATION OF CULTURE. NEW YORK, Basic Books, Inc., Publishers: 3-32.
- Giuse, D. A. and K. A. Kuhn (2003). "Health Information system Challenges: The Heidelberg conference and the future." International Journal of Medical Informatics **69**: 105-114.
- Hancock B., W. K., and Ockleford E. (2007). "An Introduction to Qualitative Research. Trent RDSU."
- Hanseth and Monteiro (1998). "Understanding Information Infrastructure (chapter 1 and chapter 3)."
- Hanseth, O. (2002). From systems and tools to networks and infrastructures - from design to cultivation. Towards a theory of ICT solutions and its design methodology implications.
- Hanseth, O. and Monteiro (1996). "Information Infrastructure Development: The Tension between Standerdization and Flexibility." The Science, Technology & Human Values **21**(4): 407-426.
- Hanseth, O. and E. Monteiro (1998). "CHAPTER 6 Socio-technical webs and actor network theory".
- Hughes, T. P. (1994). Technological Momentum, The MIT Press.
- ITIHI (2005). Framework for Information Technology Infrastructure for Health in India. New Delhi. **2**.
- Johanna, I., Westbrook, et al. (2007). "Multi-method evaluation of information and communication technologies in health in the context of wicked problems and socio-technical theory." JAMIA **14**(6): 746-755.
- Jonathan, P. A. (2004). "Redefining the network: enrollment strategies in the PDA industry." Information Technology & People **17**(2): 171-185.
- Kaplan, B. (1995). "An evaluation model for clinical inforamtion systems. Clinical Imaging systems." Medinfo **95**(2): 1087.
- Kaplan, B. (1997). "Addressing organizational issues into the evaluation of medical system." Journal of the American Medical Informatics Association **4**: 94-101.
- Klein and Myers (1999). "A set of principles for conducting and evaluating interpretive field studies in information sustem." Mis Quarterly **23**(1): 67-94.
- Latour, B. (1987). Machines in Science in Action, Harvard University Press.
- Latour, B. (1988). The pasteurization of France. Cambridge and London, Harvard University Press.
- Latour, B. (1990). "Drawing things together." Representations in Scientific practice.

- Latour, B. (1991). Technology is society made durable. A sociology of Monsters. j. Law. Routledge, London: 103-131.
- Law, j. and M. Callon (1988). "Engineering and sociology in a military aircraft project: a network analysis of technological change , ." Social Problems **35**(3): 285.
- Lee, A. S. (1989). "A Scientific Methodology For MIS Case Studies." MIS Quarterly **13**(1): 33-52.
- Lenz, R., T. Elstner, et al. (2002). "A Practical Support to Process Support in Health Information systems." Journal of the Medical Informatics Association **9**(6): 571-585.
- Masys, A. J. (2005). "A systemic perspective of situation awareness." Disaster Prevention and Management **14**(4): 584-557.
- McLoughlin, I. (1999). Creative Technological Change: The Shaping of Technology and Organisations. Routledge, London.
- Mildon, J. and T. Cohen (2001). "Drivers in the electronic medical records market." Health Management Technology **22**: 14-18.
- Monteiro, E. (2000). Actor-Network Theory and Information Infrastructure. From Control to Drift: The Dynamics of Corporate Information Infrastructure. C. U. A. Ciborra. Oxford, Oxford University Press: 71-83.
- Murphy, G. F. e. a. (1999). "Electronic Health Records: Changing the Vision,." Harcourt Brace & Co., Philadelphia: 5.
- Myers, M. D. (1997). "Qualitative research in information systems." Mis Quarterly **21**(2): 241-242.
- Orlikowski, J. W. and Y. JoAnne (2006). "ICT adn Organizational Change: A Commentary." The Journal of Applied Behavioral Science **42**: 127-139.
- Ottino, J. (2003). "Complex systems." AICHe Journal **49**(2).
- Ovretveit, J., T. Scott, et al. (2007). "Improving quality through effective implementation of information technology in healthcare." Int J Qual Health Care **19**(5): 259-66.
- RCGP (1998). "Royal College of General Practitioners Health Informatics Taskeforce. Scope EHR." [www.schin.ncl.ac.uk/rcgp](http://www.schin.ncl.ac.uk/rcgp) Last accessed on March 7, 2008.
- Rowlands, B. (2005). ""Grounded in Practice: Using Interpretive Research to build Theory". " The Electronic Journal of Business Research Methodology **3**(1): 81.
- Sahay, S. (2001). "Special Issue on "IT and Health Care in Developing Countries". " EJISDC **5**(0): 1-6.
- Schwandt, T. (2001). Dictionary of Qualitative Inquiry. California, Sage, Thousand Oaks.
- Stephen, K. (2000). Proof of Vedic Culture's Global Existence. New Delhi, World Relief Network.
- Stoop, A. P. and M. Berg (2003). "Integrating quantitative and qualitative methods in patient care information system evaluation: guidance for the organizational decision maker." Methods Inf Med **42**(4): 458-62.
- Trauth, E. M. (2001). Qualitative Research in IS: Issues and Trends. Hershey, PA, Idea Group Publishing.
- Van Bommel, J. H. and M. A. Musen (1997). Handbook of Medical Informatics. Heidelberg, Springer.
- Walsham, G. (1993). "Interpreting Information Systems in Organizations." Wiley Chichester.
- Walsham, G. (1997). "Actor-network theory and IS research: current status and future prospects." In Proc. IFIP WG: 467-480.
- Webster, J. (1995). "Networks of collaboration or conflict? Electronic data interchange and power in the supply chain." Journal of Strategic Information Systems **4**: 31-42.
- Williams-Jones, B. and E. Janice (2003). "Actor-Network Theory: a tool to support ethical analysis of commercial genetic testing." New Genetics and Society **22**(3): 271-297.

