To Study the Process of implementation and adoption of Clinical information system at RGCI&RC

A dissertation submitted in partial fulfillment of the requirements
For the award of

Post-Graduate Diploma in Health and Hospital Management

By:
(**Dr Shuchi Vashishtha**)

International Institute of Health Management Research
New Delhi -110075
Jan-April 2012

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By

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Finally, an honorable mention goes to my family and friends for their understanding and support on me in completing this project.

Thank You

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Certificate of Internship Completion

Date:……..

TO WHOM IT MAY CONCERN

This is to certify that **Dr. Shuchi Vashishtha** has successfully completed her 3 months internship in our organization from January 22nd, 2012 to April 23, 2012. During this intern she has worked on "**To Study the Process of implementation and adoption of Clinical information system at RGCI&RC**" under the guidance of me and my team RGCI&RC.

We wish her good luck for her future assignments.

(Signature)

_____(Name)

_____Designation

Certificate of Approval

The following dissertation titled "**To Study the Process of implementation and adoption of Clinical information system at RGCI&RC**" is hereby approved as a certified study in management carried out and presented in a manner satisfactory to warrant its acceptance as a prerequisite for the award of **Post- Graduate Diploma in Health and Hospital Management** for which it has been submitted. It is understood that by this approval the undersigned do not necessarily endorse or approve any statement made, opinion expressed or conclusion drawn therein but approve the dissertation only for the purpose it is submitted.

Dissertation Examination Committee for evaluation of dissertation

Name	Signature
_____	_____
_____	_____

Certificate from Dissertation Advisory Committee

This is to certify that **Dr. Shuchi Vashishtha,** a participant of the **Post-Graduate Diploma in Health and Hospital Management**, has worked under our guidance and supervision. He is submitting this dissertation titled "**To Study the Process of implementation and adoption of Clinical information system at RGCI&RC"** in partial fulfillment of the requirements for the award of the **Post- Graduate Diploma in Health and Hospital Management**.

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

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Abstract

This project is based on the study of the phases of clinical implementation of Electronic Health Record in a leading hospitals located in Rohini and the process of its adoption in the OPDs. The Hospital is a leading and well respected corporate healthcare provider in India. It provides high quality Oncology services for all types of cancers at primary, secondary and tertiary levels. Currently the hospital is at the transitional stage between paper and electronic state. When adapting a traditional process to the new electronic era, unique opportunities and challenges are offered that involve the actors: patients, pharmacists, and also health care and EHR system providers and other stakeholders. The attitude of the stake holders is a very crucial part of implementation as well as Adoption New technologies may introduce new risks with the extended use of prescription information in large scale database. Patient safety has become a hot topic in research and media during recent years. These issues make user Adoption even more difficult. The study envisages the benefits and issues with the transformation, the attitude of the user towards transformation and the whole process of adoption. It includes the study of all the stages that has been adopted in the implementation of the OPD module of the Electronic Health Records till date. The special focus would be to identify the various concerns of the users, which came across during the different stages of Implementation and adoption. The study is mainly involved with the Implementation in OPD and IPD catering to the needs of the concerned Hospital, but the results generated can also be utilized in for Implementation in OPD and IPD of Hospitals at smaller level as well as Standalone clinics. Future Implementation in big Corporate Hospitals (Standalone or Chain) would also become a relatively easy task. As during the period of study, the phases of Transform and Sustain would not be covered; therefore it would not be possible to obtain the data of the issues faced during these phases in this project from the implementers. Therefore in such cases data could be obtained only from the past experiences of the Implementer and by analyzing the various cases of EHR implementation Worldwide.

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Abbreviations

RGCI&RC	Rajeev Gandhi Cancer Institute & Research Centre
OPD	Out Patient department
IPD	In Patient Department
EHR	Electronic Health Record
HIT	Health Information Technology
CPRS	Computer-based Patient-Record System
HIS	Health Information System
VistA	Veterans Health Information Systems and Technology Architecture
CPOE	Computer-based Provider Order Entry

Part – I

1. Introduction to Organization

ABOUT RAJIV GANDHI CANCER INSTITUTE AND RESEARCH CENTRE

Rajiv Gandhi Cancer Institute & Research Centre (**RGCI&RC**) started functioning on 1st July, 1996 is a comprehensive cancer care set-up with all the facilities for diagnosis and treatment of all types of cancers, available under one roof. Initiated as a 152-bedded hospital the Institute has been growing steadily and presently is a 238-bedded hospital with an imp inching need for further expansion in terms of beds and other facilities to meet the growing demand. As part of its efforts to provide the best medical technologies for patient care, the hospital has added a Bone Marrow Transplant Unit in the year 2000, IMRT (Intensity Modulated Radiotherapy Technique) & Color-Doppler technique in the year 2002 and a current-generation PET-CT Scan facility in 2008. The Department of Surgical Oncology, Radiation Oncology and Medical Oncology of Rajiv Gandhi Cancer Institute & Research Centre have set up high standards in the medical field.

Since its inception on 1st July 1996, the Institute has proved its capability as a center of Excellence. The hospital has registered over 100,000 Patients from Delhi, neighboring States as well as from Foreign Countries. RGCI&RC is an exclusive Oncology Tertiary Cancer Care Centre.

RGCI & RC - A Unit of Indraprastha Cancer Society

Indraprastha Cancer Society & Research Centre is a non-profit public society managed by a group of socially responsible, selfless, philanthropists. Society was formed in the year 1994 under the society's registration act, 1860. Besides patient care, one of the main objectives of the society is to study and undertake scientific research on all aspects of patient care, and in particular to investigate its incidence, prevalence, distribution, cause, symptoms and to promote its cure.

Rajiv Gandhi Cancer Institute & Research Centre is the Visionary Project of Indraprastha Cancer Society & Research Centre aimed at providing the best of Oncological Care to those who need it. At the apex level is the Governing Council, for governance & the Management Committee, for managing affairs of the institute.

The institute started functioning on 1st July, 1996 when a soft opening was done by Hon'ble Smt. Sonia Gandhi. However, it was formally inaugurated by the then, President of India, Dr. Shankar Dayal Sharma, in the presence of Smt. Sonia Gandhi and other dignitaries, on 20th August, 1996.

Initiated as a 152 bedded hospital, it has been growing steadily and has never looked back. Presently it is a 241 bedded hospital, with state of the art facility for the diagnosis and treatment of cancer and is recognized as one of the premium Institutes not only in northern India but also in the entire country. Since its inception, the institute has proved its capability as a Centre of excellence and has so far registered about 1, 25,000 patients coming from India and abroad. A large number of patients from Nepal, Bangladesh, Srilanka, and other neighboring countries are also utilizing the facilities of our Institute.

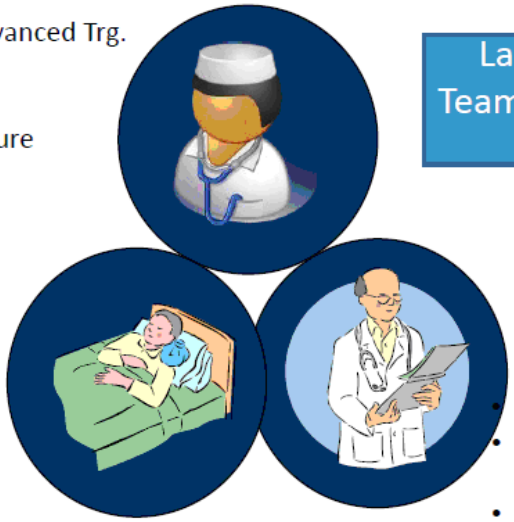
The philosophy of RGCI & RC is to constantly strive towards, excellence in onco-care through combination of latest technology, competent personnel and a humane touch. This is reflected by the addition of Bone Marrow transplant unit in the year 2000 IMRT (Intensity Modulated Radiotherapy Technique) & Colour Doppler techniques in the year 2002.

In cancer diagnosis, the institute has installed a 40 a sliced advance PET-CT in the year 2007. In the same year, a 1.5 Tesla MRI with dedicated technology for cancer specific diagnosis was also installed. Dexa Scan & PFT services have been commissioned from 2008-09.

The institute has now commissioned two state of the art Image Guided Radiation Therapy (IGRT) units. Using this cutting edge technology, it is possible to treat the tumors that move along with respiration or have internal motion. This technique also carries out a close monitoring of the part being irradiated during the entire course of treatment. Combined together, Radiation Oncology at RGCI & RC includes precision and quality of the highest standards. In addition we have also installed MRI and PET-CT which are unique diagnostic equipments. The latest addition in the technology up gradation is the Da Vinci, state-of-the-art, Robotic surgical equipment, the first of its kind in an exclusive cancer hospital, in India.

Ashray, a hostel has been built about 200metres away from the main hospital building to cater to the lodging and boarding requirements of the relatives of the patients, seeking treatment in RGCI & RC from outside Delhi

- 300+ Nurses, Basic & Advanced Trg.
- Avg. Exp 2 yrs
- 64% Staff Turn over/year
- 75% No computer exposure



Largely, Clinical Team Not Computer literate

- 14 Sr. Consultants, >15 yrs
- 35 Consultants + Associates (<=10 yrs)
- 60 Residents (<5 yrs)
- 25% Doctors not computer Savvy

- Total of 250 Beds,
- 4 O T, Post OP 14 beds , ICU (14 Beds)

The Governing Council Members of Indraprastha Cancer Society & Research Centre

- Shri Rakesh Chopra– Chairman
- Smt. Jyotsna Govil – Vice Chairperson
- Shri Pramod Maheshwari- Hony. Secy.
- Shri O P Nayar- Hony. Treasurer
- Shri K K Mehta- Principal Advisor
- Shri Madan Agarwal - Member
- Shri R K Ahooja - Member
- Shri RN Bansal - Member
- Shri Lalit Bhasin - Member
- Smt. Harmala Gupta - Member
- AVM H L Kapur (Retd.) - Member
- Dr. Sunil Khetrapal - Member
- ACM O P Mehra (Retd.) - Member
- Dr. K V Swaminathan - Member
- Shri B Swarup - Member
- Representative of LG of Delhi - Member

1.1 Vision

To establish an Oncological Institution of International excellence providing facilities for Cancer Diagnosis, Treatment, Education, Training and Research based upon ethical, scientific, professional principles following the latest management trends particularly in the field of quality and environment.

"The Institute strives to meet Major unmet Medical needs in the field on Oncology with its Innovative Diagnostics, Therapeutic Services & Support Services."

1.2 Mission

To update the Institutional facilities in line with the updated global modernization scenario to ensure that the best in Oncology can be delivered to maximum possible population in the most cost efficient manner. To achieve this goal by establishing up to maximum of 400 beds in the present campus and by outreach programs through satellite centers with collaborations and affiliation with centre of repute and through telemedicine network.

1.3 Values

Rajiv Gandhi Cancer Institute & Research Centre always holds it patients, who come for diagnostic and therapeutic treatment, in high esteem. It also encourages teamwork, mutual respect and trust among the management, consultants, resident doctors, medical and Para-medical, and the staff of supportive services. Transparency, proper diagnosis, proper treatment and correct advice, to the patients, are the hallmarks of this institute.

1.4 Location

Rajiv Gandhi Cancer Institute & Research Center
Sector - V Rohini Delhi - 110 085.
Helpline: +91-11-47022222
Appointment: +91-11-47022070/71

2. Area of Engagement

The area of engagement in the organization during the internship was the EHR Project. An Electronic Health Record is an evolving concept defined as a systematic collection of electronic health information about individual patients. It is a record in digital format that is capable of being shared across different healthcare settings by being embedded in network-connected enterprise wide information systems.

I was engaged in the OP adoption program of EMR managed by the IT department of RGCI&RC. My role was to ensure the smooth adoption of EMR by the various end users, physicians, medical assistants, nurses and dieticians. I provided them training on CPRS

(Computerized Physician Record entry System). Now the hospital is going live with the IP modules of EMR and I have been given the responsibility of looking after the adoption of the same.

2.1 Routine or general management

My role was to:

- Monitor the work of these medical assistants
- Train the newly joined medical assistants.
- Prepare a daily report of the work done by the medical assistants. The report consists of the number of notes, prescriptions, orders fed by the medical assistants OPD wise.
- Conduct meetings of medical assistants on issues in adoption process.
- Prepare OPD wise monthly adoption report.
- Train consultants, senior resident doctors, junior resident doctors, DNBs in CPRS.
- Train new joiners in CPRS.
- Prepare SRS document for dietary module.
- Train kitchen team in dietary module.
- Make a Risk management matrix before IPD adoption.
- Train consultants, senior resident doctors, junior resident doctors, DNBs in IPD module.
- Make sure all the Hardware is available in the wards and ready to be used before Go Live.
- Support the users during Go Live
- Prepare the daily adoption report.

2.2 In-depth study

The RGCI&RC is going through adoption of EHR in phases. The adoption started with OPD in 2009 and is in its post implementation phase I studied the detailed workflow of the OPD and how it changed after computerization and then I did an in-depth study on the phases of implementation so in order to understand and analyze the perspective of end user did Post implementation study in OPD. To conduct the study I prepared a detailed questionnaire on post implementation questionnaire and got it filled by the doctors. Then I divided the questionnaire into variables ie Communication between staff and patient, Patient Care, Patient safety, Job satisfaction and Turnaround time for documentation and patient care processes. Then I analyzed them. After analyzing the questionnaires the loopholes were identified and recommendations were given.

I studied the adoption process in RGCI&RC in-depth and studied the adoption OPD wise and came out with the monthly adoption report OPD wise to analyze which OPD is performing better and which one is performing worst. Then I made a monthly adoption

report of the hospital to analyze the progress in adoption. After analyzing the loopholes were identified and recommendations were given.

The adoption is now starting with IPD which is in preimplementation phase. I studied the detailed workflow of the IPD and how it is going to change after computerization and then I did an in-depth study on the phases of implementation, in order to understand and analyze the perspective of end user did a pre implementation study in IPD. To conduct the study I prepared a detailed questionnaire on preimplementation and got it filled by the nurses. Then I divided the questionnaire into variables ie Communication between staff and patient, Patient Care, Patient safety, Job satisfaction and Turnaround time for documentation and patient care processes. Then I analyzed them. . After analyzing the questionnaires the loopholes were identified and recommendations were given.

3 Managerial Tasks Done in Departments

In OPD my role was to:-

Manage a team of 15 medical assistants.

Assign them daily tasks

Prepare a daily performance report

Mentor and train medical assistants for EMR adoption in OPD .

Conduct meetings on adoption progress review

In IPD my role was to:-

Prepare a Risk management matrix before IPD adoption.

In Dietary module my role was to:-

Prepare SRS document for dietary module.

In Adoption process my role was to:-

Prepare Daily Progress report of medical assistants

Prepare Monthly adoption report OPD wise

Prepare Monthly adoption report of the hospital.

4 Reflective Learning

During the entire duration of Internship, there has been a lot of learning from all the quarters' i.e. from officials on site as well as off site. Apart from that the experience of the mentor has been very useful for knowledge transfer.

Some of the learning's during the entire internship programme is as under

- Practical issues involved in the various stages of the implementation which may result in deviations from the project plan.
- The various perceived risks and benefits among the users regarding the implementation.
- The various barriers observed during the different stages of implementation and the various strategies mulled in order to remove the hindrances.
- The basic workflow followed by the RGCI&RC in order to carry out their processes, the shine points of the workflows as well as the limitations in the current workflows which can be sorted out.
- The OPD Module of the EHR which is in the process of Implementation, the various functionalities supported by it as well as the various areas in the module which require customization as per the user requirements.
- The various techniques to handle the user are changing state of mind and to convince the users to accept the change process by informing them of the various benefits of the change process.
- The various techniques involved to ensure the end user participation throughout the implementation process so that to instill a sense of belongingness in the end user regarding the EHR. This would ensure better acceptability among the users.
- The techniques to bring the ideas of Top Management and the End users at the same table in order to ensure similarity in the two and make efforts to iron out any differences among the two.
- The different ways to gauge the level of competence of the end users in order to determine the level of training that needs to be provided to equip them of the necessary knowledge required by the end users to run the EHR efficiently. This will

also help in the identification of super users or champions that could help in smooth transition to the new EHR.

- The different techniques employed by the service provider for resource planning to ensure efficient resource utilization.
- The interpersonal skills required in such big projects to ensure the continuity of operations.

Part II

1 Introduction

Technology is one of the most pervasive and ubiquitous tools in the healthcare today. Information technology solutions have already started to become an integral part of the healthcare system to raise its productivity and enable innovations. it is now widely accepted as part of daily work practices in most of the organizations.

There is compelling evidence to demonstrate that the adoption of health informatics results in improved patient safety and the delivery of a higher level of patient care. Health care informatics uses technology, such as computers and networking, and multidisciplinary health sciences, such as biomedical and pharmacy, to improve patient care. Informatics organizes patient data into a coherent format suitable for smooth health care processes.

Incorporation of IT in healthcare industry can result in improved teamwork; diagnosis related information is delivered at a faster rate; potential drug interactions and allergies are identified earlier; and health records are maintained more consistently and securely. By demonstrating the substantial savings that can be achieved through using it in the healthcare industry, we believe that we can accelerate the deployment of new technologies to help healthcare providers tackle the challenge of stretching budgets further.

The rapid rise and spread of health care informatics is linked to technology and computers advances during the 1970s. The systems, of this time, used a single mainframe and time-shared computers to process all patient information. By the 1980s, health care practitioners used several small computers on the same patient database. Organizations began to develop standards and protocols for health care information transmissions. This form of informatics was unable to produce customized reports and still focused on financial aspects.
Over the last few decades, information technology (IT) has significantly altered the nature of work and existing organization structures in many industries (Wheeler, 2002). One such

industry that has seen dramatic changes in technology is the healthcare organization. IT is seen as an enabler of change in healthcare organizations, and Healthcare Information Technology (HIT) is currently receiving great attention and playing an important role in healthcare organizations. Many research papers (Betes, 2000, Johnston et al., 2003, Overhage et al., 1996, Wong et al., 2003, and Menachemi and Brooks, 2006) reported that IT in healthcare has significant potential to improve patient safety, organizational efficiency, and patient satisfaction. And the realization of these benefits is especially important to successful HIT adoption.

In 2004, President Bush introduced the initiative to make Electronic Health Records (EHR) available to U.S. residents within the next ten years and through the executive order created the National Coordinator of Health Information Technology. The Administration worked to expand the use of HIT to increase efficiency, reduce medical errors, and improve quality of care while protecting patients' privacy and personal information. The National Coordinator presented the framework for the strategic action that established four goals for national adoption of HIT and the most important roles in the widespread adoption of HIT include:
(1) Establishing a motivation and providing the leadership necessary for its accomplishment;
(2) Facilitating the development of standards for EHR and promoting their interoperability;
(3) Using HIT as the largest purchaser and provider of healthcare, including the deployment of high technical solutions; and
(4) Providing different environments and incentives that will expedite the cost-effective adoption of HIT and the realization of its potential benefits (Rash, 2005).

Despite the enormous interest and effort in adoption of HIT, and continuous introduction of HIT at a comparatively rapid pace, many physicians and healthcare professionals are uncertain about how to adopt HIT to catalyze the transformation, and many still doubt physicians and practitioners are ready for the widespread deployment. The healthcare industry has been also slow to adopt HIT, and little evidence of the significant productivity improvement and potential benefits has been identified in the massive healthcare sectors, because the assessment of the number of healthcare professionals and hospitals that have

adopted HIT are diverse and unreliable (Brailer and Terasawa, 2003). Only a small number of U.S. healthcare providers have fully adopted HIT as there are significant financial, cultural, technical and legal barriers to its adoption. These include a lack of access to capital, a lack of data standards, and resistance from healthcare providers.

