"Barcode Medication Administration: Issues & Benefits Realized by Nurses in a Multi Specialty Hospital"

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

Post - Graduate Diploma in Health and Hospital Management

By

Anindam Basu

PG/10/005

International Institute of Health Management Research

New Delhi - 110075

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Under the Guidance of

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April, 2012

Certificate of Approval

The following dissertation titled **"Barcode Medication Administration: Issues & Benefits Realized by Nurses in a Multi Specialty Hospital"** is hereby approved as a certificate 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
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ABSTRACT

Bar Code Medication Administration: Issues & Benefits Realized by Nurses in a Multi Specialty Hospital

Anindam Basu

Background behind the study: Every hospital implementing Bar Code Medication Administration (BCMA) has a prime motive of reducing medication errors that would automatically increase the patient satisfaction and would also increase the overall hospital image. BCMA works in a very simple and basic five rights of medication administration done by nursing which consists of Right Patient, Right Medication, Right Route, Right Dose and Right Time. Literature confirms that most of the medication errors occur at the time of medication administration done by the nurses (approx 59%) which is on a higher side as far as medication errors are concerned. Keeping that in mind, the hospital implemented open source VistA EHR integrated with BCMA module in mid 2011. Sometimes after implementation of these kinds of ICT systems we only focus on the final outcome that we tend to lose focus on the problems faced by the end users as it may show a negative impact about the application. But it is not always technology who can be blamed for all the hardships been faced by the end users, but sometimes the process and people are also becoming the source of problems when it comes to smooth functioning of the application. The study majorly focuses on the problems faced and benefits realized by the nurses' (end users for BCMA) after the implementation of EHR system and what all steps can be taken up to reduce the burden.

Objectives of the Study: The general objective of this dissertation is **to study the Problems faced and the Benefits realized by the Nurses regarding BCMA system in ABC Super Specialty Hospital situated in the northern part of India.**

Specific objectives are as follows:

1) Working of BCMA and information flow between the systems.
2) Process impact on the working of BCMA
3) Direct and Indirect roles of different Stakeholders for medication administration

4) SWOT analysis of BCMA system.

Research Design/ Methodology

The dissertation study is a mixture of both qualitative and quantitative data. It is a questionnaire based cross sectional study and prospective in nature.

Sample Size: 100 Nurses.

Sampling Technique used: Simple Random Sampling

Primary Data Sources: Questionnaire (Open + Close Ended Questions); Interviews: (Structured & Unstructured) & Observation: Non Participant

Secondary Data Sources: Literature available about BCMA; BCMA user manual (Confidential from the client side); SOP for BCMA and QRGs for the end user & Books, websites etc.

Results: The major problem that they are facing is due to process related (p=0.000) & pharmacy related (p=0.008). Also when analyzed individually Less No. of COWs used in wards (p=0.000); Pharmacy dispenses drugs incorrectly (p=0.000) & Scanner doesn't work properly (p=0.003). Other than this most of the nurses have realized the direct as well as the indirect benefits of the system. Also the SWOT analysis of the system has shown a positive side as a whole.

Conclusion: No ICT system is perfect in this world; it is dependent on people, process and technology to make it a success. Since the system has been implemented from last 8 months but still has shown a tremendous adoption by the end user. The application would work smoothly if there is a timely medication order entry by the physician, stopping bulk orders for pharmacy, pharmacy uses unit dose packaging efficiently & effectively and nurses' reducing the use of workaround frequently in the system for better effectiveness of the application.

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List of Abbreviations

VistA: Veterans Health Information Systems & Technology Architecture

BCMA: Bar Code Medication Administration

CPRS: Computerized Patient Record System

CPOE: Computerized Physician Order Entry

HIS: Hospital Information System

EHR: Electronic Health Record

SWOT: Strengths, Weakness, Opportunities and Threats

MAR: Medication Administration Record

LAN: Local Area Network

EMAR: Electronic Medication Administration Record

TAT: Turn Around Time

SOP: Standard Operating Procedure

QRGs: Quick Reference Guides

CDSS: Clinical Decision Support System

VDL: Virtual Due List

COWs: Computer on Wheels

ICUs: Intensive Care Unit

ICT: Information Communication & Technology

PART 1

INTERNSHIP

REPORT

1.1 ORGANIZATIONAL PROFILE

Dell Services is an information technology services provider based in Plano, Texas, USA. Peter Altabef has served as president and chief executive officer since 2004. For more than 26 years, Dell has empowered countries, communities, customers and people everywhere to use technology to realize their dreams. Customers trust it to deliver technology solutions that help them do and achieve more, whether they're at home, work, school or anywhere in their world.

On September 21, 2009, Perot Systems agreed to be acquired by Dell for $3.9 billion. The acquisition resulted in a compelling combination of two iconic information-technology brands. H. Ross Perot and eight associates founded Perot Systems in June 1988 after having sold Electronic Data System (EDS) to General Motors. Before its acquisition by Dell Inc., Perot Systems was a Fortune 1000 corporation with more than 23,000 associates and 2008 revenues of $2.8 billion. Perot Systems maintains offices in more than 25 countries around the world, including the United States, Europe, India, China and Mexico

As a top-five finisher for the third consecutive year, Perot Systems was named to the Fortune magazine ''Most Admired Companies in America'' list for IT Services in 2008. Dell Services is the No. 1 healthcare information technology services provider in the world according to the latest IT services worldwide market share report by Gartner, Inc. The report also ranks Dell second for computer hardware support in the Education market.

The expanded Dell is better positioned for immediate and long-term growth and efficiency driven by:--

- Providing a broader range of IT services and solutions and optimizing how they're delivered

- Extending the reach of Perot Systems' capabilities, including in the most dynamic customer segments, around the world

- Supplying leading Dell computer systems to even more Perot Systems customers.

It provides a portfolio of services to help hospitals identify and take advantage of EHR through the implementation of EHR.

Healthcare delivery and administration continues to become more complex. Uncompensated care is on the rise, demographics are changing, and patients are demanding more for their healthcare dollars. All the while, there continues to be a shortage of healthcare professionals to address the ever-demanding needs of consumers and patients.

To meet these challenges, Dell Perot Systems provides the right combination of clinical and business process improvements, coupled with technology to help hospitals and health systems achieve an environment that is interconnected, streamlined, efficient, and patient-focused. Its vision for the healthcare industry is simple: It wants healthy people to successfully interact with a safe, efficient, and consumer-friendly healthcare system.

Their team of physicians, nurses, and clinicians, as well as healthcare consultants and technologists are experienced in end-to-end hospital operations and understand how to develop, design and implement processes and technologies that bring about real provider transformation. They apply their extensive experience and expertise for:

- Clinical Transformation - Healthcare providers today are facing the challenges of increasing the quality of care delivery and enhancing services while reducing costs. By implementing advanced clinical systems combined with care transformation programs, organizations are finding ways to fund new change initiatives while improving quality. Dell Perot Systems joins with the staff to improve care delivery processes and achieve measurable results.

- Information Technology Solutions — Operational performance can be improved only when information technology is planned, designed and implemented to support an efficient way of doing things. Dell Perot Systems can help improve the productivity

and quality of your services, as well as enhance the usefulness of clinical, HR, patient accounting, and administrative applications. Their global technology capabilities and Solution Centers deliver concentrated expertise for Cerner, McKesson, Meditech, Lawson, and Siemens solutions to name a few. Implementing, integrating, and supporting the right infrastructure automates clinical and administrative processes and in turn enhances the quality of care delivery

- Revenue Cycle Solutions — Whether the organization is financially distressed, has limited access to capital, high volumes of low-yielding accounts, or simply wants to improve the overall performance of their revenue cycle, Dell Perot Systems has the expertise and solutions that improve all revenue cycle metrics, with the realization that increasing cash is key because it provides the financial resources that allow for improving patient care.

It delivers the best healthcare possible. Whether it is a hospital, health system, or physician practice providing care, a health plan paying for care, or an integral part of the healthcare supply chain, delivering the best healthcare possible requires being responsive, efficient, accurate, and innovative in a constantly changing industry.

Every day around the globe, its mission is to provide the full spectrum of infrastructure, application, and business process solutions that are the best service possible. By leveraging its extensive expertise, they are able to provide the organizations with creative, integrated, and innovative solutions that best meet their tactical and strategic objectives. For 20 years, other organizations have put their trust in Dell Perot Systems to deliver solutions that improve the business of health so they can transform care.

1.2 Area of Engagement: The area of engagement in the organization during the internship was the EHR project in one of the organization's customer. The customer is having a chain of hospitals in the northern part of India and most of the customer sites have been implemented with the Open Source VistA EHR system. The internship was divided into two phases which is as follows:

a) Undergoing Training of different modules: For the smooth running of the hospital operations which consists of both clinical and administrative work, the whole integrated EHR system has been divided into various smaller modules and therefore initial training of all the modules are must which consists of the following:

    i. CPRS Module

    ii. Pharmacy Module

    iii. BCMA Module

    iv. VOE Scan Module

    v. HIS

    vi. Dietary Module

    vii. Clinical Transformation Session

b) Involvement in the project: After undergoing training of different modules, there was involvement in the project which consists of the following managerial tasks:

    i. Involved in the automatic failover testing: Was a part of testing team for testing different scenarios during automatic failover of the server.

    ii. Upgrading of the Learning Management System: Involved in upgrading the training material for the customer.

    iii. Designing of the test questionnaire for the trainees who were trained in the different modules.

    iv. Worked as an Application Support Management Resource (ASM) at one of the customers' site.

    v. Train the Trainer Session: Was involved in training the trainer at the customer site, in which the trainers from the customer side were trained in CPRS and BCMA module for further training of the end users by them.

1.3 Reflective Learning's:

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

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

1) Ground issues been faced by the end user after the implementation of   the   integrated EHR System.

