

# INFORMATION TECHNOLOGY DIFFUSION IN HEALTH CARE SECTOR IN BANGALORE

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## 1. Abstract

Information technologies are transforming the way health care is delivered. Innovations such as computer-based patient records, hospital information systems, computer-based decision support tools, community health information networks, telemedicine and new ways of distributing health information to consumers are beginning to affect the cost, quality and accessibility of health care. This paper discusses the relationship between information technology and new trends in the health care delivery system as health care is bought online. To perform empirical analysis, at first the responses (primary data) have been retrieved by means of semi-structured interviews conducted with senior management professionals who offer their full time services. Data analysis using different statistical approaches, such as reliability test, mean, standard deviation, Chronbach Alpha values estimation, factor analysis to evaluate the significance of IT diffusion in health care, the role of IT in improving clinical decision-making, information management, communication, costs and access to care.

## Key Words:

Information Technology, Computer, Tele medicine, Health

## 1.1 Introduction

Information Technology enables its services especially in patient care, administrative, operational areas and brought positive attitude, employee satisfaction. The healthcare sector should take initiatives, facilitate for smooth progress and proper functioning of Information Technology enabled services in the hospital.

The doctor-patient ratio in India is less (1:1000) than the WHO prescribed limit of 1:1700. The key issue of Indian health care sector is lack of healthcare infrastructure, affordability and healthcare financing model in the country.

In a developing country like India with high population, needs low cost medical services. Many studies reveal that Information technology in healthcare sector reduces cost and helps to improve service standards in hospitals.

Information technology (IT) and Information Technology Enabled Services (ITES) have seen stupendous growth during the last decade. The IT industry as a whole, has placed India on the world map as a major knowledge-based economy & outsourcing hub.

The Indian Information technology and ITES sectors go hand in hand in every aspect. The industry has not only transformed India's image on the global platform. National Association of Software and Services Companies (NASSCOM) predicts that the IT will bring in around US\$ 225 billion by 2020.

According to NASSCOM the opportunity for India is worth around 300\$ million annually. The application of information technology would help a lot in disseminating health care information to the health care professionals when ever and where ever it is needed and would help to update the professionals on various aspects of health care and prove to be an excellent contributor in better health care provisioning.

## 1.2 Research Objectives

This research paper will aim at fulfilling the following research objectives:

- To examine the relationship between Information Technology and healthcare sector performance
- To explore and analyse adoption and diffusion of IT in healthcare centres in Bangalore
- to evaluate and analyze the problems in adopting information technology in health care sector
- To know the benefits of Information technology in health sector

## 1.3 Materials and Methods

To perform empirical analysis, at first the responses (primary data) have been retrieved by means of semi-structured interviews conducted with healthcare organization administrative and management staff. To strengthen reason of study and make it broadly accepted, respondents have been selected from different healthcare organizations in Bangalore that are corporate in nature. A semi-structured interview was conducted for a sample of 120 using convenient sampling. The sample was taken from 50 hospitals that have bed strength more than 100. The participants were administrative staff like Hospital Administrator, Head of IT, System administrators, Operations/Data centre support, Network & Telecommunications Support, Project/Programme Manager who offer their full time services in hospitals. Data analysis using different statistical approaches, such as reliability and consistency test, mean, standard deviation, Chronbach Alpha values estimation, factor analysis using Statistical Package for Social Science's (SPSS) software to evaluate the significance of IT diffusion in health care, the role of IT in improving clinical decision-making, information management, communication, costs and access to care.

### 2.1 Types of Health information technology adopted in the organization

Implementation of information technology in health care sector facilitates better management of patients care through the secure use and sharing of health information. Though the IT implementation all the details related to the patients will be available electronically when it is needed and improves the quality of care as well as makes the health care as more cost effective. It is important to understand what health IT is and what are the different IT services or provisions offered in the healthcare sector. The implementation of the health care IT improves the quality of health care, prevents errors and improves the efficiency of administration. Hence the analysis has been done on types of health information technology adopted in the organization (Table 4.21).