The potential benefits of the widespread adoption of HIT make it essential to investigate the evidence that currently supports the benefits of HIT across healthcare environments, and many survey methodologies are aimed at obtaining estimates of population parameters in rigorous fashion. To estimate the amount of resources needed to adopt HIT, we need to investigate the perceived benefits of HIT adoption across healthcare organizations. The purpose of this study is to develop a survey instrument that could be used to determine the healthcare professionals' perception of HIT adoption, in relation to perceived benefits of using CPOE. To address the need for the investigation of perceived benefits of HIT adoption, we develop a survey instrument based on a priori construct of perceived benefits glanced from the review of perceived benefits in diverse research areas. This paper outlines the broad understanding of HIT, the current state of HIT adoption, the constructs of perceived benefits, and the development of an instrument to investigate perceived benefits of HIT adoption.

Electronic Medical Record:

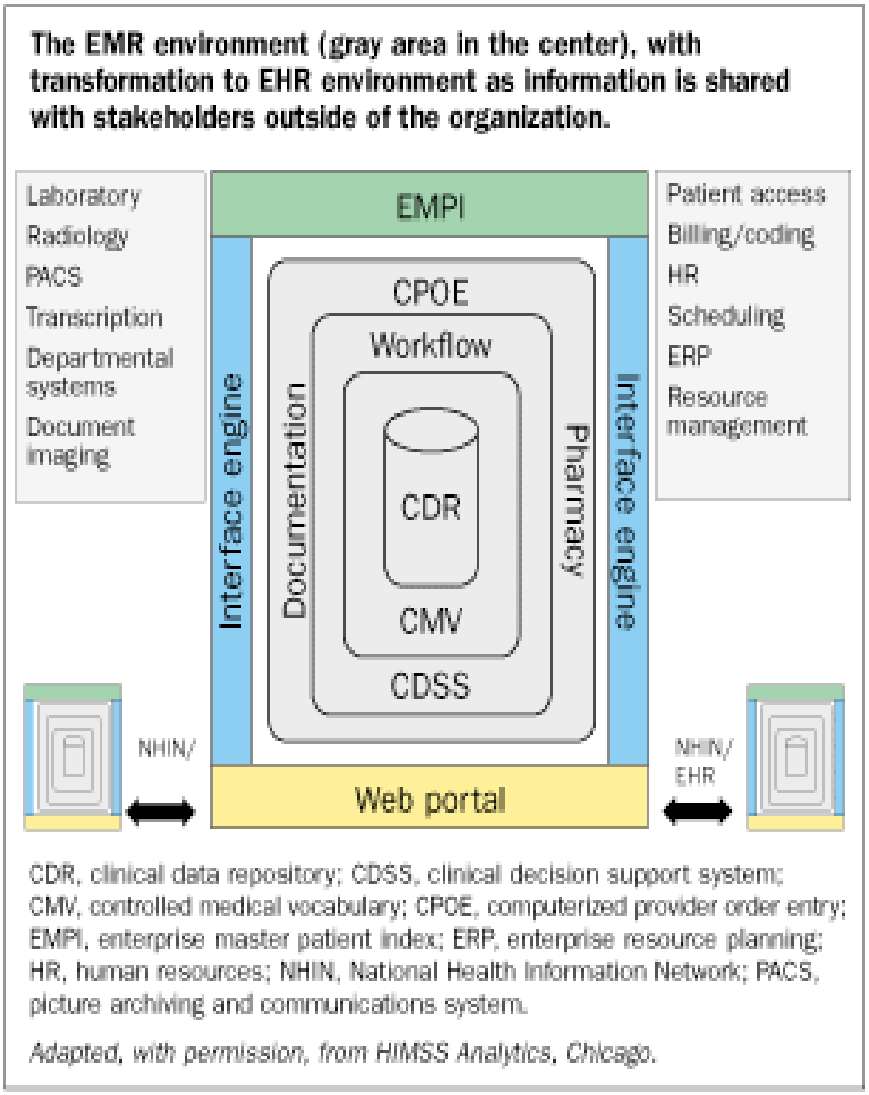
It is an application environment composed of the clinical data repository, clinical decision support, controlled medical vocabulary, order entry, computerized provider order entry, pharmacy, and clinical documentation applications. This environment supports the patient's electronic medical record across inpatient and outpatient environments, and is used by healthcare practitioners to document, monitor, and manage health care delivery within a care delivery organization (CDO). The data in the EMR is the legal record of what happened to the patient during their encounter at the CDO and is owned by the CDO.

Electronic Health Record:

It is a subset of each care delivery organization's EMR, is owned by the patient and has patient input and access that spans episodes of care across multiple CDOs within a community, region, or state (or in some countries, the entire country). The EHR can be established only if the electronic medical records of the various CDOs have evolved to a level that can create and support a robust exchange of information between stakeholders within a community or region.

Advantages of an Electronic Health Record

- Easy access to information.
- Comprehensive and standardized documentation.
- Improved quality of patient care.
- Increased nursing efficiency.
- Improved process communication.
- Reduced medication errors.
- Reduced hospital costs.



Purpose of CPRS:

The purpose of a patient record is "to recall observations, to inform others, to instruct students, to gain knowledge, to monitor performance, and to justify interventions" [Reiser, 1991]. The many uses described in this statement, although diverse, have a single end goal— to further the application of health sciences in ways that improve the well being of patients. Yet, observational studies of physicians' use of the paper-based record find that and other practical limitations reduce the effectiveness of traditional records for storing and organizing an ever increasing number of diverse data. A computer-based patient record is designed to overcome many of these limitations, as well as to provide additional benefits that cannot be attained by a static view of events.

A **computer-based patient-record (CPR)** is a repository of electronically maintained information about an individual's lifetime health status and health care, stored such that it can serve the multiple legitimate users of the record. Traditionally, the patient record was a record of care provided when a patient is ill. Managed care encourages healthcare providers to focus on the continuum of health and health care from wellness to illness and recovery. Consequently, the record must integrate elements regarding a patient's health and illness acquired by multiple providers across diverse settings. In addition, the data should be stored such that different views of those data can be presented to serve many uses.

A **computer-based patient-record system** adds information-management tools to provide clinical reminders and alerts, linkages with knowledge sources for health-care decision support, and analysis of aggregate data for outcomes research and improved management of the healthcare delivery system. To use a paper-based patient record, the reader must manipulate data either mentally or on paper to glean important clinical information. In contrast, a CPR system provides computer-based tools to help the reader organize, interpret, and react to data.

Ways in Which a CPRS Differs from a Paper-Based Record

In contrast to a traditional patient record, whose functionality is tethered by the static nature of paper— a single copy of the data stored in a single format for data entry and retrieval— a computer-based patient-record is flexible and adaptable. Data may be entered in a format that simplifies the input process (which includes electronic interfaces to other computers where patient data are stored) and displayed in different formats suitable for their interpretation. Data can be used to guide care for a single patient or in aggregate form to help administrators develop policies for a population. Hence, when considering the functions of a CPR, we do not confine discussion to the uses of a single, serial recording of provider–patient encounters. A CPR system extends the usefulness of patient data by applying information-management tools to the data.

Inaccessibility is a common drawback of paper records. In large organizations, the traditional record may be unavailable to others for days while the clinician finishes

documentation of an encounter. For example, paper records are often sequestered in a medical records department until the discharge summary is completed and every document is signed. During this time, special permission and extra effort are required to locate and retrieve the record. Individual physicians often borrow records for their convenience, with the same effect. With computer-stored records, all authorized personnel can also access patient data immediately as the need arises. Remote access to CPRs also is possible. When the data are stored on a secure network, authorized clinicians with a need to know can access them from the office, home, or emergency room, to make timely informed decisions.

Documentation in a CPR is usually more legible because it is recorded as printed text rather than as hand writing, and is better organized because structure is imposed on input. The computer can even improve completeness and quality by automatically applying validity checks on data as they are entered. For example, numerical results can be checked against reference ranges. Typographical errors can be detected if a datum fails a reference range check. Moreover, an interactive system can prompt the user for additional information. In this case, the data repository not only stores data, but also enhances their completeness.

Data entered into a computer can be reused. For example, a physician could reuse her clinic visit note in the letter to the referring physician and the admission note. Reusability of data is one way that a CPR increases efficiency of the provider's workflow.

Reuse of data also increases the quality of data. The more users and uses that depend on a data element, the more likely that it will be reviewed and be kept up-to-date. The degree to which a particular CPR demonstrates these benefits depends on **several factors:**

- **Comprehensiveness of information**: Does the CPR contain information about health as well as illness? Does it include information from all clinicians who participated in a patient's care? Does it cover all settings in which care was delivered? Does it include the full spectrum of clinical data, including, clinicians' notes, laboratory-test results, medication details, and so on?
- **Duration of use and retention of data.** A record that has accumulated patient data over 5 years will be more valuable than is one that contains records of only the visits made during 1 month.

- **Degree of structure of data.** Medical data that are stored simply as narrative text entries will be more legible and accessible than are similar entries in a paper medical record. Uncoded information, however, is not standardized, and inconsistent use of medical terminology limits the ability to search for data. Use of a controlled, predefined vocabulary facilitates automated aggregation and summarization of data provided by different physicians or by the same physician at different times. Coded information is also required for computer-supported decision making and clinical research.
- **Ubiquity of access.** A system that is accessible from a few sites will be less valuable than one accessible from any computer by an authorized user

Historical Perspective

The historical development of the medical record parallels the development of science in clinical care. The development of automated systems for dealing with health-care data parallels the need for data to comply with reimbursement requirements. Early health-care systems focused on inpatient-charge capture to meet billing requirements in a fee-for-service environment. Contemporary systems need to capture clinical information in a managed-care environment focusing on clinical outcomes in ambulatory care.

The Flexner report on medical education was the first formal statement made about the function and contents of the medical record [Flexner, 1910]. In advocating a scientific approach to medical education, it also encouraged physicians to keep a patient-oriented medical record. The contents of medical records in hospitals became the object of scrutiny in the 1940s, when hospital accrediting bodies began to insist on the availability of accurate, well-organized medical records as a condition for accreditation. Since then, these organizations also have required that hospitals abstract certain information from the medical record and submit that information to national data centers. Such discharge abstracts contain (1) demographic information, (2) admission and discharge diagnoses, (3) length of stay, and (4) major procedures performed. The national centers produce statistical summaries of these case abstracts; an individual hospital can then compare its own statistical profile with that of similar institutions.

In the late 1960s, computer-based hospital information systems (HISs) began to emerge. These systems were intended primarily for communication. They collected orders from nursing stations, routed the orders to various parts of the hospital, and identified all chargeable services. They also gave clinicians electronic access to results of laboratory tests and other diagnostic procedures. Although they contained some clinical information (for example, test results, drug orders), their major purpose was to capture charges rather than to assist with clinical care. Many of the early HISs stored and presented much of their information as text, which is difficult to analyze. Moreover, these early systems rarely retained the content for more than a few days after a patient's discharge.

The introduction of the problem-oriented medical record (POMR) by Lawrence Weed [Weed, 1969] influenced medical thinking about both manual and automated medical records. Weed was among the first people to recognize the importance of an internal structure of a medical record, whether stored on paper or in a computer. He suggested that the primary organization of the medical record should be by the medical problem; all diagnostic and therapeutic plans should be linked to a specific problem.

Morris Collen was an early pioneer in the use of hospital-based systems to store and present laboratory-test results as part of preventive care [Collen, 1983]. Use of computers to screen for early warning signs of illness was a basic tenet of health-maintenance organizations (HMOs). Other early university hospital-based systems provided feedback to physicians that affected clinical decisions and ultimately patient outcomes. The HELP system [Pryor, 1988] at LDS Hospital and the CCC system at Beth Israel Deaconess Medical Center [Bleich et al., 1985] continue to add more clinical data and decision-support functionality.

Until recently, the ambulatory-care record has received less attention from the commercial vendors than the hospital record because of differences in financing and regulatory requirements. The status of ambulatory care records was reviewed in a 1982 report [Kuhn et al., 1984]. Under the influence of managed care, the reimbursement model has shifted from a **fee-for-service model** (payers pay providers for all services the provider deemed necessary) toward a payment scheme where providers are paid a **fixed fee** for a specific

service (payers pay a fixed amount for services approved by the payer). In some regions of the country, health-care–financing models are progressing toward a **capitated system** where providers are given a fixed fee to take care of all the health-care needs of a population of patients. In such managed-care environments, providers are motivated to reduce the cost of care by keeping their population of clients healthy and out of hospitals. Information-management tools that facilitate effective management of patients outside of the hospital setting help providers to achieve these goals. The emphasis on ambulatory care brought new attention to the ambulatory record.

Thirty years ago, a single family physician provided almost all of an individual's medical care. Today, however, responsibility for ambulatory care is shifting to teams of health-care professionals in outpatient clinics and HMOs. Ambulatory records may contain lengthy notes written by many different health-care providers, large numbers of laboratory-test results, and a diverse set of other data elements, such as X-ray–examination and pathology reports and hospital-discharge summaries. Accordingly, the need for information tools in ambulatory practice has increased. Among the early systems that focused on ambulatory care, COSTAR [Barnett, 1984], the Regenstrief Medical Record System (RMRS) [McDonald et al., 1992], STOR [Whiting-O'Keefe et al., 1985], and TMR [Stead & Hammond, 1988] are still available today.

Veterans Health Information Systems and Technology Architecture (VistA)

The Veterans Health Information Systems and Technology Architecture (VistA) is an enterprise-wide information system built around an electronic health record, used throughout the United States Department of Veterans Affairs (VA) medical system, known as the Veterans Health Administration (VHA).VistA, is an integrated system of software applications that directly supports patient care. By 2008, the VHA was the largest single medical system in the United States, providing care to 5 million veterans, employing 180,000 medical personnel and operating 163 hospitals, over 800 clinics and 135 nursing homes. By providing electronic health records capability, VistA is thereby one of the most widely used EHRs in the world.

Features

The VistA system is public domain software, available through the Freedom of Information Act directly from the VA website, or through a growing network of distributors. The VistA software alliance is a non-profit trade organization that both promote the widespread adoption of versions of VistA for a variety of provider environments. VistA is a collection of about 100 integrated software modules. Some of the modules included in VistA which enables the user with a number of advantages are

Computerized Patient Record System (CPRS) Module

The most significant is a graphical user interface for clinicians known as the Computerized Patient Record System (CPRS), which was released in 1997. In addition, VistA includes computerized order entry, bar code medication administration, electronic prescribing and clinical guidelines. CPRS provides a client–server interface that allows health care providers to review and update a patient's electronic medical record. This includes the ability to place orders, including those for medications, special procedures, X-rays, nursing interventions, diets, and laboratory tests. CPRS provides flexibility in a wide variety of settings so that a consistent, event-driven, Windows-style interface is presented to a broad spectrum of health care workers. CPRS provides electronic data entry, editing, and electronic signatures for provider-patient encounters as well as provider orders. Its computer-based provider order entry (CPOE) capability is an important enabler in the migration from paper-based charting to electronic medical records (EMRs).

Laboratory Module

Laboratory module enables the user with Ordering of tests and procedures on both patient and non-patient specimens, Collection and Accessioning of specimens into the Laboratory database, Processing and analysis in appropriate department or work areas, review and verification of results, Reporting of results and/or diagnoses for clinical health care treatment, Analysis and reporting of quality control data used in generating results and Providing management statistical data as well as requirements for accreditation by regulating bodies and agencies

Radiology Module

Radiology / Nuclear Medicine package is a comprehensive software package, designed to assist with the functions related to processing patients for imaging examinations. The Radiology / Nuclear Medicine package automates the entire range of diagnostic functions performed in imaging departments, including request entries by clinical staff, registration of patients for exams, processing of exams, recording of reports/results, verification of reports on-line, displaying/printing results for clinical staff, automatic tracking of requests/exams/reports, and generation of management statistics/reports, both recurring and ad hoc. The Radiology / Nuclear Medicine package automates many tedious tasks previously performed manually, providing faster, more efficient and accurate data entry and more timely results reporting. One of the important features provided by VistA is

VistA Imaging

The Veterans Administration has also developed VistA Imaging, a coordinated system for communicating with PACS (radiology imaging) systems and for integrating others types of image-based information, such as, pathology slides, and scanned documents, into the VistA electronic medical records system. This type of integration of information into a medical record is critical to efficient utilization.

Surgery Module

The Surgery package is designed to be used by Surgeons, Surgical Residents, Anesthetists, Operating Room Nurses and other surgical staff. The Surgery package is part of the patient information system that stores data on the Department of Veterans Affairs (VA) patients who have, or are about to undergo, surgical procedures. This package integrates booking, clinical, and patient data to provide a variety of administrative and clinical reports.

Pharmacy Module

The Pharmacy package provides a method of management, dispensing, and administration of inpatient drugs within the hospital. Hospital Medications combines clinical and patient information that allows each medical center to enter orders for patients, dispense medications by means of Pick Lists, print labels, create Medication Administration Records (MARs), and create Management Reports. Hospital Medications also interacts with the

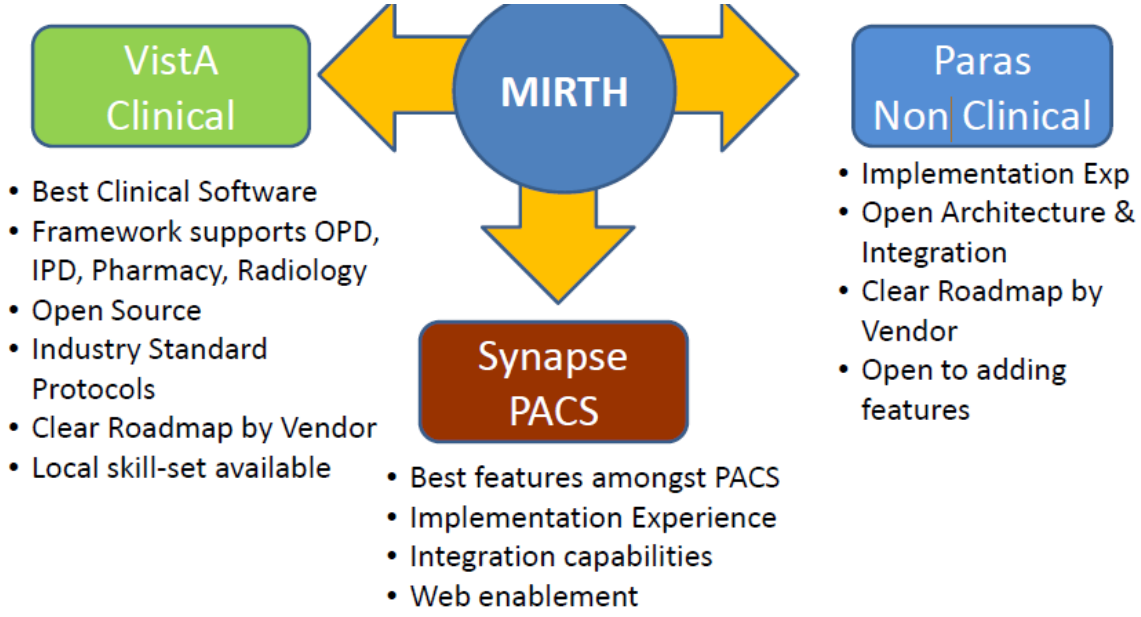
Computerized Patient Record System (CPRS) and the Bar Code Medication Administration (BCMA) packages to provide more comprehensive patient care.

VistA was developed using the M or MUMPS language/database. The VA currently runs a majority of VistA systems on the proprietary Intersystem's Cache version of MUMPS, but an open source MUMPS (Massachusetts General Hospital Utility Multi-Programming System) database engine, called GT.M for Linux and Unix computers has also been developed. GT.M is an implementation of the Standard M programming system (M = MUMPS = Massachusetts General Hospital Utility Multi-Programming System). VistA is written in Standard M. GT.M is an implementation of M from Fidelity Information Services. In addition, the free and open source nature of GT.M allows redundant and cost-effective failsafe database implementations, increasing reliability for complex installations of VistA.

Current status of the hospital

RGCI&RC is a non for profit organization working for welfare of cancer patients. It is a part of Indraprastha society. The transformation of the hospital from paper based to computer based started in the year 2009. There are four vendors supporting this transformation i.e. OHUM, SRISHTI, FUGI and MEDTECH. OHUM is helping in clinical transformation, SRISHTI in non-clinical transformation, FUGI in LIS and MEDTECH in scanning of documents.