2) The step by step approach in training the users using the traditional train the trainers approach before the implementation of the ICT system.

3) Various techniques to handle the end user at the customer side at the time any issue arises.

4) Changes in the workflow after the implementation of the Integrated EHR system.

5) Workflow been followed in the green field hospital which is totally working on the ICT systems from day 1.

6) Process of downtime and what all processes are followed in both the customer side and organization side.

7) The process of support management to the end user at the customer side by the onsite and offsite infrastructure and application team through a centralized call center (24*7).

PART 2

DISSERTATION

REPORT

CHAPTER 1

DISSERTATION

OVERVIEW

Dissertation Overview:

The dissertation has been conducted in 302 bedded ABC Super specialty hospital situated in the outskirts of National Capital Delhi. Currently they are using open source EHR named VistA (Veterans Health Information Systems & Technology Architecture) from the mid 2011. BCMA (Bar Code Medication Administration) a module of VistA EHR has also been implemented with Computerized Patient Record System (CPRS) and is constantly running till date. The following dissertation report focuses on the current problems faced by the nurses regarding BCMA and what all benefits they have realized about the system after the implementation.

1.1 Problem Statement:

After the successful implementation of the integrated EHR system which includes BCMA system, the medication administration process is been effected in a big way. The Nurses' day to day activity has been affected after the implementation of the integrated system like: the change in the processes after the implementation, the system checks which is making the nurses more accountable etc. BCMA works on a very simple fact of nursing care i.e. for any medication administration the 'Five Rights' required are: Right Patient; Right Medication; Right Dose; Right Route; Right Time. BCMA adds up to the five rights one more right and which is Right Documentation. For any successful ICT system implementation, change in the technology and changes in the processes has a great impact on the people (end users) using the application. No IT system from the day of Go – Live is 100 percent fine. Gradually it takes some time to settle and also some time to actually become a habit for the end user as previously they were totally working on the manual system. Initially users would face some of the problems which could be either System related or Process related.

1.2 Objective of the Study:

The general objective of this dissertation is **to study the Problems faced and the Benefits realized by the Nurses regarding BCMA system in ABC Super Specialty Hospital situated in the northern part of India.**

Specific Objective:

Specific objectives are as follows:

1) Working of BCMA and information flow between the systems.
2) Process impact on the working of BCMA
3) Direct and Indirect roles of different Stakeholders for medication administration
4) SWOT analysis of BCMA system.

1.3 Scope of the project:

This study includes accessing the effect on nurses' for medication administration after the implementation of the Integrated EHR in the hospital which also has a component of BCMA application. It includes the study of problems they are facing after the implementation of the system and what are the benefits they think they have got from this system.

1.4 Need of the study:

The new integrated EHR with BCMA application now has become a very essential part for the nurses' day to day activity. With BCMA in place with prior motive of reducing medical error, the impact of the application becomes very important. Therefore the study would help us to know:

a) What are the problems the end users are facing & how these problems can be reduced to minimal?
b) Is there a need to change some of the processes involved during the medication administration procedure.
c) What is the perception of the end users and what all can be done for more improvement of the system?
d) This study would help the implementation team and the client organization for their future implementation of the integrated system in other hospitals.

1.5 Assumptions:

Assumptions for the study are as follows:

a) All the respondent know the functionality of BCMA system well i.e. they are been trained properly regarding the system.

b) All the BCMA areas are utilizing only this system for medication administration process.

c) All the respondents know the process related changes occurred after the implementation of the EHR system.

1.6 Data Sources:

Primary data sources: a) Structured Questionnaire; b) Structured Interview; c) Non Participant Observation

Secondary data sources: a) Literature available for BCMA; b) BCMA user manual; c) SOPs & QRGs for the end user; d) Books, websites etc.

1.7 Work Plan: It includes the activity table and the Gant chart for the overall project.

ID	Task Name	Start	Finish	Duration	Jan 2012					Feb 2012				Mar 2012				Apr 2012	
					1/1	8/1	15/1	22/1	29/1	5/2	12/2	19/2	26/2	4/3	11/3	18/3	25/3	1/4	8/4
1	Defining the Problem	1/2/2012	1/23/2012	16d		▬	▬												
2	Literature Survey	1/24/2012	2/3/2012	9d				▬											
3	Methodology Adopted	2/6/2012	2/20/2012	11d						▬									
4	Data Collection	2/21/2012	3/9/2012	14d								▬							
5	Data Compilation & Analysis	3/12/2012	3/20/2012	7d											▬				
6	Documentation	3/21/2012	3/30/2012	8d													▬		
7	Submission of First Draft to Advisor	4/2/2012	4/2/2012	1d														▎	

Fig #1: Gant chart representing the dissertation project plan

Activity	Estimated Time Taken	Expected Outcome
Defining the Problem	16 days	Problem Defined and Proposal
Literature Survey	09 days	Final Draft of the Proposal
Methodology Adopted	11 days	Finalization of Tools to collect data; Code Book Preparation for SPSS
Data Collection	14 days	Filled up Questionnaires from the respondents.
Compilation and Analysis	07 days	Bar graphs, pie charts, tables, workflows etc.
Documentation	08 days	Preparation for the final report
Submission of the first draft to advisor	By 02nd April 2012	First Draft Ready

Table #1: Activity table for the project plan

1.8 Limitations:

1) Pre Implementation data is not available. Therefore comparative analysis is difficult.
2) The questionnaire to be filled up consists of different sections. Therefore the study may not cover up all the aspects as expected/desired from the objectives.

CHAPTER 2

PROJECT

OVERVIEW

Project Overview:

Medication Administration is a very important and fundamental task widely undertaken up by the nurses. As medication administration directly deals with the life of the patient, therefore the overall process of Medication Administration to them is underpinned by legal and professional requirements. Nurses administer medications multiple times per shift. Since it is such an integral component of nursing practice, medication errors therefore have been identified as an appropriate outcome indicator for Nurses' day to day work (Bulechek*et al;* 1994). National Patient Safety Agency's (2007) statistics shows that 59.3 percent of the medication errors occur during the administration stage. According to different studies not only administration of medication plays a significant role in medication errors but also ordering of the medication (7-20%); transcribing the medication order (7-10%) & dispensing the medication order from the pharmacy to the inpatient department (10-15%) plays a vital role in medical errors. Since 2000, the Veterans Health Administration has pioneered the development & deployment of Barcode Medication Administration (BCMA) System. BCMA and CPOE (Computerized Physician Order Entry) technologies are two ways to improve inpatient medication administration process. The two processes have not only improved the inpatient medication safety by automating the process of medication checking (drug to drug interactions; allergic interactions) but also making the medication administration record electronic and in real time access.

For any hospital, the main focus point is to provide the best patient care which would lead to patient satisfaction and delight. Therefore, nursing medication administration process is one of the core service areas for any hospital to grow as an organization but also as individual (Nurses) themselves. For any hospital following a manual drug administration process, the phase of clinical transformation from manual to electronic becomes very crucial. No system is this world is 100 percent perfect. Every clinical staff in a hospital faces some of the difficulties during the early stages of implementation which gradually decreases after some time. System implemented would never be a success if the end users are not actually realizing any benefits of the system after the implementation. The present study deals with the issues faced by the nurses and benefits realized by them of BCMA system in a multispecialty hospital who has just implemented the system (Just 6 -8 months ago).

2.1 Introduction

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. ABC Multispecialty Hospital has Open Source VistA as their EHR system.

Veterans Health Information Systems and Technology Architecture (VistA)

VistA is an enterprise-wide information system built around an Electronic Health Record (EHR), used throughout the United States Department of Veterans Affairs (VA) medical system, known as the Veterans Health Administration (VHA) has its roots in the late 1970's. It's a collection of about 100 integrated software modules. By 2003, the VHA was the largest single medical system in the United States, providing care to over 4 million veterans, employing 180,000 medical personnel and operating 163 hospitals, over 800 clinics, and 135 nursing homes. About a quarter of the nation's population is potentially eligible for VA benefits and services because they are veterans, family members, or survivors of veterans. By providing electronic health records capability, VistA is thereby one of the most widely used EHRs in the world. Nearly half of all US hospitals that have a full implementation of an EHR are VA hospitals using VistA.

VistA was developed using the M or MUMPS language/database. The VA currently runs a majority of VistA systems on the proprietary InterSystems Caché version of MUMPS, but an open source MUMPS database engine, called GT.M, for Linux and Unix computers has also been developed. Although initially came as separate releases, publicly available VistA distributions are now often bundled with the GT.M database as an integrated package. This has considerably eased installation. 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.

Features: VistA supports both ambulatory and inpatient care, and includes several significant enhancements. The most significant is a Graphical User Interface (GUI) for clinicians known as the **Computerized Patient Record System (CPRS)**, which was released

in 1997 (K. Meldrum *et al*, 1999). 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 which advances a patient centered approached to clinical computing rather a department centered approach. 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 installation was mandated nationally in 1999 and virtually all physicians and medical practitioners in VA usually now use it. 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.

Bar Code Medical Administration (BCMA): BCMA is a bedside application that validates the administration of medications. It was installed in VA in the time frame of 1999 – 2002 (Johnson C.L. *et al,* 2002). BCMA enables nursing to use a bedside computerized medication administration record (MAR). Patient identification wristbands and nursing staff identification cards are bar coded with unique identification numbers. Medications are packaged in plastic containers with bar-coded content identifiers and placed on the medication carts by the pharmacy service. To administer a medication, the nurse scans the patient's wristband, the packaged medication, and the employee ID card. The data are sent to an electronic MAR. Advantages include positive verification of patient identification and prescribed medication at the point of care, an immediate alerting capability to prevent the wrong medication from being administered, precise medication administration documentation noting on time, early and late dosing and automated missing dose requisition.

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.

