

## ABSTRACT

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Health information technology (HIT) is gaining momentum and widespread use globally in healthcare institutions through the implementation and use of HIT such as telemedicine and electronic medical records. The literature has discussed various aspects of health information technology such as increasing accessibility of healthcare, improving efficacy, reducing associated errors and providing cost efficiency. However, the potential of HIT as a medium of learning has largely been ignored by extant literature. This dissertation seeks to understand the mechanisms of learning in the context of health information technologies. It investigates learning in the context of two health information technologies- telemedicine and electronic medical records. The two essays investigate the characteristics of learning under telemedicine and under electronic records. The first essay uses a quantitative mode of investigation, while the second essay utilizes a qualitative mode of research.

The first essay deals with telemedicine, a healthcare information technology that provides healthcare across geographic boundaries. The essay investigates how the telemedicine process facilitates learning in terms of a facilitator-learner theoretical model. It explores the impact of facilitator characteristics and learner characteristics on learning. Additionally, the essay also examines the impact of individual-level variables (such as learner capability and trust in the facilitator) as well as organizational variables (such as quality of telemedicine technology) on the learning mechanism in telemedicine. Data for this essay is drawn from surveys administered over several hospitals that use telemedicine in India.

The second essay studies the role of electronic medical records in information dissemination and learning. In this essay, the role of electronic medical records in asynchronous discovery learning is investigated. It explores the impact of individual and organizational factors on self-directed learning through the medium of electronic medical records. The essay identifies factors such as case complexity, department, familiarity with technology and status that influence learning through electronic medical records and discusses the impact of these factors on learning through emerging propositions. The essay also discusses motivations for using electronic medical records (EMRs) as well as the consequences (or benefits) of using EMRs. The second essay draws on interviews of members of healthcare teams in a multi-specialty hospital that uses electronic medical records.

LEARNING MECHANISMS AND HEALTH INFORMATION TECHNOLOGY

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## Dedication

*To Kunal and Gugs*

## Acknowledgements

My dissertation involved traveling extensively around India on a shoe-string budget for the past two years. In the course of my travels I met several exceptional individuals and institutions in healthcare selflessly serving their patients in very basic conditions. I thank the doctors, nurses, technicians and administrators at various hospitals who have helped me. I also thank the people that I met during my travels who welcomed me, helped me negotiate with red-tape and patiently drew maps immaculately labeled with signposts (the burnt tree by the old hut).

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## Chapter 1: Overview

*“I swear by Apollo the healer, Asclepius, Hygieia and Panacea, I take to witness all the gods, all the goddesses, to keep according to my ability and my judgment, the following Oath and agreement: To consider dear to me, as my parents, him who taught me this art; to live in common with him and, if necessary, to share my goods with him; To look upon his children as my own brothers, to teach them this art; and that by my teaching, I will impart a knowledge of this art to my own sons, and to my teacher's sons, and to disciples bound by an indenture and oath according to the medical laws, and no others.”*

*Hippocratic Oath (5<sup>th</sup> Century BC)*

The Hippocratic oath is required of all those who enter the medical profession.

The portion of the oath quoted above primarily deals with knowledge in the context of medicine and healthcare. The oath essentially portrays knowledge of medicine as sacred and reverent. It commands the holder of this knowledge to teach and spread this knowledge, but with a caveat. Paraphrased the caveat reads:

*“All that may come to my knowledge in the exercise of my profession or in daily commerce with men, which ought not to be spread abroad, I will keep secret and will never reveal.”*

The oath recognizes the importance of medical knowledge and the power this knowledge grants its holder in terms of benefits to society and mankind at large. Knowledge in medicine (like all other areas) is valued and to a certain extent guarded. As Dewey (1938) in his seminal work *“Education and Experience”* describes, medical knowledge is learnt through the process of “ministering” to patients.

Traditionally, geographic distances have posed as barriers to the provision of healthcare. Today, with advances in information technology, mechanisms such as telemedicine connect patients and rural doctors/paramedical staff with specialists

across the world providing care to millions of individuals in need of medical attention.

Additionally, technologies such as electronic medical records provide physicians with the ability to summon a patient's entire medical history. This mitigates the loss of important patient information and ensures that medical errors will be kept to a minimum. However, the central question of how these technologies impact knowledge transfer within the network of healthcare teams is often ignored. Specifically, how do the advances in health information technologies influence learning in healthcare? What factors influence learning in the context of these technologies?

The introduction of the World Wide Web and the impact of the Internet in revolutionizing retail are topics extensively discussed by researchers. Particularly, the role of the Internet in providing customers with multiple sources of knowledge that enable the customers to make better informed choices while increasing their product knowledge has garnered much attention. In a similar vein, health information technologies provide increased access to information sources for healthcare personnel. In the case of telemedicine, previously a general practitioner was limited to referring complex cases to a specialist. In comparison, telemedicine affords these individuals the opportunity to observe first hand how a specialist proceeds with diagnosing and treating these cases. In essay 1 of this dissertation, I pose the question: Do the interactions between specialists and non-specialists act as a learning mechanism to increase the knowledge of non-specialists with respect to the specialty in question? If yes, what factors influence knowledge transfer between specialists and

non-specialists? Answering these questions will lead to an enhanced understanding of how telemedicine encounters can be improved in order to increase the level of learning and the efficacy of interactions.

Similarly, in the era of paper-based patient records, members of a healthcare team were limited to performing the tasks prescribed to them in accordance with their responsibilities and job descriptions. Following the work patterns of their colleagues, required these individuals to either refer to the paper-based record in question or to ask questions to their colleagues. More than often, the strict rules of hierarchy prevailing in healthcare organizations inhibited such interactions and limited the development of individuals' knowledge repositories outside their immediate areas of training and specialization.

Electronic medical records blur boundaries surrounding knowledge and information in patient care scenarios. Members of a healthcare team can now access information pertaining to any patient and learn about the diagnoses and treatments prescribed by other members of the medical team, enhancing their understanding and knowledge of other areas of healthcare. In essay 2 of this dissertation, I investigate how electronic medical records impact learning. I also investigate features of these records as well as organizational factors and individual characteristics that influence the acquisition of knowledge.

Organizational learning is a topic of interest to managers. Knowledge is an important asset for organizations. Even product-oriented companies rely on teams of workers. Worker knowledge and intellectual capital are keys to organizational success. Intellectual capital refers to the professional skills, know-how and relational

capabilities of employees. Human or worker capital is an element of intellectual capital and refers to the knowledge, competencies and capabilities of employees (Veltri, Bronzetti and Sicoli 2011). A firm's intellectual assets can be used to achieve competitive advantages (Argote and Ingram 2000). In particular, learning amongst a firm's employees or intra-firm knowledge transfer is an important source of competitive advantage and a driver of firm performance (Kogut and Zander 1992, 1993, 1996; Nahapiet and Ghoshal 1998; Nonaka 1994; Watson and Hewett 2006). Employee learning is a key driver of firm innovativeness and firm performance (Jaworski and Kohli 1993; Watson and Hewett 2006).

Human capital is particularly important in healthcare due to the high degree of management complexity that characterizes healthcare. As discussed by Veltri, Bronzetti and Sicoli (2011), healthcare possesses unique characteristics that include combining different types of professional expertise (such as clinical, administrative and nursing expertise), long periods of academic training (especially for healthcare professionals such as clinicians) and important skills (such as sensitivity, passion and motivation).

Hence, employee learning is important for healthcare organizations and presents an important strategic resource. However barriers to employee learning exist in most organizations. Knowledge is an important strategic resource and gives control over important firm decisions. Hence, employees may be unwilling to share knowledge possessed by them with other employees (Bock et al 2005). Health information technologies mitigate these barriers by providing opportunities for learning that overcome traditional barriers to learning. For instance, in the case of

telemedicine, a non-specialist can observe a specialist in practice examining, diagnosing and prescribing treatment plans for patients. In a traditional scenario, it would be extremely unconventional for non-specialists to accompany patients to a specialist. Electronic medical records act as a repository of knowledge. Healthcare workers can refer electronic medical records to follow and understand the actions of their colleagues with respect to a patient care scenario.

Hence, the two essays examine learning in the context of health information technologies. They draw attention to an often-overlooked advantage provided by health information technology- promoting learning in healthcare organizations. I examine learning under different circumstances. In telemedicine, the healthcare team is virtual in nature linked by telemedicine technology. Learning is synchronous with the learner (or the non-specialist) and the facilitator (or the specialist) interacting at the same time over telemedicine technology. In contrast, the essay on electronic medical records deals with conventional healthcare teams. The healthcare team members can follow and interpret the actions of other team members through EMRs, albeit not in real time. In other words, learning is asynchronous.

However, in both cases I examine active learning or learning that is initiated by the learner without any active input from the facilitator. In each essay, I identify factors that influence learning. In essay 1, I also describe the learning mechanism between non-specialists and specialists. In essay 2, I provide a discussion of the motivations for engaging in learning through electronic medical records as well as the consequences (or benefits) of EMRs. Taken together, the essays in this dissertation



provide insights into learning in healthcare facilitated by the use of health information technology.

## Chapter 2: Learning through Telemedicine: Synchronous learning

### Abstract

Telemedicine is gaining momentum as a cost-effective mechanism to provide healthcare across boundaries. In developing countries, such as India, telemedicine provides the opportunity to extend the provision of healthcare to rural and traditionally underserved areas while removing the stress and financial burden of travel on patients and their families. The composition of a telemedicine team includes both specialists (clinicians with advanced medical degrees) and non-specialists (general practitioners and technicians). The mandates of telemedicine require that patients accompanied by non-specialists communicate and seek the opinion of specialists separated by physical/geographic distance. This process increases the knowledge of non-specialists with respect to a particular specialty. There is a paucity of literature addressing the role of telemedicine as a learning mechanism for non-specialists.

Additionally, the interaction between specialists and non-specialists during a telemedicine encounter can contribute to the learning mechanism in telemedicine. In particular, the information shared by non-specialists, the feedback provided by specialists and aspects such as technical quality of the telemedicine encounter, the perceptions of trust (in a specialist) and capability (of non-specialists) require further investigation. This essay explores and defines the learning that takes place in a

telemedicine encounter. I also examine the impact of organizational variables such as the quality of technology on the learning mechanism in telemedicine.

### 2.1 Introduction

A recent media article (Lynch 2012) reports on the adoption of telemedicine by Walmart. The article describes how doctors seated miles away examine patients at local Walmarts helped by telemedicine technology (through blue-tooth devices) administered by nurses. The readings from the devices are transmitted to the doctor who in turn converses with the patient over a flat-screen television and recommends medications. This example points towards the growing popularity of medicine as a medium of providing quality long-distance healthcare.

The American Medical Association defines telemedicine as “medical practice across distance via telecommunications and interactive video technology” (Daly 2000). Initially developed to provide care in military settings (Garshnek and Burkle 1999; Huston and Huston 2000), telemedicine soon expanded to provide healthcare to rural and/or historically underserved regions (Lee et al. 2000). Telemedicine virtually transcends distance and increases specialist reach and total market healthcare delivery” (Dyb and Halford 2009; Huston and Huston 2000).

Most extant studies of telemedicine tend to focus on either the clinical or the technological aspects of telemedicine. The clinical studies examine the extension of telemedicine to different specialties such as cardiology (Kumar, Saxena and Giri 2006) and geriatrics (Chang, Yuan and Li 2009). Extant research on the clinical side also investigates the penetration of telemedicine to various geographic regions such as Africa (Kifle et al. 2006a; 2006b; Mbarika 2004), Alaska (Choudhury et al. 2008),

Amazon (Miscione 2007) and India (Sudhamony et al. 2008). On the technological side, prior research investigates factors such as bandwidth (Lu and Koutsakis 2011), cost (Gamble, Icenogle and Savage 2004; Tarakci, Ozdemi and Sharafali 2009) and security (Yang et al. 2006).

In the IS literature, researchers have now started exploring the managerial and organizational issues that affect the success of telemedicine. In this tradition, (Hu et al. 1999), propose a framework to explain physician technology acceptance. Chau and Hu (2002) extend this and show that physicians differ from managers in their decision to accept technology and base this decision on the usefulness of the technology rather than on the opinion of their colleagues or the control they possess over technological operations.

Telemedicine encounters usually involve a doctor (typically a specialist) at one end and a non-specialist (a primary care doctor or a nurse or a paramedical staff member) accompanied by a patient at the other end. Thus a telemedicine team involves a virtual team with team members connected by health information technology. Health information technology allows members of a telemedicine team (a specialist and a non-specialist) to communicate with each other and exchange their opinions about a patient. Similar to other virtual teams (Sarker et al 2002; Maruping and Agarwal 2004), a telemedicine team differs with respect to the knowledge and expertise of its members. Hence, some members of a telemedicine team (such as a specialist) are more likely to possess a higher degree of knowledge related to their clinical specialty in comparison to other members (such as a non-specialist). Hence, these members (specialists) act as knowledge repositories or sources of knowledge.

Health information technology in addition to linking team members, also allows the specialist and the non-specialist to interact with each other in real-time with respect to the diagnosis and treatment of the patient in question. This distinguishes telemedicine from traditional medical encounters involving the seeking of specialist opinion. In these (traditional) scenarios, a non-specialist simply refers the patient to a specialist. The absence of health information technology prevents interaction of the specialist and the non-specialist in real-time while the specialist examines and diagnoses the patient.

Hence, in telemedicine, health information technology affords non-specialists with an opportunity to observe the specialist in action, diagnosing and treating a patient. Also, team members in telemedicine teams take on functions that differ from regular (non-telemedicine) interactions (Nicolini 2007). To elaborate, in a telemedicine consultation, distance separates the patient and the specialist and hence the specialist can only examine the patient virtually using technological tools. The specialist relies on the non-specialist to elaborate on patient symptoms and to perform physiological examinations and laboratory tests. Thus, health information technology allows non-specialists to don non-traditional roles, continuously interact with specialists and to observe specialists diagnosing a patient in real-time. It could also facilitate learning by non-specialists. This aspect of learning through telemedicine presents an interesting research opportunity.

There is a growing interest in knowledge management and its implications for firms. A special issue of the MIS Quarterly focuses on the role of information technologies in knowledge management (Sambamurthy and Subramani 2005). Joshi,

Sarkar and Sarkar (2007), discuss knowledge management in information systems development teams. Paul (2006) explores telemedicine with respect to knowledge management. However, he focuses on the nature of telemedicine as a collaborative activity and identifies factors that make telemedicine a successful collaborative activity. Drawing on literature in information systems, medicine, psychology and marketing, I suggest that the mechanism of learning is affected by characteristics of the learner (or the recipient of learning) and the facilitator (or source of learning). To the best of my knowledge, there is hardly any research that examines learning the context of telemedicine. Although literature implies that telemedicine could act to increase knowledge sets of individuals, research has not examined the process of learning in telemedicine and the factors that influence the learning mechanism in telemedicine.

The goal of this essay is to investigate the learning in telemedicine. I propose the following 3 related research questions:

1. What is the underlying learning mechanism in telemedicine?
2. How do facilitator characteristics and learner characteristics impact the learning mechanism in telemedicine?
3. What is the impact of organizational characteristics (such as quality of telemedicine technology) on the learning mechanism in telemedicine?

I use surveys implemented across several hospitals practicing telemedicine to study learning in the context of telemedicine. The essay's findings contribute to the literature on HIT by identifying the dynamics of learning through telemedicine. They also point towards factors that can enhance or inhibit the learning in a telemedicine

encounter. This research also contributes towards the literature in knowledge management and learning by identifying the learning mechanism characterizing telemedicine and the distinguishing characteristics of this learning mechanism.

## 2.2 Theoretical Background

In this section, I discuss extant literature pertaining to telemedicine, specifically to the advantages of telemedicine and to telemedicine in the context of India. I then specify the features of telemedicine as a virtual team activity. I follow this with a discussion of learning in the context of telemedicine.

### 2.2.1 Telemedicine - Benefits and Applicability

Telemedicine involves the provision of medical care across distance by using technology such as videoconferencing (Daly 2000). Telemedicine virtually transcends the barriers of distance, allowing for patients to interact with specialists and thereby “despatializing healthcare delivery” (Dyb and Halford 2009). Simultaneously, it also allows specialists to increase their reach, serve rural areas and subsequently to increase their total market (Huston and Huston 2000).

The use of telemedicine to overcome physical and geographic barriers in the provision of healthcare has also resulted in its use in providing healthcare to rural and/or historically underserved regions (Lee et al. 2000). Examples of these range from the provision of healthcare to the Papago Indian Reservation in Arizona (Huston and Huston 2000; Lee et al. 2000; Smith 2005); providing midwives at community hospitals access to obstetrician expertise and advice (Dyb and Halford 2009; Norum et al. 2007); the management of patient encounters in Alaska (Lee et al. 2000) and

healthcare management in prisons (Charles 2000). Several nations face a paucity of healthcare in general and specialized healthcare in particular. In developing nations, such as India, specialty hospitals are largely confined to large metropolitan cities. In India, rural areas have access to only 20% of the total health services but in contrast, almost 80% of India's population resides in these rural areas (Ganapathy 2002; Pal et al. 2004). Hence, either patients or specialists have to traverse distances in order to overcome this scarcity of secondary and tertiary healthcare. This in turn leads to increased monetary costs such as travel costs and non-monetary costs including patient worry and frustration (Smith 2005).