There is a need to integrate these four different systems, by means of an Integration Engine. The Open source Integration Engine Mirth is used to send the messages between these two applications – VistA PARAS, SYNAPSE AND MEDTECH... An HIS wrapper needs to be created to convert data from HIS into an HL7 message and vice versa.



The middleware platform which is being used for the integration of VistA with the existing HIS is Mirth. An integration engine is software which moves data between information systems. This process involves the transformation of data between messaging standards and requires support for multiple transmission protocols.

Mirth is an open source Java-based integration engine sponsored and primarily developed by Web Reach, Inc. Mirth was designed based on the client-server style and the enterprise service bus architecture.

Mirth delivers the industry's first free, open source Health Level 7 (HL7) messaging middleware. The standards-based Mirth software is designed to dramatically reduce the time and cost required to achieve health information system interoperability and data exchange, and to speed secure information sharing across communities of healthcare professionals.

"Mirth's ability to support multi-channel messaging modes, multi-protocol connectors, multiple languages for transformer scripting, and a full complement of end-point technologies make it an attractive interface engine for VistA-based solutions,"

The clinical transformation is happening in phases. It started with the radiation department and is now in its post implementation phase. Then OPD transformation started which is in implementation phase and the IPD transformation is in pre implementation phase.

In OPDs the doctors are extremely busy and are resistant in using the system, medical Assistants have been provided in OPD's to facilitate the adoption of CIS At present there are 15 OPDs and 12 medical assistants. The medical assistants enter clinical notes and investigation request during OPD. During non OPD hrs they accompany the providers in daily rounds and complete the IPD notes.

1.1 Rationale for the study

Paper based records or HIS system of the hospital will be revamped to a complete electronic and an integrated system, Thus improving the overall quality, standardization and efficiency in the hospital's system.

1.2 Scope of the project

The study answer the question –

Who the study benefits: – The Benefits is for the users of the system and above all the organization.

Who will be benefited: - one who realizes the benefits in pre-implementation phase and anticipate the potential outcomes. And the one who understands the issues that can be faced or being faced in pre and post implementation and understands solutions for them.

1.3 Problem statement

We want to realize the potential benefits and identify the issues related to VistA EHR implementation in the organization seamlessly, without defects, where all stakeholders are aware and informed of the outcomes and status.

We want to measure the overall adoption of EMR in OPD in the hospital. Today we have seen too many implementation and adoption failures in different organizations that result in too many rollbacks. If we ignore this problem; we may not able to monitor performance benchmarks or the potential benefit indicators of the system which is moving from paper based system or HIS to a complete electronic record, further damage to quality reputation.

2. Literature Review

2.1 Health Information Technology

In accordance with the increased attention to patient care, new devices and technologies have provided more accurate information about patients for better healthcare delivery. Information technology plays a significant role in managing information, and new technology has continued to evolve in healthcare industry. In the 1960s, computer-based experiments in medical recordkeeping and management began, and Shortliffe and Detmern (1991) reported the technology improvement in healthcare as a strategy for coping with the cost and inefficiency of healthcare systems, however most hospital operated manually and only largest providers had implemented automated billing systems. In the 1970s, patient records began to be used both medical and administrative data for the increasing number of review and audit purposes (Blois, 1984). As personal computers appeared in the late 1970s, physicians began adopting EHR systems and most medical facilities in the 1980s maintained both paper and computer-based record system. By the late 1980s, ideal computer-based patient records had to be designed so as to provide some combination of time-oriented, source-oriented and problem-oriented (Stead and Hammond, 1983). However, until the end of the 1980s, important benefits from the computer-based patient records had been only partially achieved, so the Institute of Medicine (IOM) established the Patient Record Project to develop generally acceptable computer-based patient records in 1989.

During the last decades, various aspects of quality management have been introduced into healthcare organizations, and HIT is one of challenges which could change dramatically in healthcare. Healthcare providers have applied a number of diverse technological innovations that have influenced both clinical and administrative aspects of delivery of medical services. HIT includes a variety of integrated data sources and has been shown as a solution to improve patient safety and to reduce inefficiencies. Therefore, it has a great potential to

improve the quality of care, to support healthcare IT infrastructure, and to save money on administrative costs. Healthcare information technology is defined by the Government Accountability Office (GAO) as "technology used to collect, store, retrieve, and transfer clinical, administrative, and financial health information electronically" and also refers to "the application of information processing involving both computer hardware and software that deals with the storage, retrieval, sharing, and use of healthcare information, data, and knowledge for communication and decision-making" (Brailer D, 2004). Six types of HIT are categorized by Felt-Lisk (2006):

- **Electronic Prescribing**: E-prescribing is defined as "Entering a prescription for medication into automated data entry systems such as PC, PDA or other, and thereby generating a prescription electronically, instead of handwriting the prescription on paper" (First Consulting Group, 2001). It is also known as Computerized Physician/ Provider Order Entry (CPOE). E-prescribing applications have basic functions in common, and involve Clinical Decision Support to the clinicians such as a drug database for prescribing, formulary checking, drug interaction checking, and a drug reference database.

- **Electronic Lab Results**: Any test report received by a physician is printed on paper and sent by a printer, fax or mail. With electronic lab results, clinicians may have advantages of significant time-saving that is realized between the instant of ordering the test and obtaining the final result.

- **Electronic Clinical Note Systems**: Clinical notes are central and important parts of Electronic Health Records (EHR), and E-clinical health systems include information on patients' demographics, clinical notes, medical history and follow-up orders.

- **Electronic Images**: E- clinical images include CT, MRI, and PET scans and improve the image quality and quality efficiency of electronic images.

- **Electronic Lab Orders**: Physicians can electronically order tests, manage their laboratory testing need, and receive results by eliminating hassles associated with paper requisitions and reports.

- **Electronic Reminders for Guideline-Based Intervention**: Patient-specific electronic clinical reminders are delivered directly through EHR to better integrate clinical decision support and physician workflows. Patient summary screening helps physicians be able to click on the reminders to obtain more information about the content or to turn the reminders off.

Figure 1 shows the percentage of hospitals with clinicians using the six selected types of IT. The researchers conducted telephone interviews with around 650 peoples of hospital quality improvement directors and senior executives in hospitals in the 50 states and District of Columbia. In this report, almost 90 percent of hospitals used at least one of the listed technologies. The graph shows that electronic lab results were most common (88 percent of hospitals) and electronic prescribing was least common (21 percent of hospitals). From this study, they reported that the adoption of electronic reminders and e-prescribing was more delayed than other types of HIT due to implementation difficulties.

HIT has the potential to make healthcare safer and more efficient, but has been limited by a lack of knowledge about how to implement it successfully. According to the Department of

Health and Human Services (HHS), only a few U.S. healthcare organizations have fully adopted HIT due to significant financial, technical, cultural, and legal barriers to its adoption such as a lack of access to capital, a lack of data standards, and resistance from healthcare providers (Powner, 2006). The current state of HIT adoption and related issues will be discussed in section 2.1.3.

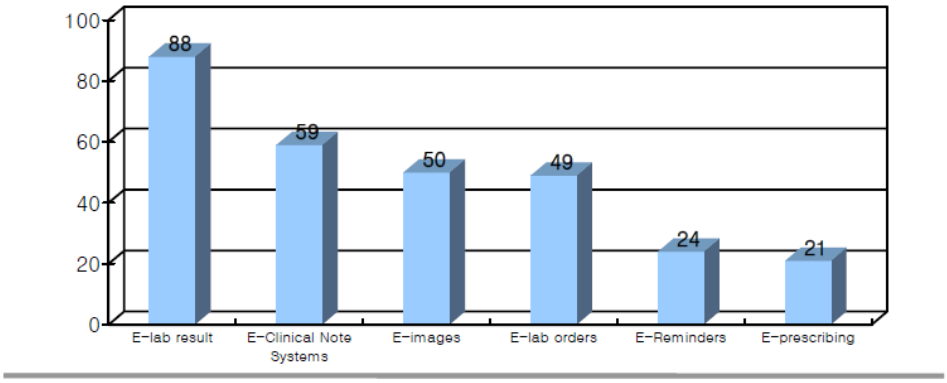


Figure 1. Hospitals with Clinicians Using Selected IT Capabilities (Felt-Lisk, 2006)

Figure1. Hospitals with Clinicians Using Selected IT Capabilities (Felt-Lisk, 2006)

Benefits of Healthcare Information Technology

Many findings in the literature concerning HIT implementation contain empirical data and evaluations on benefits, and effects of HIT use on the healthcare professionals' performance (Leapfrog Group, 2006, RAND health, 2005, and Menachemi and Brooks, 2006). Review of the literature suggests that most benefits from using HIT fall under one of the following categories: *quality of care* (Chertow et al., 2001 and Evan et al., 1999, Dexter et al., 2004, Overhage et al., 1996, Schriger et al., 2000, and Leapfrog, 2006), *effect on efficiency* (Wong et al., 2003, Leapfrog, 2006) , *effect on cost* (Erstad, 2003, Agrawal, 2002, RAND health, 2005, Menachemi and Brooks, 2006, and Jacobs et al., 2000), and *additional benefits* (Bates et al., 1998, and Agrawal, 2002). The following discussion of benefits is organized by four categories:

Quality of Care

In recent years, there has been greater attention paid to quality of healthcare. Despite investing over $1.7 trillion annually and spending more on healthcare than any other nation, the U.S. ranks much lower than other countries on several health measures (RAND health, 2005). There have been many complaints that patients often do not receive proven therapies or preventive measures, and that the rate of preventable medical errors remains high. Many researchers are focused on how providers, patients, and policies can affect the great number

of factors that influence the quality of care. This includes the training of healthcare personnel, improving delivery system processes, and attention to systemic level factors such as technologies and medical records. Specific benefits of HIT concerning the quality of care include:

- **Medical Error Reduction**

The Agency for Healthcare Research and Quality (AHRQ) has noted that insufficient or improper point-of-care treatment information is a frequent and significant cause of medical errors. Communication problems and access to information are easy to cause most medical errors; therefore new information management technologies must be implemented and smoothly integrated within the existing healthcare infrastructure. According to studies, HIT also decreased medical errors by improving medication dosing such as antibiotics and anticoagulants (Chertow et al., 2001 and Evan et al., 1999).

- **Adherence Support**

HIT can improve quality of care by increasing adherence to guideline-based care. The Decision Support functions which were embedded in EHRs or CPOE are a part of adherent studies that show the effect of HIT on enhancing preventive healthcare delivery (Dexter et al., 2004, and Overhage et al., 1996).

- **Effective Disease Management**

In addition to benefits mentioned above, the use of HIT systems also provides enormous potential in improving clinical decision making and disease management. The disease management delivers healthcare services with analysis of relevant data and cost-effective technology to improve the health outcomes of patients with specific diseases. One often studies showed that the use of HIT systems was found to increase documentation advice and recommendations for laboratory testing and treatment (Schriger et al., 2000).

Effect on Efficiency

The pursuit of efficiency has become a central objective within most healthcare systems. However, the analysis and measurement of efficiency is a complex task due to the multiple objectives of healthcare organizations and the many gaps in HIT systems. The following is an improvement in efficiency saving.

- **Efficiency Saving**

It delivers to achieve the same performance with fewer resources. Through adoption of HIT, healthcare organizations can potentially reduce healthcare professionals' administrative time such as documentation-related nursing time (Wong et al., 2003), the delivery of treatment through CPOE (Kuperman et al. ,1999), and hospital stays from the result of increased patients' safety and coordination of patient care.

Effect on Cost

The effect on cost can also be realized when implementing HIT. The following is a discussion of the potential increased revenue opportunities related to HIT implementation.

Improved Productivity

Productivity means the result of an individual's labor and the measurement of individual's work or output. HIT can improve workflows through better resource utilization and by reducing redundancies (Erstad, 2003); therefore, healthcare professionals are more productive when they generate greater results by using HIT, and improved productivity will lead to cost saving.

Paper Reduction

Time spent organizing, retyping information in medical records, and looking for the paper-based charts are reduced when using HIT, and the cost of maintaining medical records which include the cost of paper, and printing paper can be reduced.

Reduced Transcription Costs

The process of transcription is widely known to be expensive, slow, inefficient, and error prone communications. When physicians and nurses directly enter their notes into EHR, transcription costs can be reduced by utilizing structured flow sheets, and point of care documentation (Agrawal, 2002). Therefore, transcription cost saving can be a significant, depending on the implementation of HIT.

Drug Utilization

The most obvious evidence of drug utilization is to improve patient care and reduce overall drug costs by CPOE and Clinical Decision Support (CDS) functions of EHR through structuring medication selections. Physicians can be also advised about the cost-benefits of specific drugs, and can be given recommendations of alterative drugs when they order through CPOE or CDS (RAND health, 2005).

Improved Laboratory Tests

EHR, CPOE and CDS have the potential to reduce redundant tests by making clinicians aware of current results and by alerting them of excessive new orders. One study found the potential for considerably reduced costs and time using a portable micro analyzer for all routine laboratory tests without any changes in the quality of care (Jacobs, et al., 2000).

Additional Benefits

Many additional benefits exist that can be acquired by utilization of HIT. Discussions of these additional benefits follow.

Improved Patient Safety

To improve patient safety is one of the most urgent issues facing healthcare today.
Increased safety results from the safety alerts and reminders by EHR and CPOE systems for medications. CPOE can offer warnings about a potential adverse reaction with patient are other drugs; therefore CPOE can achieve medical error reductions and thereby can increase the patient safety (Bates, et al., 1998).

Improved Regulatory Compliance

According to increased security of data and better patient confidentiality, the use of HIT systems can allow for compliance with federal regulations, including Health Insurance Portability and Accountability Act **(**HIPAA) for record keeping and reporting (Agrawal, 2002), and can assist in regulatory policies.

Computerized Provider/ Physician Order Entry (CPOE)

Computerized Provider/Physician Order Entry (CPOE) is a prescription ordering system that allows physicians to enter an order for a medication and clinical laboratory or radiology test directly into a computer instead of handwriting which can cause medication errors. The National Coordinating Council for Medication Error and Prevention (NCCMERP) has approved the definition of medication errors[1]. Baxter International reported that 39 % of medication errors arise from prescribing, 23% occur during transcribing or compounding by pharmacists, and 38% occur during administration by nurses. As patient safety is a matter of a primary concern in healthcare, patient safety focuses on reducing medication errors, and healthcare professionals expect that progressive technology would provide better solutions. The Leapfrog Group encouraged the use of CPOE as clinical information systems can provide all kinds of decision support to the care- givers of patients, and CPOE is a structural and control improvement to enhance patient safety (Leapfrog Group fact sheet, 2006). CPOE can help physician's decision support at the point of ordering and also provide the latest information about a drug and cross reference allergies, interactions, and other problems of a patient with the chemical entity being prescribed (Bates, 2000). In addition to these benefits mentioned above, improved efficiencies afforded by CPOE are: (1) to allow interaction checking such as drug-drug or drug-allergy; (2) to reduce the turnaround time from ordering and to improve this process; (3) to eliminate illegible handwriting, observations for duplicated orders or redundancy; and (4) to reduce healthcare costs.

Despite these potential benefits, many healthcare organizations have delayed CPOE implementation due to the following reasons. CPOE is expensive, a highly complex application that must include physicians, nurses, and other healthcare professionals in the phase of the system development, educate clinicians about the system, and keep them informed during all phases of the development and the implementation within an organization.

There may be also organization cultural barriers of CPOE implementation such as physician resistance to computer usage when they order prescriptions. CPOE implementation takes time, and the process is complex and difficult. However, healthcare organizations, researchers and policymakers have many opportunities to speed nationwide adoption of CPOE as patient-safety intervention, thus they must encourage promoting adoption of CPOE.

2.2 Healthcare Information Technology Adoption

Problems to Evaluate HIT

It is important that precise evaluation needs not only the understanding of HIT adoption but also behavioral processes that are affected by technologies. However, evaluation of IT in healthcare organizations is not easy to perform due to the complex healthcare environment, different healthcare professional groups with different practices, and external factors such as economic constraints, regulatory issues, and the growing gaps between communities' access to technologies. These may cause problems to evaluate and analyze HIT and its adoption.

For example, different researchers or stakeholders may have different opinions and views of successful HIT implementation. Many studies of HIT have problems during evaluation, and one main problem is to choose suitable evaluation methods (Ammenwerth and Keizer, 2004). Wyatt (1994) reported that to develop clear evaluation criteria is often difficult to address in studies due to the complexity of the evaluation research; therefore, adequate evaluation methods such as quantitative or qualitative methods and research designs, and evaluation criteria and clear motivation for the study must be required to evaluate HIT adoption.

HIT Adoption

In this section, the studies regarding the estimation of HIT adoption are reviewed.
It is important to note that the value of HIT depends on how well healthcare organizations adopt and implement it, and how well clinicians in their practices use it. The adoption concentrates on the challenge of getting clinicians and customers to use electronic applications and information networks to keep medical records, to access relevant information about a patient's data and illness, and to offer patient safety and better decisions. The adoption includes the need to train physicians, nurses and healthcare staffs until they are comfortable with any HIT systems, and to provide technical support and other, and to make healthcare professionals and customers aware of the benefits of HIT systems. The widespread adoption of HIT can result in significant healthcare cost savings and improved patient health and safety. Nevertheless, the adoption of HIT has been slow, because several barriers are still present: the high costs of investment in HIT, the maintenance required in all information systems, security and privacy issues, and decreased productivity because healthcare staffs need time to adapt to new systems. According to RAND Corporation (2005), complex healthcare technologies make it difficult to measure the adoption due to multiple functions and several particular aspects of such implementation in HIT and the diversity of opinions on the definition of adoption. In addition, healthcare organizations present a particularly difficult challenge due to their existing organizational structure, assumptions about clinical work processes, and financial challenges.

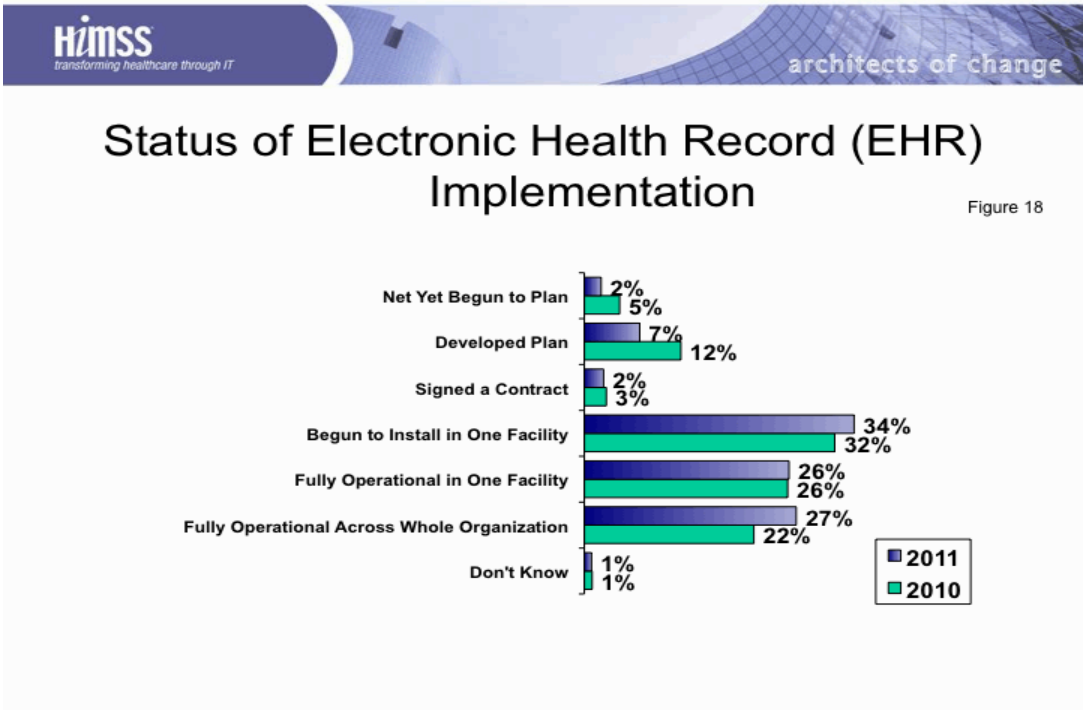


Figure2. Status of Electronic Medical Record Implementation (HIMSS Leadership survey, 2011)

In the report by Blumenthal et al. (2006), the researchers assessed the quality of existing surveys and their data, and estimated current levels of EHR adoption based on collected surveys. 36 existing studies were determined by reviewing existing definitions of EHR and the meaning of the term 'adoption'. They reported that 8.6 percent of approximately 1,000 Community Health Centers (CHC) in the U.S. have a fully implemented EHR, and 15.9 percent report have a partial EHR system in the most recent data.