Presently VistA is composed of 99 packages (Brown S *et al* 2003). Of these, there are 16 infrastructure applications, 28 administrative and financial applications and 55 clinical applications. VistA applications perform functions in common with other HIS such as laboratory, pharmacy, radiology, scheduling and ADT.

Core VistA Infrastructure: VistA applications are built on top of a common infrastructure. This approach serves several purposes (VistA Monograph, 2002). They are as follows:

- It integrates applications at the database level; common data are not shared, not replicated.
- It makes applications consistent from the perspective of both users and developers.
- It minimizes maintenance expenses. Core code is centrally updated and distributed for use by others.
- It provides a stable layer between applications and operating systems to help insulate applications from changes.

2.2 Research Questions:

The following are the research questions this dissertation study would be dealing with:

1) What do individuals (who are adequately tech savvy) feel about manual drug administration process?

2) Do individuals with previous IT experience find BCMA process better than Manual Drug Administration process?

3) Does more clinical experience leads to better accomplishment of the benefits realized from BCMA system?

4) What is the mindset of respondents with more clinical experience about the manual drug administration process with respect to BCMA process?

5) Is there any relationship between problem faced by the users and benefit realized of the BCMA system?

6) What are the major problems been faced by the nurses in the hospital after BCMA implementation?

2.3 Literature Review

1. Using BCMA Software to Improve Patient Safety in Veterans Administration Medical Centers

Johnson Connie L *et al;* 2002 Journal of Healthcare Information Management – Vol. 16, No.1

Background of the Study: Medication errors had been a major reason of Morbidity and Mortality in United States and Veterans were also a part of it. Authors in the above mentioned article had shared the success story of BCMA in Veterans Administration Medical Centers. Authors has explained the success of BCMA by providing the examples from one of the Veterans Medical Centers' "Eastern Kansas Health Care System" where the pilot project of BCMA was done and then it was implemented to all the Hospitals under the Veterans Administration.

How BCMA came into picture: To tackle the serious issue of Medication errors, Department of Veterans Affairs $50,000 in startup funds in 1992 to the Eastern Kansas Health Care System to check the feasibility of developing a bar-coding system for administering medications that would improve patient safety and care by reducing medical errors. Two major challenges came: writing specific software checks into the system & finding a vendor to develop light weight portable hardware. They use the radio frequency, utilized both UHF and spread spectrum technology to communicate with VistA (Mainframe computer system). In 1994, the hardware and software design process was completed. A 30 bedded gerontological psychiatry ward was chosen as a pilot study. Over next 12 months, after fine tuning the software and hardware in august 1995 it was utilized fully by the Hospital in all the 22 nursing units. Using the prototype the Eastern Kansas' prototype, Department of Veterans Affairs established a new project in August 1998 and called it "Bar Code Medication Administration (BCMA)".

Results: With the usage of BCMA prototype developed in Eastern Kansas Health Care System, there was an exceptional improvement in the reduction of Medication errors from 1993 to 2001.

- 75.47 percent improvement in errors caused by the wrong medication being administered to a patient
- 61.97 percent improvement in errors caused by the incorrect doses being administered
- 93.48 percent improvement in wrong patient errors
- 87.41 percent improvement in wrong time errors
- 70.34 percent improvement in errors caused when medications scheduled for administration were not given

Conclusion: The manual medication administration was does converted into electronic format, reducing the communication gap between physicians & nurses. For any successful implementation of any IT system, the pilot study of that system is must. Also whenever a system is implemented, there is a process changes which also happened in this case too. After the implementation of BCMA system, the involvement of the Pharmacy department became very important as they would now involve in verifying the drugs ordered by the physician to the patient. The use of wireless system instead of wired LAN (Local Area Network) with a portable device for nurses, the adoption of the system became far easier.

2. **The Impact of a Closed – Loop Electronic Prescribing and Administration System on Prescribing Errors, Administrating Errors and Staff Time: a Before- and – After Study.**

Franklin, O'Grady, Donyai, *et al;* Qual Saf Health Care 2007; 16:279-284. doi: 10.1136/qshc.2006.019497

Background of the Study: The study was conducted in a 28 bed general surgery ward of a London Teaching Hospital, with a mean patient stay of 7 days and 24 admissions per week, 70% of whom were elective. The objective behind the study was to assess the impact of a closed loop electronic prescribing, automated dispensing, barcode patient identification and electronic medication administration record (EMAR) system on prescribing and administration errors, confirmation of patient identity before administration, and staff time. A before and after study was conducted in which data was collected on all outcomes 3 – 6 months before and 6 – 12 months after the intervention. The intervention included closed

loop electronic prescribing, automated dispensing, barcode patient identification and EMAR system. The intervention went live on June 2003.

Results: Main outcomes to be measured were percentage of new medication orders with a prescribing error, percentage of doses with medication administration errors (MAEs) and percentage given without checking the patient's identity. Also the time spent prescribing, providing a ward pharmacy service & Nurses' time on medication tasks were measured. The prescribing errors got reduced from 3.8 % to 2.0 %. Also there was a reduction in medication administration errors (from 7 to 4.3 %) & patient identification unchecked after the intervention (from 82.6 % to 18.9 %). There was an increase in staff time for prescribing (from 15 s to 39 s); increase in pharmacy service (from 68 min to 98 min) and nursing time on medication tasks increased (from 21.1% to 28.7%) after the intervention.

Conclusion: A closed-loop electronic prescribing, dispensing and barcode patient identification system reduced prescribing errors and MAEs, and increased confirmation of patient identity before administration. Time spent on medication-related tasks increased. But with time and regular practice the time would also get reduced from the staff.

3. Effect of Bar- Code Technology on the Safety of Medication Administration

Poon Eric G. *et al*; N Engl J Med 2010; 362: 1698-707

Background of the study: The 735 bedded tertiary academic medical center having 35 adult medical, surgical & intensive care units were facing mainly with the transcription and administration errors before the hospital planned to roll out bar code verification technology within an Electronic Medication Administration Record (known as bar-code eMAR) in April 2005.

Methodology used: A before and after, quasi experimental study was conducted in the setup. The study period constituted of 9 months from February to October 2005 in which the authors assessed rates of errors in order transcription and medication administration on units before and after implementation of bar-code eMAR. The administration errors were defined into the following: errors in timings (involving administrations that were early or late by more than 1 hour) and errors unrelated to timing. They appointed two clinicians for

reviewing the errors to determine their potential to harm patients and classified those that could be harmful as potential adverse drugs events.

Results: Authors observed 14,041 medication administrations and reviewed 3082 order transcriptions. Observers (appointed clinicians) noted 776 non timing errors in medication administration on units that did not use the bar-code eMAR (an 11.5% error rate) versus 495 such errors on units that did use it (a 6.8% error rate) — a 41.4% relative reduction in errors. The rate of potential adverse drug events (other than those associated with timing errors) fell from 3.1% without the use of the bar-code eMAR to 1.6% with its use, representing a 50.8% relative reduction. The rate of timing errors in medication administration fell by 27.3%, but the rate of potential adverse drug events associated with timing errors did not change significantly. Transcription errors occurred at a rate of 6.1% on units that did not use the barcode eMAR but were completely eliminated (zero error) on units that did use it.

Conclusion: Use of the bar-code eMAR substantially reduced the rate of errors in order transcription and in medication administration as well as potential adverse drug events, although it did not eliminate such errors. Their data showed that the bar-code eMAR is an important intervention to improve medication safety.

4. <u>Nurses' Perception of a (BCMA) Bar-coded Medication Administration System</u>

(Gooder, V. (June 2011). Nurses' Perception of a (BCMA) Bar-coded Medication Administration System: A Case Control Study. Online Journal of Nursing Informatics (ONJI), 15, (2), Available at http://onji.org/issues/?p=703

Background behind the study: The study hospital was a 280 bedded acute care facility in the western United States of America. Prior of the implementation of the BCMA, medications were ordered on a paper based physician order sheet which was scheduled by the pharmacist on an electronic Medication Administration Record (e -MAR). Nurses were required to verify the scheduled medication against the paper based physician order at the beginning of each shift. After administration of the drugs the nurses were documenting it in the e MAR. Therefore to avoid the medication error, the hospital thought of documenting the medication prior to administration to patient which gets automatically entered in the electronic MAR and also helps the nurses by alerting them about any new drug ordered to the patient as a part of a pilot project for the implementation of BCMA system in the hospital.

This case control study analyzed the perceived effect of BCMA on nurses' ability to provide medications, perceptions of medication errors & nurses' gratification with the medication administration process. The author in this study hypothesized that an increasing level of frustration felt by the nurse may lead to a decrease in the level of satisfaction with the overall medication administration process.

Methodology used: The author has developed a questionnaire which constituted 8 questions. First 5 questions were to measure the perception of Nurses' of how easy the medication administration was. The questionnaire was distributed to one unit that was implementing BCMA system (experimental unit; in this case it was nurses' from the 28 bedded medical unit) and another unit that was not (control unit; which was 28 bedded cardio – vascular step down unit) one month before and five months prior the implementation of the BCMA system. The BCMA system implemented on the experimental unit was the AdminRX® system (McKesson Automation, Inc. Pittsburgh, PA). A handheld device was used with wireless technology and a bar-coding scanner in the device& microprocessor with a 2.3 x 2.3-inch screen; GUI (Graphical User Interface) along with a touch pen. The system was linked with the hospital systems computerized medication ordering and BCMA system. The handheld device displayed the electronic medication administration record which allowed for verification of new orders entered by the pharmacists, double signatures on certain medications, documentation of medication administration, and alerting. The nurses' were trained using train the trainer methodology.