The ability of telemedicine to provide access to expert advice across distance has led to its increased acceptance and use in developing nations, particularly in India and Africa. In these countries, telemedicine is viewed as a cost-effective method of increasing access to healthcare (Huston and Huston 2000; Smith 2005). In India, research shows that telemedicine also lowers travel and time costs and helps address rural healthcare problems (Ganapathy 2002).

### 2.2.2 Telemedicine as a team activity

Telemedicine as a group or team endeavor possesses its own unique characteristics. Telemedicine encounters involve two groups separated by physical distance, virtually connected via telemedicine. The two groups constitute a telemedicine team and the constitution of these groups varies and includes various combinations such as a patient accompanied by a doctor communicating with a specialist; a patient accompanied by a non-doctor healthcare provider communicating with a doctor/specialist; a patient directly communicating with a doctor or a



specialist; a patient communicating with medical providers who are not doctors; and a doctor, typically a non-specialist communicating with a specialist. Thus in a telemedicine team, members are separated by physical distances. Maruping and Agarwal (2004) define virtual teams as “geographically/organizationally dispersed and [using] information and connection technology (ICT) as a medium for team communication”. Hence telemedicine involves a virtual team (comprised of specialists and non-specialists).

Extant research in IS (Maruping and Agarwal 2004) indicates that that team members in virtual teams possess different knowledge and expertise. The composition of virtual teams with respect to member knowledge and expertise is further illustrated by Sarker et al (2002) who discuss the diversity of backgrounds and knowledge possessed by members of virtual teams and state that “Virtual teams are ICT-mediated temporary work groups often consisting of individuals with diverse backgrounds and areas/levels of expertise.....” (Sarker et al. 2002). Thus, telemedicine consists of a virtual team linked by health information technology and composed of members with varying degrees of expertise or knowledge. In the next sub-section, I discuss how differences in expertise contribute to learning in telemedicine.

### 2.2.3 Learning in Telemedicine

The framework proposed by McGrath and Argote (2000) suggest that members of an organization are repositories of knowledge. As discussed in the previous sub-section, the virtual team in telemedicine is composed of specialists and non-specialists who differ in their degrees of expertise or knowledge. It is not

unreasonable to assume in the case of telemedicine that specialized knowledge primarily resides with specialists.

Learning occurs when members of an organization interact (De Long and Fahey 2000). In telemedicine, health information technology allows specialists and non-specialists to interact with each other. This contrasts with referrals in regular clinical scenarios where a non-specialist is not privy to the interaction between a specialist and a patient and where discussions between specialists and non-specialists do not occur in real time. Hence, in telemedicine, a non-specialist is able to observe a specialist as the specialist virtually examines and diagnoses the patient. Hence, learning in telemedicine may be likened to observational learning.

As postulated by Albert Bandura (1966), observational learning occurs when an individual observes other individuals' activities and imitates the behavior. Observational learning has 4 elements or steps in the process of learning- attentional process, retention process, behavioral production process and motivational process. In the attentional process, the learner's attention is drawn to some element of the facilitator's actions. In the retentional process, the learner retains or stores this observation in his/her memory. In the behavioral production process, the learner emulates the observed behavior. Finally, the motivational process consists of the facilitator reinforcing the observed and emulated behavior through rewards and punishments. In the case of telemedicine, the attentional process could occur when the non-specialist observes the specialist as s/he remotely examines and questions the patient. The retentional process would involve the non-specialist storing this observation in his/her memory and the behavioral production process would involve

the non-specialist recalling or emulating this behavior in his/her own place of work or at a future telemedicine consultation. However, the final element of observational learning (the motivational process) is not a part of telemedicine as the facilitator (the specialist) does not play an active role in the process and learning is completely controlled by the learner (the non-specialist). In this aspect telemedicine does not completely fulfill the defining characteristics of being an observational learning process.

Telemedicine is also similar to situated learning (Lave and Wenger 2003). In situated learning, the learning process or mechanism occurs as an unintentional event when newcomers and old-timers interact in a community of practice. In the case of telemedicine, non-specialists almost unconsciously learn while participating and interacting with specialists in a telemedicine encounter. In situated learning, the interaction between novices and experts is termed 'legitimate peripheral participation' and situated learning results in the novices gradually becoming experts and mentors to other novices. In telemedicine, while the non-specialist unintentionally gains knowledge, it would be incorrect to assume that the non-specialist would gain sufficient skills in the specialty to eventually mentor another novice in the concerned specialty. Thus, telemedicine varies slightly from this aspect of situated learning.

Learning in telemedicine is a form of active learning as learners discover concepts on their own and apply these concepts to their own knowledge base to fit their backgrounds and experiences. The telemedicine learning mechanism is also a form of synchronous learning. Synchronous learning entails the learner and the facilitator simultaneously interacting through means of computer-mediated

technology. In telemedicine, the facilitator (or the specialist) and the learner (or the non-specialist) interact in real time over health information technology.

Thus, learning in telemedicine possesses its own unique characteristics that operate in a complex virtual environment. Additionally in telemedicine, organizational variables such as the quality of technology, may play a role in learning. The mechanism of learning in telemedicine is also subject to the characteristics of telemedicine team members- in particular, the characteristics of the facilitator of learning (or the specialist who is the repository of specialty-related knowledge) and the characteristics of the learner (or the non-specialist). This study seeks to study the mechanism of learning in telemedicine and the effect of source characteristics, recipient characteristics and organizational variables on the transfer of knowledge. In the next section, I develop hypotheses about the impact of source characteristics and recipient characteristics on information transmitted from recipients to the source and on feedback provided by the source to the recipient. I also outline the role of organizational variables (quality of technology) as moderators.

### 2.3 Hypothesis Development

#### 2.3.1 Model Assumptions

This essay is limited to telemedicine scenarios where a telemedicine team consists of a patient accompanied by a non-specialist (usually a general practitioner or a technician) at a physical site called the ‘spoke site’ and a specialist who is located at another physical site called the ‘hub site’ (Gamble, Icenogle and Savage 2004). The team members virtually interact with each other through telemedicine technology.

This virtual interaction is termed as a teleconsultation. The spoke site and the hub site are separated by physical and often geographic distance. Figure 1 illustrates the teleconsultation.

I follow extant literature and define specialists as experts or “those who have been recognized in their profession as having the necessary skills and abilities to perform at the highest level” (Shanteau 1992). This implies that specialists being consulted are experts in comparison to the non-specialists (general practitioners and technicians) who are non-experts with respect to a given medical specialty. The non-specialist and the specialist differ in terms of knowledge and information. I term these differences as knowledge asymmetry and information asymmetry:

**Knowledge Asymmetry:** Specialists possess a higher degree of knowledge with respect to the specialty, and often possess higher educational qualifications than non-specialists. In medicine, specialists are required to possess both a degree in general medicine as well as a degree in their area of specialty. In contrast, non-specialists such as general physicians or technicians do not possess specialized degrees. Given this, it is reasonable to assume that specialists/experts possess a higher degree of knowledge with respect to their specialty than general physicians/non-experts. This assumption finds justifications in the definitions of expertise by extant research which describes experts as being in the “most advanced state of knowledge which allows them to achieve dramatic improvements in the speed and accuracy of task performance” (Brockmann and Anthony 1998). Hence, in a telemedicine team, members differ in terms of knowledge possessed with respect to a given specialty. In other words, there is knowledge asymmetry (Lin, Geng and Whinston 2005) with the

specialists possessing higher knowledge and acting as repositories of knowledge (Argote and Ingram 2000; De Long and Fahey 2000). I categorize specialists as facilitators of learning and non-specialists as learners.

**Information asymmetry:** Additionally, in telemedicine, the non-specialist is in direct contact with the patient and can hence examine the patient and his symptoms via a face-to-face interaction. In contrast, the specialist can only examine the patient virtually. Hence an asymmetry of information (Lin, Geng and Whinston 2005) exists, with the learner possessing complete patient information. This information must be transmitted to the facilitator (or source of learning) in order to receive patient feedback and facilitate learning.

The dual mechanisms of information asymmetry and knowledge asymmetry combine to create the learning mechanism in telemedicine. Knowledge asymmetry and information asymmetry in turn create the mechanism of feedback and information sharing. These mechanisms (feedback and information-sharing) are in turn affected by organizational-level factors and individual level factors. I discuss the learning mechanism, its components and factors influencing the learning mechanism in the following sections

### 2.3.2 The Learning Mechanism in Telemedicine

I propose that the learning mechanism in telemedicine consists of 4 stages or steps. These include the initiation of learning, information sharing from a non-specialist to a specialist, feedback given by a specialist and the interaction between information shared and feedback exchanged. Each of these stages is detailed below:

a) **Initiation of learning:** As described in the preceding section, knowledge asymmetry prevails in telemedicine with specialists/ experts possessing a higher degree of knowledge in their specialty than non-specialists/non-experts. This implies that a gap in knowledge exists between specialists and non-specialists, with the specialists possessing a higher degree of specialty related knowledge (Marshall 1998). This gap in the knowledge necessitates the learning mechanism. Learning begins or is initiated when a need is identified (Szulanski 1996). The initiation stage consists of the identification of this need, and subsequently finding knowledge to satisfy this need. In the telemedicine scenario, the knowledge gap may be equated to the need. The satisfaction of this need or the solution to this need lies in the learning mechanism that occurs between experts and non-experts.

Exchange theory (Blau 1964; Homans 1961) argues that an individual will interact with other individuals if his expected outcome of interaction is positive. Javalgi et al (1993) have extended the notion of exchange theory to medicine, and in particular to the context of specialist and non-specialist interactions. They posit that advantages including patient access to the best possible treatment and consequently patient satisfaction initiate interaction between non-specialists and specialists. They however study the process of referrals in a traditional medical scenario whereby which primary care physicians transfer patients to the care of specialists. I extend this to telemedicine and posit that the knowledge differential between specialists and non-specialists acts as an added motivation/benefit for non-experts/ non-specialists who seek a specialist's opinion on a patient expecting a positive outcome in the form of learning. I find support in Berendsen et al (2006; 2007) who note that non-specialists

are eager to learn by collaborating with specialists. Hence, knowledge asymmetry triggers or initiates the learning mechanism in telemedicine. At this stage, the non-specialist assumes the role of the learner and views the specialist as the facilitator of learning. However, the facilitator (specialist) plays a passive role and is unconscious of his role in imparting learning. The initiation of learning is followed by the sharing of information between specialists (facilitators) and non-specialists (learners).

b) **Information-sharing:** Following initiation, the learner (the non-specialist) approaches the specialist (facilitator) for his/her opinion with respect to a patient. However, as discussed earlier, information asymmetry exists with non-specialists (learners) possessing complete patient-related data relative to specialists (facilitators). The specialized nature of healthcare and the need for learning leads to information sharing (Goh, Gao and Agarwal 2011). Non-specialists share information such as patient data and reports with specialists to gain the specialist's opinion (Lin, Geng and Whinston 2005). Information asymmetry affects learning (Gigone and Hastie 1993; Lin, Geng and Whinston 2005; Stasser, Taylor and Hanna 1989; Stewart and Stasser 1995). The completeness of information provided, affects the efficacy of learning (Gnyawali, Stewart and Grant 1997; Lin, Geng and Whinston 2005; Murray and Peyrefitte 2007; Thomas-Hunt, Ogden and Neale 2003). A limited amount of time is available within a teleconsultation. If a learner (non-specialist) provides all the information s/he possesses with respect to a patient scenario, then the specialist (facilitator) can focus his/her energies on diagnosing the patient and prescribing treatments for the patients. In other words, the telemedicine encounter can proceed quickly to its outcome. On the other hand, if the non-specialist does not provide



complete information on a patient, the specialist will need to spend more time attempted to gain pertinent information on the case from the specialist and this will adversely affect the efficacy of the telemedicine encounter and the efficacy of learning that occurs in the course of the telemedicine encounter. Hence, I propose that increased levels of information sharing positively contribute to learning:

*Hypothesis 1: A positive relationship exists between the information provided by the learner (non-specialist) and the learner's perceptions of learning in a telemedicine encounter.*

c) **Feedback exchanged:** Following the sharing of information, the specialist will provide his/her opinion and proposed treatment plan to the non-specialist. This is termed as feedback exchanged. Feedback is an essential prerequisite for learning. If an environment provides good feedback, skill and expert intuition will develop (Kahneman and Klein 2009). Feedback/communication helps novices learn and the absence of feedback can hamper learning by increasing cognitive loads on individuals and preventing them from adequately processing and retaining knowledge (Bonner and Walker 1994). An expert source will initiate feedback and thereby transfer knowledge from itself to a less expert source (Perloff 1993; Szulanski 1996). Feedback facilitates interaction and creates a shared context to facilitate learning (Davenport and Prusak 1997; Sarker et al. 2002; Szulanski 1996; Von Krogh, Ichijo and Nonaka 2000). The frequency of feedback (Bresman, Birkinshaw and Nobel 1999; Burkink 2002; Cumming and Teng 2003; Leenders, Engelen and Kratzer 2003; Szulanski 1996) is an important factor in learning. Non-specialists want feedback about the quality and appropriateness of their referrals (Marshall 1998).

Feedback decreases the knowledge asymmetry between specialists and non-specialists and aids in learning. As with any team activity, the extent of feedback exchanged by the facilitator with the learner is an important factor in learning (Bresman, Birkinshaw and Nobel 1999; Joshi, Sarker and Sarker 2007). In accordance with this, I propose that higher levels of feedback positively influence the learner's (non-specialist's) perceptions of learning from a telemedicine encounter:

*Hypothesis 2: The level (frequency and extent) of facilitator feedback positively influences the learner's perceptions of learning in a telemedicine encounter.*

**d) Interaction between information-shared and feedback exchanged:**

Information-sharing and feedback are interconnected processes. However, the nature of interaction between information-shared and feedback is complicated. On one hand, gaining complete information helps specialists form a comprehensive understanding of the problem at hand and facilitates better-informed decisions and feedback (Gnyawali, Stewart and Grant 1997; Lin, Geng and Whinston 2005; Murray and Peyrefitte 2007; Thomas-Hunt, Ogden and Neale 2003). On the other hand, researchers observe that communication, courtesy, respect and reciprocation are key conditionals in the interactions between specialists and non-specialists (Ludke and Levitz 1983). Research indicates that treating general physicians with respect is important for the making of a successful telemedicine encounter, and non-specialists may feel discouraged from learning if the information they provide is not reciprocated with a high level of feedback from the specialist (Paul 2006).

Hence, there are two perspectives, each of which suggests a different form of the interaction between information-shared and feedback. The first predicts that

learning will be high when information-shared and feedback exchanged are both high. The other predicts that when non-specialists share a high level of information, they expect specialists to reciprocate with a proportionally high level of feedback. When a non-specialist provides a high amount of information, s/he will be more sensitive to the feedback provided by the specialist: the more the feedback provided by the specialist, the more the learning from the telemedicine encounter. This may be considered as a complementary hypothesis and is detailed in the following proposition:

*Hypothesis 3: Information sharing will moderate the relation between feedback and learning, such that the relation between feedback and learning will be positive for individuals who provide a relatively high level of information-sharing, and will be weaker for those who provide a relatively lower level of information-sharing.*

This interaction between information-sharing and feedback comprises the last and final stage of the learning mechanism. In the next section, I discuss the influence of organizational variables and individual-level variables on the learning mechanism.

### 2.3.3 Factors Influencing the Learning Mechanism in Telemedicine

In this section, I discuss the impact of individual-level variables (such as capability and trust in the facilitator) and organizational-level variables (such as the quality of technology) on information-shared and feedback-exchanged and thereby on the learning mechanism in telemedicine.

**A) Effect of learner (non-specialist) characteristics:** Characteristics of the learner (such capability) affects the ability of the learner to provide relevant information to the specialist. Additionally, learner capabilities

affect absorptive capacity (the ability to absorb the feedback) and retentive ability (the ability to retain and use feedback and the resultant knowledge) and affect the success of learning (Druckman and Bjork 1991; Glaser, Abelson and Gamson 1983 ; Szulanski 1996). An absence of absorptive capacity handicaps learners from exploiting feedback and knowledge gained from sources and affects learning (Szulanski 1996). Thus, I propose that individuals with high learning (absorptive and retentive) capabilities are likely to provide more relevant and clear information to facilitators acting to strengthen the positive relationship between information sharing and learning.

*Hypothesis 4: Learner characteristics (such as capability) will strengthen the relationship between information provided by the learner and learning in a telemedicine encounter.*

**B) Effect of facilitator (specialist) characteristics:** Characteristics of the source, that is the specialist or facilitator of learning impact the relationship between feedback exchanged and learning (Kahneman and Klein 2009). These factors include source credibility (Bock and Kim 2002; Davenport and Prusak 1997; Joshi, Sarkar and Sarkar 2007; Von Krogh, Ichijo and Nonaka 2000; Sarker et al 2002). A facilitator, perceived as credible or trustworthy is more likely to affect learning (Szulanski 1996). I follow extant literature and define facilitator trust as consisting of the trust placed by the learner in facilitator's diagnosis and treatment plan (De Long and Fahey 2000; Joshi, Sarkar and Sarkar 2007;

Javalgi et al 1993). I hypothesize that learners are more inclined to trust and learn from the feedback provided by facilitators who are perceived as being more trustworthy than those who are perceived as being less trustworthy. Thus, facilitator trust is likely to strengthen the positive relationship between feedback and learning in telemedicine.