The Medical Records Institute (MRI) released the survey of Electronic Health Record Trends and Usage and compiled data from 1383 individuals, excluding vendors and consultants to reduce bias. The survey revealed the following findings in regard to the adoption of EHR applications and functions.

- Most used EHR administrative and financial applications with the greatest increase in use were compared to last year appear to be the following applications: billing and accounts receivable (57.2 %), scheduling (56.4 %), patient appointments (55.4 %), and claims processing (53.9 %).

- most planned EHR administrative and financial applications were reported: patient eligibility (27.2%), charge capture and/or coding (26.2%), master person index or enterprise directory to support multiple facilities (22.0%). However, in this study we must carefully consider that a straightforward test for unbiased ness of data is verified because results of the survey in the EHR implementation were not interpreted as a measure of the actual implementation levels of EHR components, and were included non-U.S. providers as about 10.4 % of its sample.

Clinical Information Technology (CIT) systems, the subset of HIT, include a variety of applications above EHR and CPOE. According to the Center for Studying Health System

Change (HSC), a nonpartisan policy research organization made a data bulletin known for findings on the topic: Growing Availability of Clinical Information Technology in Physician Practices. The researchers reported that the percentage of physicians' access to IT for each of the five clinical activities increased at least five percent between 2000-01 and 2004-05.
Figure 3 shows the percentage of physicians with each clinical activity. Despite the higher rate of growth in five clinical activities, the researchers reported that nearly 80 percent of physicians lacked IT to write prescriptions in 2004-05; however, there has been rapid diffusion in public and private efforts to promote CIT adoption in physician practices which can drive forces in development and implementation of Clinical IT systems.

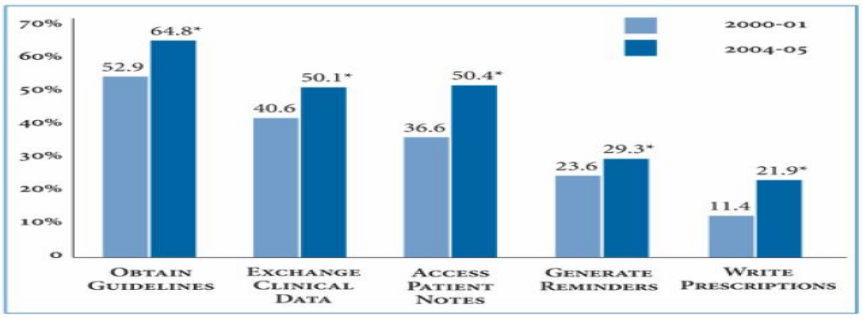


Figure 3. Percent of Physicians in practices with IT for Specific Clinical Activities in 2000-01 and 2004-05 (Marie et al., 2006)

There are many other sources of HIT adoption data, but many reports have survey design flaws and response problems. The RAND Corporation (2005) recommended the HIMSS-Dorenfoest database which seems to have the highest quality of data, and to represent the most clinical HIT adoption in hospitals and integrated healthcare delivery systems. The reviewing in this section shows the most current data of HIT adoption from each different approach in the variety of HIT applications, but must to review carefully what each study targeted on, and what types of technology they investigated and analyzed.
In the leadership survey of Corporate Information Officers (CIO) (Healthcare Information and Management System Society (HIMSS), 2011), the researchers reported the results on HIT adoption in healthcare facilities. Approx 70 percent of respondents indicated that they have either developed a plan to implement an electronic medical record (EMR) system or they have begun to install EMR hardware and software. Figure 2 shows status of the EMR implementation. 22 percent of healthcare organizations have fully operational systems, 26% have fully developed one facility, 32 percent of healthcare organizations have begun installation, and 15 percent have a development plan to implement. Surprisingly,5 percent still do not plan to adopt EMR, and we consider that this actual state of no plans to implement EMR may be caused by significant barriers such as the lack of adequate funding and resources, difficulties in finding and evaluating EMR solutions, and problems in changing the existing organization structure.

Benefits from using EMR :

Direct Benefits

- Paper Reduction and Saving
- Data Re-keying
- Error reduction
- Saving time of data entry and re-entry
- Avoiding filing costs and maintenance
- Decreased information overload and paper documentation
- Decreasing support costs
- Better financial and operational results
- Reduced training time

Indirect Benefits

- Improvement in operational efficiency
- Improved work cultures
- Efficient flow of information
- Improving service levels
- Improved customer services
- The potential for process reengineering
- Better business control
- Reducing the purchasing/sales cycles (ordering, delivery and invoice)
- Reducing inventor breaks
- Increasing productivity
- Enhancing employee empowerment
- Improved customer/ employee satisfaction

Strategic Benefits

- The higher the familiarity of the customer-retailer relationship
- Increased business relationships with other companies using same applications or Technologies
- Faster response and access to information
- Improved customer loyalty
- Improved the company's image
- Enhanced ability to compete with competitor's technology or its strategy

2.3 About VistA

For more than twenty years, the department of Veterans Affairs (VA) has developed and adopted health information technology (IT) systems that support a broad range of patient care and administrative processes. These systems include computerized patient records, or electronic health records; radiological imaging; and laboratory and medication ordering and administration, Known collectively as the Veterans Health Information Systems and Technology Architecture (VistA).

These systems were implemented with the goal of improving patient outcomes and increasing efficiency in VA health care delivery. As a result of the implementation of these systems through a series of initiatives, the VA is one of the few national, health IT– enabled, integrated delivery systems in the United States.

It helps to provide integrated electronic health care with interactive exchange among patients, providers, government agencies, and insurers, resulting in an increase in the overall quality, safety, and efficiency of health care delivery with fewer medical errors, increased administrative efficiency, decreased health care costs, and expanded patient access to affordable health care.

Electronic prescribing can reduce medical errors, decrease in pharmacy costs, improve both doctor and pharmacy administrative efficiency, eliminate handwriting interpretation errors, reduce phone calls between pharmacists and physicians, reduce data entry, create electronic records to ensure that prescription information is retained.

VistA has various clinical & financial impacts. It has affected care delivery processes, costs & outcomes a lot. It has improved the efficiency in work. Efficiency can be traced by taking in to account some of the factors .these factors could be reduction in cost, time, space medication errors etc.

When we talk about costs, we can see that costs are reduced. There is no doubt that initially the implementation costs were high & also initially the speed was less so might have not helped in cost reduction, but with the due course of time it has contributed a lot in the cost effectiveness.

VistA Pharmacy can also do real-time, point-of-care validation for administration of unit dose and IV medications. This is done by BCMA i.e. Bar Code Medication Administration,

a component of VistA. This helped in reducing inpatient costs for preventable adverse drug events caused by inpatient medication administration errors.

Also as VistA offers for e-prescribing, it helps in saving time & money both. E-prescribing helped in average reduction in pharmacist labor cost of about $0.97 for each new prescription and $0.37 for each renewed prescription.

It has been projected that effective VistA Pharmacy implementation in 90% of patient care settings could save nearly $82 billion annually in health care efficiency and safety by the year 2015, with $77.4 billion saved by increased efficiency, $1billion from reduction of inpatient adverse drug events (ADES), and $3.5 billion from reduction of ambulatory ADES. Taking into account lower savings during the "ramping up" years, cumulative savings from improved efficiency and safety could reach $628 billion.

Medication errors:

One of most important thing to be taken into consideration is that use of VistA helps in reduction of the medication errors.

Medical prescriptions are known to have a high error rate mainly because of poor handwriting and possible drug or allergy interactions with the prescribed medication. The world VistA EHR comes with a sophisticated drug-drug, drug-allergy, and drug-lab monitoring check system. This feature is automated within world VistA EHR and has been proven to reduce medication errors. The institute of medicine has reported that preventable medication errors result in at least 1.5 million ADES and 7,000 deaths each year in the United States.

E-prescribing is expected to reduce these errors in a variety of health care settings. The results of a study of the potential impact of CPOE on prescribing errors in a 700-bed academic medical hospital indicated that 64.4% of all verified prescribing errors were likely to be prevented with CPOE, including 43% of the potentially harmful errors. Another 22.4% were judged as possibly prevented with CPOE depending on specific CPOE system characteristics.

A 2008 retrospective review of 10 studies in hospital and ambulatory settings showed that CPOE and CDS contributed to a statistically significant decrease in ADES in 50% of the studies. Four studies (40%) showed no statistically significant reduction in ADE rates, and

one study demonstrated no change. Studies on "homegrown" systems, studies comparing manual chart review to detect errors, and studies comparing e-prescribing with handwritten prescribing seemed to show a higher relative risk reduction than other studies.

It was concluded that few studies of the effect of CPOE with CDs on the rates of ADES exist and that none of these have been randomized controlled trials. More study is needed to evaluate the benefit of commercially developed CPOE with CDS systems on reducing ADES.Also the system uses Bar Code Technology to stock, pick and return medications to reduce medication errors.

Computerized physician order entry (CPOE) systems are electronic prescribing systems where users enter orders into a computer, replacing handwritten orders on paper. CPOE can significantly reduce medication errors, since past research found the majority of medication errors, 39%, occurred at the ordering stage in the medication use system. CPOE replaces hand written prescriptions and hand transcribing of the prescription, eliminating procedures that can introduce medication errors.

Research has shown that prescriptions ordered electronically have lower error rates than handwritten prescriptions compared the error rates for handwritten versus computer-assisted prescriptions, and found a 2.3% medication error rate for handwritten prescriptions, with 3.9% needing clarification, compared to a 7% error rate and .8% clarifications needed for computer-assisted prescribing.

Medication administration records generated automatically as part of a pharmacy management system can reduce medication errors because of increased accuracy and legibility, preventing errors at the transcribing stage where 12% of errors occur.(7). CPOE standardizes orders by forcing prescribers to include a dose, route and frequency for each prescription entered.

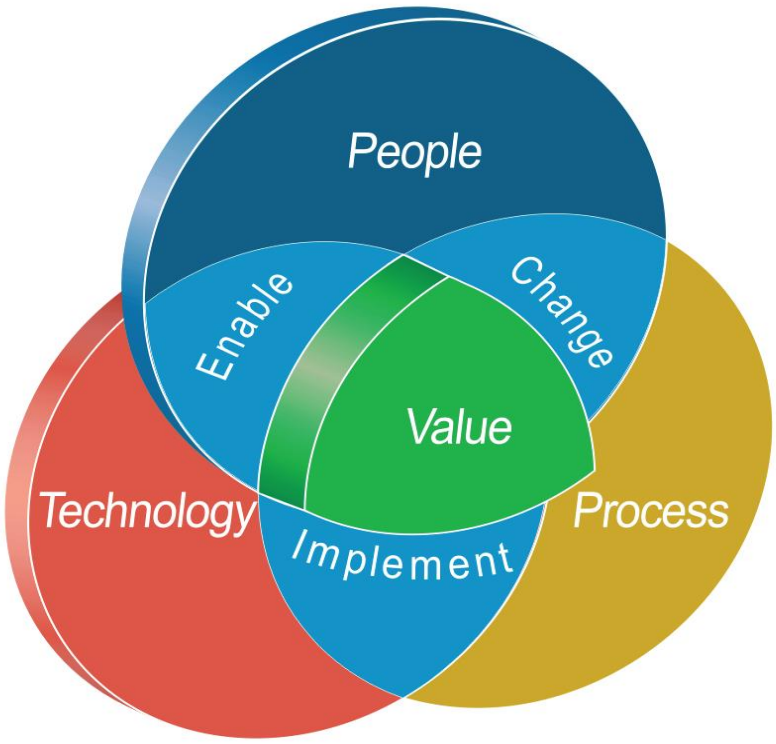
Recent research has shown that health information technology in hospital pharmacies can reduce medication errors. Anderson et al (2002) used a computer simulation model to show that implementation of a comprehensive medication delivery system designed to detect and prevent ADES could save 1,226 days of hospitalization and $1.4 million annually, even if the system only prevented 26% of medication errors.

2.4 Implementation

Points to keep in mind before starting off with the EHR implementation:

- The hospital's EHR implementation has a better chance for success if the hospital organizes it into three categories: team, tactics and technology.
- Studies have found that a practice's employees are the key to an EHR implementation's outcome, with project managers playing a critical role.
- Everyone involved with the new EHR will need to be open-minded about changing the way the practice operates.
- If the hospital's EHR implementation team is given unrealistic goals, the project is likely to end as a perceived failure.
- When it comes to the hospital's implementation tactics, spend as much time as possible planning, which should cut down on surprises as the project proceeds.
- It's critical that the hospital maintain a consistent policy on who will handle data entry and which data they will enter.
- It's critical that the hospital maintain a consistent policy on who will handle data entry and which data they will enter.
- When the hospital is ready to "go live" with the EHR, try to avoid starting on a Monday, which is already the hospital's busiest day.
- Many practices designate in-house EHR "power users" to whom other employees can turn first for advice and support.
- Technological problems, such as poorly written software or inadequate server memory, can cripple an EHR implementation.
- Line up expert IT support and maintenance.
- The hospital's data should be backed up daily.
- With careful planning and good advice, the hospital's EHR project will succeed

The objective of the implementation of VistA EHR in the Healthcare organization is to ensure smooth and uninterrupted running of the same as this will enable the hospital to have a whole range of data in comprehensive form including patient demographics, medical history, medication and allergies, immunization status, laboratory test results, radiology images and billing information. This objective is set to be attained by the means of clinical transformation "a comprehensive ongoing approach to care delivery excellence that measurably improves quality, enhances service, and reduces costs through the effective alignment of people, process and technology. The clinical transformation triad is depictedas:



Clinical Transformation Triad

The measurable benefits of this transformation for the client, the clinicians, and the patients include:

- Increased safety through reduction of adverse medical events
- Increased quality through implementation of clinical best practices
- Decreased costs through identification of opportunities for improved operational efficiency
- Improved clinical adoption by effectively engaging clinicians
- Well defined metrics for success
- Improved clinical decision making, leading to accelerated process improvements throughout the organization

The goal is to attain the above sated benefits by means of clinical transformation.RGCI is not only working with vendors to successfully implement technology in their care environments, but is also striving to incorporate clinician adoption and benefits realization into these initiatives to ensure measurable success. For example, the early benefits of adding this performance improvement and tracking capability is the ability for nurses to perform 100 percent chart audits on admission and shift assessments. This capability and focus allows for improved care planning, reduced potential for omission of critical assessment information about the patient, and dramatically improved compliance.

1.5 Barriers to EHR implementation

Several obstacles have been cited as explanations why EHRs have not achieved more prevalent usage in physicians' offices. These obstacles include:

- EHR products are expensive and require a major investment
- EHR applications are not standardized
- EHRs are more difficult to use than paper-based records
- EHR implementation reduces practice productivity and disturbs workflow (at least initially)
- EHR benefits accrue to others (such as society and payers) not to providers.

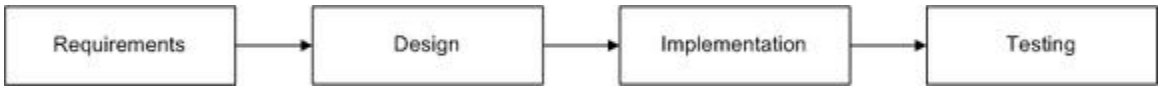
1.6 Process of implementation

Software development life cycle

Software life cycle models describe phases of the software cycle and the order in which those phases are executed. There are tons of models, and many companies adopt their own, but all have very similar patterns.

General model

The general, basic model is shown below:



Each phase produces deliverables required by the next phase in the life cycle. Requirements are translated into design. Code is produced during implementation that is driven by the design. Testing verifies the deliverable of the implementation phase against requirements.

Requirements

Business requirements are gathered in this phase. This phase is the main focus of the project managers and stake holders. Meetings with managers, stake holders and users are held in order to determine the requirements. Who is going to use the system? How will they use the system? What data should be input into the system? What data should be output by the system? These are general questions that get answered during a requirements gathering phase. This produces a nice big list of functionality that the system should provide, which describes functions the system should perform, business logic that processes data, what data is stored and used by the system, and how the user interface should work. The overall result is the system as a whole and how it performs, not how it is actually going to do it.

Design

The software system design is produced from the results of the requirements phase. Architects have the ball in their court during this phase and this is the phase in which their focus lies. This is where the details on how the system will work is produced. Architecture, including hardware and software, communication, software design (UML is produced here) are all part of the deliverables of a design phase.

Implementation

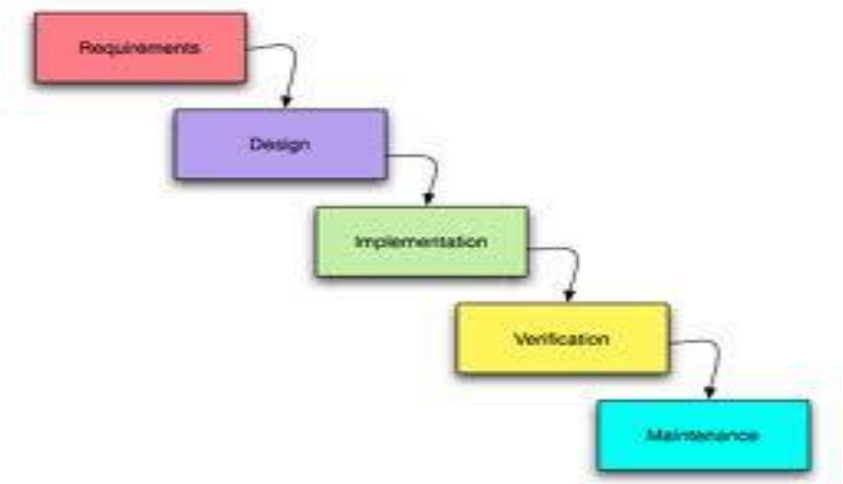
Code is produced from the deliverables of the design phase during implementation, and this is the longest phase of the software development life cycle. For a developer, this is the main focus of the life cycle because this is where the code is produced. Implementation my overlap with both the design and testing phases. Many tools exists (CASE tools) to actually automate the production of code using information gathered and produced during the design phase.

Testing

During testing, the implementation is tested against the requirements to make sure that the product is actually solving the needs addressed and gathered during the requirements phase. Unit tests and system/acceptance tests are done during this phase. Unit tests act on a specific component of the system, while system tests act on the system as a whole. So in a nutshell, that is a very basic overview of the general software development life cycle model. Now lets delve into some of the traditional and widely used variations.

Waterfall Model

This is the most common and classic of life cycle models, also referred to as a linear-sequential life cycle model. It is very simple to understand and use. In a waterfall model, each phase must be completed in its entirety before the next phase can begin. At the end of each phase, a review takes place to determine if the project is on the right path and whether or not to continue or discard the project. Unlike the general model, phases do not overlap in a waterfall model.



Advantages

- Simple and easy to use.
- Easy to manage due to the rigidity of the model – each phase has specific deliverables and a review process.
- Phases are processed and completed one at a time.
- Works well for smaller projects where requirements are very well understood.

Disadvantages

- Adjusting scope during the life cycle can kill a project
- No working software is produced until late during the life cycle.
- High amounts of risk and uncertainty.
- Poor model for complex and object-oriented projects.
- Poor model for long and ongoing projects.
- Poor model where requirements are at a moderate to high risk of changing.