Results: As the questionnaire to be filled up was voluntary from the nurses; the return rate of the questionnaires was as low as 42%. A total of 33 staff members retuned surveys on BCMA from the experimental unit & 26 staff members returned the surveys from the control unit. The completed surveys have various amount of missing data. The control group was significantly less satisfied with the overall medication administration process. The process of getting medications scheduled by pharmacy in the computerized system was less timely on the control unit than on the experimental unit. With the implementation of BCMA the experimental group had decreased in satisfaction with the medication administration in three areas which constituted of: Ability to determine which medication was due decrease with use of BCMA; Difficulty to see what medications the patient had already; Overall dissatisfaction with the medication administration process using BCMA.

Conclusion: The above study demonstrates that implementation of BCMA systems may have negative impact on nurses' attitude towards the medication administration process & may make the work processes more difficult. As it was a pilot implementation there were very few participants for this study and with low return rate of questionnaire, the result was overall negative for BCMA system. Though BCMA has many benefits for the Hospital as well as it increases the patient safety but the study demonstrated that it may have a negative impact on the nurses' attitude & perception towards the electronic system. The author has significantly focused on the inclusion of the electronic system to be designed as per the process of the hospital & keeping in mind the end user's attitude towards to reduce the resistance against the system itself.

5. <u>**Medication Errors Occurring with the Use of Bar – Code Administration Technology**</u>

   Reprinted Article – Pennsylvania Patient Safety Authority Vol. 5, No.4 – December 2008

The article mainly focuses on the Failure Modes in the BCMA process that mainly leads to the frustration of the nurses' and also sometimes reduces the overall goal of BCMA i.e. to reduce the medication errors to the patient to a greater extent. This article has been written by reviewing the available literatures and reports from the different healthcare facilities in US. Pennsylvania Patient Safety Authority (an independent state agency) with ECRI Institute and ISMP (Institute of Safe Medical Practices) has come up with four major issues that BCMA faces which can be categorized as:

a) **Dispensing Node**: Some errors associated with BCMA do not originate with the technology, rather they occur earlier in the medication use process i.e. the dispensing phase. This gets continued during Bar Code verification at the administration phase. A review of medication errors associated with barcode technology submitted to the USP MEDMARX program between June and August 2006 showed that the most frequent cause of BCMA-related errors was mislabeling. Sixty-five of the 128 (51%) reported labeling errors resulted from attaching a bar code associated with one product to a different product. Another 29 (22.7%) of the reports of mislabeling indicated that the bar code was affixed to the wrong strength of the correct medication. Fully implementing a BCMA system, therefore, may involve repackaging many medications and relabeling each dose with a bar code. This may include the purchasing of automated repackaging

equipment, increasing pharmacy staff, providing adequate space within the pharmacy to prepare these medications, and implementing a verification process to ensure that the bar code is correct and readable by the same scanners and database used by the nurses on the patient care units.

b) **Administering Node**: Alerts that are generated by BCMA systems often may not be noticeable. For example, a system may generate a visual display of the alert but not provide a distinct auditory alert. If a nurse does not look at the screen for any alerts after scanning a patient's wrist band and/or bar-coded medications, errors will ensue. Additionally, the alerts are not hard-stops, meaning that the system does not physically stop a practitioner from proceeding with scanning or administering a Medication. The alert is merely a warning that may or may not require a simple key stroke (e.g., hitting the "Enter" key on a keyboard) to override.

c) **Failure to scan medications:** The effectiveness of bar coding technology in safeguarding patients is limited by the extent to which it is correctly and consistently used at the bedside by each clinician administering medications. In a study of the 85 facilities under the Hospital Corporation of America facilities using BCMA in June 2004, only 64% of patient armbands were scanned and only 86% of medication labels were scanned (Englebright JD, Franklin M. Managing a new medication administration process. J NursAdm 2005Sep; 35(9):410-3.). In one of the reviews the article has mentioned about a Dutch Hospital where the 5 most frequently cited reasons for not verifying barcodes were: Difficulty in Scanning Barcode on the medication labels, lack of awareness, delay in responses from computer system, shortage of time & administration of medication before time.

d) **Workarounds and Overrides:** A workaround is a method of accomplishing an activity when the usual system/ process are not working as desired. While a workaround provides an impermanent resolution to the immediate problem, it also signals that the system may need some improvement. But to save time and to avoid unnecessary checks from the system, nurses may work around the safety features of the BCMA System. One of the

examples of a workaround includes a failure to scan every tablet or capsule included in a patient's dose which is a serious risk behavior.

Conclusion: The article concluded that new technologies would not be a panacea for medication errors, but it can provide safeguards not possible with fully manual processes. The article suggested some of the steps for maximizing BCMA's impact on medication safety which include FGDs and Surveys of Nurses' for their feedback; Establish a multidisciplinary team consisting of IT, Nurses, Pharmacist & Physicians; Analyze BCMA's log constantly etc.

6. **Improving Patient Safety by Identifying Side Effects from Introducing Bar Coding in Medication Administration**

Research Paper; Patterson Emily S, *et al* **J Am Med Inform Assoc.** 2002; 9:540-553. DOI 10.1197/ jamia.M1061.

Background of the Study: Medication Administration was observed on acute care and nursing home wards of 3 VA hospitals selected on the basis of BCMA implementation schedules and willingness to participate. The hospitals varied in size from small to moderate and all the three hospitals the same CPRS (Computerized Patient Record System) had been using for at least for 1 year before the introduction of BCMA. All the three hospitals were using the BCMA as mandatory in three shifts for more than 1 month. The prior objective of the research paper was to identify proactively negative side effects prior to the occurrence of adverse events. The study was not designed to evaluate the effectiveness of BCMA in reducing the frequency of predefined failure modes.

Methodology Used: A cross sectional observational study of medication before and after the implementation of BCMA system was done. One observer (EP), trained in ethnographic field observations in complex settings conducted all the observations for both before & after implementation of BCMA system. The observation was the whole day observation at all the shifts for the nurses. Before the BCMA execution, seven nurses were observed for a total of 21 hours on 7 nurses during 10 medication passes at one hospital. Succeeding BCMA implementation, 26 nurses were observed for a total of 60 hours during 23 medication passes at the three hospitals. In addition, the observer also looked out Computerized Order Entry (2

Physicians, 2 Hours) and order verification by inpatient pharmacists (5 pharmacists, 2 pharmacy technicians, 10 hours) at hospital 1. 20 complementary interviews were carried out with practitioners, computer support personnel and nurse managers from the three hospitals. During the observations, the authors recorded time – stamped, detailed, handwritten field notes of verbal and physical behavior, targeted at the identification of negative, unforeseen side effects, as well as information captured in the electronic patient record. The observations were guided by five conceptual frameworks from the human factors literature base which are: Recognition- primed decision making (RPD); Human- automation interaction; Workload; Authority- responsibility doublebinds & Mutual Awareness.

Results: Ethnographic observations were condensed into 67 nurses – BCMA interactions and classified into 12 categories. Authors identified five negative effects after BCMA implementation: Nurses confused by automated removal of medications by BCMA; It has degraded coordination between nurses and physicians; Nurses were dropping activities to reduce workload during busy periods; There was an increase in priority of doing those activities which could be monitored and there was a decrease in ability to deviate from routine sequences.

Conclusion: The study illustrates a well targeted observational study before and after naturally occurring points of change can be used to better understand processes of transformation, workflow and adaptation. Whenever there is a change and especially the technology change initially disturbs the system. Side effects following the introduction of BCMA were observed that might create new paths to Adverse Drug Events (ADEs). These "best practices" training that might be implemented before the occurrence of adverse events. The authors studied the side effects at the very early stage and also concentrated only on few nurses. More generalized results including the ICUs of the hospital would have been totally different.

CHAPTER 3

RESEARCH

METHODOLOGY

Research Methodology

The study was conducted at ABC Multispecialty Hospital situated in New Delhi.

3.1 Research Design: The dissertation study involves analysis of both primary and secondary data. It is a mixture of both Quantitative and Qualitative data which is a cross sectional study & prospective in nature.

Cross - Sectional Study: Also known as one – shot or status studies are the most commonly used designs in the social sciences. The design is best suited to studies aimed at finding out the prevalence of a phenomenon, situation, problem, attitude or issue, by taking a cross section of the population. They are useful in obtaining an 'overall' picture as it stands at the time of the study.

Prospective: It refers to the likely prevalence of a phenomenon, situation, problem, attitude or outcome in the future. Such studies attempt to establish the outcome of an event or what is likely to happen.

Pre – Requisite of the study: For this study all the features of BCMA and its integration with other modules in VistA was studied properly. Study of the workflow and process of medication administration (before and after the implementation) for the patient was done.

Definition of the Respondent: The respondent for the above study should be a regular staff of the hospital using BCMA application for medication administration. Therefore the nurses from Non – BCMA (like Emergency, Labor) area were not considered for this study.

3.2 Type of Data: The data were collected by the following methods:

1) Primary Data Collection: There are times when the information must be collected and this approach is known as primary data collection. The primary data collected were both quantitative and qualitative in nature. Tools which were used for primary data collection were:
   a) Questionnaire: Please see Annexure; constituted both open and closed ended questions.

b) Interview conducted with Chief Nursing Officer and Clinical Pharmacologist. Please see annexure. Interview was structured one.

c) Observation: Non Participant Observation.

2) Secondary Data Collection: Secondary data is the data that has been already collected by someone else for a different purpose. Here we have to extract the required data from the available resources. The tools used for secondary data were:

a) Literature available about BCMA

b) BCMA user manual (Confidential from the client side)

c) SOP for BCMA and QRGs for the end user.

d) Books, websites etc.

3.3 Sample:

Sample Size: 100 Nurses

Sampling Technique used: Simple Random Sampling

Data was collected from the nurses via filled questionnaire. Out of 125 questionnaires, 100 questionnaires were completely filled and were therefore taken into consideration. The working of doctors, nurses & pharmacists for medication administration were observed for a period of one week.