Table 4.21 Types of Health information technology adopted in the organization

Types of Health information technology adopted in the organization	Mean	Std. Dev
Electronic Prescribing: Computerized Physician/ Provider Order Entry (CPOE)	4.275	0.448

Electronic Lab Results	4.925	0.264
Electronic Clinical Note Systems	4.483	0.549
Electronic Images	4.708	0.456
Electronic Lab Orders	3.441	0.658
Electronic Reminders for Guideline-Based Intervention	3.241	0.744

Majority of the respondents affirmed that their organization has adopted electronic prescribing: computerized physician/ provider order entry (CPOE) (M=4.275, S.D=0.448). Through the electronic lab reports clinician can print the result through printer and can fax or mail to the physician as well as patients. Electronic laboratory helps to get the faster result of the tests as well as it saves the time that is realized between the instant of ordering the test and obtaining the final result.

It is observed that most of the hospital has established electronic lab results (M=4.925, S.D=0.264). Clinical note explains the communication that occurred between patients and health care providers. The structure of the clinical notes is enhanced through the adoption of electronic health care record (EHR) and computer-based documentation (CBD) systems. Majority of the respondents affirmed that they are adopted electronic clinical note system which includes information on patient's demographics, clinical notes, medical history and follow-up orders (M=4.483, S.D=0.549). E-clinical image involves CT, MRI and PET scans which can exactly detects the issues in the body part clearly through high quality images and also increases the efficiency of the medical reports. Majority of the respondents revealed that their organization is having better e-clinical image proving components (M=4.708, S.D=0.456).

Nowadays, one of the critical challenges faced by physician is sending lab orders electronically. As the adoption EMR increases, few of the physicians who are highly office-based may finds the needs of setting up electronic laboratory ordering to increase the practice efficiency. Instead of ordering through manual processes associated with paper based orders, electronic lab ordering in an EHR is time saver process and improves accuracy of orders and makes better patients care. Very less fraction of the respondents affirmed that they their organization contains electronic lab orders system (M=3.441, S.D=0.658). Electronic reminders are the part of EHR to provide better clinical decision support as well as to manage the workflow of physicians. Such remaining system helps the physician to schedule the time properly and manage the time for each patient's observations. Further, it provides the detailed information about the specific patients' problems. However, respondents has revealed that such system is not effectively implemented in their organization (M=3.241, S.D=0.744).

## 2.2 IT Adoption Factors

The adaptation of IT in the health organization not only depends on financial stability of the organization but also depends on thought process of the technologies. However, the adoption of the IT in healthcare organization may creates difficulties due to the complex health care environment, several healthcare providers are following different care practices and some external practices such as economic constraints, regulatory issues, and the growing gaps between communities' access to technologies. Such issues may create problems to evaluate and analyze HIT and its adoption. The adaptation HIT may depend on many factors such as external pressures, internal pressures, Clinician Vs Manager Motivators etc.

### A. Influence of External Pressure

The external pressure is associated with the increasing demand for services. This may be influence on the organization from the organizational environment by the competitive pressure and demands by the trading partners. increases for the more advanced facility providers.

Table 4.22 Influence of external pressure

Influence of External Pressure	Mean	Std. Dev
Payer incentives for IT adoption	3.783	0.842
Proliferation of medical knowledge beyond human cognitive capacity	4.016	0.840
Increasing demand for services	4.575	0.643
Patient (healthcare consumer) expectations	4.450	0.605
Regulatory pressures for increased patient safety and quality of outcomes	3.900	0.782
Need for improved communication between clinicians relating to patient care	3.708	0.863
External pressure to improve efficiency and reduce cost of healthcare	4.916	0.277
Regulatory and Legislative controls regarding patient privacy	4.316	0.467

External pressure is considered as encouragement or pressure and is sometimes considered as recommendation, request or providing incentives or imposing penalties (M=3.783, S.D=0.842). Very small fraction of the respondents affirmed that proliferation of medical knowledge beyond human cognitive capacity is considered as one of the external pressure to adopt IT in healthcare (M=4.016, S.D=0.840). Respondents revealed that the adoption of the innovation by their competitor demands the adoption to completely utilize the innovation at an inter-organizational level (M=4.575, S.D=0.643).