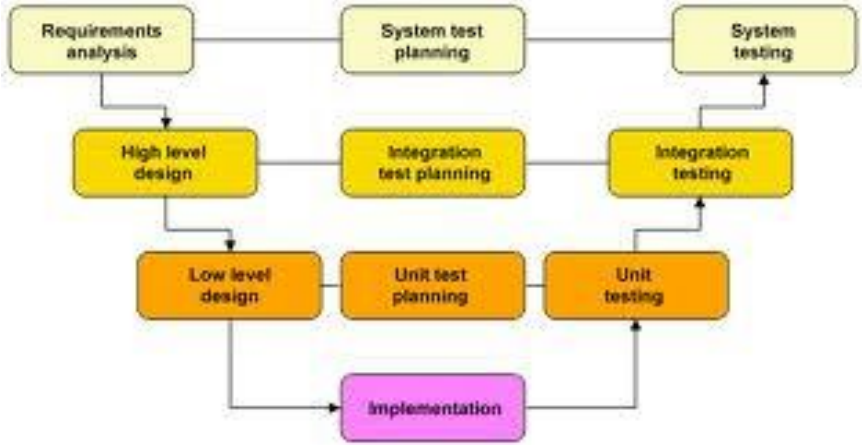
V-Shaped Model

Just like the waterfall model, the V-Shaped life cycle is sequential path of execution of processes. Each phase must be completed before the next phase begins. Testing is emphasized in this model more so than the waterfall model though. The testing procedures are developed early in the life cycle before any coding is done, during each of the phases preceding implementation.

Requirements begin the life cycle model just like the waterfall model. Before development is started, a system test plan is created. The test plan focuses on meeting the functionality specified in the requirements gathering.

The high-level design phase focuses on system architecture and design. An integration test plan is created in this phase as well in order to test the pieces of the software systems ability to work together.

The low-level design phase is where the actual software components are designed, and unit tests are created in this phase as well. The implementation phase is, again, where all coding takes place. Once coding is complete, the path of execution continues up the right side of the V where the test plans developed earlier are now put to use.



Advantages

- Simple and easy to use.
- Each phase has specific deliverables.
- Higher chance of success over the waterfall model due to the development of test plans early on during the life cycle.
- Works well for small projects where requirements are easily understood.

Disadvantages

- Very rigid, like the waterfall model.
- Little flexibility and adjusting scope is difficult and expensive.
- Software is developed during the implementation phase, so no early prototypes of the software are produced.

- Model doesn't provide a clear path for problems found during testing phases

Spiral Model

The spiral model is similar to the incremental model, with more emphases placed on risk analysis. The spiral model has four phases: Planning, Risk Analysis, Engineering and Evaluation. A software project repeatedly passes through these phases in iterations (called Spirals in this model). The baseline spirals, starting in the planning phase, requirements are gathered and risk is assessed. Each subsequent spirals builds on the baseline spiral.

Requirements are gathered during the planning phase. In the risk analysis phase, a process is undertaken to identify risk and alternate solutions. A prototype is produced at the end of the risk analysis phase.

Software is produced in the engineering phase, along with testing at the end of the phase. The evaluation phase allows the customer to evaluate the output of the project to date before the project continues to the next spiral.

In the spiral model, the angular component represents progress, and the radius of the spiral represents cost.

Advantages

- High amount of risk analysis
- Good for large and mission-critical projects.
- Software is produced early in the software life cycle.

Disadvantages

- Can be a costly model to use.
- Risk analysis requires highly specific expertise.
- Project's success is highly dependent on the risk analysis phase.
- Doesn't work well for smaller projects.

1.7 Phases of EHR implementation

EHR implementation can be characterized by several phases: Decision, Selection, Pre-Implementation, Implementation, and Post-Implementation. The decision has already been taken and VistA was selected for implementation.

Pre implementation phase

A decision is made to move forward with implementing an EHR. The steps within this phase include: communicating and involving people – staff and patients; redesigning workflows; establishing a project plan; getting help; timely training; and having fun.

Communicating and involving people

The crucial elements for a practice preparing to implement an EHR are people, planning, leadership, and implementation processes. The key to success is the involvement of people – those connected to the practice and patients. Participation in the assessment and implementation of the EHR will ensure that individuals' information needs are considered and addressed. In turn, the people will have a greater investment in the success of the system. To gain the confidence of everyone, communication is a major cornerstone. Everyone in the practice must know about the EHR project plus the goals and the plans for implementation. These actions initiate the "buy-in" process and prepare the staff to respond to any patient questions.

Redesigning workflow

A well-run physician practice office is a complex operation with well-defined workflows. Principles that influence the redesign of workflows include simplicity, accessibility for patients, safety, comprehensiveness of documentation, and delegation.

Establishing a project plan

There are many views about project management. The following issues are useful to determine the success and failure of health informatics projects of any size.

• **Clarity of responsibility** One person needs to be designated as the leader or coordinator of the effort. This person is most likely the champion. Clearly defined lines of communication and responsibility promote progress and effective reporting.

• **Setting objectives** The first step in managing the project is the setting of realistic objectives and timelines. All significant parties involved need to commit emotionally and display ownership of project objectives. Obtaining early project ownership among staff requires a participative approach. The objectives include specific, realistic definitions of project success. Until this stage is completed, no further work should proceed.

• **Action planning** Generally a project plan defines its action steps in terms of major steps with specific start and end dates for each step. The planning process then moves to the next lower level of detail. As successively lower levels of detail are reached, project leaders need to seek input from the practice staff. This is critical to obtain both their valuable input and their psychological commitment.

• **Tight control and feedback procedures.** An organized system must be designed and put into place to obtain timely feedback on the status of each portion of the project. It is critical to obtain the earliest possible warning of any deviations from schedule or budget – positive or negative.

• **Ongoing problem solving** Unforeseen problems arise in virtually every project, although quality planning does help to reduce them

• **Project completion** As the project approaches completion, an evaluation process should begin to measure the success of the project against the original success criteria. In fact, evaluation should be incorporated into an ongoing monitoring and improvement process within the practice.

Getting help

A contingency plan for obtaining help and support needs to be included in the original plan. Do not save this until a serious problem suddenly looms. Decisions about who will handle initial problems as well as how to escalate the process – both inside and outside of the practice – need to be considered and defined.

Conducting training

There is increasing recognition that training, effective change support and stakeholder education are key to a successful transition to an EHR. Quality training can help significantly in reducing anxieties about using a new system. The availability of technical and training support during the initial implementation is essential. Timing of training is critical. Training that is either too early or too late will waste resources and raise

frustrations. The technology introduces the required tools to transform daily work, and training introduces the requisite skills to do it. The nature of technology has both a facilitating and a hindering effect. The design of the technology incorporates assumptions about its use that are not always congruent with the goals of the ambulatory practice members. Training must be brief, high-quality, closely timed to the point of need, and specifically directed to the practice's staffing and needs. Training needs to include a "practice" version of the system. Good training does more than build skills; it continues the communication and involvement opportunities. There are multiple audiences to be considered when planning training associated with EHR implementation and tailoring training strategies and plans to different subgroups (physicians, nurses, practice managers, receptionists, and physician extenders) makes sense.

Implementation Phase

This phase assumes that realistic expectations were developed. If physicians and other key office staff are oversold on what the new system will do, the system is doomed to be regarded as at least a partial failure. The EHR champion must help the practice set realistic expectations for the impact on initial productivity during the early system implementation stages. During the implementation of an EHR, practice productivity will initially decline, no matter how good the system and what the preparations are for its implementation.

The following concepts must be addressed during the implementation process: engaging the patient; making changes and managing change; implementing rapidly and supporting extensively; and encouraging the practice.

Engaging the patient

Patients, especially those who visit more frequently, know when changes occur. Informing the patients about the anticipated EHR and what it will mean for them is important. Some practices develop a one-page handout to tell more about what will happen, when, and potential inconveniences and planned benefits for the patients. Early patient communication and involvement is useful.

Making changes and managing the change

No EHR system can be used immediately "as delivered," nor can any EHR system totally satisfy the needs of a busy practice. Given this reality, it is important at the pre-implementation stage and during implementation to identify the practice needs to customize the selected system.

Each practice is unique in terms of its dynamics. Understanding the environment facilitates change management. Champion leaders need to identify key issues as they arise and address them as rapidly as possible. A change management strategy generally includes mechanisms for soliciting feedback at all stages of the change process. The alternative of not identifying problems and not providing feedback about problem resolution leads to misinformation within the office practice. Feedback obtained must be addressed promptly. Every issue cannot be resolved to everyone's satisfaction, but sharing information about which issues can be addressed (or not) and in what time frame is important.

Implementing rapidly and supporting extensively

When it is time for the actual implementation, complete the implementation as rapidly as possible and provide ample support. A primary goal is to have adequate personnel for direct support. Supplementary support in the form of written manuals, "how to" laminated cards, and online tutorials can also address the varied learning styles of individual users.

Encouraging the practice

Celebrating change-related milestones remains important. As noted in the studies of Lorenzi et al., throughout an implementation effort there are many people who contribute directly or indirectly. The people who are the "heroes" for their efforts in the implementation process should be acknowledged and honored. Practice leaders need to reassure people about the changes that have taken place. Celebrations bring people together in a relaxed and informal setting to laugh a little and celebrate the success. It is important to stress that this is a celebration of reaching a significant milestone on a long journey, not an arrival at a destination.

Post-implementation phase

The post-implementation phase involves continuous updating, training, evaluation, and again, celebration. Typically information systems have "updates" on a routine basis. When an update occurs, system users must be informed about the changes and re-trained if required. Each change to the system has implications for the daily work of the practice. Failure to continuously educate will cause individuals or the entire practice to "fall behind," with resultant problems in system use and practice productivity.

Evaluating the process of implementing an EHR is significant. Did the implementation process occur smoothly? Did everyone in the practice participate and feel involved? Did events occur as planned? What were the strengths and weaknesses of the implementation? Evaluating the actions that occurred and the staff's reaction to them helps to shape both the practice and its future evolution. Very often what happens during an implementation is very different from what was planned. It is important to know what happened to either avoid repeating mistakes in the future or to follow a similar path to success at a later time.

Continue celebrating the new information system through sharing information and taking time to recognize and share success with the entire staff and with patients.

1.8 Clinician adoption rates

The adoption rate at RGCI&RC was 40% in January, 50% in February and 40% in March. The healthcare transformation requires a fundamental and interconnected change in the structure and function of healthcare systems that will transform the characteristics of healthcare, resulting in optimized health and quality of life for all patient populations and added value for all stakeholders.

A Continuous Measurable Process:

The healthcare transformation is a continuous process that provides real measurable value, but poses significant challenges. First, transformation requires a substantial investment of time, talent, and financial resources to be successful. Clinical systems and the needed

hardware and infrastructure are expensive and require expertise for successful deployment and for the ongoing maintenance and updates that are necessary for continued benefits.

Second, a successful transformation effort needs to have precisely aligned critical success factors. The strategic drivers for the business and the stakeholders need to be well understood and the drivers for sustainability of the continuous process of improvement required for transformation need to be articulated. Success requires an unwavering focus on the structures and functions to be transformed with a clearly defined methodology, roadmap, and accountability for making the change happen. It is imperative that success is described in terms of value measures that are defined and validated.

Third, the continuous process of transformation is challenging to execute: the healthcare environment is dynamic, with changing regulatory requirements, practice variations, and reimbursement standards at the same time that there are entrenched practices and practitioners within organizations that are reluctant to change.

1.9 Barriers in User adoption

The benefits of using electronic health records (EHRs) have been well documented; however, a number of implementation barriers have impeded their widespread use. Prior reports call for the use of electronic health records to make healthcare information available at the point of patient care, as well as to save lives (Dick & Steen, 1991; Dick, Steen, & Detmer, 1997; Institute of Medicine, 2003b). User adoption is essential in order to realize the benefits of an EHR. While HER integration nationwide by physicians and other healthcare providers is critical for continuity of patient care, the literature provides evidence of failed clinical system implementations, due to lack of adoption by users (Lorenzi & Riley, 1995; Lorenzi, Riley, Ball, & Douglas, 1995). As the key coordinator and provider of patient care, physician acceptance of an EHR application will determine the overall success of a product's implementation (Anderson, 1997; Lorenzi & Riley, 1995; Lorenzi, Riley, Blyth, Southon, & Dixon, 1997). However, prior research indicates that physicians will not use a product that interferes with their workflow, changes the way they care for patients or places limitations on the way they practice medicine (Anderson, 1997). Predicting the reasons why physicians accept or reject a new information system will allow an organization to proactively take corrective action to increase acceptability. Using case study

and survey methods, this research examines physician attitudes toward an electronic health record system (EHR) prior to implementation in an academic based healthcare system.

Conclusions: HIT has the potential to enable a dramatic transformation in the delivery of health care, making it safer, more effective, and more efficient. Some organizations have already realized major gains through the implementation of multifunctional, interoperable HIT systems built around an EHR. However, widespread implementation of HIT has been limited by a lack of general knowledge about what types of HIT and implementation methods will improve care and manage costs for specific health organizations. The reporting of HIT development and implementation requires fuller descriptions of both the intervention and the organizational/economic environment in which it is implemented.

3. Objectives of the dissertation

3.1 General Objectives:

- To Study CPOE in VistA CPRS
- To study all the phases of implementation of VistA CPRS in the hospital

3.2 Specific Objectives:

- The specific objectives are:
- To study the workflows involved with the CPOE in the CPRS module.
- To study the pre implementation phase in IPD.
- To study the implementation phase in OPD.
- To study the full process of implementation of dietary module

4. Data and Methods

4.1 Study Design

Type of study : Analytical Study

Sampling technique: Random Sampling

Type of Data: Primary Data

Collection technique: Through Discussions and Structured questionnaires.

Data Collection Tool: Questionnaire

Variables:

- Communication between staff and patient
- Patient Care
- Patient safety
- Job satisfaction
- Turn around time for documentation and patient care processes.
- Training on CPRS

Preimplementation phase

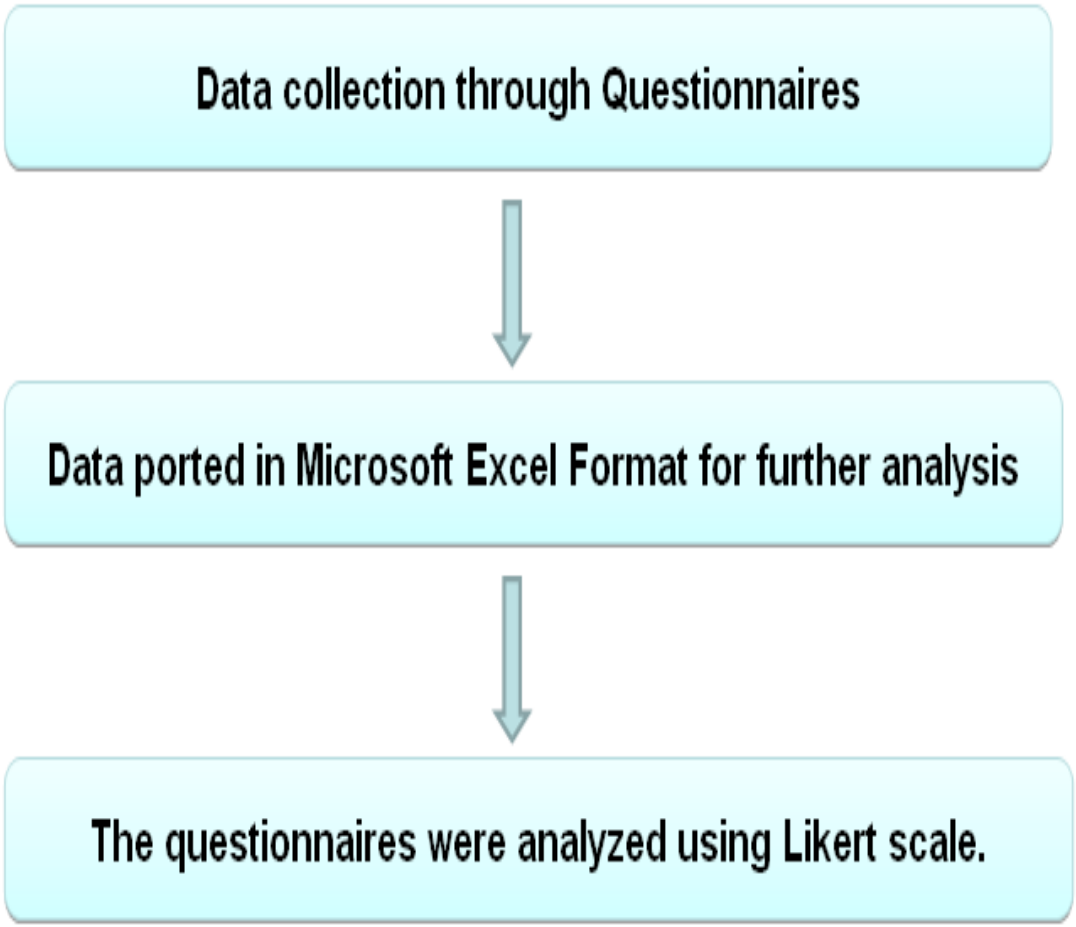
- **Population :** Nursing staff
- **Sample Size** : 40

For Preimplementation phase

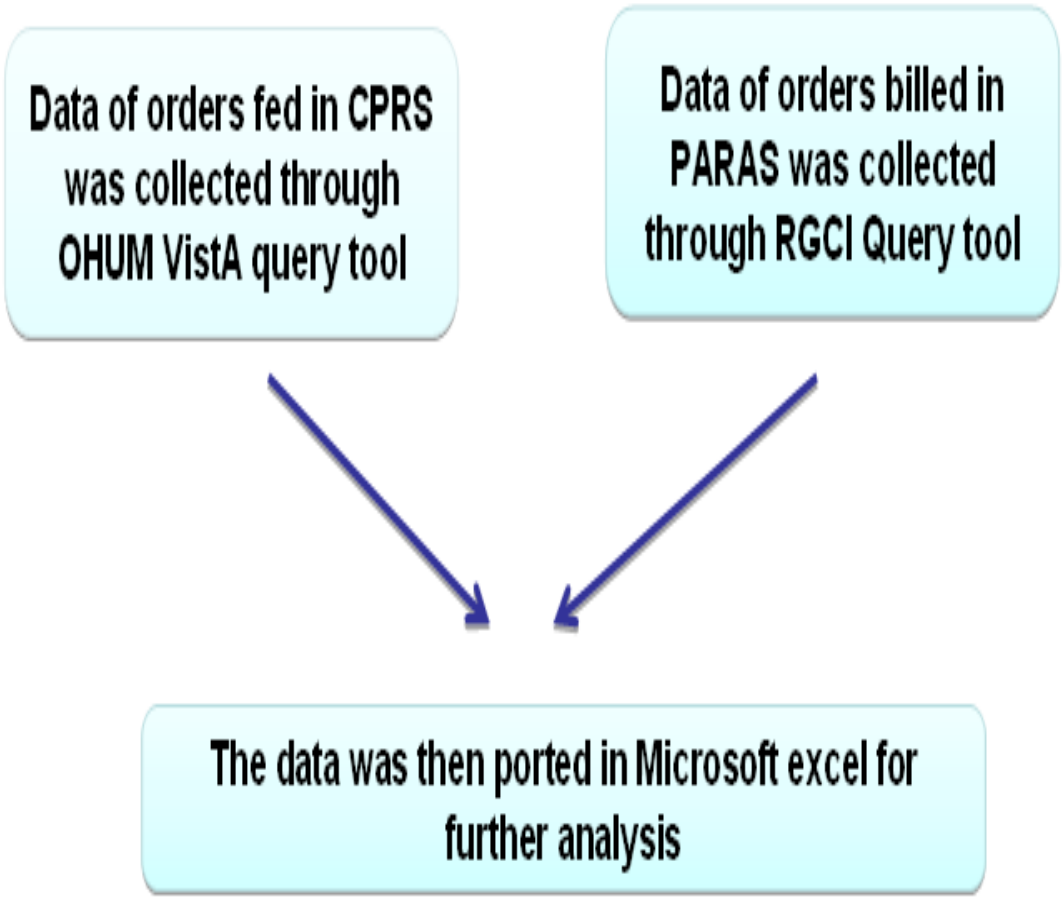
- **Population** : Doctor/Consultant
- **Sample Size** : 30