Other Tools used for the study:

SPSS v 16.0; Microsoft Office Excel 2007; Microsoft Office Visio 2007; Microsoft Project 2007

3.4 Limitations to the Study:

1) Pre Implementation data is not available. Therefore comparative analysis is difficult.

2) The questionnaire to be filled up consists of different sections. Therefore the study may not cover up all the aspects as expected/desired from the objectives.
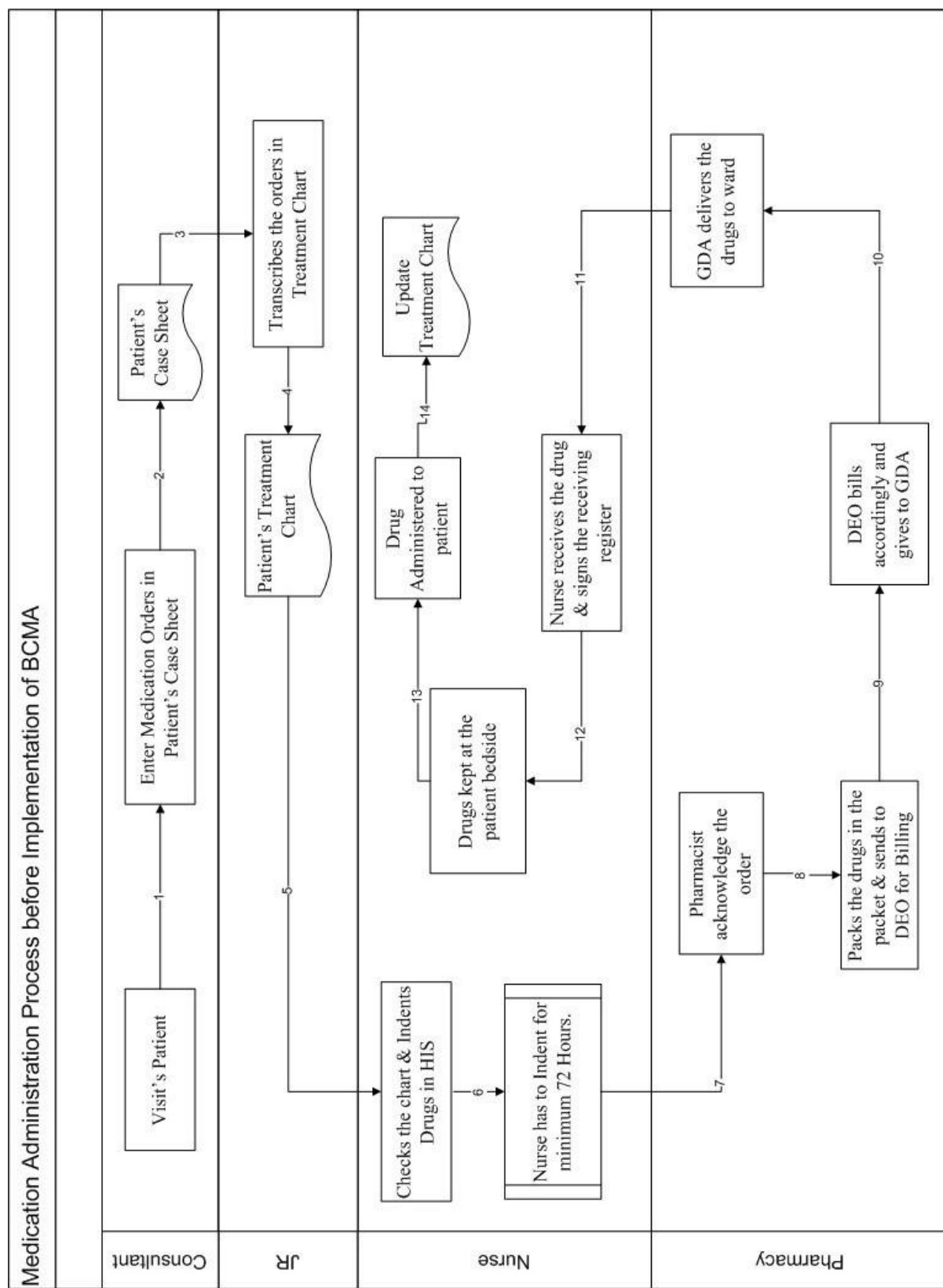
Fig #2: Medication Administration Process before the implementation of BCMA system
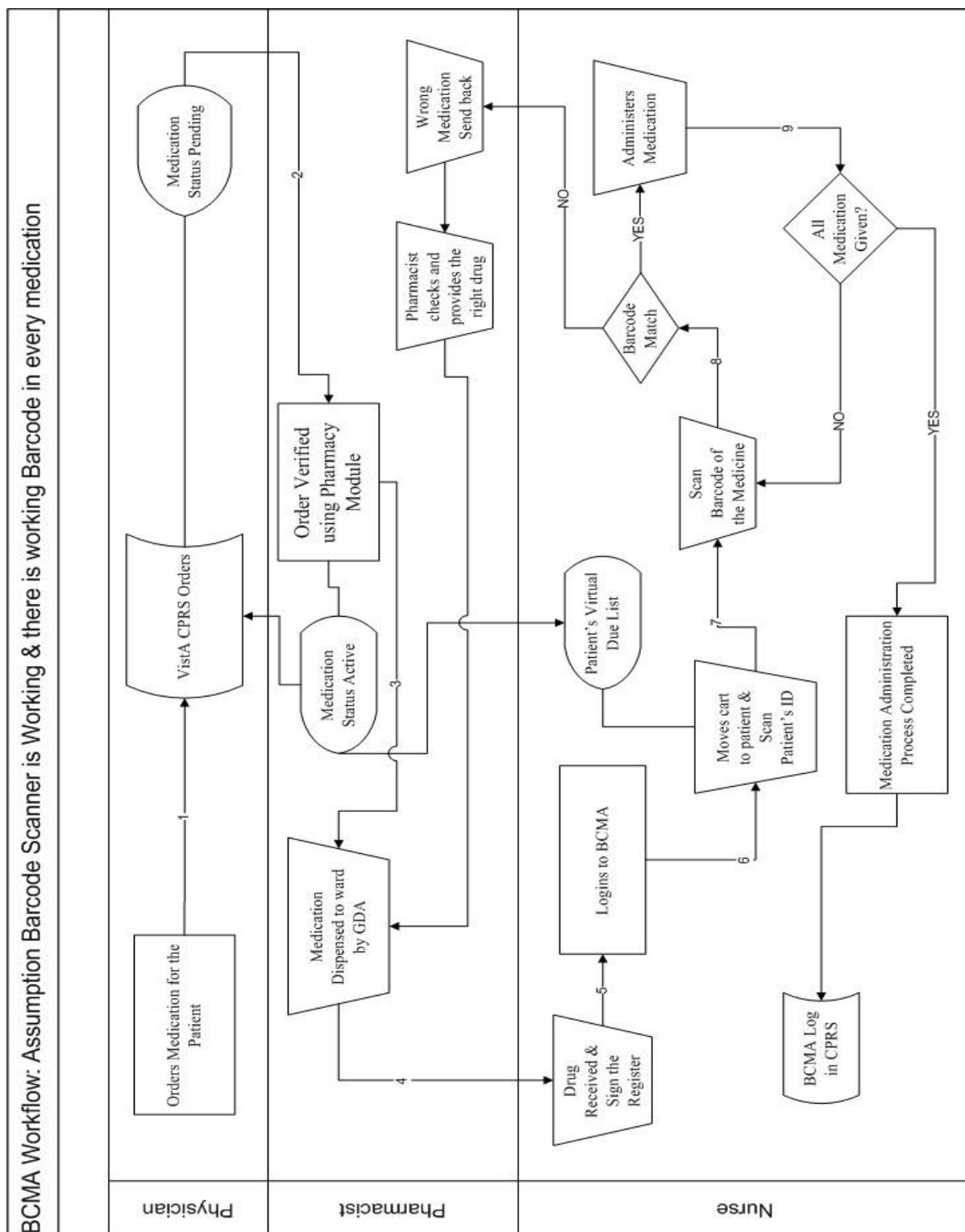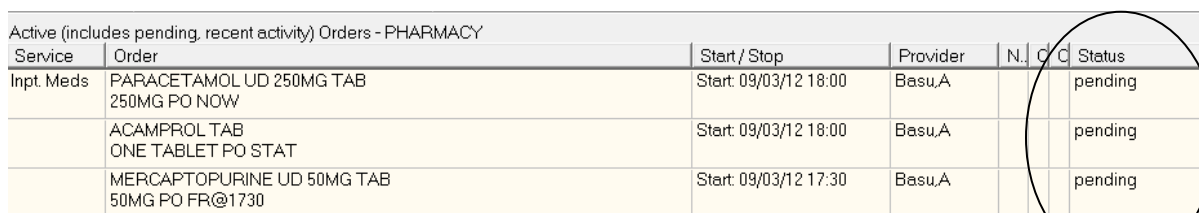
Fig #3: Medication Administration process after the implementation of BCMA System

3.5 Workflow of Medication Administration to patient in systems' perspective

Medication administration to the patient sometimes becomes one of the key performance indicators for Hospital as well as Nurses' Day to Day routine. Medication errors as discussed earlier majorly happen during the administration stage of the drug to the patient. The following processes would provide an insight of how the medication administration process is been completed in the system itself.

Ordering of the Drug:

This process is been done by the doctors because they only have the rights to give medication orders in VistA CPRS (Computerized Patient Record System) module. VistA CPRS comprises of CPOE (Computerized Physician Order Entry) which helps in placing the drug orders for a specific patient. As an electronic ordering system, VistA CPRS also provides with the CDSS (Clinical Decision Support System) for ADRs (Adverse Drug Reactions); Duplicate Orders etc which guides the doctor to place correct order for the patient. It is to be noted here that VistA CPRS works on Generic Drugs, therefore the necessity of knowing the proper generic of the drug is must for the Physician. Multiple generic drugs have been configured as Brand Names in the system itself. The following image shows drug orders been placed by the doctor for a specific patient.