In addition, the demands from the potential customers to adopt innovation strongly impacts on IT adoption in the organization (M=4.450, S.D=0.605). One of the regular requirements for IT adoption is to provide the quality and safety of care through the reduction of preventable harms (M=3.900, S.D=0.782), it may be possible by the IT adoption by collecting real-time clinical data from patients care workflows and maintaining it safely.

In the healthcare organization, communication is the major part of information flow, since the physician comes to know about the patient's problem through the proper interaction with patients in the convenient way. It is indeed that, the errors in the communication process may leads to substantial clinical morbidity and mortality. Sometimes clinician may lacks in getting the patients details in such cases adoption of IT helps to access the complete details of the patients (M=3.708, S.D=0.863).

Many health care organizations charges more for many medical care tests, checkups and laboratory scanning's. Many organizations is following lengthy process in treating the patients. Hence such organization is demanded for the adoption of innovation technology to improves the medical care efficiency and to reduce cost of the healthcare (M=4.916, S.D=0.277). Legislative and regulatory compliance is a fundamental accountability of Boards and one that is becoming increasingly complex in the healthcare sector (M=4.316, S.D=0.467).

## B. Influence of Internal Pressure

The internal pressure represents the requirements of the internal people of the organization. It reveals the issues faced by the people who are working for the organization. It may be in their daily care processes or in the testing and laboratory process. Providing the better services to employees increases the care process of the patients and enhances the organization reputation and reduces the cost of the medical care. Some of the internal pressure factors are given in table 4.23.

Table 4.23 Influence of external pressure

Influence of Internal Pressure	Mean	Std. Dev
Internal pressure to improve efficiency and reduce cost of healthcare	4.608	0.490
Staff expectations	4.533	0.808
Inadequate capital funding	3.983	0.829
Concerns about maintenance costs	4.791	0.407
Unclear benefits / return on investment	4.208	0.743
Lack of internal IT expertise	2.666	0.967
Lack of project management maturity	4.358	0.742
IT infrastructure capability to support high availability	4.758	0.429
Complexity of IT solution implementation	2.991	0.991
Lack of transparency of full costs of IT	3.175	0.895

Internal pressure reveals the problems that the patients, physicians, clinicians and nursing staff faced while providing medical care. Hence solving the internal issues or improving the medical care by adopting IT is required in the health care sector (M=4.608, S.D=0.490). The traditional procedures in recording the patients details requires lot of paper work to record the patients conditions in everyday, such process consumes more time to reporting as well as recording the conditions. In addition, some of the tests such as blood pressure, sugar content in the body of the patients is all consumes more time. Hence staffs expects automation in the patients care to provide the better care to the employees (M=4.533, S.D=0.808).

Capital resource represents the total pool of funds spent by the organization or government to build, obtain or upgrade physical assets such as property, buildings, technology or equipment. Respondents revealed that capital is another internal factor to adopt IT (M=3.983, S.D=0.829). If the health care providers maintaining the equipments for the test results and patients check up, it needs the proper maintaining of the equipments. Such components has high maintenance costs hence healthcare developer looking for the equipment which is having low maintenance cost (M=4.791, S.D=0.407). Every organization is aiming to gain the profit from their business. In order to get profit or return on their investment organization needs to fulfill the patients expectation or has to increase the patients perception towards the facilities and accuracy of the health care treatment. So they needs innovation technologies to

provide faster results of the patients illness causes and provide better medications (M=4.208, S.D=0.743).

On the other hand, few healthcare organization is not adopted the advanced technologies in their organization due to lacking of expertise in the IT support department (M=2.680, S.D=0.957). The challenges faced by the health organization in recent days are to deliver more efficient and better information and to provide faster quality services at the lowest price. To achieve this objectives healthcare organization needs more comprehensive and integrated technological solutions, in order to optimize their available resources, as a means to eliminate inefficiencies and to achieve planned benefits from investments. More and more, project management is recognized as being a key tool for use in developing initiatives that are aimed at promoting the implementation of organizations' strategies. Very smaller fraction of the respondents affirmed that organization is lacking in management maturity (M=3.260, S.D=0.964).