4.2 Methodology

For Pre and Post implementation Analysis

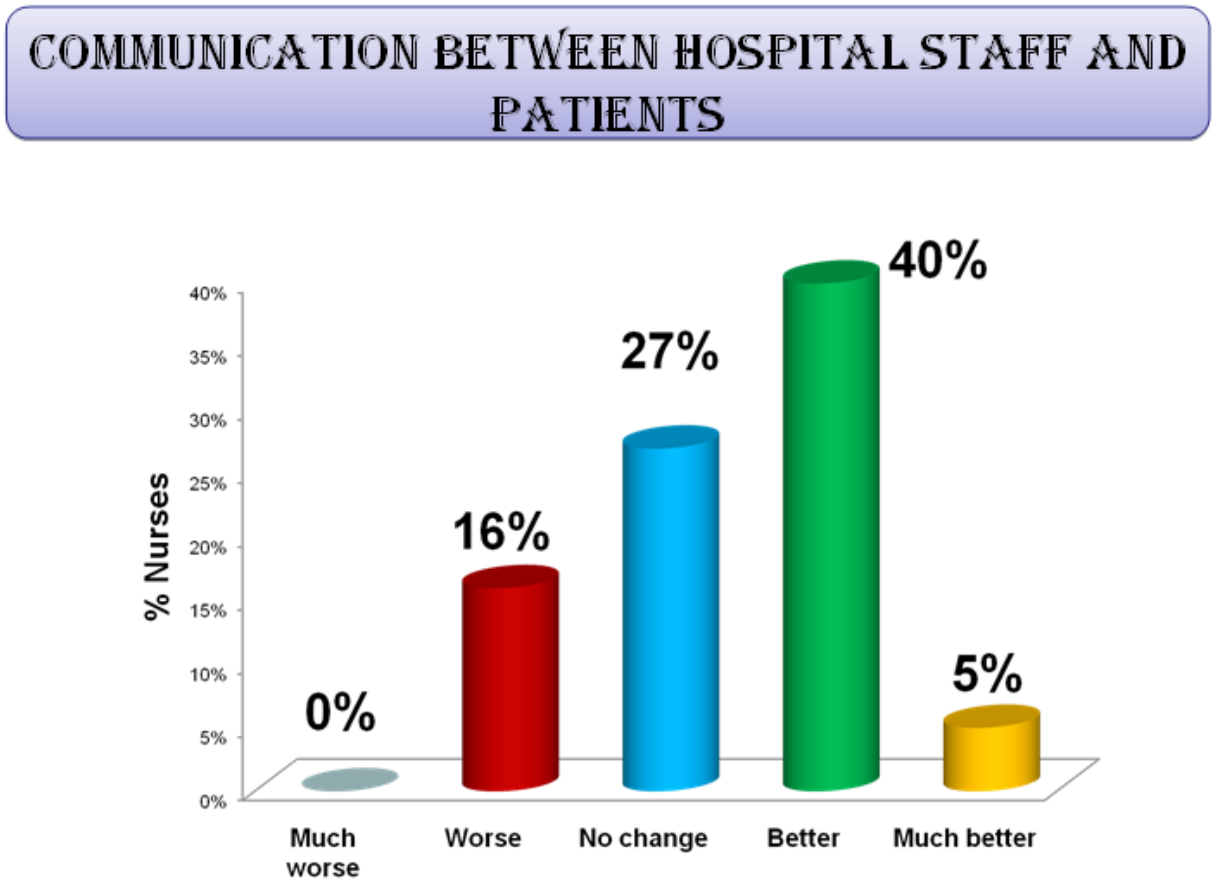


For Adoption analysis



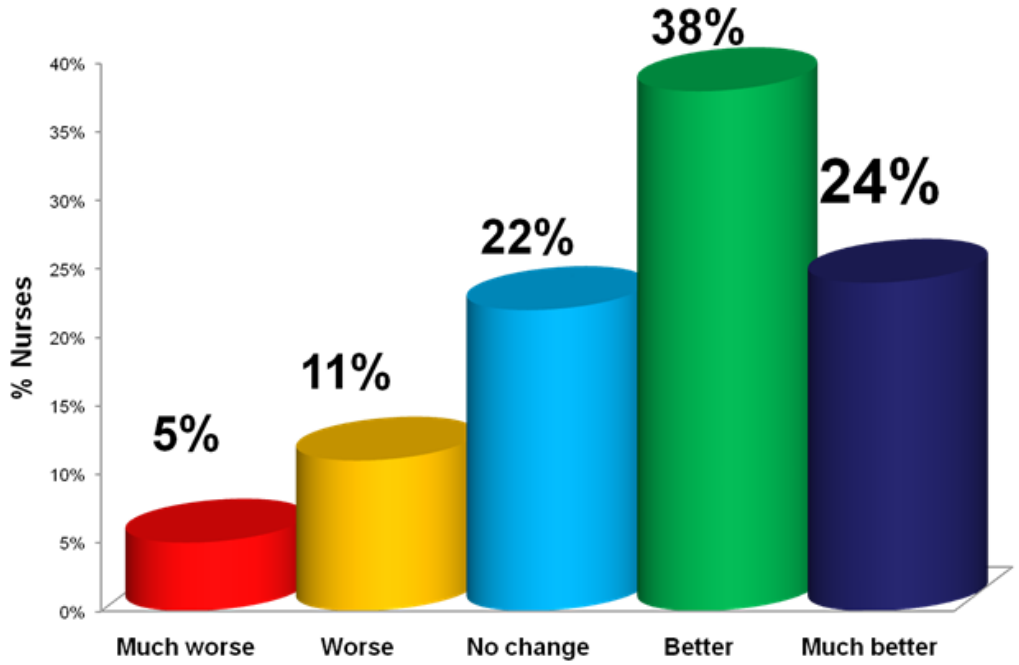
5. Results and Findings

5.1 Pre Implementation Phase



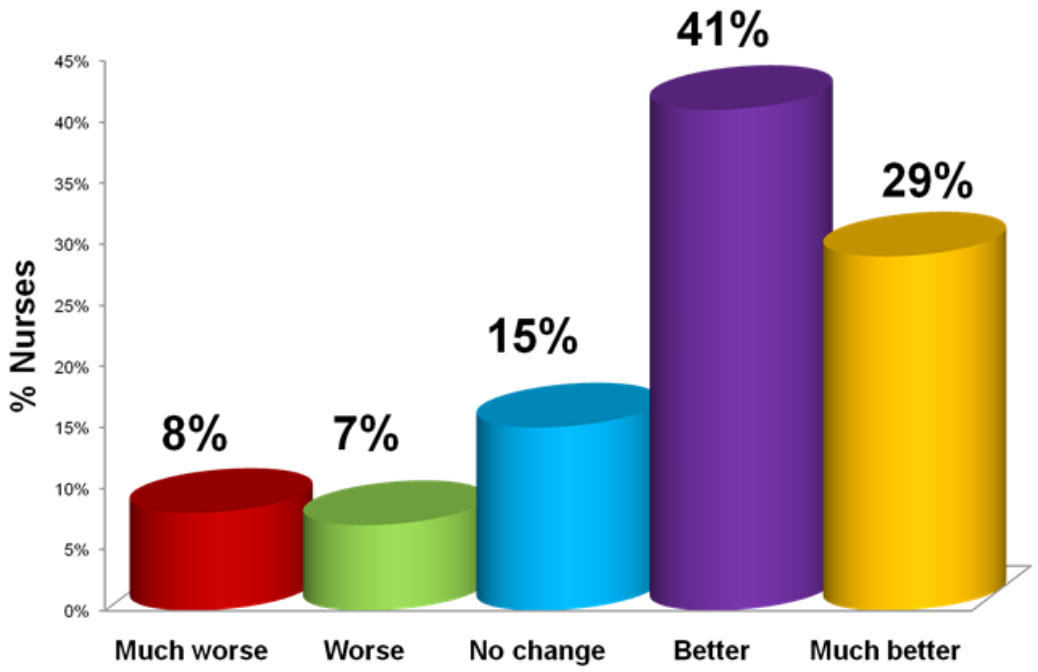
- Out of 40 nurses interviewed
- 0% nurses found it to be much worse.
- 16% nurses found it to be worse.
- 27% nurses found no change.
- 40% nurses found it to be better.
- 17% nurses found it to be much better.

PATIENT CARE



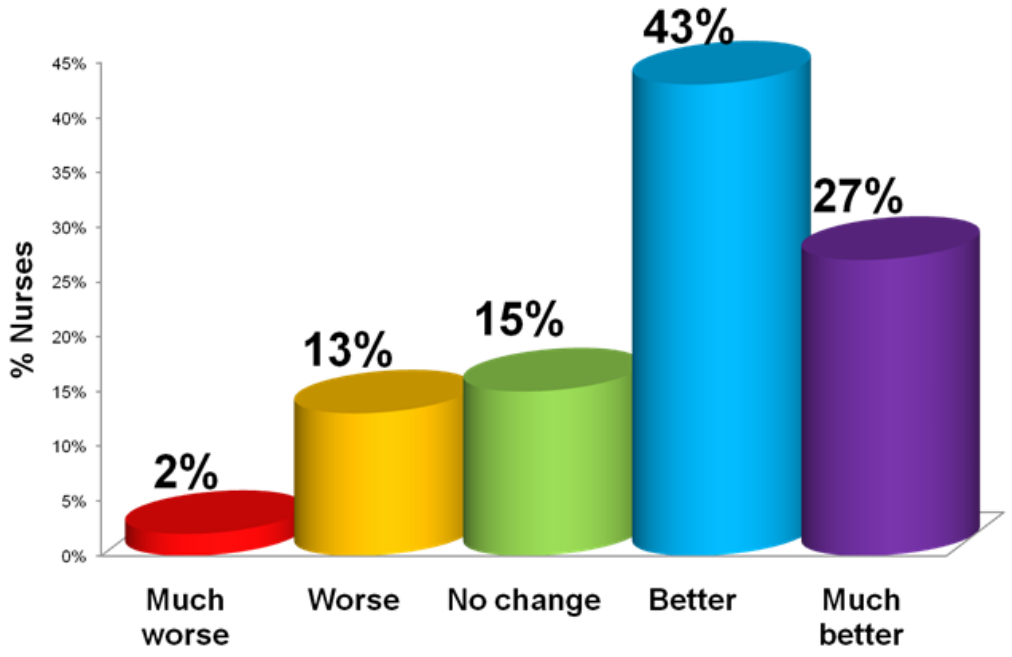
- Out of 40 nurses interviewed
- 8% nurses found it to be much worse.
- 17% nurses found it to be worse.
- 35% nurses found no change.
- 61% nurses found it to be better.
- 39% nurses found it to be much better.

PATIENT SAFETY



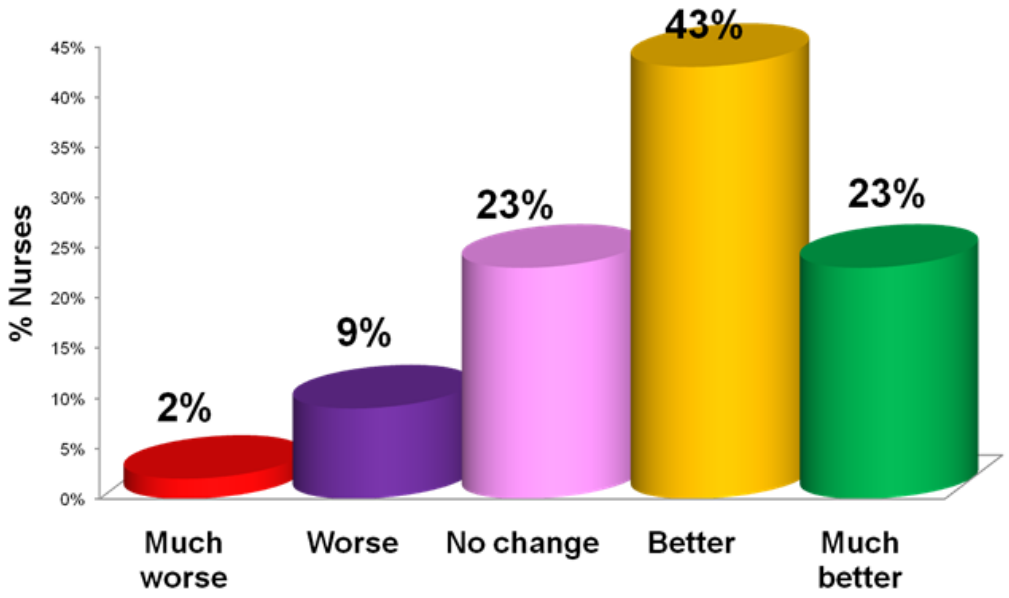
- Out of 40 nurses interviewed
- 8% nurses found it to be much worse.
- 7% nurses found it to be worse.
- 16% nurses found no change.
- 40% nurses found it to be better.
- 29% nurses found it to be much better.

JOB SATISFACTION



- Out of 40 nurses interviewed
- 3% nurses found it to be much worse.
- 13% nurses found it to be worse.
- 15% nurses found no change.
- 42% nurses found it to be better.
- 27% nurses found it to be much better.

TURN AROUND TIME FOR PATIENT CARE PROCESSES

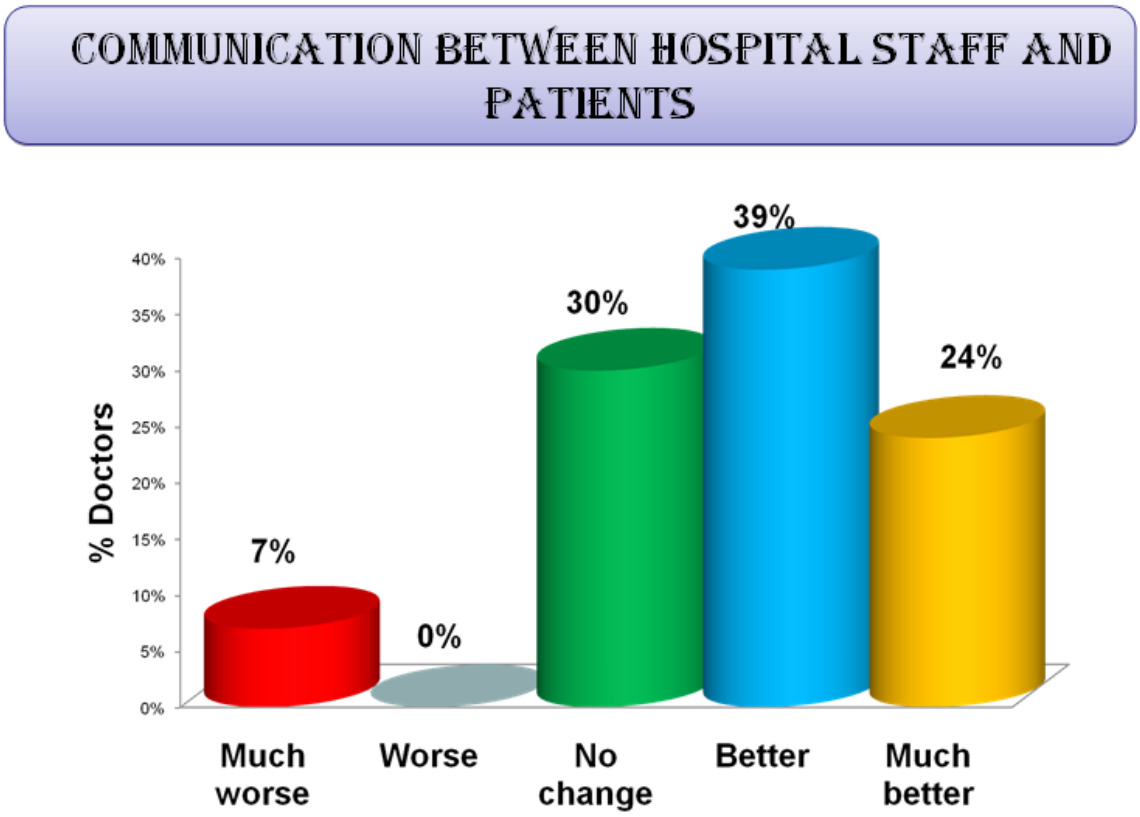


- Out of 40 nurses interviewed
- 3% nurses found it to be much worse.
- 9% nurses found it to be worse.
- 23% nurses found no change.
- 42% nurses found it to be better.
- 23% nurses found it to be much better.

TRAINING ON CPRS

Approx. 100% of the nurses found that there is a need for more training and an on job training would be helpful

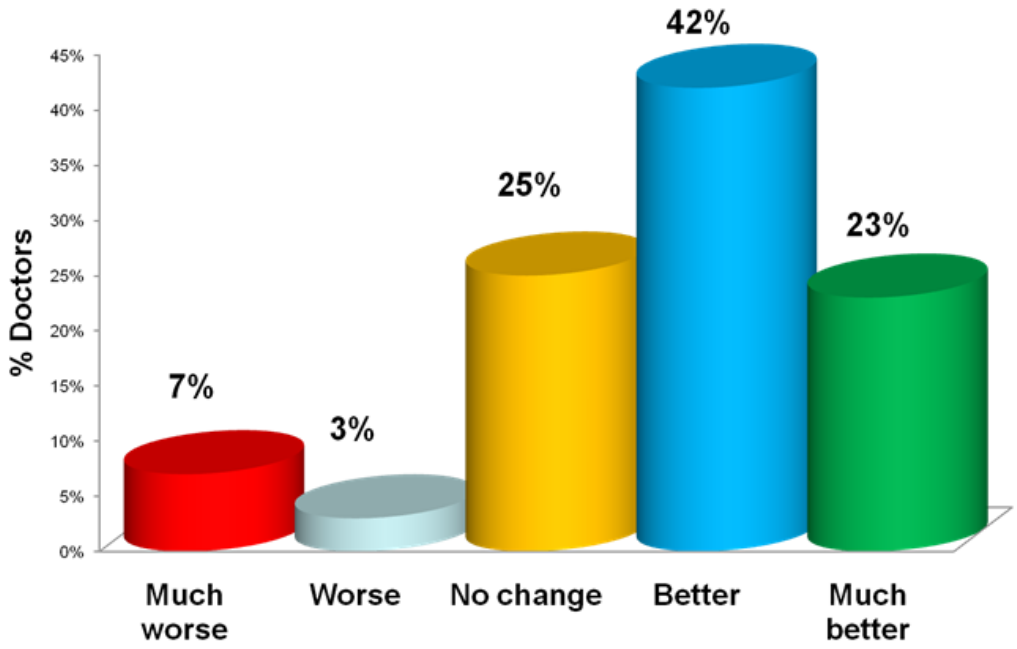
5.2 Post Implementation Phase



Out of 30 doctors interviewed

- 7% doctors found it to be much worse.
- 0% doctors found it to be worse.
- 30% doctors found no change.
- 39% doctors found it to be better.
- 24% doctors found it to be much better