Service	Order	Start / Stop	Provider	N.	C	C	Status
Inpt. Meds	PARACETAMOL UD 250MG TAB 250MG PO NOW	Start: 09/03/12 18:00	Basu,A				pending
	ACAMPROL TAB ONE TABLET PO STAT	Start: 09/03/12 18:00	Basu,A				pending
	MERCAPTOPURINE UD 50MG TAB 50MG PO FR@1730	Start: 09/03/12 17:30	Basu,A				pending

Active (includes pending, recent activity) Orders - PHARMACY

Fig #4: CPRS Ordering Screen

Here the status shown here is pending (encircled) which denotes that the prescribed drug has to verified by the pharmacist using the Pharmacy module in VistA. When the drugs are been verified by Pharmacist, the status of the order changes to active. It may be noted here that an active drug gets automatically expired after 14 days of ordering. In the following figures it would be shown the changes done in the pharmacy module after the verification of the drugs.

Verification of Drug using the Pharmacy Module in VistA

Pharmacy module in VistA is been used by the pharmacist to verify the drugs for a given particular patient. Using the Pharmacy module the pharmacist can also change the order, edit the order or even provide some instructions to the nursing staff etc. The 3 major steps used in verification of the drugs in Pharmacy Module are: FN (Finish seeing the details of the drug); AC (Accept the order as given by the physician) & VF (Verify the drug again before printing out the label). Following are the figures showing screens at the time of order seen in pharmacy module & after verifying the orders by the pharmacist.

```
- - - - - - - - - - - - - - - - -  P E N D I N G  - - - - - - - - - - - - - - - - -
   1    ACAMPROL TAB                           ?   *****   *****   P
           Give: 1 TABLET PO STAT
   2    MERCAPTOPURINE UD 50MG TAB             ?   *****   *****   P
           Give: 50MG PO FR@1730
   3    PARACETAMOL UD 250MG TAB               ?   *****   *****   P
           Give: 250MG PO NOW




            Enter ?? for more actions
PU   Patient Record Update              NO   New Order Entry
Select Action: Quit// So    Select Order

Select ORDERS (1-3): █
```

Fig #5: Pharmacy Module Verification Screen. Statuses of the drugs are pending.

```
- - - - - - - - - - - - - - - - A C T I V E - - - - - - - - - - - - - - - - - - -
   1    MERCAPTOPURINE UD 50MG TAB             C   09/03   23/03   A
           Give: 50MG PO FR@1730
   2    ACAMPROL TAB                           O   09/03   23/03   A
           Give: 1 TABLET PO STAT
   3    PARACETAMOL UD 250MG TAB               O   09/03   23/03   A
           Give: 250MG PO NOW




            Enter ?? for more actions
PI   Patient Information              SO   Select Order
PU   Patient Record Update           NO   New Order Entry
Select Action: Quit// █
```

Fig #6: Pharmacy Module After verification. Statuses of the drugs are active.

Whenever the drugs gets verified in the pharmacy module, there is a real time information flow in the CPRS and BCMA where the status of the drugs gets changed into active from pending.

Fig #7: CPRS screen after the verification of drugs in pharmacy module of VistA

BCMA: Administration of the drugs to the patient.

For BCMA to show the current list of medication for a particular patient the pre-requisite is that the Order has to be in the active stage i.e. Physician has placed the order in CPRS and Pharmacist has verified the order and has dispatched it to the nursing station. Anything missed or delayed, BCMA won't be showing the medication list in the Patients' Virtual Due List. Virtual Due List is the screen in the BCMA Module where it shows the entire medication list to be administered for patient at that point of time. Whenever a nurse login to BCMA and scans the patient's wristband (where the Barcode is there) the following screen gets open (Virtual Due List).
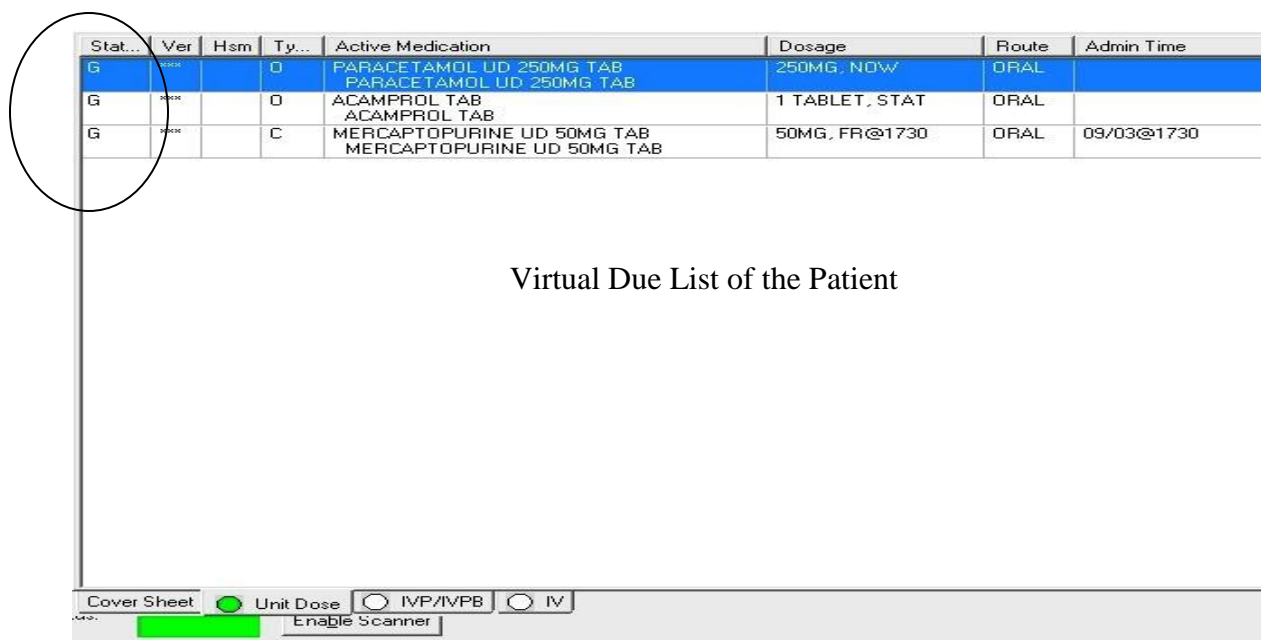

Fig #8: BCMA Screen; Virtual Due List of the patient at that point of time.

Now the nurse scans the barcode of the medicine provided to him/her from pharmacy. The barcode scanner reads barcode and if the medication is correct, then the status gets changed into **given.** If the medicine is incorrect then there is a prompt of invalid medication & system doesn't allow the nurse to administer the drug to patient.

Fig #9: BCMA Screen; after correct administration of the drug. Status changes to given.

The administration details for the drugs now can be seen in CPRS by double clicking on the drug to know the administration history. Also the administration history of the drugs can be seen in the Medication Administration History and Medication Administration Log in reports tab of CPRS.
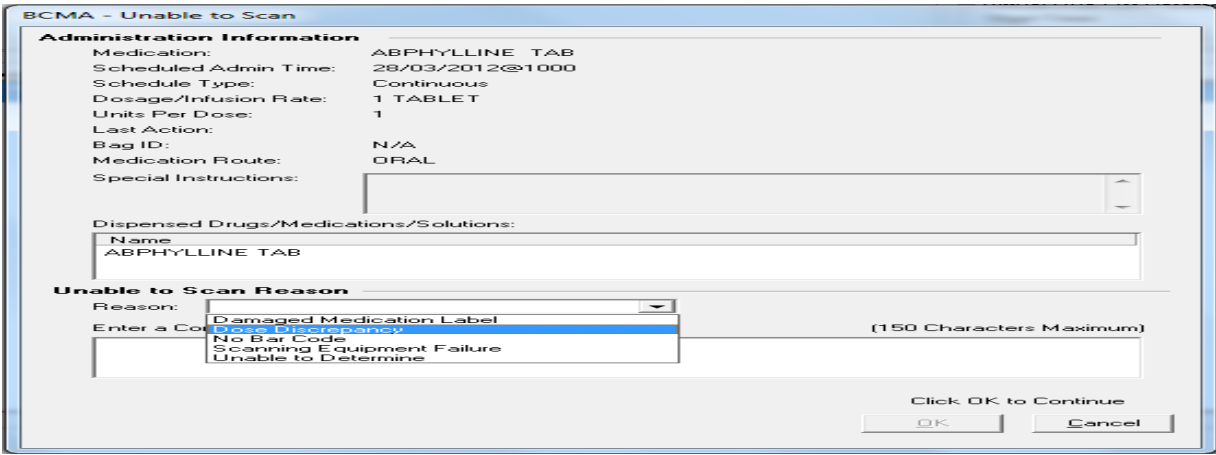
BCMA is not an independent system which can be clearly demonstrated in the above workflow. Interdependency of this system with other system signifies that not only system but also the process if not followed properly, BCMA won't be a successful system for reducing the medication error at the administration phase.