*Hypothesis 5: Facilitator characteristics (such as trust in a facilitator) will strengthen the relationship between feedback provided by the facilitator and learning in a telemedicine encounter.*

The above sub-sections discuss the impact of individual-level variables on information-sharing and feedback. In the next sub-section, I discuss the impact of technology (an organizational-level) variable that affects both information-sharing as well as feedback in a telemedicine encounter.

**C) Effect of technology quality:** Karlsen and Gottschalk (2004) note that video technologies (such as health IT) can affect learning. Studies report that technical problems interfered with information sharing and exchanging feedback (Barton et al. 2007; Javalgi et al. 1993). Research in IS has also demonstrated that technological characteristics such as perceived ease of use and usefulness of telemedicine technology influence information sharing and feedback (Chau and Hu 2002; Hu, Chau and Sheng 2002). The ease of use of a technology impacts learning (Chau and Hu 2002; Szulanski 1996). I posit that technological aspects such as the

quality of technology influence both information-shared as well as feedback exchanged:

*Hypothesis 6a: The quality of technology will strengthen the positive relationship between information sharing and learning.*

*Hypothesis 6b: The quality of technology will strengthen the positive relationship between feedback and learning.*

Figure 2 shows the learning mechanism in telemedicine. As discussed in the preceding paragraphs, information shared and feedback exchanged both affects learning. Information sharing and feedback exchanged also interact with each other. Learner capability and trust in the facilitator influence information-sharing and feedback respectively. The quality of technology during the teleconsultation affects both information sharing as well as feedback exchanged.

## 2.4 Methodology

### 2.4.1 Instrument Development

A survey questionnaire (please see Appendix A and B) was developed to test the hypotheses in this study. I prepared a questionnaire for specialists and a separate questionnaire for non-specialists. Unless otherwise noted, all survey items were rated on a five-point scale ranging from 1 = strongly disagree to 5= strongly agree.

**Dependent Measures:** Learning was operationalized as a 4-item scale measuring the perception of a non-specialist regarding learning in the course of a telemedicine encounter. Sample items for learning include: “After the teleconsultation, I feel I have increased my knowledge about the specialty.”

**Independent Variables and Control Variables:** Information sharing was operationalized as a 4-item scale and measured the extent to which specialist perceives the extent of patient related information (such as test results, important patient symptoms and patient past history) shared by the non-specialist. Sample items for information sharing include: “The non-specialist is able to provide sufficient information on the length and duration of the patient’s symptoms” and “ On an average, the non-specialist is well aware of a patient’s history”.

Feedback was defined as a 4-item scale measuring the perceptions of the non-specialists regarding the extent and frequency to which a specialist discusses diagnosis, treatment plans and reasons for treatment plans with the non-specialist. Sample items for feedback include “The specialist discusses the reasons for his/her diagnosis with me.”

Quality of technology was defined a 5-item scale measuring an individual’s (the non-specialist’s) rating of the overall technical quality of the telemedicine encounter. Sample items include “Overall the quality of the telelink was good”, and “The overall technical aspects were good”.

Capability (of the non-specialist) was defined as a 5-item scale measuring the specialist’s rating of the non-specialist’s level of medical skills and diagnostic abilities. Sample items include- “The non-specialist displays an ability to acquire new skills”. Trust (in the facilitator) was operationalized as a 5-item scale measuring the extent to which the non-specialist perceives the specialist as being knowledgeable and the extent to which the non-specialist trusts the diagnosis of the specialist. Sample items include: “I would rate the specialist’s diagnosis as credible.”

I also include several controls. Demographic controls include sex (dichotomized as male and female), age (categorized into increments ranging from the lowest age of entry into the healthcare workforce to retirement; creating a categorical variable) and education (categorical). I tested for non-response bias by comparing the responses of early respondents with late respondents (Armstrong and Overton 1977). Non-response bias did not appear to be a concern.

#### 2.4.2 Sample and Survey Distribution

Specialists were defined as individuals possessing specialized medical degrees in an area of medicine such as ophthalmology or oncology. A M.B.B.S (Bachelor of Medicine, Bachelor of Surgery) degree in India is considered as the equivalent of a M.D. degree in the United States. In contrast to its American counterpart, individuals may be admitted to an M.B.B.S program immediately after high school. In contrast, admission to medical school in the United States usually requires individuals to complete at least 3 years of premed courses at the university level. Additionally, in India, after acquiring a M.B.B.S degree, individuals can choose to practice medicine or to acquire higher more specialized degrees. These specialized degrees in the India are called M.D (doctor of medicine) degree. In the United States after acquiring an M.D. individuals can practice medicine or go in for a fellowship in the specialty of their choice. I wish to stress on these potentially confusing distinctions between medical education in the United States and India to avoid any misinterpretations.

Hence, in the context of this study, I define specialists as individuals who possess a specialized degree (that is a M.D. degree). Non-specialists consists of general practitioners and paramedical staff who possess a M.B.B.S degree or other



qualifications such as a Bachelors, Masters or Diploma in healthcare. The survey was pre-tested with 10 specialists and 10 non-specialists (5 general practitioners and 5 paramedical staff members) who regularly participate in telemedicine consultations. As my research questions focus on perceptions of telemedicine by specialist- non specialist dyads, I attempted to maximize the variance within specialist- non specialist dyads by selecting a research design that would span as many healthcare institutions as possible. I contacted hospitals practicing telemedicine across India. Twenty hospitals agreed to participate in the study. I coded the surveys with identification numbers. I asked the hospitals to distribute the surveys to different specialist non-specialist dyads ensuring that each specialist- non-specialist pair got surveys with identical identification numbers. This was done in order to minimize multiple responses by non-specialists who share the same specialist or vice versa. I distributed 500 surveys. A total of 217 surveys were returned, 19 surveys were discarded due to incomplete data. The final data set included 84 matched specialist non-specialist dyads, that is a total of 168 participants.

#### 2.4.3 Descriptive Statistics

Table 1 summarizes the demographic profile of the respondents. 76.2% of the non-specialist respondents are females. 41.7% of non-specialists possess a basic medical degree (M.B.B.S) while the rest possess a bachelors degree or a high school diploma. Non-specialists range from 19 to 35 years in age with majority of the non-specialists (57.1%) in the 24 to 28 years age group, 19 % in the 19-23-age group and 23.5% in the 29 to 35 age group. In contrast, the specialists have a wider age range from 24 years to 59 years. This is logical as specialists tend to spend more time in

medical school before joining the work force and all specialists in the sample possess a specialized medical degree (M.D. degree). Specialists tend to be concentrated in the 24 to 28 age group (35.7%) and the 29 to 35 age group (35.7 %). There are more male specialists (59.5%) than female specialists (40.5 %). Table 2 shows a list of the hospitals involved in the survey and includes the number of beds, the number of cases and the number of telemedicine consultations on basis.

I check the reliability of the questionnaire using Cronbach's alpha. Table 3 shows the means, standard deviations and reliabilities of the survey constructs. Cronbach's alpha for each of the constructs exceeds 0.7 considered to be a good measure of reliability for a developing questionnaire (Bowling 1997). I also check the internal consistency of the questionnaire by checking corrected to item total correlations. Kline (1993) recommends deleting any item with a corrected to item total correlation of less than 0.3.

I test the validity of the constructs using factor analysis as some items are adapted from studies in information systems as well as from medicine. The KMO (0.694) and the Bartlett's test of sphericity (significant at 0.000) conform to the acceptable levels for factor analysis. Principal component analysis is used to evaluate if the items are linked to their underlying factors. All items have factor loadings greater than 0.5 and loaded on relevant constructs. Table 4 shows the results of the factor analysis. I checked the constructs for multicollinearity. As shown in Table 5, variance inflation factors for all constructs are low (less than 3) indicating no multicollinearity issues. Additionally, the inter-item correlation matrix in Table 6 does not show any correlations between the independent variables exceeding 0.8.

## 2.5 Results

I tested the study hypotheses using a step-wise multiple regression. Table 7 presents the results of the step-wise regression analysis for learning. In step 1, I entered control variables such as education, gender and age. In step 2, I entered the independent variables. These include information sharing (IS), feedback (FB), learner capability (LC) and facilitator trust (TR). In step 3, I enter the interaction terms between information sharing, feedback and individual and organizational variables.

The addition of step 2 added significant variance in individual perceptions of learning. Overall, the addition of the independent variables accounted for 20.8% of the variance in the model. The independent variables significantly improve prediction of learning. Adding, the interaction effects of information sharing, feedback, individual and organizational variables accounted for another 13.1% of the variance. As expected, the interactions accounted for significant incremental variance in learning.

The first study hypothesis stipulated a positive effect of information sharing on learning. This hypothesis was supported (standardized beta = 0.232). The second hypothesis (H2), proposed that a positive relationship exists between feedback and learning. The step-wise regression results show support for this hypothesis (beta = 0.318). Hypothesis 3 focused on the interaction between information sharing and feedback. Results indicate that this interaction was a significant predictor of learning (beta = -.044). As this interaction was significant, I also tested whether the simple slopes of the regression lines at low (-1 SD) and at high (+1 SD) levels of the

moderator were significant. As seen in Figure 3, tests of simple slopes reveal that when information sharing is high (slope is high and significant), it strengthens the relationship between feedback and learning. Conversely, low information sharing weakens the relationship between feedback and learning. Thus, I find support for hypothesis 3.

In step 3, hypothesis 4 predicting that learner capability will positively influence information sharing and learning is supported (beta= 0.417). I also find support for the fifth study hypothesis which predicts that trust in the facilitator will positively influence feedback and learning (beta=0.296). The final two hypotheses deal with impact of technology. Results reveal that technology quality positively affects the relationship between information-sharing and learning (beta=0.277). Analysis also reveals that technology quality positively affects the relationship between feedback and learning (beta=0.112). Thus, Hypotheses 6a and 6b are supported.

## 2.6 Discussion

In this section, I provide a discussion of the study's results and implications, study limitations and directions for further research.

### 2.6.1 Implications

This study investigated the role of telemedicine in facilitating learning between specialists and non-specialists. While extant literature has discussed several aspects of telemedicine, the role of telemedicine in learning in healthcare has been

largely overlooked. The results from the study indicate that telemedicine contributes to non-specialist's perceptions of learning. This points towards an important (and understated) benefit of telemedicine. The study also hypothesized that learning in telemedicine takes place through the dual and complementary mechanisms of information-sharing and feedback. Results from the analysis reveal that information-sharing and feedback significantly and positively influence learning in a teleconsultation. The finding on the effect of information sharing on learning suggests that healthcare organizations can conduct regular training and education programs to ensure that non-specialists are familiar with the basics of select specialties and order sufficient tests to maximize the efficiency of learning in telemedicine encounters.

The learning mechanism described in this study proposes learning in telemedicine consists of information-sharing, feedback and the interaction between information-sharing and feedback. This is supported by results from the analysis. An interesting implication of the analysis reveals that high levels of information-sharing coupled with low levels of feedback decrease perceptions of learning in a telemedicine encounter. This emphasizes the need for adequate feedback in specialist non-specialist dyads to ensure that the interaction is conducive to learning. Healthcare administrators could emphasize on the need for specialists to provide non-specialists with sufficient feedback and reasons for their diagnosis and treatment plans and thereby increase learning through telemedicine encounters.

This research study also explores and identifies the role of individual-level and organizational level factors on the non-specialist's perceptions of learning. The findings reveal that the capability of the learner (or the non-specialist) is an important

variable that moderates the influence of information-sharing on learning. This implies that learners with higher capacities to learn will process and transfer more information and will positively contribute to the learning experience. Previous work on knowledge management in teams such as Joshi, Sarkar and Sarkar (2007), consider only the capabilities of the source of knowledge (or in this case the facilitator of learning). My research focuses on both learner (recipient) as well as facilitator (source) characteristics. Additionally, I find that the trust in the facilitator of learning (or the specialist) affects the relationship between feedback and learning, leading to higher levels of learning when the facilitator is perceived as being trustworthy. This is similar to findings by previous research (Joshi, Sarkar and Sarkar 2007) that considers facilitator (source) credibility (or trustworthiness).

The study also explores the role of organizational level factors on learning. Specifically, the quality of technology perceived in the course of the telemedicine encounter affects both the information-shared as well as the feedback exchanged and thereby affects learning. The study emphasizes the role of technology quality in telemedicine. A high level of technology quality facilitates the smooth sharing of both information and feedback. This suggests that healthcare organizations need to ensure that the quality of technology provided during telemedicine encounters is optimal to facilitate learning.

### 2.6.2 Limitations

The essay uses a survey instrument to measure learning in a telemedicine interaction rather than actually assessing a teleconsultation. Study subjects self report perceptions of learning as opposed to learning being accurately measured through

observations or improvements in performance. This weakens external validity. Assessing an actual telemedicine consultation could reveal interesting and important dynamics between specialists and non-specialists while preserving external validity. However, while this would present an ideal methodology, patient confidentiality and physician privacy ruled out this method. I believe that in this study, the surveys were appropriate surrogates of actual observation as the surveys were administered immediately following telemedicine consultations.

The unit of analysis in this essay was a specialist- non-specialist dyad. Surveys were mailed to particular specialist non-specialist dyads by parent hospitals. Some of these specialist non-specialist dyads may be at the rudimentary stages of telemedicine interactions and hence may not completely at ease with each other or may have found it difficult to rate each other. Also, time constraints of the hospitals and participants in questions prevented asking each specialist/ non-specialist involved in telemedicine consultations at a hospital to rate all the specialists/ non-specialists that they have encountered in the course of telemedicine consultations at the hospital. This study is also not able to isolate instances where non-specialists do not provide sufficient information and specialists have to request non-specialists for further information on a patient or even schedule another teleconsultation in order to accurately diagnose the patient in question.

Responses to the study were voluntary and subject to self-selection bias as interested specialists and non-specialists were more likely to respond to the survey than others. Caution is also required as the analysis only included a few study variables and hence inferences about causality cannot be made. Additionally data is

cross-sectional and not longitudinal and hence causal relationships can at best be inferred and not proven. The problem of endogeneity whereby unobserved variables are likely to be related to variables such as information-sharing and feedback and on the perceptions of learning in a telemedicine encounter must be considered and require further exploration.

Given that I use the same instrument to measure non-specialists' ratings of specialists' trustworthiness as well as non-specialists' perception of learning in a telemedicine encounter, there is a possibility of common methods variance. I tested for common methods variance but as a single factor did not emerge from the exploratory factor analysis and also as a single factor did not account for majority of the covariance (Podsakoff et al 2003), I did not find common methods bias to be present. However common methods bias is always a potential problem especially in studies involving trust and can only be minimized by implementing longitudinal surveys. A longitudinal study was not possible due to administrative barriers from the hospitals in question. Finally, my study explores perceptions of learning in telemedicine encounters that take place in an international setting (India). Eastern cultures such as India are highly collectivist (Hofstede 1991). Specialists and non-specialists from other cultures (such as the United States) may exhibit considerable differences with respect to the learning mechanism in telemedicine as well as factors influencing the learning mechanism. Additionally, the Indian healthcare system is unencumbered by insurance and third-party liability concerns. Thus, it is possible that the study results are not entirely generalizable to other countries such as the United States.



### 2.6.1 Future Research

The current model of the learning mechanism in telemedicine is at its preliminary stage and is basic in nature. Several individual-level and organizational-level variables could contribute to the learning mechanism. Individual-level variables such as learner and facilitator motivations, personality dimensions (Barrick and Mount 1990), learning styles (Bostrom, Olfman and Sein 1990), personal innovativeness (Agarwal and Prasad 1998) and experience or familiarity with technology could affect the learning mechanism in telemedicine. Organizational-level variables such as status cues may also affect the learning mechanism in telemedicine. Future research could also extend the learning mechanism model proposed in this study to include these variables.

Future research could also examine how learning in a telemedicine encounter affects individual attitudes towards telemedicine. Future work could also seek to employ a longitudinal study of telemedicine encounters. Finally, research could be conducted on the learning mechanism in telemedicine encounters taking place in Western countries (such as Europe or the United States) where culture is less collectivist in nature. This would present an interesting avenue for future research.

### 2.7 Conclusions

Despite its limitations, this study makes important contributions. Learning is central to organizational success and innovation and presents an important strategic and competitive advantage. Healthcare is characterized by increasing competition and

hence learning in healthcare is an important resource. There is a paucity of literature discussing learning with respect to health information technology. This study appears to be one of the first to investigate learning in the context of telemedicine.

My research provides an insight into learning in telemedicine teams composed of individuals with varying degrees of information and expertise. In particular, I examine self-motivated and directed learning or active learning in the context of virtual teams (such as those in telemedicine). Learning in telemedicine is also synchronous with the learner and the facilitator communicating in real-time. This research examines the impact of information asymmetry and knowledge asymmetry and the resultant learning mechanism involving feedback and information sharing. I also include important psycho-social elements that pertain to both the learner (or the recipient of learning) as well as the facilitator (or the source of learning).

More generally, this essay contributes to the literature on learning and knowledge management. This project included an extensive survey of healthcare institutions that practice telemedicine in India. As India is rapidly emerging as a center for healthcare tourism and a strong player in the healthcare market, this study could have potential managerial implications in Indian healthcare in particular. Learning is an important strategic resource for organizations and self-directed learning aided by health information technology (such as telemedicine) presents a powerful and important tool for organizational success.