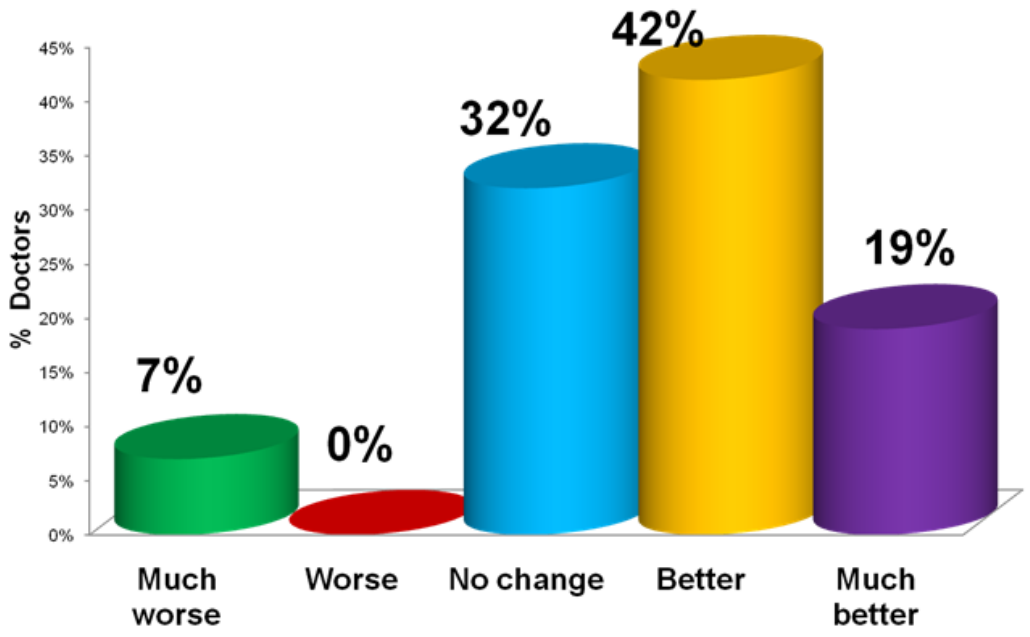
PATIENT CARE



Out of 30 doctors interviewed

- 7% doctors found it to be much worse.
- 3% doctors found it to be worse.
- 25% doctors found no change.
- 42% doctors found it to be better.
- 23% doctors found it to be much better

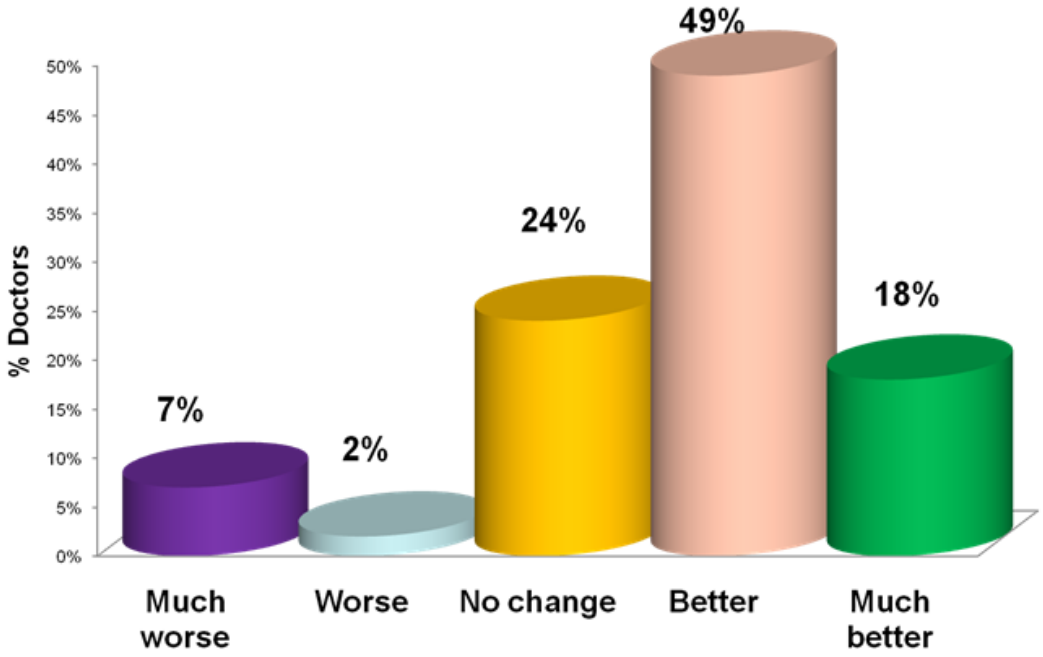
PATIENT SAFETY



Out of 30 doctors interviewed

- 7% doctors found it to be much worse.
- 0% doctors found it to be worse.
- 32% doctors found no change.
- 42% doctors found it to be better.
- 19% doctors found it to be much better.

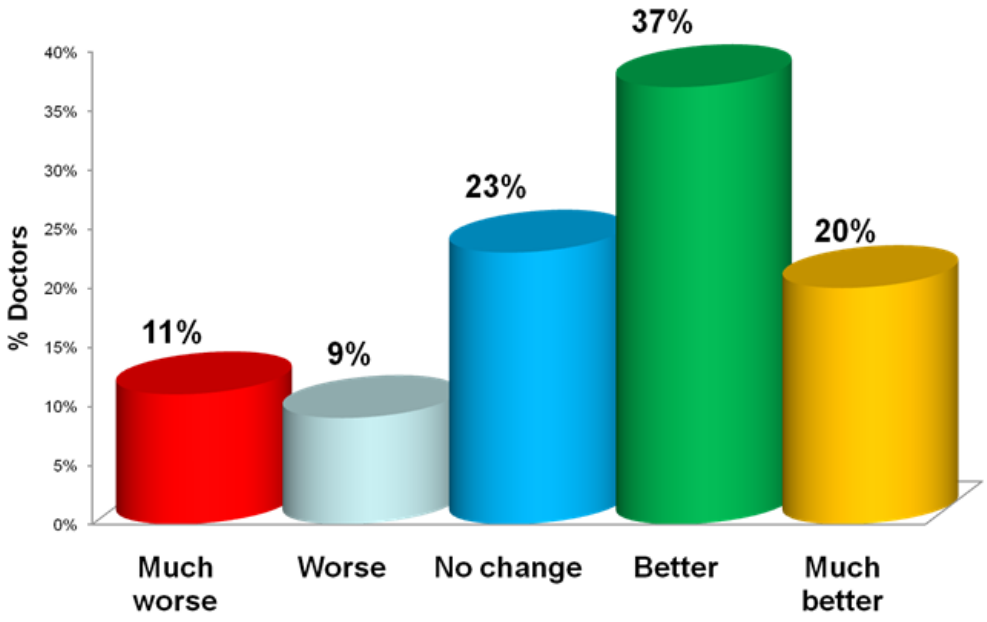
JOB SATISFACTION



Out of 30 doctors interviewed

- 7% doctors found it to be much worse.
- 2% doctors found it to be worse.
- 24% doctors found no change.
- 49% doctors found it to be better.
- 18% doctors found it to be much better.

TURN AROUND TIME FOR DOCUMENTATION AND PATIENT CARE PROCESSES



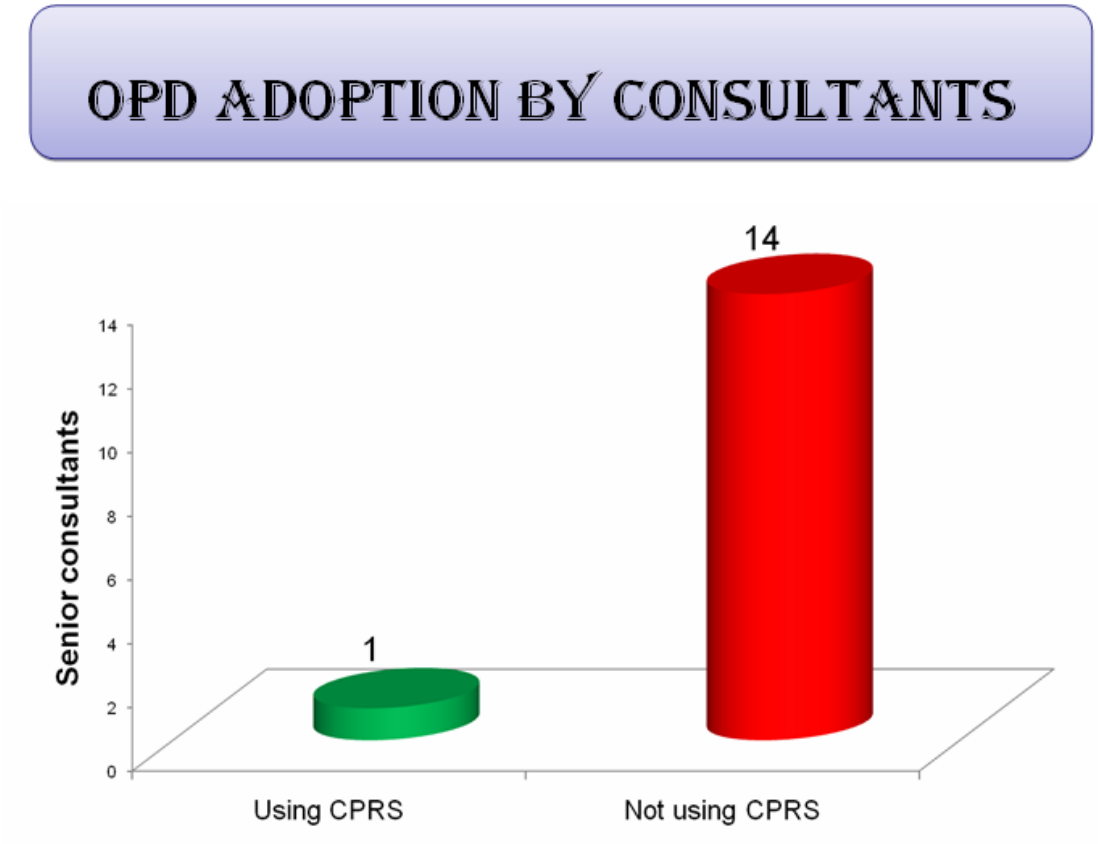
Out of 30 doctors interviewed

- 11% doctors found it to be much worse.
- 9% doctors found it to be worse.
- 23% doctors found no change.
- 37% doctors found it to be better.
- 20% doctors found it to be much better.

TRAINING ON CPRS

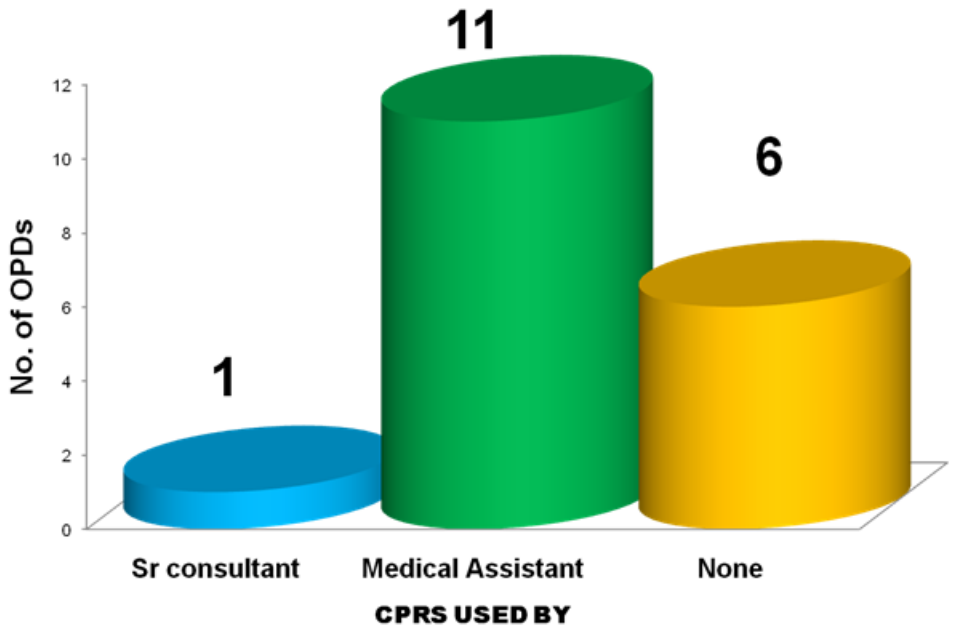
Approx. 100% of the doctors found that there is a need for more training and an on job training would be helpful

5.3 Adoption analysis



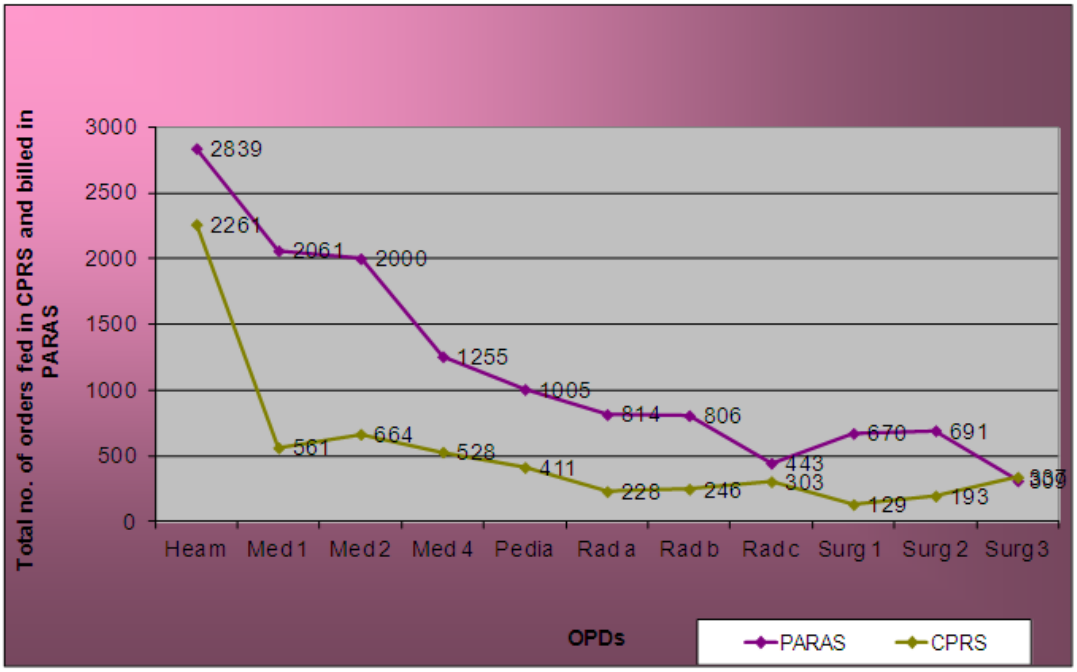
There are 15 senior consultants in RGCI&RC out of which only one is using CPRS himself.

CLINICAL ADOPTION AT OPDS



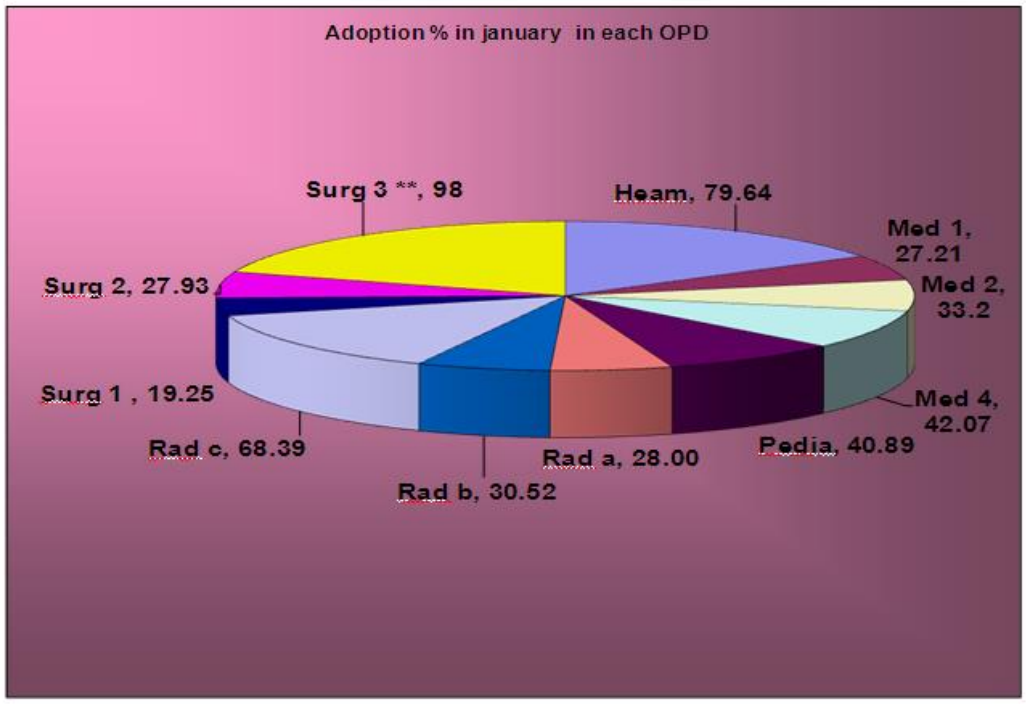
- **There are 18 OPDs in RGCI&RC out of which**
- **In one OPD sr consultant is using the system**
- **In 11 OPDs medical assistants are provided**
- **In 6 OPDs no one is using CPRS**

ADOPTION IN JANUARY



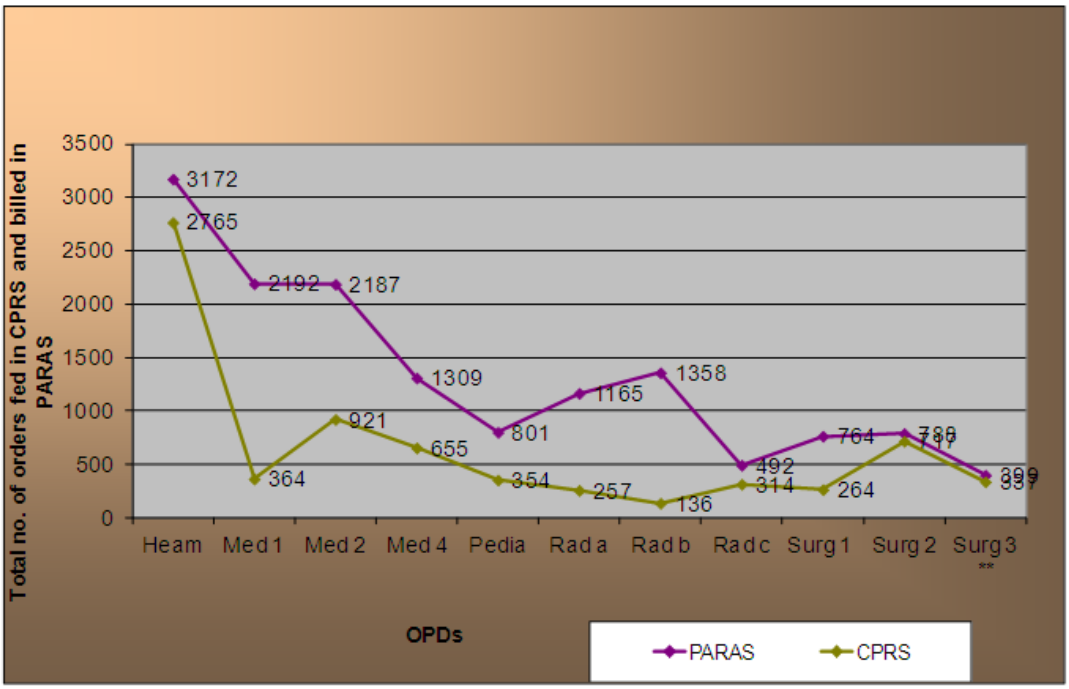
The graph shows the number of orders placed in CPRS and billed in PARAS. As the two graphs come near, the percentage of adoption increases. Thus the adoption is seen best seen in Surgical 3 and worst in medical 1.