3.6 Workaround been followed when one of the component is not working

When technology makes a health care process slower or less efficient, or when it requires steps that are impossible or seem unnecessary, clinicians create workarounds. Workarounds are described as "informal temporary practices for handling exceptions to normal workflow" or alternatively, as processes that are different from the anticipated, intended sequence of steps to achieve a specific goal. Work-arounds are beneficial in that a goal is achieved even when the anticipated process for achieving that goal cannot be completed. In health care, this may mean that a patient receives a needed medication or that an order is received and completed. Work-arounds are at times necessary to ensure that care is given. Here, for BCMA system used in the hospital workarounds has been created so that the care to the patient is not hampered when necessary. The workaround has been designed for the following reasons:

1) Barcode scanner is not working properly.
2) Barcode in the medication is tampered
3) Barcode is not present in the medication (but the medication details are there in the package and the nurse is confident that it is the same drug which has to be given)

The workaround which is present in the BCMA system can be illustrated by the following examples. Let us assume that the barcode is working properly and the nurse has reached the Virtual Due List of the Patient. Now the barcode in the drug is tampered and therefore the Barcode is not readable. At this moment nurse uses the workaround to administer medication to the patient. Nurse selects the medication, right click on the selected medication and click unable to scan and the following window pop ups. Nurse clicks on the specific reason and provide comments which are optional and then click ok. Let say the reason selected is unable to determine.
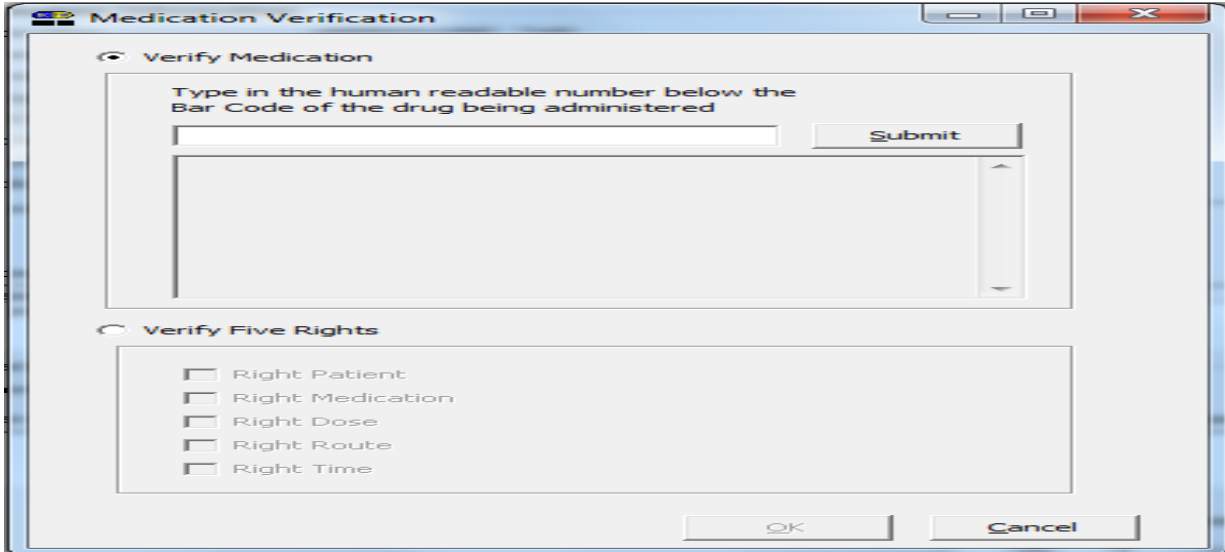
Fig #10: Unable to scan window

This allows the user to give medication to the patient manually where there is a least requirement of the barcode scanner. The barcode of the medicine consists of 2 codes where one represents the HIS code of medication for billing purpose and the 2nd code represents the code of the medication used for BCMA. Next screen asks for a 5 digit number to be entered by the user which represents the code of the medication.

Fig #11: Workaround screen in BCMA for administration

If for example the number is also not readable then manually the user has to verify the 5 rights for medication administration which is Right Patient; Right Medication; Right Dose; Right Route & Right Time. However, workarounds have negative impacts, as well. The more the usage of workarounds would decrease the overall benefit of the system i.e. reduction in medication error as workaround increases the manual processes.

CHAPTER 4

RESULTS

4.1 Hospital Profile

Total Number of Beds	**302**
Total Number of Nurses (as on 2nd March'12)	**Over 600**
Total Number of pharmacists (IP)	**15 (working in shifts)**
Average prescription in a day	**5000**
Nurse to Patient Ratio	**ICU = 1:1 Wards = 1:4**
IT infrastructure No. of COWs	**ICU = 1:1 Wards = 8 per floor**
Network connectivity	**LAN + WLAN**
Sample Size	**100**

Table #2: Short profile of the Hospital

ABC Multispecialty Hospital is a 302 bedded hospital situated in the outskirts of Delhi. The hospital was previously having an in – house developed Hospital Information System (HIS) working. Hospital used open source VistA EHR having CPRS, BCMA, Pharmacy, Laboratory etc. as the prime modules to be utilized for the real time access of the patient medical record. For smooth functioning of the hospital, there is a need to integrate these two different systems, by means of an integration engine. The open source Integration engine "Mirth" is used to send the messages between these two applications. Also, an HIS wrapper needs to be created to convert data from HIS into an HL7 message and vice versa. Hospital came up with this integrated EHR system in mid of year 2011 and working with ease from the beginning. Both the applications are been fully utilized by every department for fulfilling the clinical data requirement.

4.2 Respondents' profile

Q2: Gender Distribution of Nurses; N=100 (in %)
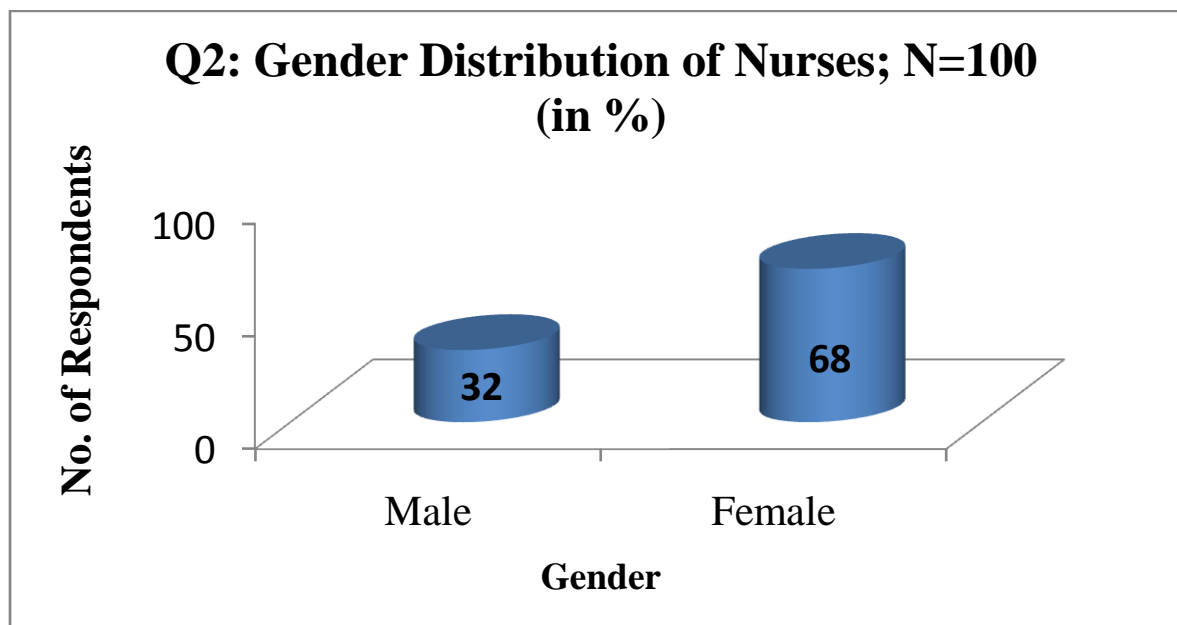
Fig #12: Graph showing Gender Distribution of the respondents

Q8: Initial Training of BCMA

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Prior EHR Implementation	60	60.0	60.0	60.0
	New Employee Orientation	26	26.0	26.0	86.0
	Unit Orientation	14	14.0	14.0	100.0
	Total	100	100.0	100.0	

Table #3: Table showing the Initial training received by the nurses.

Training for any new system plays a pivotal role in acceptance of the system by end users. 60 percent of the respondents have received training before the system became live in the hospital. Users were trained using the traditional "Trained the Trainer" method where super users are first recognized from the organization, they are trained thoroughly about the system and every end user is been trained by them which consists of both class room and practical sessions for practice.

Q3: Location of Nurses; N =100 (in %)