## Chapter 3: Health Information Technology as an Equalizer: Asynchronous Learning through Electronic Medical Records

### *Abstract*

Electronic medical records or EMRs help in managing patient data and records and provide personnel in healthcare organizations with access to a comprehensive set of patient care data. EMRs offer several benefits such as the coordination of patient care, minimizing medical errors and providing timely alerts and reminders to physicians. The data provided by electronic medical records also allows healthcare personnel to observe the actions of their colleagues with respect to patient care. However, the impact of EMRs on learning in healthcare is ignored by extant literature.

In this study, I investigate perceptions of individuals in healthcare towards learning through electronic medical records. Through a series of semi-structured interviews, the study identifies factors affecting learning through EMRs and presents the influence of these factors through emerging propositions. The study also identifies individual motivations for engaging in learning through electronic medical records. The analysis also reveals important consequences (benefits) of using electronic medical records in healthcare. The study contributes to the health information technology and knowledge management literatures.

### 3.1 Introduction

Research in health informatics and information systems development (ISD) highlights the role of health information technology (HIT). HIT support can help hospitals by reducing the burden of organizational tasks and records such as scheduling appointments, preparing and maintaining medical charts and coordination between individuals and departments (Lenz and Reichert 2007). Health information technology such as electronic medical records or EMRs can help reduce the amount of resources and effort, minimize errors, enable greater productivity and a more efficient use of resources.

Electronic medical records are an important element of health information technology as well as of health care reform as evidenced by the amount of money invested in developing comprehensive and centralized nation-wide EMRs by countries such as the United Kingdom (a total investment of 24.7 billion dollars till date) and the United States (proposed investment of 75 billion dollars to 100 billion dollars). The United States government has adopted the HITECH (Health Information Technology for Economic and Clinical) Act that provides subsidies to providers and hospitals that implement electronic medical records.

Literature emphasizes the role of electronic medical records or EMRs and their role in affecting healthcare outcomes such as healthcare productivity (Eastaugh 2010). Literature also focuses on technological innovations in EMRs such as CPOE or computerized physician order of entry (Eastaugh 2010, Koppel et al 2005). Extant work also points towards the failure of electronic medical records in healthcare scenarios. Research shows that electronic medical records or EMRs are complex to

develop but less likely to produce improvements in efficiency or revenue (Davidson and Heineke 2007). The failure of computerized healthcare technologies such as EMRs to influence clinical activities has also been discussed (Liu, Wyatt and Altman 2006). The study of information technology in healthcare is limited to discussions about the capabilities of the technology, user issues and concerns with the technology, factors that affect the adoption of technology by individuals, factors governing usability of the technology and specific advances in health information technology. Additionally, the study of knowledge management in health information systems is limited to studying the impact of technology related knowledge on individual performance.

Electronic medical records require members of healthcare teams to fill in information related to a patient care scenario. Healthcare team members also read and interpret the information filled in by other team members in EMRs. In comparison to paper-based records, the information is now available instantaneously and can be viewed even after the episode of care through electronic medical records. Thus, electronic medical records act as electronic knowledge repositories and facilitate the entry and interpretation of information. I propose that by accessing the information contained in EMRs, members of healthcare teams can read, interpret and learn from the actions of their colleagues with respect to a particular patient care scenario. In simple terms, electronic medical records provide healthcare teams with access to information detailing the role of each member's contribution to a patient care scenario. Interpreting and understanding these actions and details can lead to individual level learning in healthcare.

Although literature yields considerable insight into the numerous advantages of EMRs, very little attention has been paid to the learning that occurs through studying electronic medical records, the differences in learning across different levels of the healthcare hierarchy and the influence of factors such as familiarity with technology on learning through electronic medical records. Work on health information technologies, is largely silent on the capacity of EMRs to facilitate the transfer of information between healthcare team members, the resultant knowledge acquisition or learning by team members and the factors influencing learning. The role of electronic medical records in information dissemination and learning, presents an important and interesting research opportunity.

The goal of this essay is to investigate the effect of electronic medical records on learning in healthcare. In an effort to investigate learning in the context of EMRs, I propose 3 related research questions:

1. Are electronic medical records used as a source of learning by individuals employed in healthcare use?
2. What is the effect of individual characteristics (such as familiarity with technology) and organizational characteristics (such as clinical specialty and status in the organizational hierarchy) on learning through EMRs?
3. What are the motivations underlying learning through electronic medical records?

Specifically, through semi-structured interviews, I identify the features of learning through electronic medical records and distinguish between asynchronous situated learning through EMRs and asynchronous discovery learning through EMRs.

After articulating the study's research method, I present the results of the data analysis in the form of a set of formal observations (propositions) detailing the influence of various constructs on asynchronous discovery learning through electronic medical records. These observations present an emerging picture of individual and organizational factors influencing learning through electronic medical records. I identify individual motivations for engaging in asynchronous discovery learning through EMRs. Finally, I discuss how individuals in healthcare perceive EMR consequences (benefits).

### 3.2 Background and Literature Review

In this section, I provide a short overview of electronic medical records (including EMR history and a description of EMR content). I follow this with a discussion on the advantages and disadvantages of electronic medical records as discussed by extant literature. I then specify the features of learning in the context of EMRs. I end this section by identifying factors that may influence learning in the context of electronic medical records and presenting tentative propositions on how each of these factors influence learning through EMRs.

#### 3.2.1 Electronic Medical Records- History and Characteristics

An electronic medical record is defined as all “electronically stored records of any aspect of patient treatment that has official status within the hospital system and is in principle stored for a period of time (at least equal to the patient's stay in the hospital” (Berg and Bowker 1997). The history of electronic medical records or EMRs can be traced back to 1969 when the first electronic medical record named

PROMIS (Problem Oriented Medical Record) was developed at the Medical Center of Vermont. PROMIS was structured around problem lists. Almost simultaneously, a similar version called ARAMIS (American Rheumatism Association Medical Information System) was developed. In contrast to PROMIS, ARAMIS was a time oriented medical record. Improvements such as incorporating medical reminders into EMRs were implemented as early as 1972 with RMRS (Regenstrief Medical Record System) at the Wishard Memorial Hospital.

Over the years, electronic medical records have considerably evolved. Electronic medical records now consist of two parts- an administrative component (with patient details and billing details) and a clinical component. The clinical component is broken into 4 sections known by the acronym SOAP. The symptom section deals with the presentation of patient complaints, the observation section notes patient test results, the analysis section gives the clinician's diagnosis and the treatment section provides the clinician's prescribed treatment plan for the patient. In addition, EMRs often provide automatic reminders and warnings such as potential medicine interactions and patient reminders. They also provide platforms for healthcare teams to send patient related email and to place orders for medication. Electronic medical records are often confused with electronic health records or EHRs. EHRs are electronic medical records aggregated across all hospitals (geographic locations) and across time for a patient. That is, EHRs provide a complete longitudinal summary of patient related data (Ludwick and Doucette 2007).



### 3.2.2 EMRs: Benefits

Electronic medical records offer several benefits including saving nursing personnel time, permitting more thorough and consistent documentation than paper charts; sorting the information into different categories; enabling screening and chronic care tracking; facilitating timely sharing of information; automatically uploading test results and calculating medication; saving scarce resources and individualizing patient care plans (Malley et al 2009; Berg and Bowker 1997; Lee, Yeh and Ho 2002). They also prevent the loss of information (Rodriguez et al 2002). Electronic medical records present information and help make patient care decisions (Lenz and Reichert 2007). The role of electronic medical records in increasing the provision of primary and secondary care, chronic care treatment and laboratory testing has also been discussed (Alfreds and Witter 2008). Research on electronic medical records in particular has studied the impact of EMRs on improving physician productivity and facilitating communication (Bhargava and Mishra 2011; Urkin, Goldfarb and Weintraub 2003). The role of electronic medical records on decreasing workload, improving patient safety, providing speedier access to patient records, conserving resources and individualizing care plans is also discussed by extant literature (Moody et al 2004; Dorr, Jones and Wilcox 2007; Lee, Yeh and Ho 2002).

But research has also focused on the drawbacks of electronic medical records. These drawbacks include ineffectiveness in increasing physician productivity (Cheriff et al 2010; Stevens 2010); restraining the diagnostic categories as well as ability to write free text (Berg and Bowker 1997; Berg et al 1998) and the shift from a patient-centric culture to an information-centric culture (Lee, Yeh and Ho 2002). Research

indicates that electronic medical records are complex to develop and unlikely to produce greater efficiency or higher revenues (Davidson and Heineke 2007).

Literature varies on the role of electronic medical records in reducing workloads of healthcare personnel. While research indicates that EMRs save nurses time (Malley et al 2009; Moody et al 2004), it also indicates that EMRs may increase time spent attending to electronic communication and workload (Kleiner et al 2002; Liederman and Morefield 2003).

There is also an extensive body of research on the resistance of healthcare personnel to adopting electronic medical records (Timmons 2003; Beuscart-Zaphir et al 2001). This stream of work extends to identifying the factors affecting the acceptance of electronic medical records (Dorr et al 2007; Campbell, Harris and Hodge 2001; Travers and Downs 2000; Seckman, Romano and Marden 2001). Prior research on EMRs has also focused on exploring how electronic medical records are perceived by various members of healthcare teams such as nurses (Moody et al 2004), pharmacists (Porteous et al 2003), physicians (Lee, Yeh and Ho 2002; Dorr et al 2007; Ammenwerth et al 2003). Research also discusses factors examining factors influencing the acceptance of electronic medical records by healthcare team members (Campbell, Harris and Hodge 2001, Krall and Sittig 2002). The attitude of healthcare team members towards electronic medical records has also been discussed (Liederman and Morefield 2003; Schubart and Einbinder 2001; Moody et al 2004). Studies also assess the usability of electronic medical records (Beuscart-Zaphir et al 2001). However, there is a paucity of work in health informatics and information systems discussing the role of electronic medical records in learning. Hence, a key

contribution of this essay is to examine the role of electronic records on learning.

Next, I discuss learning in the context of EMRs

### 3.2.3 Learning through EMRs

Learning depends on access to information (Borgatti and Cross 2003). Health information technology increases access to information and increases the size and diversity of the learning network (Guzzo and Dickson 1996). Electronic medical records contain valuable information related to patient care. With paper records, some parts of a patient chart are limited to the exclusive purview of clinicians and unavailable to other social subnetworks (such as nursing and administrative staff and residents). Electronic medical records are unencumbered by such restrictions and supply complete information to all subnetworks. Various healthcare personnel involved in a patient care scenario can acquire information about the activities performed by other healthcare team members by examining EMRs. Through electronic medical records, individuals can access information about the activities of others and this in turn provides a context for their own activities (Kuziemsky and Varpio 2011). Electronic records allow healthcare personnel to share knowledge and enable the coordination of care (Reddy, Shabot and Bradner 2008). The information present in electronic medical records helps healthcare personnel to make decisions (Lenz and Reichert 2007).

There is a clear distinction between information and learning. Information is data while learning is the process of collecting and interpreting information (Cooper 2007). Learning differs from information as learning refers to information applied by individuals with respect to their own context and experience (Karlsen and Gottschalk

2004; De Long and Fahey 2000). Learning occurs when individuals acquire learn through various sources or when knowledge moves between organizational units (Argote and Ingram 2000). Learning occurs within a framework and systems and procedures constitute this framework (Seng, Zannes and Pace 2002). Health information technology such as electronic medical records is an example of one such framework that supports learning (Karlsen and Gottschalk 2004). Through information technology (such as EMRs), individuals get increased access to information, which in turn increases their familiarity and expertise in new areas and increases their knowledge quotient in these areas thereby enabling learning (Cohen and Levinthal 1990; Aral, Brynjolfsson and Van Alstyne 2012).

Patient care provides a medium for clinicians and other healthcare staff to learn by doing (Dewey 1938). A wide range of knowledge exists in healthcare organizations with nursing personnel, general practitioners and specialist possessing different and often complementary sets of knowledge. This provides an ideal environment for inter-professional learning. Learning in organizations is usually manifested through changes in the knowledge or performance of individuals (Argote and Ingram 2000, Hammick et al 2007). Evidence shows that learning occurs in healthcare. For instance, Hughes (1988) mentions that experienced nurses often are able to point towards a diagnosis and unofficially administer injections and routine medications.

Learning through EMRs may be compared to experiential learning as elucidated by Rogers (1983). In experiential learning, the learner controls and directs the learning experience. The learning experience (in experiential learning) is based on

case-based reasoning. Case-based reasoning involves taking experiences and solutions of previously encountered problems and applying them to new problem situations. In experiential learning and case-based reasoning, learning is self-directed, that is individuals without the help of others constructing their own learning objectives, finding appropriate learning resources and working to increase their knowledge and skills (Knowles 1975). Similar to experiential learning and case-based reasoning, I propose that the learning through EMRs is a form of active or discovery learning with the learner taking the incentive on his/her own to explore concepts hitherto unknown. Simply put, the source of learning (also referred to as the facilitator) plays no role in initiating the learning mechanism. Learning is initiated and completely controlled by the learners. This is also similar to inductive learning in the case of machine learning where new concepts and methods are learned without any direct input from the source. Learning in EMRs is a form of asynchronous learning or learning in which the learner and the facilitator do not communicate at the same time. Several factors may act to influence this process of learning through EMRs. I identify and discuss potential factors that may affect learning through EMRs in the next sub-section.

#### 3.2.4 Factors Influencing Learning

I consider a situation where an individual member (referred to as the reader of the EMR) of a healthcare team reads an electronic medical record with information entered by another individual member of the healthcare team (referred to as the author of the EMR). I assume that the electronic medical record relates to a particular patient care scenario that involves both the reader of the EMR and the author of the

EMR as members of the healthcare team in question. The EMR contains information entered by both the reader as well as the author. This information could relate to the treatment plan, diagnosis and medications administered in the patient care scenario.

I posit that electronic medical records (EMRs) reduce information deficits and enable learning in healthcare scenarios. Based on the preceding section on learning as it relates to EMRs, it is proposed that learning in the context of electronic medical records may be categorized into two types- asynchronous discovery learning and asynchronous situated learning. I define asynchronous discovery learning as learning initiated by the reader for the purpose of gaining more information about a subject of interest without any input or initiation from the author of the EMR (who is a passive facilitator or source of learning). In asynchronous discovery learning, the learner (the reader of the EMR) actively searches through electronic medical records with the explicit objective of learning from the records. In contrast, I define asynchronous situated learning as a form of situated learning (or learning through a community of practice) in which the learner (reader of the EMR) learns almost unconsciously through electronic records in the course of his/her patient care responsibilities. In both types of learning through EMRs, learning is asynchronous- that is learner and the facilitator do not communicate at the same time), and there is complete learner control over learning- that is the facilitator plays no role and only acts as a source of knowledge through EMRs.

My aim in this essay is to explore asynchronous discovery learning in the context of healthcare. Specifically, to identify factors and mechanisms underlying asynchronous discovery learning. Eisenhardt (1989) notes that a priori identification

of constructs can help shape theory and to measure constructs more effectively. It may be noted that these constructs are tentative and no construct is guaranteed a place in the final research outcome. With this in mind, based on a review of extant literature, I propose that the following factors or constructs could potentially affect learning in the context of electronic medical records:

**Familiarity with technology:** The reader of the EMR understands and comprehends the information in an electronic medical record. Prior experience with technology or familiarity with technology makes it more likely that the technology will be used (Schubart and Einbinder 2001). Ease of use is an important variable in models like TAM (Ward et al) that determine the extent to which a technology will be accepted and used. Moody et al (2004) find that nurses with computer expertise have a more favorable attitude towards EMRs. Similarly, physicians who are not exposed to technology are more likely to have a negative attitude towards technology (Johnson et al 2002). User familiarity with technology increases the acceptance and use of EMRs by physicians (Ammenwerth et al 2003) and nurses/paramedical staff (Liu, Wyatt and Altman 2000; Pagliari et al 2005). Hence, individuals who are more familiar with technology are more likely to engage in asynchronous discovery learning (learning undertaken by the learner in which the learner and the facilitator do not communicate at the same time) using EMRs as a source of learning than individuals who are less familiar with technology.

**Organizational status:** Healthcare is characterized as a strongly hierarchical and authoritarian culture (Goh, Gao and Agarwal 2011; Mannion et al 2009). Often status differences prevail in healthcare. In general, clinicians regard themselves as

superior to nursing and administrative personnel. Individuals in a team may derive status from the knowledge or expertise they are thought to possess (Wittenbaum 2000). Literature suggests that general physicians are considered to be of lower status compared to specialists and super-specialists who are considered as being of higher status (Berendsen et al 2006, 2007; Paul 2006). Status impedes learning between individuals (De Long and Fahey 2000). Literature documents that individuals lower in healthcare hierarchies are anxious to be considered as competent colleagues by their colleagues who are higher in the organizational hierarchy (Berendsen et al 2006; 2007). When these individuals perceive others as occupying a higher status relative to themselves in the organizational hierarchy, they (non-specialists) will be reluctant to ask for information fearing the risk of being perceived as incompetent (Stasser and Titus 2003, Larson et al 1996).

In some instances, nursing and administrative personnel react to the often inferior position given to them in the healthcare hierarchy, and adapt strategies to “passively resist” the power structure (Simpson 2007; Rice et al 2010). It has also been reported that status differences prevail within the clinicians with specialists being viewed as having a higher status and a higher position in the clinical hierarchy (Marshall 1998). General practitioners view specialists as having a higher status but feel that they (general practitioners) are as competent as specialists, but simply have less income (Berendsen et al 2006, 2007). Research has also revealed that specialists feel that the “gatekeeping role” played by general practitioners impinges on their (the specialists’) clinical autonomy (Pena-Dolton et al).