ADOPTION STATUS IN EACH OPD



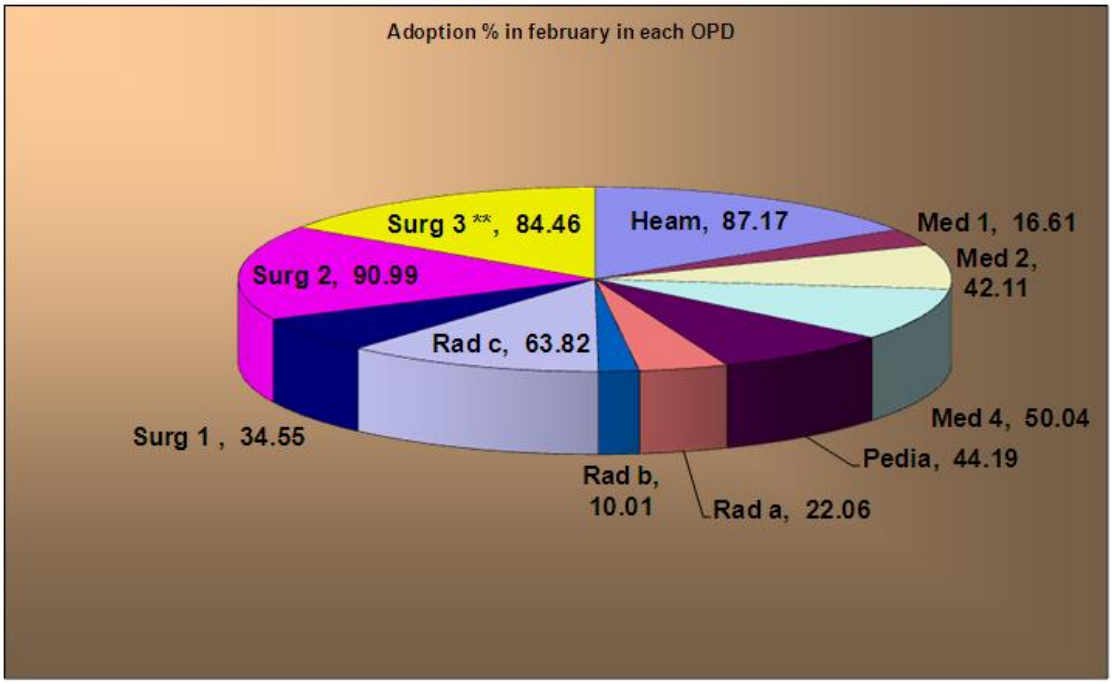
OPD wise adoption shows that best adoption is in surgical oncology 3 and the worst is in surgical oncology 1

ADOPTION IN FEBRUARY



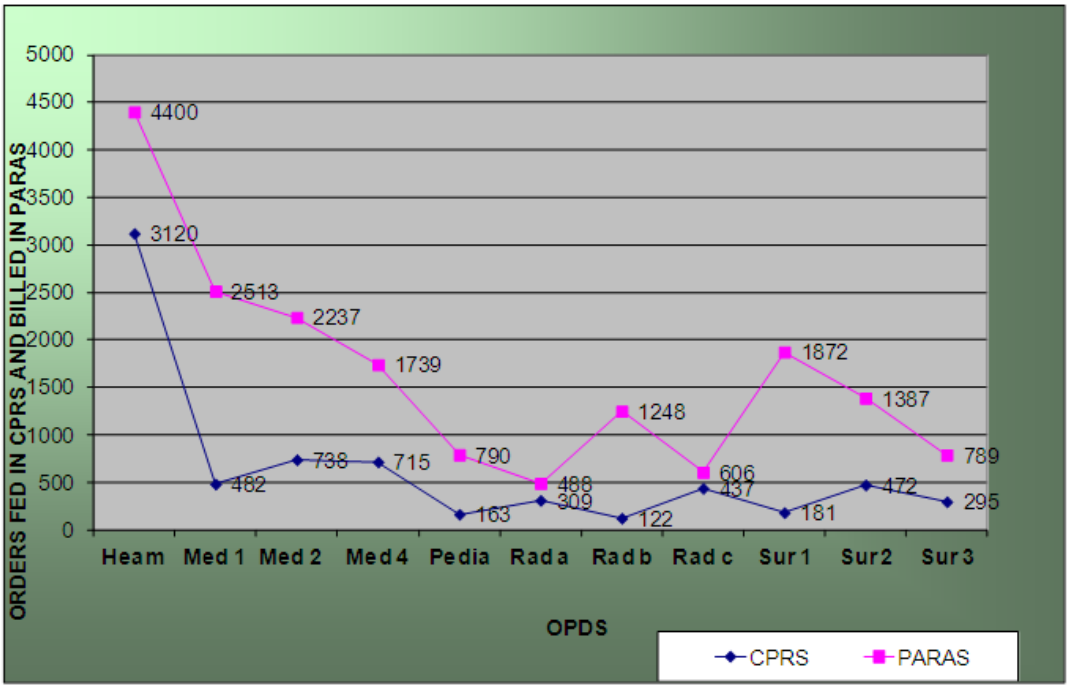
The graph shows the number of orders placed in CPRS and billed in PARAS. As the two graphs come near, the percentage of adoption increases. Thus the adoption is seen best seen in Surgical 2 and worst in medical 1.

ADOPTION STATUS IN EACH OPD



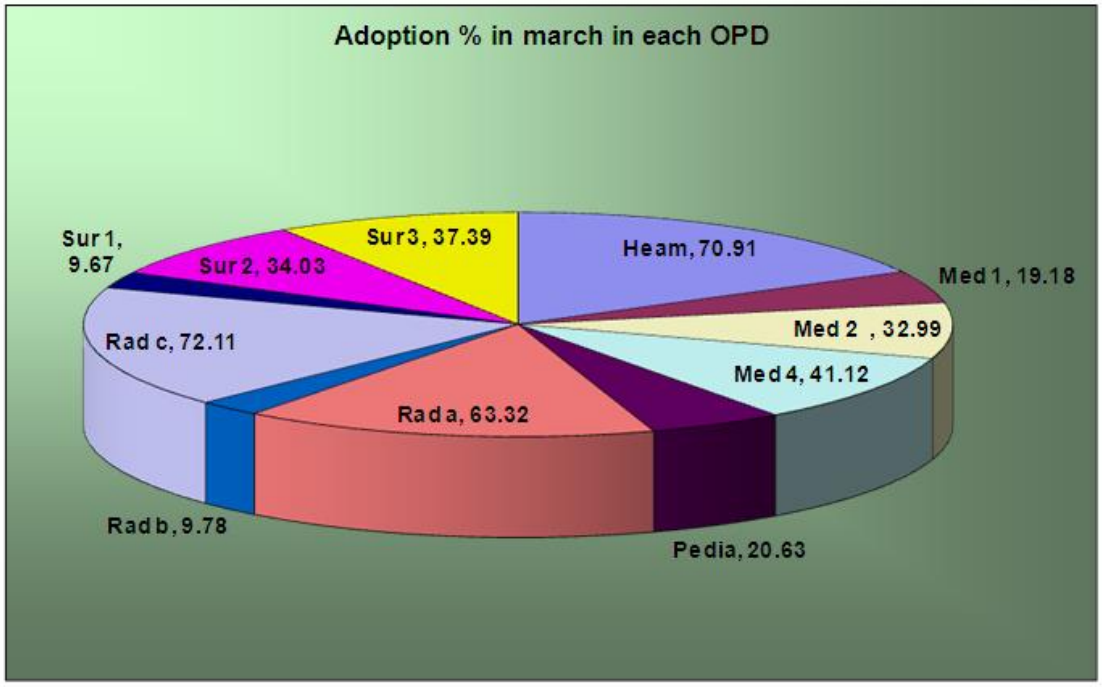
OPD wise adoption shows that best adoption is in surgical oncology 2 and the worst is in radiation oncology B

ADOPTION IN MARCH



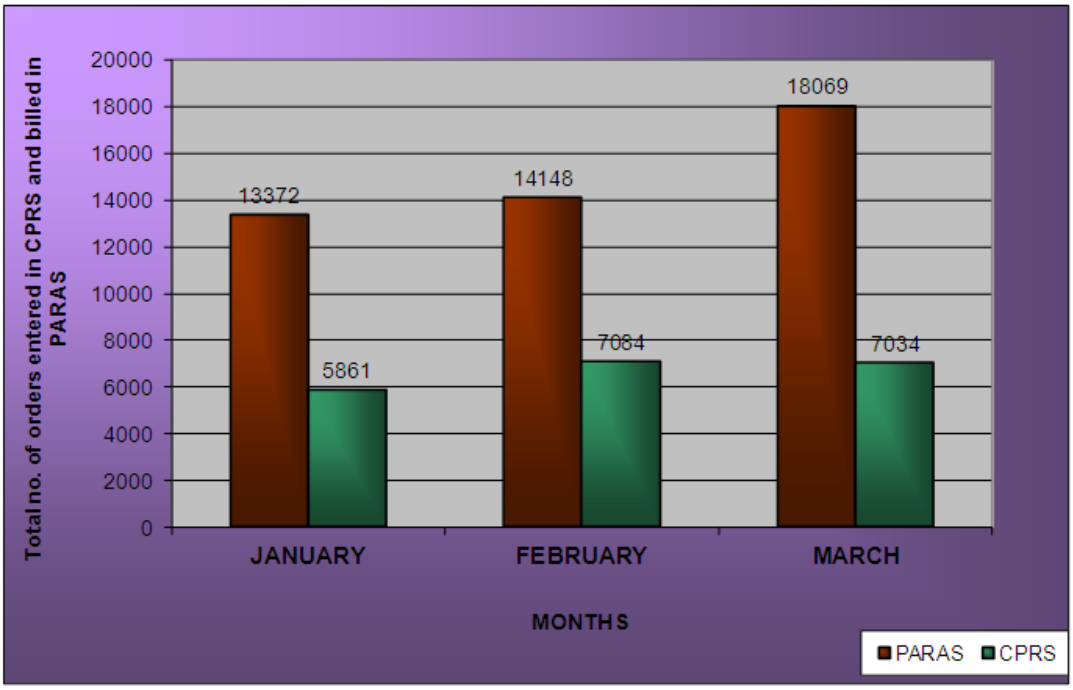
The graph shows the number of orders placed in CPRS and billed in PARAS. As the two graphs come near, the percentage of adoption increases. Thus the adoption is seen best seen in Radiation C and worst in medical 1.

ADOPTION STATUS IN EACH OPD



OPD wise adoption shows that best adoption is in Radiationl oncology C and the worst is in surgical oncology 1

TOTAL ADOPTION IN HOSPITAL



The total adoption in hospital was approximately 40% in January, 50% in February and 40 % in March

6. Discussion

Amongst the multitude of reasons driving hospital automation, these can be broadly classified as internal and external drivers. Internal drivers are those emanating from within the organization as a response to operational challenges, quality initiatives and organizational drive. External drivers come about as a result of market competition, customer expectations and regulatory requirements.

Quality pushes the adoption of information systems for reasons like parameterization, data acquisition, aggregation and analysis, performance measurement and monitoring. Parameters like time of action, reasons for delay in discharge process are measured at the point of action and analyzed over a period of time to uncover the process & operational inefficiencies and then be able to optimize it.

Monitoring of operational cost is mandatory for any organization to be able to survive in the competitive environment. This requires an Information System to be in place to support a secure way of handling transactions, store data and present information in an analyzable format. Audits (accounting, process, clinical etc.) depend on this data for assessing the state of affairs and finding gaps or loopholes, with an opportunity to improve the systems & processes.

Efficient utilization of organizational resources is promoted through resource planning which is brought about by the visibility of enterprise wide process and information. Trawling through the information systems, the operational reports capture the slackness in the processes and allow for constant monitoring. Once this information becomes available, the decision makers are empowered to take objective & informed decisions, thereby resulting in measurable performance improvement.

Healthcare today finds itself at crossroads facing three major moving targets:

- Cost
- Access
- Quality

For healthcare to be sustainable and be able to meet the patient's requirements, it has to be cost efficient & provide access to quality care. Increasingly the Information Systems are called upon to support these objectives. The benefit of Information Systems adoption in achieving these objectives flows from the following

- Time - Real time flow of information
- Place - Remote dissemination of information
- Standardization - Processes & Workflows
- Coordination -Among care providers
- Decision support – Clinical knowledgebase, Clinical pathways & protocols
- Retrospective analysis – Trends, audits, outcomes
- Predictive analysis – What-if, simulation & modeling

Hence with the implementation of VistA EHR the client will be able to meet its said objectives to a larger extent and be self sufficient in carrying out its operations

To understand it better I did a SWOT analysis of the adoption.

6.1 SWOT Analysis on CIS adoption

STRENGTHS

- Trained Medical Assistants
- Co operative staff
- Strong IT Support
- Superior capabilities of improved operational efficiency
- Management Support

WEAKNESSES

- Hectic schedule of doctors
- Non computer savvy staff
- Attrition among nursing staff
- Lack of defined processes
- Increased Chances of errors due to data entry by data entry operators

OPPORTUNITIES

- To become a fully computerized hospital.
- Instant availability of Patient record.
- Significant degree of paper reduction.
- Significant reduction in the hospital cost.
- Better Patient Care

THREATS

- Patient resistance due to :
  - Initial time consumption
  - Reduction in ‘human touch’
- Security Concern
- Failed attempts could result in financial losses and negative sentiment toward effort
- Electronic records are not recognized in Court of Law.

6.2 Limitations of the study

- As during the period of study, the phases of Transform and Sustain would not be covered; therefore it would not be possible to obtain the data of the barriers faced during these phases in this project from the implementers. Therefore in such cases data could be obtained only from the past experiences of the Implementer and by analyzing the various cases of EHR implementation Worldwide.

- Another limitation of this study is that generalisibility cannot be achieved for the entire implementation project only from the information generated in this project, as this project covers only one set of hospitals that belongs to a single brand with a same set of top management.

- Owing to the complexity of each institution and their heterogeneity, a success-story with a system in a specific hospital cannot be considered to be a sufficient guarantee for a safe implementation in another one. Moreover, many different commercial and home-made systems are available, and each of them needs to be carefully evaluated.

- To increase the chance of successful implementation, the development of evaluation and certification methods is highly desirable and mechanisms for feedback and continuous improvements should be in place.

7. Recommendations

The recommendations are divided into five categories i.e.:-

- Management
- People
- Process
- Infrastructure
- Implementation

7.1 Recommendations for Pre Implementation and Adoption

Management

- Select Clinician leader for change management.
- Select a User Champion for each department.
- A super user to resolve the first line of problems for the end users.
- Create a clear vision regarding the new system

PEOPLE

- Awareness programs for employees
- Kiosks/Banner/ Posters to generate awareness among the employees as well as visitors/ patients.
- An easy handbook.
- Training workshops for employees on monthly basis
- Training of the user groups should be ensured for successful implementation of HIS

PROCESS

- Motivation of employees to participate in process.
- Rewards for the best user.
- Certificate at the end of each training program.

- Weightage for system usage to be linked with yearly performance appraisal of an employee.
- Training to be performed outside the clinical sessions.
- Requirements of stockholders
- Employee's satisfaction

INFRASTRUCTURE

- Hardware infrastructure planning must be effective.
- There should not be any shortage of hardware at the end user level.
- Provision of training room for users.
- Test server should be available for practicing for the end users

IMPLEMENTATION

- Phased implementation keeping in mind:
- Patient load
- Infrastructure availability
- CPRS trained nurses
- Appointment of Change Manager among doctors
- Presence of an IT support team member in wards 24*7.
- Contact information display chart

7.2 Recommendations for Post Implementation and Adoption

MANAGEMENT

- Use of CPRS to be made mandatory for all consultants.
- Change Manager to report the progress regularly
- IT team should support him completely
- Periodic Post Go-Live Assessment should be done

PEOPLE

- EHR training to be included in induction program based on their user group.
- Ongoing training support and training of new updates and enhancements to be provided for the users.

PROCESS

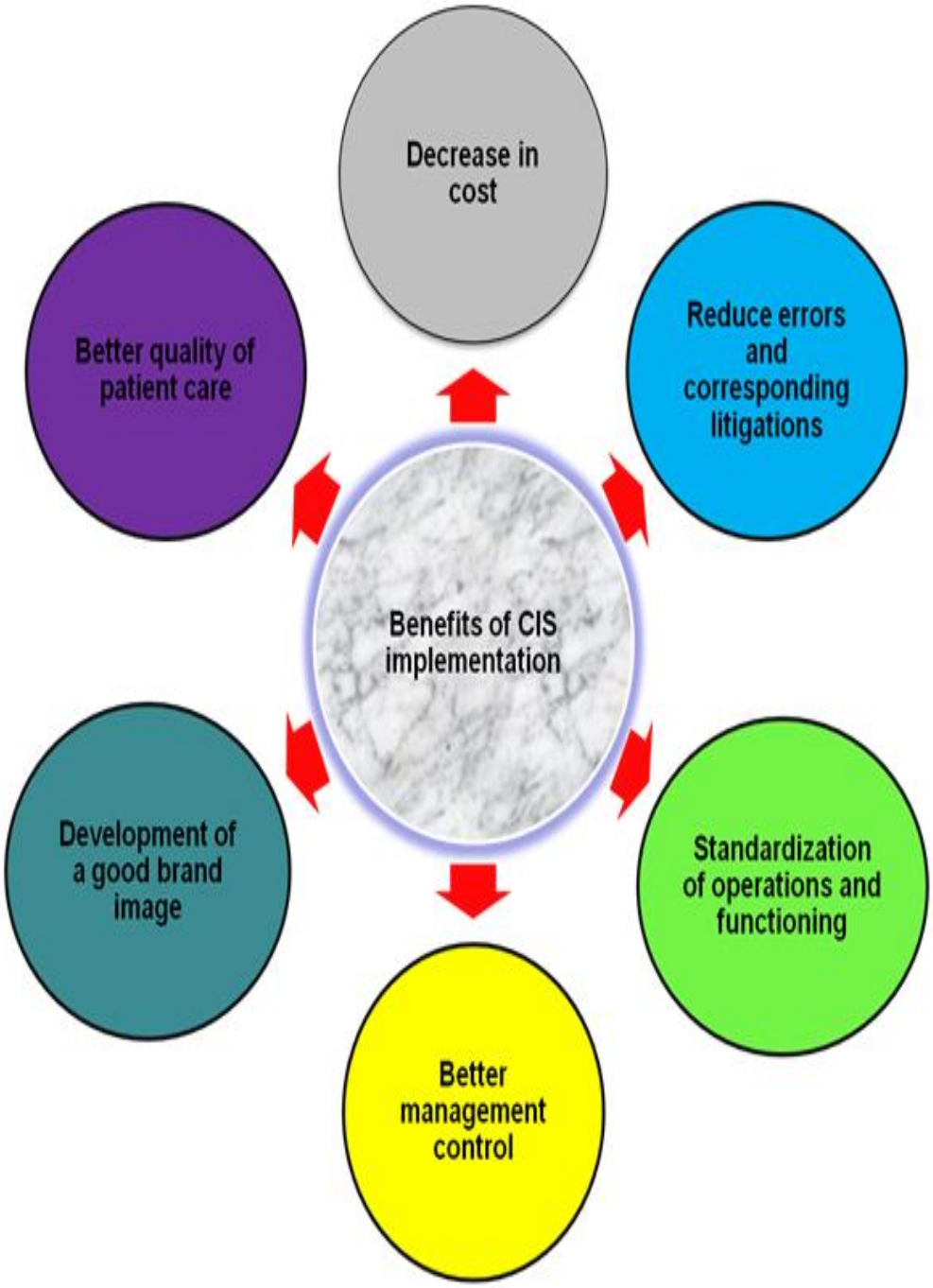
- Motivate employees to participate in process
- Rewards:-employee of the month's best user batch.
- Medical assistants to be given a regular yearly appraisal
- Regular feedback to be taken from user champions.
- Employees requirement should be attended and replied back based on their feedback given.
- Evaluate the Go-Live with Staff.

INFRASTRUCTURE

- Medical assistants to be properly staffed in OPD to reduce the human errors due to over work.
- Systems to be installed in doctor's lounge to practice in their leisure time.
- There should not be any shortage of any hardware at the end user level.

8. Conclusion

With the implementation of VistA EHR, the Multi Chain Hospital would gain in the following areas:



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10. Appendices

10.1 Pre Implementation Questionnaire

PER IMPLEMENTATION Q(

10.2 Post Implementation Questionnaire

POST IMPLEMENTATION Q(