## Appendix

### Interview questions:

1. What is your job and responsibilities?
2. To what extent you think EMR will assist or interfere your practice.
3. How often you use computer for personal use like checking email, surfing internet?
4. How much you are familiar with type writing of keyboard?
5. To whom you think, this EMR system will bring maximum advantage?
6. Who initiated this idea of EPR in your hospital, and why?
7. What is your future vision or plans for EPR in your hospital?
8. How are you involved ... and what is your role in the EPR implementation?
9. Do you have any expectations to how the EPR improve your work situation?
10. What were the main problems in interception phase?
11. What problems did you faced during implementation and presently, and how you are trying to solve them?
12. What measures are taken to create awareness and to train staff in your hospital? And what more do you suggest?
13. What type of motivation or incentives you are expecting from managers?
14. What is the most common problem you are facing while using EMR system? What you are doing to overcome it?
15. What you think, who will be the owner of this Patient information? To what extent do you want to share it with other hospitals. (For manager)?
16. What type of Standardization is followed while developing EPR? (For IT Staff)



Dr. S. S. Badrinath  
President & Chairman

## Medical Research Foundation

[Regd. Under Act XXI of 1860]  
18, College Road, CHENNAI - 600 006  
(An ISO 9001 : 2000 Certified Organisation)

V. Vaidyanathan  
Hony. Secretary & Treasurer

Dr. Lingam Gopal  
Chairman-Elect

Dr. T. S. Surendran  
Vice-Chairman

October 11, 2007

Dr. Shabbir Syed Abdul MD (MSc) Telemedicine  
University of Troms  
Norway  
Cell:+4797594530

Dear Dr. Shabbir

We are pleased to confirm that you may carry out research work in EPR and its functionality at our Institution. You will also be allowed to take interview with health care staff in the wards for a period of two months (November and December 2007). We are accepting your proposal to complete your thesis for the period of two months. You will not be provided accommodation and stipend. You also will not be permitted to examine patients.

Thanking you

With regards

A handwritten signature in cursive script, appearing to read 'S. Meenakshi'.

**Dr. S. Meenakshi**  
Director – Academics



Phone : 2827 1616, 2823 3556, 2831 1913 • Our Fax : 91-44-2826 4180  
e-mail : information@snmail.org, mrf@snmail.org  
WEB : <http://www.sankaranethralaya.org> • give online@icici.comunities.org



Figure 10-1 Letter of acceptance from SN

Picture of Taj-Mahal, the symbol of Love and one of the seven men made wonders located in Agra 250 kms from New Delhi India



**Picture 10-1 Taj-Mahal**