The status of the EMR reader could be a potentially important factor in learning through EMRs. Individuals with a lower status in prevalent organizational hierarchy are reluctant to ask questions fearing adverse reactions from their superiors. Hence, these individuals may be more likely to review EMRs as a source of information and learning. Simply put, EMRs help lower status individuals in healthcare hierarchies to overcome learning constraints by providing access to information and helping them to learn without having to approach their superiors. Thus, EMRs act as an equalizer, overcoming the learning divide imposed by status and hierarchy in a healthcare organization.

**Clinical specialties involved:** Healthcare is a highly collaborative process and work flows often embed information necessitating workers to interact frequently to obtain and exchange patient information (Reddy, Shabot and Bradner 2008). Through work flows, in addition to obtaining patient information, members also observe and interpret the activities of other members. This helps with the coordination of patient care. However, research indicates that generally, interactions in healthcare teams are poor and remain limited to peer-to-peer interactions or interactions within a member level, sometimes referred to as horizontal interactions (De Long and Fahey 2000). In contrast, interactions between different member levels that occur between superiors and subordinates or across departments, often referred to as vertical interactions remain poor at best. As knowledge bases are more heterogeneous across member levels than within a member level (Cohen and Levinthal 1990; Nonaka 1994), interactions across member levels tend to transfer more knowledge in comparison to interactions within a member level. Also, knowledge within a member level is

redundant, in comparison to knowledge across member levels. In healthcare, organizational culture tends to be hierarchical with differences in status (Berendsen 2006, 2007; Leape and Berwick 2005; Mannion et al 2009; Wright et al 1998;). Westbrook et al (2007) study the communication patterns between clinicians and nurses. They find a low frequency of interaction between groups or subnetworks (that is between clinicians and nurses) and a higher frequency of interaction within the nurse subnetwork (that is between nurses). Additionally, the sticky nature of knowledge in healthcare often makes learning difficult (Szulanski 2000).

In healthcare organizations, given the low frequency of interaction between member levels in terms of seeking advice/knowledge (Westbrook et al 2007), it is reasonable to assume that learning seldom occurs through regular (face to face) interactions. Electronic medical records provide a channel to disseminate information across member levels. Through electronic medical records, members of a medical team can now access the details of activities performed by other members of the medical team (who are from different clinical specialties). Thus, EMRs help individuals in a healthcare organization to acquire knowledge across different organizational levels. Individuals may be more likely to initiate learning in scenarios where EMRs involve multiple specialties.

This section detailed the history and development of electronic medical records. I also provided an overview of the advantages and disadvantages of electronic medical records. This reveals a paucity of literature discussing the role of EMRs in learning in healthcare organizations. I also categorized learning in the context of electronic medical records into two categories- asynchronous situated

learning (where learners or individuals employed in healthcare unintentionally learn by studying EMRs in the context of their patient care duties) and asynchronous discovery learning (where learners or individuals employed in healthcare intentionally initiate learning through EMRs outside the context of their regular patient care duties). Finally, this section also identified 3 factors that could potentially impact learning through electronic medical records. These include individual familiarity with technology, individual status in the organizational hierarchy of the healthcare organization and clinical specialties involved in the EMR. In the next section, I provide a description of the methodology used for this essay.

### 3.3 Methodology

#### 3.3.1 Data Description

I chose to employ a qualitative study following an interview approach for this research as qualitative research is integral to research involving complex social processes by highlighting human interactions and relationships among variables (Gephart 2004) and this is applicable in a field such as healthcare. I interviewed nurses, technicians and doctors in a hospital that exclusively uses electronic medical records for patient care. The hospital is situated in India. The hospital made a complete transition from paper records to electronic medical records in early 2006. The hospital has a total of 244 beds and 40,000 patients are seen annually. A total of 640 nurses, 212 doctors and 115 technicians work in the hospital. After approaching the hospital and receiving requisite permissions and IRB approval, I received a list of personnel in each category (doctors, nurses and technicians) from the concerned

administrative department. I then visited the hospital during different shifts (morning, afternoon and night) and randomly visited personnel in various departments. I presented each potential participant with an introductory letter from the head of the department requesting their participation in the interviews.

### 3.3.2 Data Collection Technique

As electronic medical records operate in an environment akin to virtual environments, I chose to interview respondents instead of surveying them to enable a rich taxonomy of their experiences (Dube and Robey 1998). Learning is a highly personal and individual process. Interviewing healthcare personnel allows taking in a wide variety of information and to interpret learning in the context of everyday tasks carried out by these personnel. Further, interviewing also allows for immediate follow-up and clarification. Qualitative research (interviews) is also conducive to study respondents in their natural settings while maintaining an empathic neutrality (Patton 1990).

The research approach in this essay may be best described as a positivist approach as research indicates that positivist approach is best suited for situations where study goals involve understanding whether study variables have an impact on observed phenomena and to uncover facts and potential propositions (Gephart 2004; Gephart 1999; Guba and Lincoln 1994; Lincoln and Guba 2000). In this study, I wish to investigate whether the variables outlined earlier in the paper (such as familiarity with technology, status in organizational hierarchy and clinical specialty involved) influence learning. I conduct the study using a series of well-defined open-ended

questions followed by probing questions. Research indicates that this methodology is apt for cases where the experiences of individuals are important (Bonoma 1983). This method of qualitative research is also apt to understand processes and identify benefits in settings such as healthcare characterized by a large variety of complex and inter-related activities (Benbasat 1984). Qualitative interviews using open-ended questions also allow for individual variations (Hoepfl 1997).

In order to maximize time available for interviews and to keep interactions focused, I used an interview protocol (Hoepfl 1997). The interview protocol included questions about participant background (educational qualifications, prior experience, experience at current institution); preference for paper vs. electronic records; advantages vs. disadvantages of EMRs; features of the last EMR that they have viewed; features of the last EMR they have learnt from and inferences from a previously viewed EMR. Please see Appendix C for details of the interview protocol.

### 3.3.3 Data Collection

I spread the data collection over several days. I also collected data during different shifts (morning, afternoon and night) to minimize any bias. I visited the hospital during different shifts (morning, afternoon and night) and randomly visited personnel in various departments. I presented each potential participant with an introductory letter from the head of the department requesting their participation in the interviews. Participants who agreed to be interviewed filled out an informed consent form. I audiotaped the interviews with participant consent.

The overall objective was to investigate whether respondents learnt from EMRs and to identify the type of learning that took place. The interviews ranged in duration from 30 to 45 minutes. All interviews were audio recorded and transcribed for future analysis. Interviews were supplemented with copious field notes. The interviews were conducted in English, but participants were given the choice of expressing themselves in their local language to enable them to speak freely of their experiences. Hence, some of the quotations expressed in the results were translated into English, omitting any potentially identifying information. In the next section, I provide details of the analysis and coding.

### 3.4 Analysis

#### 3.4.1 Sample

I provide a description of participant backgrounds and demographics in Table 3. In accordance with Pettigrew (1988), random sampling is not necessary. I follow Harris and Sutton (1986) and chose a sample that was not random but reflected cases that would help me to reflect the theory across a broad range of learning situations involving EMRs. This involved sampling several departments and ensuring that nurses, doctors and technicians were sampled in every department. A department-wise breakdown of samples is presented in Table 8. I stopped adding cases when observed phenomena appeared redundant and incremental learning was minimal (Glaser and Strauss 1967).

### 3.4.2 Data Coding and Analysis

As mentioned earlier, I audiotaped the interviews with a hand held recorder. All tapes were immediately transcribed and typed with information including details of the respondent (name, department and position) and the time at which the interview was conducted. The interviews were typed in a script-format with paragraph breaks to denote individual speakers. The interviews were supplemented with copious fieldnotes about subject reactions, interview interruptions, gestures, accents, and facial expressions observed by the researcher in the course of the interview. These notes were also entered into the interview transcripts.

I used a combination of methods derived from content analysis (Webber 1985), ethnographic interviewing (Merriam 1998; Stake 1995) and data reduction methods (Miles and Huberman 1994) to analyze the qualitative data generated. As discussed, typing the interviews in a script- format helped with synthesizing interviews, or in data reduction (Miles and Huberman 1994). Based on the potential study constructs, propositions and the interview protocol, I created a provisional list of codes (see Table 9). These codes were used throughout the fieldwork. Following Gersick (1989) in the positivist tradition of qualitative research, I prepared a qualitative map of each interview with codes next to the synopsis of each interview, with code letters on the margins denoting every spot where certain variables had been identified or certain statements had been made. The resultant codes reflected both the provisional list of codes as well as other codes identified in the course of interview analysis.

As fieldwork progressed, further codes emerged that uncovered important aspects in learning through EMRs. As I was coding by hand, revising codes presented a messy option that could potentially confound data analysis (Miles and Huberman 1994). Hence, I ensured that codes developed during the course related to each other as well as to earlier codes.

Analysis of interview transcripts also helped in discovering new aspects. The open-ended interviews allowed me to even identify some “serendipitous findings” (Eisenhardt 1989). As recommended by experts (Lincoln and Guba; Strauss 1987), I stopped the coding and adding codes process when all the incidents in the interview transcripts could be classified and categories were “saturated”.

### 3.5 Findings

#### 3.5.1 Emerging Propositions

The interviews with participants spanned across several weeks. I interviewed nurses, technicians and doctors across several departments. The interviews were coded and examined for patterns by taking pairs of subjects from within a group or from different groups and examining them for similarities and differences.

Respondents may be categorized into groups based on different classifications. Based on the preliminary and a priori identification of constructs, respondents could be classified according to their position in the hierarchy of the healthcare organization as nurses, technicians and doctors. Respondents may also be classified according to their clinical specialty.

Asynchronous discovery learning was assessed by asking each respondent to recall an EMR seen within the past week that stood out in his or her memory. I then



asked the respondent to recall salient features of the EMR and the number of times that they had viewed the EMR. I also asked the respondent if they had reviewed the EMR after the course of their regular duties and responsibilities and the reasons for doing so. Finally, I asked the respondent if they had learned from the EMR and to recall what s/he had learnt. However, preliminary interviews soon revealed that it was necessary to be more specific about the definition of learning. In the preliminary interviews, subjects misinterpreted learning as learning about computers and gaining familiarity with computers. Hence, questions were reformulated to specifically ask the respondent if reading the EMR had enhanced any aspect of their clinical or medical knowledge.

The patterns I observed across different respondent groups (groups classified according to organizational status and groups classified according to clinical specialty) allowed me to draw inferences about learning through EMRs and in particular about asynchronous discovery learning. In the following paragraphs, I present these inferences as propositions with respect to factors influencing learning in the context of EMRs:

Results indicate that of the respondents who report that they learn through electronic medical records, 68% appear to be engaging in some form of asynchronous discovery learning. The remaining 32% appear to be engaging in asynchronous situated learning (that is unintentional learning in the course of their responsibilities and duties). I further examined cases where respondents engage in asynchronous discovery learning to investigate the effect of a priori constructs specified earlier in this essay.

Earlier in the essay, I cited extant literature to propose that individuals who are more familiar with technology are more likely to engage in asynchronous discovery learning using EMRs as a source of learning than individuals who are less familiar with technology. The interview guide elicited information from respondents about their level of familiarity with technology by asking questions including experience with computers, role of computers in daily life (at home and at work) and use of social networking websites. Based on the coding scheme, I categorize individuals on the basis of the level of familiarity with technology- as highly familiar with technology; medium familiarity with technology and low familiarity with technology.

An analysis of the number of individuals engaged in asynchronous discovery learning in each category (high, medium and low) revealed that of 45 individuals with low familiarity with technology only 25 engage in asynchronous active learning. In contrast, 45 individuals from 64 individuals with medium familiarity with technology engage in asynchronous active learning. Finally, 14 of the 15 individuals classified as having high familiarity with technology also engage in asynchronous discovery learning using EMRs. This result indicates that familiarity with technology is an important construct that influences learning through EMRs and leads to the following proposition.

*Proposition 1: The EMR reader's familiarity with technology is positively associated with his/her tendency to engage in asynchronous discovery learning using electronic medical records.*

In the literature review, I proposed that individual status in the organizational hierarchy would influence learning such that lower status individuals would be more inclined to use EMRs as a source of learning. As detailed in the preceding paragraphs 68% of all respondents engage in some form of asynchronous discovery learning. Of these respondents, 28.23% are doctors, 10.58% are technicians and 61.17% are nurses. As I discussed in my review of extant literature, it is reasonable to assume that doctors occupy a slightly higher position in the hierarchy of a healthcare organization than nurses or technicians. Combining nurses and technicians as a single (lower-organizational status) category, I find that of the individuals who use EMRs to engage in asynchronous discovery learning, 71.76% are individuals with a lower status in the organizational hierarchy while 28.23% are individuals with a higher status in the organizational hierarchy (doctors). I propose that a larger number of individuals with lower status in the organizational hierarchy (such as nurses and technicians) are more likely to use EMRs to engage in asynchronous discovery learning than individuals with a higher status in the organizational hierarchy (such as doctors).

*Proposition 2: The EMR reader's status in organizational hierarchy is negatively associated with his/her tendency to engage in asynchronous discovery learning using electronic medical records.*

In the literature review, I had identified clinical specialty as a potential factor influencing learning through electronic medical records. In the interview analysis, I coded cases where participants have reported themselves as learning from an EMR involving multiple clinical specialties. These can be termed as multi-specialty EMRs and they involve the clinical specialty of the EMR reader as well as one /more other

clinical specialties. For instance, patients initially admitted to pediatrics may be transferred to neurosurgery following complications. A total of 33 respondents list themselves as having viewed an EMR involving more than one clinical specialty. 31 (93.9%) of these individuals also list themselves as engaging in asynchronous discovery learning. Hence, the data also indicates that clinical specialty influences learning through EMRs and leads to the following proposition:

*Proposition 3: Individual tendency to engage in asynchronous discovery learning through electronic medical records will be higher in the case of EMRs involving multiple specialties.*

A detailed examination of the results reveals that of the 31 participants discussed above who engage in asynchronous active learning and view EMRs involving multiple specialties, 24 are doctors, 4 are technicians and 3 are nurses. Keeping in mind the discussion on status in the hierarchy of a healthcare organization earlier in this essay, it is reasonable to assume that doctors occupy a slightly higher position in the hierarchy of a healthcare organization than nurses or technicians. The analysis seems to indicate that a larger number of doctors (who occupy a higher status in the organizational hierarchy) engage in asynchronous discovery learning and view EMRs involving multiple specialties than technicians or nurses. In fact, almost all interviewed doctors who engage in asynchronous discovery learning list multiple clinical specialties as a dominant feature in a recently viewed EMR.

This result of the analysis indicates that EMR specialties involved and EMR reader status interact. The interaction between status and clinical specialty could be attributed to two reasons. First, individuals lower in the organizational hierarchy may

have a lower propensity to learn from other departments than individuals higher in the organizational hierarchy. This low propensity to learn may be due to limited learning capabilities or due to a lack of interest in other clinical specialties that are seen as beyond the boundaries of their work space or responsibilities. In the analysis, nurses and technicians report that they are unable to learn much from the progress notes written by doctors from other clinical specialties. Hence EMRs involving multiple specialties may involve areas that are perceived as alien by nurses and technicians. As a respondent puts it:

*I can understand new things from other departments to some extent through the system. They [doctors from other departments] write at their level. We cannot really understand too much*

A second reason is that doctors often engage in asynchronous discovery learning through EMRS involving multiple specialties to learn new methods and techniques. Doctors also tend to take a holistic view of patient treatment and this holistic view includes multiple specialties coming together to treat a patient. They also view EMRs involving multiple specialties as an opportunity to check the accuracy of their diagnoses. As a doctor states:

*I can cross check and see if my diagnosis was correct. If not, I look at the notes and realize what items I should have stressed on or which items I missed. In med school we've only learnt about the symptoms and manifestations of diseases in other departments. These are superficial details. Through examination of records we can see the finer details of treatment including medications are administered and prescribed course of treatment.*

Based on this finding I propose that individuals occupying a lower status in the hierarchy of a healthcare organization are more likely to engage in asynchronous discovery learning with EMRs only involving their own clinical specialty, while individuals with a higher status in the organizational hierarchy are more likely to learn from EMRs involving multiple specialties.

*Proposition 4: The status of the EMR reader interacts with the number of clinical specialties involved in the EMR, such that the higher the status of the EMR reader, the more the tendency to engage in asynchronous discovery learning through EMRS involving multiple specialties*

The evidence from this study also suggests that case complexity is an important variable that influences learning through electronic medical records. A total of 49 participants mention case complexity as a feature of a recently seen EMR that they have learnt from. Among these, 40 (81.63%) participants also indicate that they engage in asynchronous discovery learning. Hence, case complexity appears to increase the likelihood that participants will engage in asynchronous discovery learning.

Based on the findings, complexity may be defined as the extent to which a patient care situation is perceived as relatively difficult to understand or diagnose. I propose that healthcare team members will utilize the opportunity to learn from the actions of their colleagues in patient care scenarios characterized by high complexity. In other words, complex patient care situations will increase the likelihood of engaging in asynchronous active learning:

*Proposition 5: The complexity of the patient care scenario is positively associated with individual tendency to engage in asynchronous discovery learning through electronic medical records.*

### 3.5.2 Motivations for Asynchronous Discovery Learning

Analyzing these interviews also revealed respondent motivations for engaging in asynchronous discovery learning. A comparison of these motivations across the organizational hierarchy revealed differences in motivations between doctors, nurses and technicians. In this section, I provide a discussion of the motivations for engaging in asynchronous discovery learning.