In order to meet the strategic requirements of health care procedures, many organization are implementing IT governance to enhance their service quality and efficiency of the health care procedures. IT governance is identified as extension of corporate governance. Respondents revealed that in adoption of IT the health care organization is lacking in IT governance (M=4.358, S.D=0.742). Majority of the respondents affirmed that the adoption of IT enables high availability of the resources at any time (M=4.758, S.D=0.429). Respondents also revealed that one of the reason for slow adoption of healthcare information technology is due to misalignment of incentives, and some healthcare providers is having limited purchasing power, and variations in the viability of HER products and companies (M=2.991, S.D=0.991). Transparency is one of the vital components of a good and effective health care system. Considering to the cost, quality and effectiveness of healthcare service and products patients and consumers will become dissatisfied when the organization is lacking in maintaining transparency (M= 3.175, S.D=0.895). In order to maintain the low cost in the medical care organization needs to maintain transparency in, prices, quality, and effectiveness of medical services and products.

### 2.3 Benefits of HIT

The implementation of health information system has brought tremendous advantages for the health organizations to improve the efficiency, cost-effectiveness, quality, and safety of medical care delivery. The realization of the benefits of the HIT is essential to analyze the changes has brought through the adoption of HIT.

#### A. Quality of care

The implementation of the EMR intended to improve the quality of care as well as patients outcomes. The impact of EMR on the quality of care depends on physician performance and billing precision.

Table 4.24 Quality of care

Quality of care	Mean	Std. Dev
Medical Error Reduction	4.483	0.549
Adherence Support	4.708	0.456
Effective Disease Management	3.441	0.658
Improved Access to Data	3.750	0.937
Increased healthcare professional's Productivity	4.916	0.277

It is a terrible scenario for any physician or healthcare professional that is facing medical errors. Respondents revealed that as EMR gives the chance to prioritize the treatment schedule based on the minority and majority health issues and reduces the chances of physician negligence, hence it reduces medical errors ( $M=4.483$ ,  $S.D=0.549$ ). Adherence reflects the relationship between the patients and caregivers that impacts on the patient's treatment routine.

Respondents revealed that due to the adoption of EMR, there is a changing view of medication adherence ( $M=4.708$ ,  $S.D=0.456$ ). It involves providing the medicine to the patients, documenting the medicine, electronic medication monitors, and using some telemedicine devices to provide medicine to the treatment. Some diseases such as heart disease, cancer, and diabetes are growing from day to day. Such diseases need continuous treatment for the patients. In such a situation, the adoption of health care IT benefits to effectively manage the diseases ( $M=3.441$ ,  $S.D=0.658$ ). Significantly, electronic health records are accessible for the multiple users of healthcare during the same time to understand the patient's health condition from any place ( $M=3.750$ ,  $S.D=0.937$ ). As the EMR concentrates on increasing the perception of patients, which in turn increases the accumulation at the hospital, hence the profit of the organization increases ( $M=4.916$ ,  $S.D=0.277$ ).

## B. Effect on Efficiency

An EHR can significantly improve practice efficiency, through the structured procedures and records. Through the structured documents, the patient's details can be easily accessed as well as it enriches the patient's history and improves the management of patients and patient engagement.

Table 4.25 Effect on Efficiency

Effect on Efficiency	Mean	Std. Dev
Healthcare organizations can potentially reduce healthcare professionals' administrative time	3.825	0.846
Improved Core Measure Performance	4.791	0.407
Increased patients' safety and coordination of patient care	4.516	0.501
Improved Hospital Images	4.258	0.654
Improved Medication Reconciliation	4.231	0.844