Based on the interviews, I identify 4 motivations or reasons for engaging in asynchronous discovery learning. Table 10 provides an overview. I also discuss the differences between technicians, nurses and doctors within each category of motivations:

- a) Rare cases: Both doctors and nurses appear to be motivated by rare cases to engage in asynchronous discovery learning. Almost 83.3% of doctors list rare cases as a motivation for engaging in learning. Comparatively, 41.8% of nurses list rare cases as a motivation for engaging in learning. Participants tend to define rare cases as unique cases that have not previously been encountered in their work experience. Nurses appear to be intrigued and happy with the case, while doctors seem to want to learn from the case. For instance, a nurse stated:

*When patients who have been in coma for several years, suddenly wake up, I feel good and I am curious to see the patient's history.*

In contrast, a doctor described a recent case that s/he categorized as 'rare':

*When almost fatal cases show signs of recovery, I am curious to know what causes the change. A child recently fell into an aquarium, and suffered tremendous chest injuries. Miraculously the child recovered. I was curious to see how doctors treated the child.*

- b) Attachment to patients: Doctors and nurses appear to feel a degree of attachment to their patients. 16.6 % of doctors and 16% of nurses list attachment to patients as a motivation for engaging in asynchronous discovery learning. This attachment makes them anxious with regard to patient progress and as a result they monitor the records of certain patients. These patients are usually young children or patients who stay for long periods or patients who are listed as being in critical condition. A respondent sums this up:

*I see young children, 4 to 6 years old as they go through chemotherapy. Initially they are very chirpy and then they get very tired. It is heart breaking. I want to see if they get better or not. I feel anxious when they miss an appointment.*

- c) Self Preservation: I define self-preservation as the tendency to protect oneself or one's loved ones against potential threats. In many instances, healthcare personnel such as technicians and nurses appear to engage in asynchronous discovery learning as they are afraid of contracting certain diseases and ailments. This fear could be a general fear or a specific fear due to exposure to a contagious disease. Almost half the technicians interviewed (50%) and



11.6% of interviewed nurses list fear of (themselves or loved ones) catching a similar disease as a reason for perusing electronic medical records pertaining to certain conditions and educating themselves about treatment options. As a nurse states:

*A young lady came in with a headache and lost her eyesight in days due to a pituitary tumour. This scared me. I looked up the case details and the treatment options. If I see cancer cases, especially in people of my age group, I look into the patient history to see the background, family history etc to see how one should go about if we get a similar disease.*

- d) Professional development: Doctors, nurses and technicians engage in active asynchronous learning for purely professional reasons. 100% of the doctors, 37.2% nurses and 71% technicians engage in active learning for developing their own abilities and enriching existing knowledge in an area of medicine. All 3 categories of healthcare professionals view electronic medical records as a means to clarify questions without asking their superiors. In the words of a respondent:

*If I see a new term, I want to learn about it and know about it. So I look it up. It is easy to clarify my doubts. Otherwise, I will have to ask someone and I will be told: "Why do you want to know it?"*

And as another respondent puts it:

*For returning patients, we closely look at the previous history and records to check how doctors have treated patients. This helps us realize what parts of the case we should emphasize on without having to ask anyone. We can also*

*look up details of procedures I do not have knowledge on so that I can learn the procedures sufficiently to explain the same to others.*

### 3.5.3 Consequences of EMRs

Extant literature has discussed the benefits of electronic medical records. The results of this study reveal new findings, particularly in the context of international healthcare. An analysis of study results revealed that 83.5 % of respondents favor electronic records over paper records, while 4.1% respondents favor paper records and 11.6% respondents favor both paper records and electronic records. Based on the analysis of interviews, I categorize benefits realized by individuals from using EMRs into 6 categories (shown in Table 11):

#### a) Savings

The results indicate that EMRs are associated with savings in terms of time, effort and money. 21.6 % of all respondents indicate that EMRs result in saving time by avoiding the need to search for paper records. The respondents stress on the fact that directly interfacing laboratory machines with EMRs results in the faster delivery of results along with eliminating the need for personnel to transcribe results. In the words of a respondent:

*Electronic records are most beneficial as they are less time consuming. It helps finish my job faster. I do not need to waste anyone's time asking them to get the details. I can get it [the details] on my own. Laboratory reports are very fast, directly from machines interfaced. I do not lose the time to give the report. Before [in paper records] I had to print the paper, jot the result, type it and sign it and send it to the department.*

40.8% also indicate that EMRs save effort in terms of typing records. Their comments suggest that information can easily be entered in electronic medical records, without expending effort in deciphering handwriting. Interviewees also indicate that redundancies of information can be avoided: *I like electronic records as they are easy and simple. In paper records, I have a lot to write. Paper records have more work. In the system [EMRs], the efficient template helps me to write less. I can cut copy and paste the report without having to replicate it.*

3.2% of respondents also indicate that EMRs save paper wastage and present a green environment friendly alternative.

b) Accessibility

37% of respondents indicate that increased accessibility of patient records is an important benefit presented by EMRs. Electronic medical records enable instantaneous access to current and past patient records including previous visit details, laboratory tests and patient history. This prevents any issues caused by patients who forget to bring or misplace their records. It also insures the healthcare organization against losing a patient's electronic medical record. Respondents view increased accessibility afforded by EMRs as an important advantage over paper records:

*In paper records, there is more chance of people losing it [the record]. Some people don't bring important papers with them. For example, a patient from another hospital came with no records or history. The patient was being given IV fluid but they had no details of the fluid. We did not know whether the fluid*

*had a BP [blood pressure] lowering medicine in it or not. If the patient had been from our hospital, we would have known all the details.*

In addition, EMRs enable healthcare personnel to access a patient's complete history without searching for paper records. Interviewees value the convenience offered by electronic medical records to review a case and case details at their convenience multiple times and indicate that this helps them in providing better patient care. As a respondent states:

*I can reuse and search electronic records even later. It is easy to review records again. I do not need to go and search for the paper record, through hundreds of files.*

c) Prediction ability

6.4% of respondents also indicate that they use the patient's history and past tests from an EMR to predict the need for laboratory tests. It is interesting to note that these respondents are from a single department-pathology. That is, 61% of respondents from pathology use EMRs to make a correlation between clinical findings and test results. For instance, in cases such as pap smears, age and patient history (current medical condition) is an important factor to predict whether or not results from tests require further investigation. Conditions like pregnancy and menopause produce certain cytological changes, which could be mistaken for abnormal results. Respondents (from pathology) also rely on the patient history to identify reasons (such as prior medical history and current medications) for potentially confusing laboratory test results. A respondent from pathology states:

*When I get tests with a low platelet count, I check previous platelet results. Platelets could be low due to malaria or due a minor clot. Only then do I do the peripheral smear for the malarial parasite. If we find high traces of copper in urine, we look at patient notes. Copper could be high due to Wilson's disease. Or it could be high because of a medicine that causes excretion of copper in urine.*

d) Continuity

Respondents in some departments are in brief or no direct contact with patients. These departments include pathology- where healthcare personnel have no direct contact with patients; and emergency medicine- where healthcare personnel see patients briefly, administer preliminary treatment and then shift the patients to other departments. Respondents in these departments indicate that EMRS help them to follow a patient's progress and remain in touch with patient care.

*Emergency room patients do not stay for very long, as we stabilize and shift them, so through the system [EMR], I can follow-up and look up patient progress.*

e) Reference

15.2% of respondents indicate that they use electronic medical records in order to reference unfamiliar terms in reports and to suggest medicine alternatives. This includes a high proportion of nurses (78%). This results in an increase in knowledge with respect to patient condition, nutrition,

medication and interactions of medication. For example, a nurse who was interviewed said that:

*Sometimes, we do not know the correct spelling or we cannot read the handwriting correctly. In this, we can use the system [EMRs] to check on the spelling. Or if the medicine is not available, the system will tell us what other medicine is okay. I have learnt a lot about the names of medications, their side effects and the generic names.*

Nurses also indicated that EMRs provide easy reference to medication contents and dietary restrictions. This is particularly important in countries such as India where diversity in religion and cultural practices necessitates that hospitals allow patients to bring their own food. Additionally, in India, a collectivist culture results in a large number of friends and family accompanying patients to hospitals. These individuals (friends and family) are termed “by-standers” by hospitals as they remain with the patients, bringing them food, attending to their general needs and taking care of billing and other details:

*When the bystanders [friends/family accompanying the patient] ask what food to give the patient, I can look up the system [EMR] and check on what to give and advice. I don't need to call the doctor. I have now learnt about what foods are given in certain conditions and why these foods are given.*

f) Accuracy

Another benefit of EMRs, as identified by respondents includes improving the accuracy of results and minimizing any clerical errors. 12% of respondents identify accuracy as a benefit of electronic medical records.

*The results are directly input into the system [EMR] so there is low chance of any clerical errors. People cannot undo the information, so the system is reliable and accurate. Nobody can misuse the information. The system does not allow us to skip any details, so all details will be complete and accurate.*

### 3.6 Discussion

In this section, I provide a discussion of the study's results and implications, study limitations and directions for further research.

#### 3.6.1 Implications

The purpose of this research was to understand how healthcare professionals learn through electronic medical records. Semi-structured interviews with nurses, technicians and doctors in a healthcare organization facilitated the identification of two distinct styles of learning through EMRs. These include asynchronous discovery learning and asynchronous situated learning. The interviews also helped to identify factors that affect learning and to explore individual motivations for learning through electronic medical records.

Additionally, the interviews suggested other interesting insights. For instance, the study identifies new benefits of electronic medical records as perceived by healthcare professionals. Along with traditional benefits (such as time, cost and effort

savings, increased accessibility and increased accuracy), the study identifies two new perceived EMR benefits. These ‘serendipitous findings’ (Eisenhardt 1989) include using electronic medical records to predict and cross check test results and using EMRs to stay in contact with patient progress in departments that are characterized by low or sporadic patient interactions.

The study also identifies and isolates instances where two different types of learning through electronic medical records take place. I term these as asynchronous discovery learning and asynchronous situated learning. In asynchronous discovery learning, a learner intentionally undertakes learning through EMRs while in asynchronous situated learning, a learner almost unintentionally learns through electronic medical records.

This study makes an important contribution in terms of identifying factors that affect learning. These factors include case complexity, departments involved in the case, learner’s familiarity with technology and learner’s status in the organization. An interesting finding is that while learners are more likely to engage in cases involving other departments, status moderates this effect. This is another example of a serendipitous finding. That is employees with a higher status in the healthcare hierarchy (such as doctors) are more likely to utilize the opportunity provided by inter-departmental cases to increase their learning across departments. This is similar to the concept of vertical learning in firms where individuals increase their knowledge across various departments of the firm. Thus, this finding has important managerial implications in terms of human resource management as well as knowledge management.



This research also identifies individual reasons for engaging in asynchronous discovery learning through EMRs. In addition to conventional reasons such as the opportunity afforded by rare cases to learn and learning for professional development, the study reveals that reasons such as attachment to patients and self-preservation instincts are equally important motivations. Particularly, it is interesting to note that doctors and nurses report a high level of attachment to their patients in certain scenarios. Also, the role of self-preservation as a motivation for learning provides a fresh perspective on learning. Results reveal that fear of contracting ailments similar to the cases observed in electronic medical records motivates learners to engage in active learning about a disease condition. This holds important implications for knowledge management.

Finally and most importantly, the study reveals an important aspect of electronic medical records- the role of EMRs in facilitating learning in healthcare. This study can be extended to other fields where employee learning plays an important role.

### 3.6.2 Limitations

The findings reveal important details with respect to learning in healthcare in general and learning with respect to electronic medical records in particular. However, in this study, data collection and analysis is qualitative in nature. I considered it best to conduct a qualitative study in order to elicit individual perceptions towards electronic records. However, a qualitative study may be seen as lacking in the rigor and structure afforded by a quantitative study such as a survey instrument. However it is noteworthy, that using a qualitative research approach has

helped identify “serendipitous findings” such as the interaction between status and clinical specialties, complexity as a factor affecting asynchronous discovery learning, fresh perspectives on EMR consequences (benefits) such as prediction ability and continuity and motivations for engaging in learning through EMRs including motivations such as self-preservation and attachment to patients.

This study attempted to identify factors influencing asynchronous discovery learning through electronic medical records. To gain a rich understanding of learning through EMRs, I focused on studying EMR based asynchronous discovery learning in the context of a single healthcare institution. While the interviews and the resulting analysis of interviews helped identify important factors underlying asynchronous discovery learning, these results may not be generalizable to other healthcare institutions.

Additionally, the healthcare institution in this study completely transitioned from paper based records to a system completely based on EMRs over 6 years ago. In contrast, other institutions approached for the study were in the process of transitioning over to EMR based systems. The hospital in question is also located in India. It is likely that factors influencing learning through electronic medical records in collectivist cultures like India (Hofstede 1991) may differ from those in Western cultures (such as the United States and Europe). The absence of insurance and third party liability in the Indian healthcare system also allow electronic medical records to contain a higher degree of patient related information. These differences may result in the results of this study not being applicable to scenarios involving other healthcare organizations, especially in the international context.

### 3.6.3 Future Research

This study explores factors that influence learning in the context of electronic medical records. While I have attempted to identify factors through an examination of extant literature and the results of interview analysis, it is important to understand that several individual and organizational factors influence learning through electronic medical records. Examples of these factors include personality dimensions and social interactions between healthcare team members. Future research could explore the effect of various individual and organizational factors on learning through EMRs.

As discussed earlier, the methodology used in this study is based on a interview methodology. A quantitative methodology such as a survey could test the emerging propositions discussed in this paper. Future research could also observe healthcare team members in real-time as they read and interpret electronic medical records and study learning in real-time. Other avenues for research include contrasting asynchronous discovery learning and asynchronous situated learning in the context of EMRs. Finally, an extension of this study in a culture where collectivism is low would present an interesting research avenue.

### 3.7 Conclusions

This essay identifies factors underlying learning in the context of electronic medical records. I present the impact of factors that influence learning in the context of EMRs in the form of emerging propositions. In keeping with extant literature, factors such as learner's familiarity with technology, learner's status in the hierarchy of the healthcare organization and the number of clinical specialties involved in the EMR influence learning in the context of electronic medical records. Additionally,

interview analysis reveals that status interacts with the clinical specialties involved in the EMR and affects learning and that case complexity is another determinant of learning through electronic medical records.

The study also reveals individual motivations for engaging in asynchronous discovery learning through electronic medical records. These motivations include EMRs concerning rare and unique cases, attachment of the learner to the patient involved in the EMR, self preservation instincts and professional development. While professional development has been identified as a motive for engaging in learning, the other three motives for engaging in learning through electronic medical records have not been widely discussed by extant literature.

The essay also explores how individuals perceive the benefits of electronic medical records. I find that in addition to traditional EMR advantages such as accessibility, accuracy and convenience, individuals in departments (such as pathology (with minimal patient contact) and emergency medicine (with a high rate of patient turnover) prefer electronic medical records over paper records as EMRs allow individuals in these departments to remain updated on patient progress even after patients are moved to other departments. I also find that individuals in departments (such as pathology) rely on electronic medical records to predict whether or not further tests are necessary and to cross-check the accuracy of test results. To the best of my knowledge, this study is the first to identify prediction ability and continuity as benefits of electronic medical records.

This research contributes to learning and knowledge management literature. Additionally, an understanding of the factors influencing learning in the context of

electronic medical records is essential to design EMRs that are more learner friendly to increase the effectiveness of learning through EMRs. The role of electronic medical records in acting as repositories of knowledge and the utilization of these EMRs by members of healthcare teams to engage in asynchronous discovery learning presents an important strategic resource for healthcare.

## Chapter 4: Implications and Conclusions

The essays in this dissertation study learning through health information technology in the context of healthcare. Learning is an important aspect of health information technology, yet this aspect is at best poorly discussed by extant literature. The first essay explores learning in the context of telemedicine. Telemedicine provides long distance healthcare to underserved areas. Thus, for countries like India which face a paucity in healthcare, with hospitals largely concentrated in urban areas (cities) and poorly concentrated in rural areas (villages) where majority of the population resides, telemedicine is an important health information technology tool. In a traditional (non-telemedicine) scenario, a non-specialist refers a patient requiring specialized care to a specialist. The patient then travels to the specialist who examines the patient and prescribes appropriate treatment.

In contrast, in a telemedicine encounter, a non-specialist contacts a specialist to request a telemedicine consultation for patients requiring specialized care. At the telemedicine consultation, telemedicine technology links the patient accompanied by the non-specialist with the specialist. In traditional medical encounters, a non-specialist is not part of the specialist's examination and diagnosis of the patient. In telemedicine encounters, the presence of the non-specialist at the consultation changes the nature of the medical encounter and provides a context for learning to take place. Telemedicine affords non-specialists with an opportunity to learn from specialists.

I find that learning in telemedicine is affected by the patient related information shared by the non-specialist with the specialist. Information asymmetry

underlies telemedicine encounters wherein non-specialists possess a greater amount of patient related information as they can directly examine patients, while specialists can only virtually examine patients. The information asymmetry necessitates that non-specialists share patient-related information with specialists. My research reveals that the learning (by non-specialists) in a telemedicine encounter is positively related to the information-shared by the non-specialist with the specialist. Hence, greater the amount of information shared, greater the perceptions of learning by the non-specialist.

I also find that feedback provided by the specialist about patient diagnosis and treatment options also affects learning. Knowledge asymmetry characterizes telemedicine encounters with specialists possessing a higher degree of knowledge relating to their clinical specialty. I find that higher the amount of feedback provided by specialists, greater the perceptions of learning by non-specialists.

The essay also reveals that the interaction between information shared by non-specialists and feedback provided by specialists is significant and influences learning. The quality of telemedicine technology is another important factor and affects both the information shared by the non-specialist as well as the feedback provided by the specialist. Individual characteristics such as capability of the non-specialist and trust placed in the specialist are also important variables. Specifically, non-specialist capability strengthens the positive relationship between the information shared by the non-specialist and learning in telemedicine. Trust in the specialist strengthens the relationship between learning in telemedicine and feedback provided by the specialist.

The findings reveal that learning is an important aspect of telemedicine interactions. They also reveal that the mechanics of a successful telemedicine encounters where a non-specialist increases his/her level of knowledge about an aspect of medicine requires attention to various elements. It is necessary for a non-specialist to provide the specialist with all information that is relevant to the patient in question. It is also important for the specialist to provide comprehensive feedback to the non-specialist including reasons for diagnosis and treatment plans. Hospital administrators must ensure a high level of technology quality during the telemedicine encounter to promote the learning mechanism in telemedicine.

Thus, telemedicine is an important knowledge management tool for healthcare. Learning through telemedicine is important for employee development and productivity. When non-specialists learn through telemedicine and enrich their knowledge, they are better equipped to diagnose and treat patients. This increases patient well-being. Increases in non-specialist knowledge can also lead to an increase in the efficiency in which non-specialists diagnose patients and order relevant tests and can in turn enhance the productivity of non-specialists in general and telemedicine encounters in particular. The findings of this essay may be extendable to other virtual team interactions that entail asymmetries in information and knowledge and necessitate information-sharing and the exchange of feedback.

The second essay deals with learning in the context of electronic medical records (EMRs). Electronic medical records are increasingly being implemented and used by healthcare organizations. They offer several advantages including reductions in paper work, managing patient records, minimizing errors and providing



comprehensive patient records to maximize the coordination of care. However, they also present a learning opportunity wherein healthcare employees can use EMRs as a source of learning to understand and learn from the actions of their colleagues with respect to a particular patient care scenario.

Healthcare employees can intentionally or unintentionally learn from electronic medical records. In both cases, learning is asynchronous as the learner and the facilitator do not communicate in real-time. However, I focus on cases where individuals intentionally search through EMRs outside the scope of their regular patient care duties to learn from the EMR. I call this as asynchronous discovery learning.

A central contribution of this essay is to frame the underlying structure of learning through electronic medical records in the context of different variables that affect the learning mechanism. The interview analysis reveals a set of emerging propositions that detail important variables affecting asynchronous discovery learning through EMRs.

First, majority of study respondents appear to engage in asynchronous discovery learning. I find that individual familiarity with technology is an important construct that influences learning through electronic medical records. Particularly, individual familiarity with technology is positively associated with the individual's tendency to engage in asynchronous discovery learning through EMRs.

I also find that individual status in organizational hierarchy is an important variable in learning through electronic medical records. Specifically, individuals with a lower status in the organizational hierarchy of a healthcare institution exhibit a

higher tendency to engage in asynchronous discovery learning through EMRs. Thus, electronic medical records act to overcome traditional constraints on learning imposed by the prevalent hierarchy in healthcare organizations by acting as knowledge repositories and allowing lower status individuals to access information and learn without approaching superiors. Hence, electronic medical records act to equalize the impact of status differences on learning.

The findings also reveal that individual tendency to engage in asynchronous discovery learning will be higher in the case of electronic medical records involving multiple specialties. I also find an interaction between status and clinical specialties involved, with lower status individuals being more likely to engage in asynchronous discovery learning with respect to EMRs involving only their own clinical specialty and higher status individuals being more likely to engage in asynchronous discovery learning with respect to EMRs involving multiple specialties. Interview analysis also reveals that case complexity is an important variable in the learning process and positively influences individual tendency to engage in asynchronous discovery learning through electronic medical records.

The analysis of qualitative data also indicates that individual motivations for engaging in asynchronous discovery learning vary. The study identifies four main motivations. First, rare cases (unique cases not seen previously) motivate both doctors and nurses to engage in asynchronous discovery learning. Second, attachment to patients seems to motivate doctors and nurses equally with respect to their tendencies to engage in asynchronous discovery learning. This is particularly applicable to patient scenarios involving young children or patients who stay for long durations. I

also find that self-preservation motives (or the need to protect self or loved ones from potential threats) are cited by technicians and nurses as motives for engaging in asynchronous discovery learning. Finally, doctors, nurses and technicians cite professional reasons as motivation for engaging in asynchronous discovery learning.

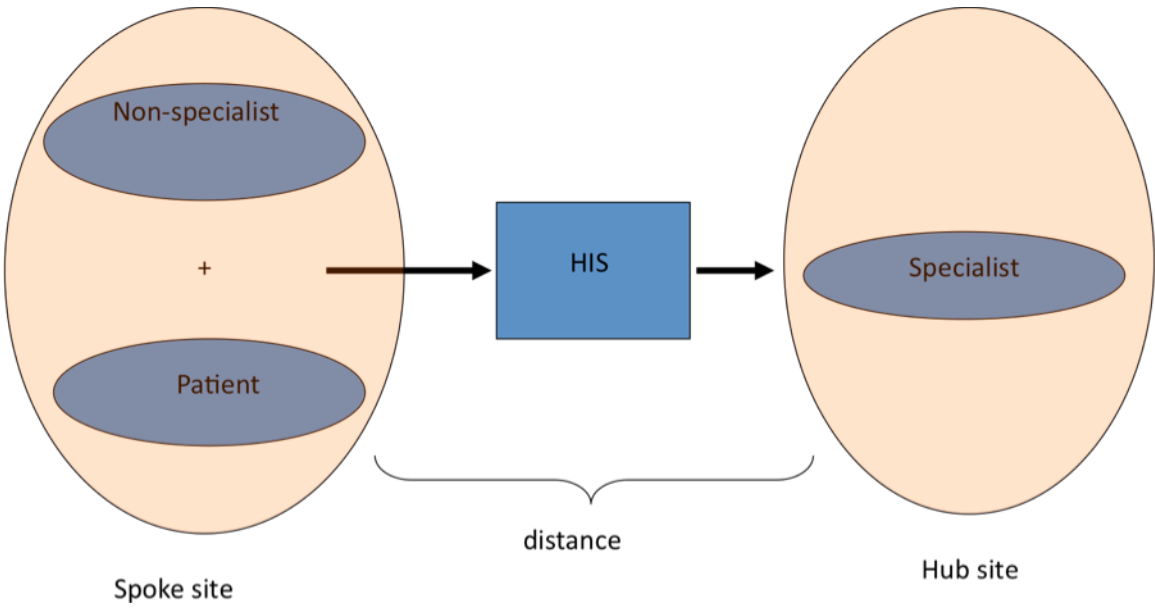
The essay also explores consequences (or benefits) of electronic medical records. These benefits include benefits often stated by extant literature on electronic medical records such as savings (in terms of space, time and effort), increased accessibility, accuracy and convenience. Interviews also indicate that respondents view EMRs as a tool to reference unfamiliar terms, meanings, diseases and dietary specifications. The interview analysis also indicates two unconventional benefits. These include the use of electronic medical records by respondents from departments such as pathology to predict the need for further laboratory tests as well as to cross check the validity of certain laboratory tests. EMRs also offer departments such as pathology and emergency medicine characterized by low patient interactions and low continuity of patient care to remain in touch with the details of patient care scenarios.

This essay contributes in identifying factors that affect learning through electronic medical records. Identifying these factors is important to promoting learning through EMRs and presents healthcare organizations with an important knowledge management tool. These factors in conjunction with the discussion on individual motivations for learning can maximize the efficiency of learning through electronic medical records. An understanding of the motives for engaging in learning and the factors affecting learning through EMRs, can help managers to create better

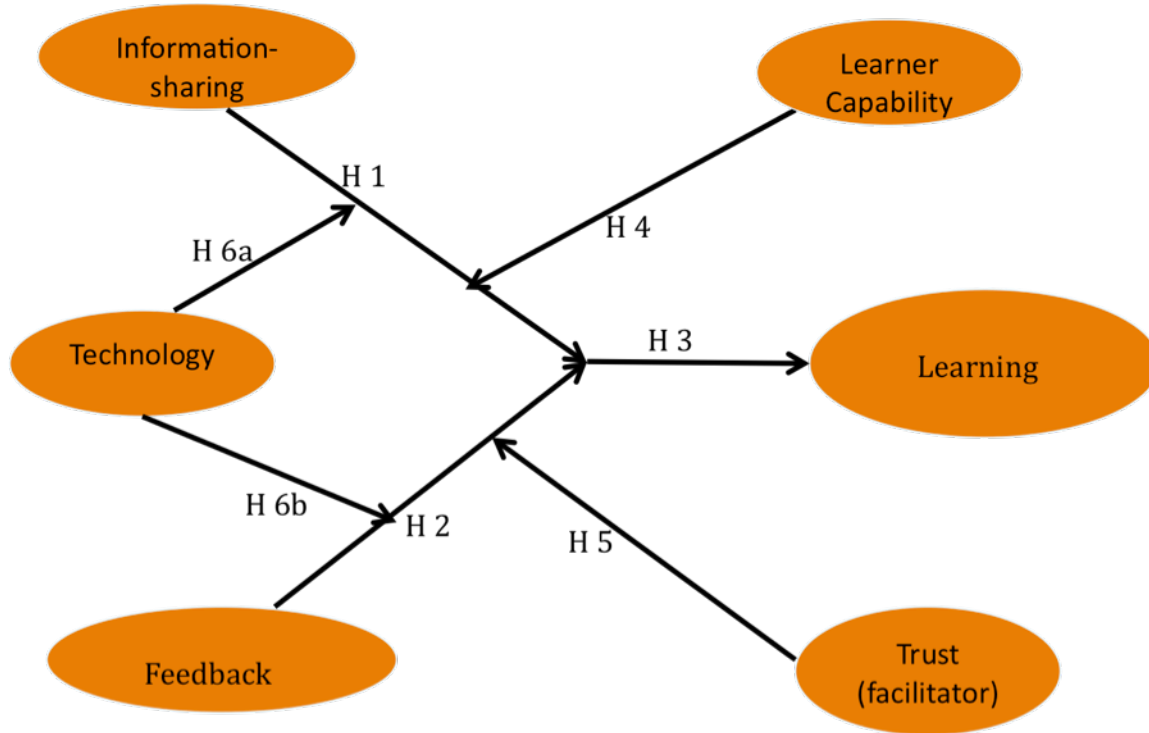
designs for electronic medical records to increase the capacity of EMRs as tools for learning.

The increasing importance of knowledge management for organizations and firms indicates that exploring learning as it relates to health information technology could reveal an important resource for healthcare. Given the premium placed on knowledge in general and knowledge in healthcare in particular, understanding learning that takes place through health information technology could increase the efficiency of using health information technology. This dissertation discusses learning in the context of telemedicine and in the context of electronic medical records, both important health information technologies that are gaining widespread use and momentum in healthcare worldwide.

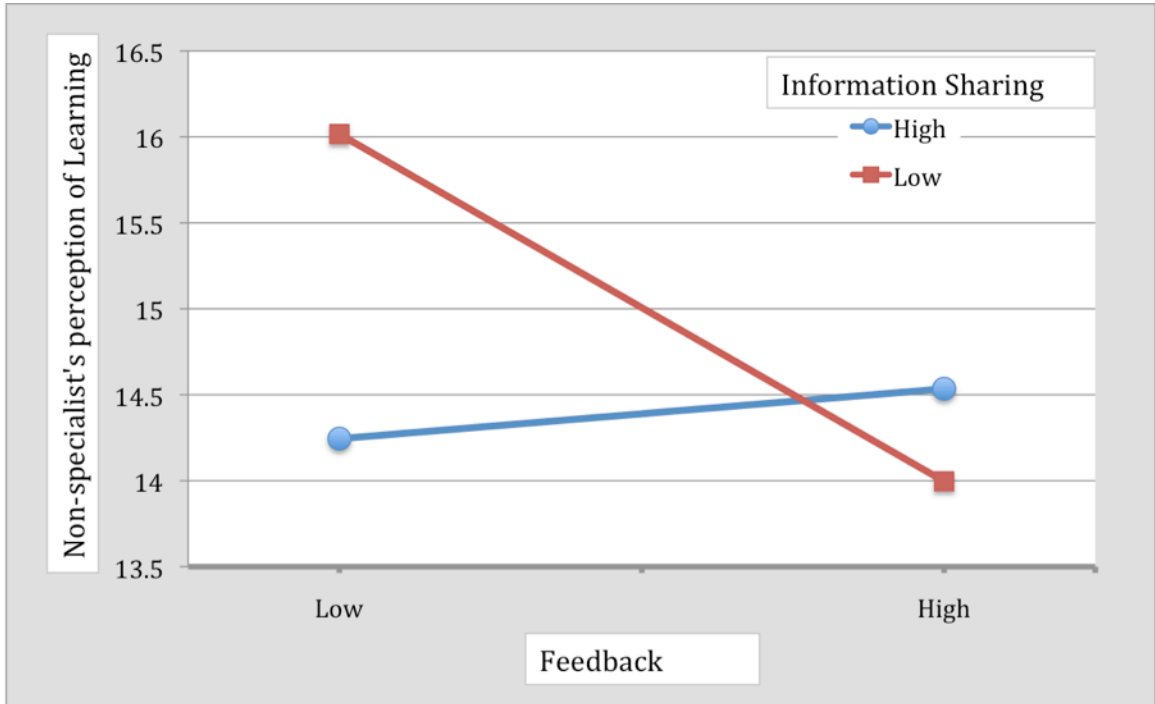
# Figures



**Figure 1:** Illustration of a Telemedicine Encounter



**Figure 2:** Learning Mechanism in Telemedicine



**Figure 3:** Information Sharing (IS) x Feedback (FB) Interaction

## Tables

**Table 1:** Descriptive Statistics for Telemedicine Survey

Demographic Profile	Non-Specialists		Specialists	
	Number	Percent	Number	Percent
<b>Highest Education</b>				
Secondary	23	27.4	0	0
Bachelors	26	31.0	0	0
MBBS	35	41.7	0	0
MD	0	0	84	100
<b>Gender</b>				
Female	64	76.2	34	40.5
Male	20	23.8	50	59.5
<b>Age</b>				
19-23	16	19	0	0
24-28	48	57.1	30	35.7
29-35	20	23.8	30	35.7
36-41	0	0	15	17.9
42-47	0	0	6	7.1
48-53	0	0	2	2.4
54-59	0	0	1	1.2
60-65	0	0	0	0



**Table 2:** Descriptive Statistics of Surveyed Hospitals

Hospital ID	Number of Beds	Number of Doctors	Average Number of Teleconsultations per day
1	1250	453	600
2	163	45	80
3	630	265	120
4	777	254	100
5	602	265	60
6	42	15	15
7	62	14	25
8	242	200	200
9	244	212	90
10	300	100	80
11	234	87	50
12	286	125	80
13	325	140	50
14	254	121	50
15	111	48	25
16	456	231	120
17	154	67	50
18	342	128	90
19	143	63	40
20	256	97	80

**Table 3:** Means, Standard Deviations, Internal Alpha Reliabilities, and Mean Interitem Correlations for Independent Variables

Scales	<i>M</i>	<i>SD</i>	Alpha	Interitem Correlation
Trust (TR)	16.63	1.85	0.80	0.44
Feedback (FB)	16.38	2.03	0.76	0.38
Technology Quality (QTECH)	16.07	2.14	0.73	0.52
Learner Characteristics (LC)	19.60	2.59	0.75	0.37
Information Sharing (IS)	16.07	1.63	0.71	0.45

**Table 4:** Factor Analysis – Rotated Component Matrix

	Components				
	1	2	3	4	5
QTECH 1	0.901				
QTECH 2	0.846				
QTECH 3	0.785				
QTECH 4	0.691				
QTECH 5	0.604				
TR 1		0.793			
TR 2		0.769			
TR 3		0.678			
TR 4		0.677			
TR 5		0.491			
LC 1			0.818		
LC 2			0.77		
LC 3			0.606		
LC 4			0.595		
LC 5			0.592		
IS 1				0.805	
IS 2				0.787	
IS 3				0.688	
IS 4				0.652	
FB 1					0.838
FB 2					0.742
FB 3					0.704
FB 4					0.485

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

**Table 5:** Correlation matrix and Variance Inflation Factors (VIF)

	<b>Education</b>	<b>Age</b>	<b>Gender</b>	<b>TR</b>	<b>FB</b>	<b>LC</b>	<b>IS</b>	<b>QTECH</b>
Education	1							
Age	-0.08	1						
Gender	0.176	.255*	1					
Trust (TR)	0.019	0.065	0.143	1				
Feedback (FB)	-0.055	0.059	0.172	.255*	1			
Learner Characteristics (LC)	0.203	0.011	-0.14	0.059	0.023	1		
Information Sharing (IS)	-0.088	0.008	-0.162	0.023	0.024	.140*	1	
Technology Quality (QTECH)	-0.143	0.054	0.178	.289*	.257*	0.071	0.092	1
<b>VIF</b>								
TR					1.55	1.579	1.566	1.171
FB				1.265		1.293	1.293	1.165
LC				1.133	1.137		1.006	1.137
IS				1.137	1.151	1.018		1.135
QTECH				1.277	1.557	1.727	1.704	