The respondents agreed that the adoption of EMR minimized the time required to document the patient's record rather than allowing more time with patient treatment and reducing administrative time ( $M=3.825$ ,  $S.D=0.846$ ). The adoption of IT supporting the organization enhances the efficiency of the services and service quality required to meet the need of the patients, thereby improving the performance of the organization ( $M=4.791$ ,  $S.D=0.407$ ). The adoption of it improved patient safety through the quality of care and enhances the coordination of patient care through better communication among multiple profiles of the care takers ( $M=4.516$ ,  $S.D=0.501$ ). Through effective organizational management, EMR improves the good opinion about the healthcare service and improves customer satisfaction and hospital image ( $M=4.258$ ,  $S.D=0.654$ ). The medication reconciliation process can help reduce medication errors that are especially common among patients who use multiple pharmacies. Creating an accurate medication list is important to patient safety. The adoption of EMR improves Medication Reconciliation ( $M=4.231$ ,  $S.D=0.844$ ).

### C. Effect on Cost

The adoption of EMR supposed to lower the healthcare cost. The adoption of technology improves the efficiency and gives all the patients details to make smarter decision in a short time. Through the adoption of technology it lowers the cost in many ways such as such reducing hospital readmissions, improving chronic disease care and minimizing physicians' malpractice risk.

Table 4.26 Effect on Cost

Effect on Cost	Mean	Std. Dev
Improved Productivity	3.641	0.481
Paper Reduction	4.800	0.401
Reduced Transcription Costs	4.558	0.498
Drug Utilization	4.608	0.490
Improved Laboratory Tests	4.200	0.805
Reduced Medical Records Storage Costs	4.208	0.743

It is fact that the healthcare software can be useful tool for improving physician productivity. Through the electronic documentation, physicians identify the solutions that will help them to use their EHRs more efficiently and, simultaneously, improve the quality of care they provide patients (M=3.641, S.D=0.481). As the healthcare software's document the details electronically, it reduces the paper needed for documentation (M=4.800, S.D=0.401). Over the past decade, most EMR return-on-investment calculations have included the assumption that physicians would adopt template-based documentation, and medical transcription costs would be significantly reduced or eliminated (M=4.558, S.D=0.498). Healthcare organizations have drug utilization reviews to ensure the safe and appropriate use of medications in a hospital, medical practice, or other healthcare setting. Through the adoption of technologies in the hospital medication usage process or medication treatment response has improved with the goal of optimizing patient outcomes (M=4.608, S.D=0.490). The results of the laboratories must ensure the accuracy, completeness, and usability of information that is transmitted to the patient's electronic health record. Thorough reviews of electronic test results and transmission of test results across electronic interfaces have become more important as health care providers increasingly request laboratory tests using computerized order entry and review most test results within the EHR (M=4.200, S.D=0.805).

### D. Additional Benefits

Table 4.27 analyses the additional benefits.

Additional Benefits	Mean	Std. Dev
Improved Patient Safety	4.291	0.834
Improved Regulatory Compliance	4.666	0.523
Enhanced Ability to Compete with Regional Healthcare Organizations	4.358	0.742
Enhanced healthcare professional's Job Satisfaction	4.758	0.429
Increased Patient Satisfaction	4.616	0.488



Electronic medical records improve improves patients safety and reduces medical errors through the improved communication and interaction among primary care providers (M=4.291, S.D=0.834). The adoption of EMR majorly reduced the medical errors among inpatients and outpatients setting, hence the chances of Regulatory Compliance is highly reduced (M=4.666, S.D=0.523). Through the adoption of IT the performance and quality of care service has enhanced which has given strength to the health care organization to Compete with Regional Healthcare Organizations (M=4.358, S.D=0.742). Being able to provide high-quality health care is a primary driver of job satisfaction among physicians. Through the electronic health record technology interferes with face-to-face discussions with patients, requires physicians to spend too much time performing clerical work and degrades the accuracy of medical records by encouraging template-generated notes. Hence respondents revealed that healthcare professional's Job Satisfaction has increased through EMR (M=4.758, S.D=0.429). Though the adoption of EMR it reduced the waiting time of patients and they can get the treatment from specialist related to specific issues as well as improved the quality of care which in turn increased the patients satisfaction (M=4.616, S.D=0.488).

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