**Table 6: Interitem Correlation Matrix**

	TR 1	TR 2	TR 3	TR 4	TR 5	FB 1	FB 2	FB 3	FB 4	LC 1	LC 2	LC 3	LC 4	LC 5	IS 1	IS 2	IS 3	IS 4	QTECH 1	QTECH 2	QTECH 3	QTECH 4	QTECH 5		
TR 1	1																								
TR 2	<b>0.381</b>	1																							
TR 3	<b>0.451</b>	<b>0.421</b>	1																						
TR 4	<b>0.381</b>	<b>0.371</b>	<b>0.448</b>	1																					
TR 5	<b>0.591</b>	<b>0.302</b>	<b>0.549</b>	<b>0.546</b>	1																				
FB 1	<b>0.269</b>	0.078	<b>0.2</b>	0.127	<b>0.353</b>	1																			
FB 2	<b>0.292</b>	<b>0.202</b>	0.148	0.157	<b>0.265</b>	<b>0.612</b>	1																		
FB 3	<b>0.181</b>	0.146	0.153	<b>0.249</b>	<b>0.33</b>	<b>0.508</b>	<b>0.274</b>	1																	
FB 4	0.033	0.191	0.158	<b>0.271</b>	0.088	0.181	<b>0.36</b>	0.186	1																
LC 1	0.015	0.177	0.127	<b>0.193</b>	-0.006	-0.056	-0.072	-0.033	0.318	1															
LC 2	0.001	-0.028	0.147	0.055	-0.052	0.101	0.106	-0.019	-0.055	<b>0.339</b>	1														
LC 3	0.029	0.06	0.079	0.174	-0.112	-0.035	-0.048	-0.099	0.029	<b>0.457</b>	<b>0.427</b>	1													
LC 4	-0.098	0.037	-0.016	0.091	-0.098	-0.096	0.034	0.026	0.06	<b>0.396</b>	<b>0.427</b>	<b>0.477</b>	1												
LC 5	-0.086	0.014	-0.104	-0.004	-0.093	-0.158	-0.031	-0.112	0.057	<b>0.201</b>	0.176	<b>0.431</b>	<b>0.518</b>	1											
IS 1	0.074	-0.057	-0.021	0.007	-0.057	0.082	0.092	0.112	0.015	<b>0.213</b>	0.111	<b>0.104</b>	<b>0.138</b>	<b>0.158</b>	1										
IS 2	0.028	-0.002	-0.071	-0.087	-0.144	0.096	<b>0.199</b>	0.054	0.027	<b>0.201</b>	0.068	-0.01	0.164	0.169	<b>0.521</b>	1									
IS 3	0.006	0.094	0.142	0.156	-0.062	0.009	-0.052	0.085	0.072	<b>0.201</b>	-0.003	0.129	<b>0.178</b>	0.176	<b>0.515</b>	<b>0.428</b>	1								
IS 4	0.023	0.029	-0.013	-0.045	-0.1	0.011	0.029	-0.048	0.005	<b>0.199</b>	<b>0.1788</b>	<b>0.111</b>	0.315	<b>0.193</b>	<b>0.449</b>	<b>0.484</b>	<b>0.288</b>	1							
QTECH 1	<b>0.237</b>	0.075	0.044	0.146	<b>0.218</b>	0.053	0.118	0.176	-0.075	-0.003	-0.02	-0.158	0.106	-0.041	-0.057	-0.089	-0.104	-0.034	1						
QTECH 2	<b>0.235</b>	0.126	0.048	0.034	<b>0.269</b>	0.079	0.107	<b>0.22</b>	-0.149	-0.114	-0.001	-0.158	0.098	-0.05	-0.051	-0.068	-0.062	0.015	<b>0.692</b>	1					
QTECH 3	<b>0.232</b>	0.162	0.025	0.109	<b>0.267</b>	-0.055	0.027	<b>0.192</b>	-0.225	-0.056	-0.047	-0.14	0.075	-0.093	-0.057	-0.111	-0.105	0.031	<b>0.677</b>	<b>0.767</b>	1				
QTECH 4	0.098	0.056	0.044	0.157	0.174	0.058	0.039	0.082	-0.031	0.067	-0.106	0.144	-0.019	-0.06	-0.133	<b>-0.195</b>	-0.069	-0.079	<b>0.317</b>	<b>0.496</b>	<b>0.379</b>	1			
QTECH 5	0.097	0.021	-0.054	0.136	0.156	-0.089	-0.03	0.034	-0.056	0.08	-0.062	0.07	0.088	0.019	0.032	-0.083	-0.044	0.117	<b>0.419</b>	<b>0.521</b>	<b>0.396</b>	<b>0.498</b>	1		

r values in bold are significant

**Table 7:** Stepwise Regression Analysis of Non-specialists Perceptions of Learning on Demographic Variables, Information-Sharing, Feedback and Interactions (with individual-level and organizational-level variables).

Variable	Step		
	1	2	3
Education	-0.042	-0.079	-0.155
Age	-0.037	-0.02	-0.005
Gender	-0.169	-0.085	-0.15
Trust (TR)		-0.134	-0.264
Learner Characteristics (LC)		-0.064	-0.189
Technology Quality (QTECH)		0.177	0.233
Information Sharing (IS)		0.232*	0.208*
Feedback (FB)		0.318**	0.304**
IS X FB			-0.44**
IS x LC			0.417**
FB x TR			0.296*
IS x QTECH			0.277*
FB x QTECH			0.112*
$R^2$	0.029	0.203*	0.334**
$\Delta R^2$	0.029	0.173*	0.131**

\* $p < 0.05$ ; \*\* $p < 0.01$

**Table 8:** Descriptives – EMR Study participants and departments

<i>Categories</i>	<i>Number of Participants</i>	<i>Percent</i>
Doctors	24	19.35
Technicians	14	11.29
Nurses	86	69.35
Total	124	100

<i>Departments</i>	<i>Frequency</i>	<i>Percent</i>
Cardiology	6	4.84
Emergency		
Medicine	9	7.26
ENT	3	2.42
Gastroenterology	2	1.61
General Medicine	11	8.87
Neurology	17	13.71
Oncology	16	12.90
Ob-Gyn	19	15.32
Orthopedics	5	4.03
Pathology	13	10.48
Pediatrics	10	8.06
Surgery	13	10.48
Total	124	100

**Table 9:** Fieldwork - Provisional Codes for EMR Learning Interviews

<b>PROPERTIES</b>	<b>CODES</b>	<b>DESCRIPTIONS</b>
<b>EMR PROPERTIES</b>		
	EMR	
EMR PREFERENCE (OVER PAPER)	EMR-PREF	Notes whether the respondent prefer EMRs over paper records?
EMR EXPERIENCE	EMR-EXP	Notes the respondent's experience in working with EMRs
EMR-NEGATIVE	EMR-NEG	Notes the respondent's evaluation of EMR disadvantages
EMR-POSITIVE	EMR-POS	Notes the respondent's evaluation of EMR advantages
<b>DEMOGRAPHICS</b>		
DEMOGRAPHICS-NAME	DEM-NM	Respondent's name
DEMOGRAPHICS-DEPARTMENT	DEM=DPT	Respondent's department
DEMOGRAPHICS-EDUCATION	DEM-EDU	Respondent's education (degrees obtained)
DEMOGRAPHICS-STAFF GRADE	DEM-GRD	Respondent's position (designation) in organization
<b>EMR-CHS</b>		
EMR-CASE TYPE	EMR-CASE	Details about the EMR last accessed
EMR-DEPT INVOLVED	EMR-DEPT	Details about the clinical specialties involved EMR last accessed
EMR-INFORMATION	EMR-INFO	Details about specific information read in EMR last accessed
EMR-FEATURES	EMR-FEAT	Other details about the EMR last accessed
<b>INFORMATION IN EMR</b>		
INFORMATION ACCESSED	INFO-ACC	Information searched for in the EMR last accessed
INFORMATION MISSING	INFO-MISS	Documents whether any information was missing
INFORMATION- CONFUSING	INFO-CONF	Documents the respondent's perceptions of the information in the EMR
INFORMATION-COMPLETENESS	INFO-COMP	Documents the respondent's perceptions of the completeness of information
<b>STATUS</b>		
RELATIVE STATUS IN ORGANIZATION	ST-REL	Respondent's perception of his/her status relative to others
STATUS IN ORGANIZATIONAL CULTURE	ST-OC	Respondent's perception of organizational status
STATUS-APPROACHABILITY OF OTHERS	ST-APPR	Respondent's perception of approachability of other individuals
<b>EMR ACCESS</b>		
FREQUENCY OF ACCESS	ACC-FREQ	Number of times the EMR was accessed
EASE OF ACCESS	ACC-EASE	Whether the respondent found it easy to access required information
ACCESS- DUTY OR POST DUTY	ACC-D/PD	Whether the EMR was accessed during or after the respondent's regular working hours
ACCESS-REASON	ACC-REAS	Reason for accessing EMR- curiosity or part of duty?
<b>FAMILIARITY WITH TECHNOLOGY</b>		
EXPERIENCE WITH TECHNOLOGY	TECH-EXP	Experience working with computers
TECHNOLOGY IN DAILY LIFE	TECH-DAILY	Use of computers in daily life (separate from work)
TECHNOLOGY AT WORK	TECH-WORK	Use of computers at work
TECHNOLOGY AND SOCIAL NETWORKS	TECH-SN	Use of social networking websites
<b>LEARNING</b>		
CLINICAL RELATED LEARNING	LEARN-CLIN	Respondent's perceptions of clinical learning by reading EMR
LEARNING RELATED TO MEDICATION	LEARN-MED	Respondent's perceptions of learning about medications by reading EMR
LEARNING RELATED TO TECHNOLOGY	LEARN-TECH	Respondent's perceptions of learning about EMR technology by reading EMR



**Table 10:** Motivations for Asynchronous Discovery Learning

<b>Motivations</b>	<b>Categories</b>	<b>Percent</b>
a) Rare Cases	Doctors	83.3
	Nurses	41.8
	Technicians	none
b) Patient Attachment	Doctors	16.6
	Nurses	16
	Technicians	none
c) Self-Preservation	Doctors	none
	Nurses	11.6
	Technicians	50
c) Professional development	Doctors	100
	Nurses	37.2
	Technicians	71

**Table 11:** Categorization of EMR Benefits

<b>EMR Benefits</b>	<b>Percent</b>
Time Savings	21.6
Effort Savings	40.8
Paper Savings	3.2
Accessibility	9.6
Predictability	6.4
Continuity	1.6
Reference	15.2
Accuracy	12

# Appendix A

<b>Telemedicine Survey for Remote site doctors/Paramedical Staff</b>
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**A. GENERAL INFORMATION**

**Background Information**

1. Please circle your highest level of education

- HSC
- Bachelors
- MBBS
- MD

2. Where do you currently serve as a doctor?

---

3. Please choose the category that best fits your age

- 19-23
- 24-28
- 29-35
- 36-41
- 42-47
- 48-53
- 54-59
- 60-85

4. Please circle your gender:            Male                            Female

**B. TELEMEDICINE ENCOUNTER**

For the following items, please circle the number of the most appropriate response.

	Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree
The specialist discusses patient symptoms at length with me. (FB1)	1	2	3	4	5
The specialist discusses patient treatment options with me. (FB2)	1	2	3	4	5
The specialist answers my questions at the teleconsultation (FB3)	1	2	3	4	5
The specialist discusses the reasons for his/her diagnosis with me. (FB 4)	1	2	3	4	5
I would rate the specialist's diagnostic ability as high. (TR 1)	1	2	3	4	5
I usually agree with the specialist's diagnosis. (TR 2)	1	2	3	4	5
I trust the specialist's diagnosis. (TR 3)	1	2	3	4	5
I rate the specialist's diagnosis as credible. (TR 4)	1	2	3	4	5
I would rate the specialist's knowledge of his/her specialty as high. (TR 5)	1	2	3	4	5
Overall the quality of the telelink was good. (QTECH 1)	1	2	3	4	5
The overall technical aspects were good. (QTECH 2)	1	2	3	4	5

	<b>Strongly Disagree</b>	<b>Disagree</b>	<b>Neither agree nor disagree</b>	<b>Agree</b>	<b>Strongly Agree</b>
The sound quality during the teleconsultation was sufficient to enable the specialist to listen to my reading of patient symptoms. (QTECH 3)	1	2	3	4	5
The specialist could see the images on the screen clearly during the teleconsultation. (QTECH 4)	1	2	3	4	5
The teleconsultation helps me to increase my skills with respect to the specialty. (LN 1)	1	2	3	4	5
After the teleconsultation, I feel I have increased my knowledge about the specialty (LN 2)	1	2	3	4	5
After the teleconsultation, I feel more ready to handle cases related to the specialty. (LN 3)	1	2	3	4	5
Interacting with the specialist increases my knowledge of the specialty. (LN 4)	1	2	3	4	5

# Appendix B

<b>Telemedicine Survey for Specialists</b>
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**A. GENERAL INFORMATION**

**Background Information**

1. Do you possess an M.D.? (Circle one of the choices which apply to you)
- Yes
  - No

2. Where do you currently serve as a doctor?
- 

3. Please choose the category that best fits your age

- 19-23
- 24-28
- 29-35
- 36-41
- 42-47
- 48-53
- 54-59
- 60-85

4. Please circle your gender:            Male                            Female

**B. TELEMEDICINE ENCOUNTER**

For the following items, please circle the number of the most appropriate response.

	<b>Strongly Disagree</b>	<b>Disagree</b>	<b>Neither agree nor disagree</b>	<b>Agree</b>	<b>Strongly Agree</b>
The remote site doctor is well aware of the patient's history. (IS 1)	1	2	3	4	5
The remote site doctor can provide sufficient information on the length and duration of the patient's current symptoms. (IS 2)	1	2	3	4	5
I was able to get sufficient information from the remote site doctor to help me make a diagnosis. (IS 3)	1	2	3	4	5
The remote site doctor points out salient points in the patient's electronic medical records and digital images. (IS 4)	1	2	3	4	5
I would rate the accuracy of the remote site doctor in recommending a referral as high. (LC 1)	1	2	3	4	5
I would rate the diagnostic ability of the remote site doctor as high. (LC 2)	1	2	3	4	5
The remote site doctor asks clear and focused questions about the patient. (LC 3)	1	2	3	4	5
The remote site doctor displays an ability to acquire new skills. (LC 4)	1	2	3	4	5
I would rate the remote site doctor's understanding of about my specialty as good. (LC 5)	1	2	3	4	5

# Appendix C

## *Interview Protocol for Essay 2:*

### I. PERSONAL INFORMATION

Gender, age, occupation, educational qualifications, department

### II. USE OF ELECTRONIC MEDICAL RECORDS

1. Do you prefer using paper records or electronic medical records (EMRs)?
2. What are your personal objectives and preferences when working with EMRs?
3. How has the record keeping process changed over time?
4. What have been some of your biggest challenges or frustrations with EMRs?
5. List some of your positive experiences while working with EMRs?

### III. INFORMATION IN EMRs

1. Could you give us a recent (in the last week) example of an EMR that provided you with a fresh perspective?
2. Do you experience any inefficiency such as redundancies of information in the EMRs?
3. Have you read the EMR seeking patient care information that should have been recorded but that wasn't included in the record?

4. Have you read the EMR for information regarding a major patient event that was not included in the EMR? What aspects of the EMR stand out in your memory?
5. Have you felt confused or unclear regarding patient care provided and patient events that occurred after reviewing the information provided by other members of the medical team in the EMR?
6. Have you spoken with other members of the medical team to clarify what happened because of lack of information in the EMR?
7. Are there any topics that are off-limits while discussing EMRs with other members of the medical team?
8. How would you rate the completeness of information in the EMR?
9. Was any information missing from the EMR that could have helped you better perform your task?
10. Would you trust the information contained in the EMR? Under what circumstances would you question the information?
11. Did you read the EMR during or after the course of your duties? How many times did you read the EMR?
12. Did you enhance your level of clinical learning by reading the EMR? How?

#### IV. STATUS

1. How would you rate your status in the hospital (with respect to other members of a medical team)?

2. How easy is it for you to discuss EMRs with other members of the medical team
3. How approachable are the other members of the medical team?
4. How frequently do you interact with the other members of the medical team?
5. Give examples of when you have perceived the other members of the medical team as approachable and accessible? Is it easier for you to read and interpret the activities of your colleagues through EMRs than to discuss the same with them in person? Under what circumstances is this applicable?
6. Do elements of hospital culture prevent you from approaching other members of the medical team .
7. Identify norms and practices that encourage/discourage :a high frequency of interaction; an expectation of collaborative problem solving; teaching structures; identifying with and learning from mistakes and seeking out knowledge and expertise

## V. TECHNOLOGY

1. Do you have any ideas on how to improve the record keeping process through EMRs?
2. Is it easy for you to use electronic medical records?
3. Is it easy for you to enter information in EMRS?



4. Have you faced any technical difficulties while entering information in EMRs?
5. Have you had much experience working with technology in general?
6. Have you had experience working with electronic medical records?
7. Do you feel that your colleagues who are younger are more adept at using EMRs than you?
8. Since when have you been working with computers?
9. Describe the use of computers in your regular life?
10. Are you on social networking websites?

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