■ No. of Respondents

ICU: 37

General Wards: 63
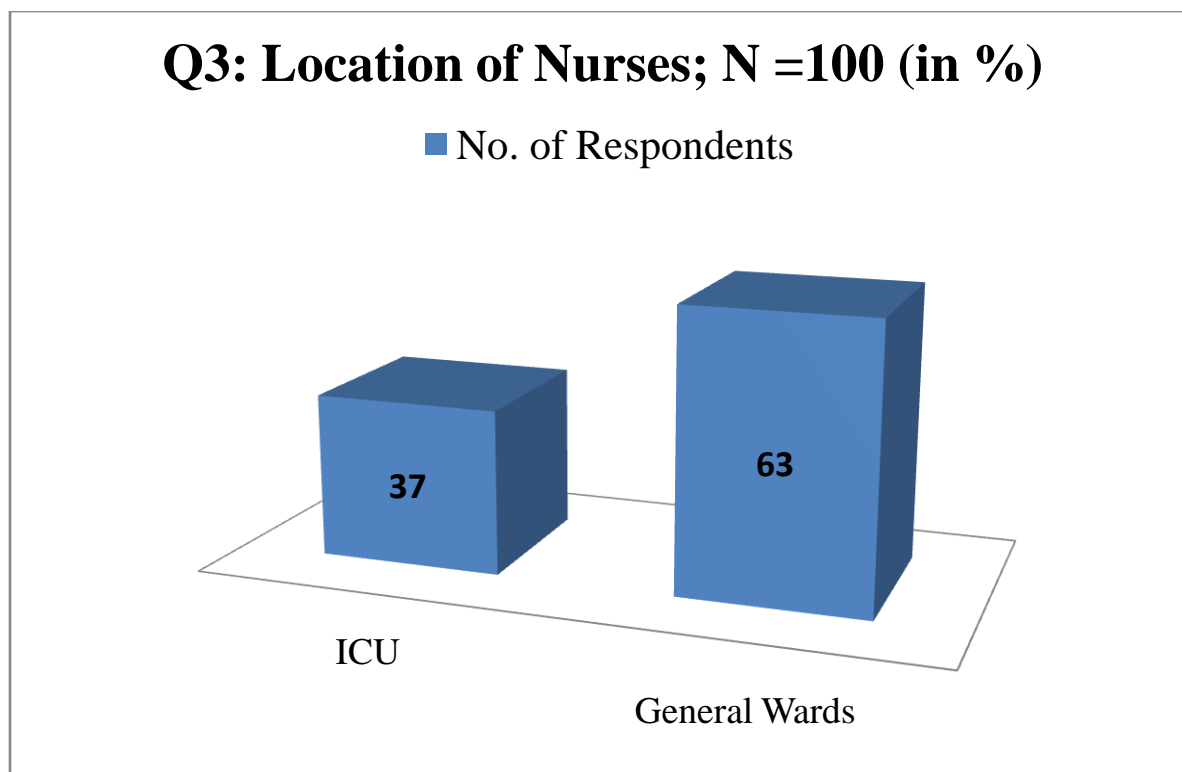
Fig #13: Graph showing Present working location of the nurses

As far as BCMA usage is concerned, BCMA can only be used in situation where we have to administer the medication first and then physically administer the drug to patient. Hospital has been divided into BCMA & Non BCMA areas where all the ICUs & General Wards comes under BCMA areas. Non BCMA areas include: Operation Theatre (OT); Emergency; Labour Room; Endoscopy; CATH Lab; CATH OBS; CATH REC etc. For their documentation they have a Medication Administration Record template in CPRS under the note title "Medication Administration Record for Non BCMA". During emergency situations like "Code Blue" etc. when the crash cart is open, then also the documentation of emergency drugs takes in CPRS.

Q5: Clinical Experience; N=100 (in %)

8

28

64

- < 1 year
- 1 - 5 years
- > 5 years
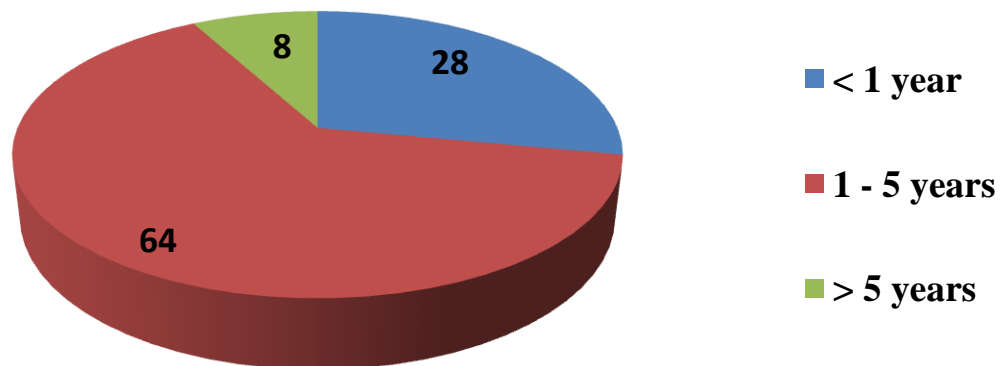
Fig #14: Pie chart showing clinical experience of the nurses

Q6: Previous IT Experience; N=100 (in%)

No. of Respondents

80
60
40
20
0

36   64

Yes   No
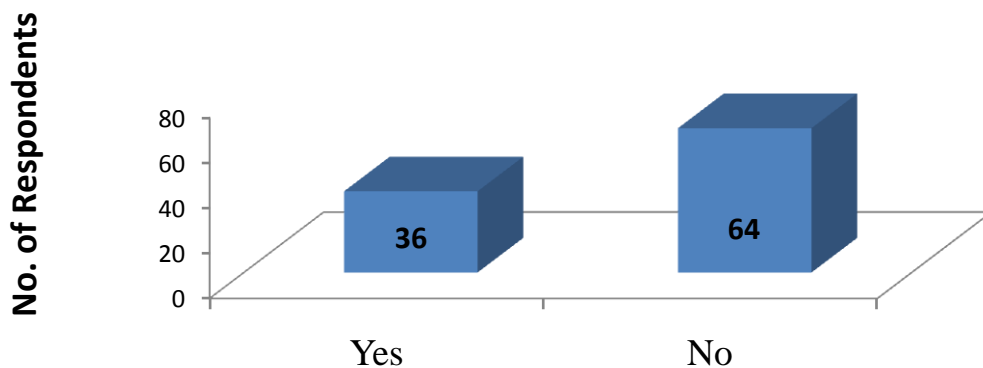
Fig #15: Graph showing previous IT experience

IT experience of the clinical staff plays a very vital role for the IT system success in the hospital. Respondents were asked about their previous IT experience prior joining this organization and 36 respondents said yes. Nurses were having IT experiences ranging from 2 months to a maximum of 36 months (3 years). More the clinical experience, more they would know the benefits of any system which is there to support their work not to replace them as an individual.

Q7: IT Knowledge; N=100 (in %)
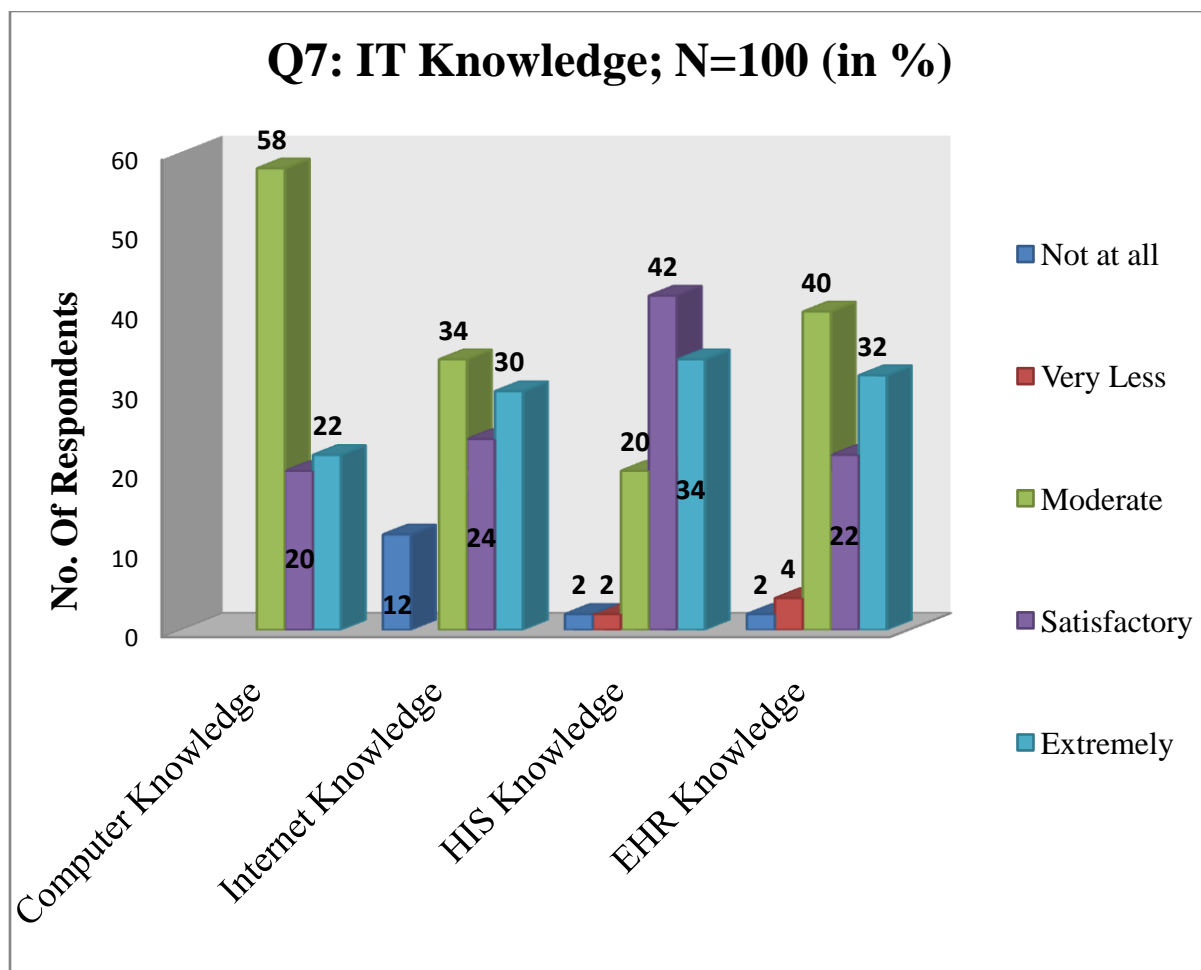
Fig # 16: Graph showing the knowledge of the respondent for various IT application

As described earlier, IT experience plays a pivotal role for a success of IT systems in an organization. As far as India is concerned there are very few healthcare providers who are dealing with the so called Healthcare IT in their organization. Therefore, not only experience but some general IT knowledge would help in better adaption of the system by the end users. When asked about their IT knowledge almost all have a descent knowledge about Computers in General (all have adequate knowledge); Internet usage (around 88%); HIS Usage (96% adequate) and EHR Usage (94 % adequate). Respondents who think they have moderate & above knowledge (tech savvy) have been considered to be having adequate knowledge.

Q11: Manual Drug Administration was better; N=100
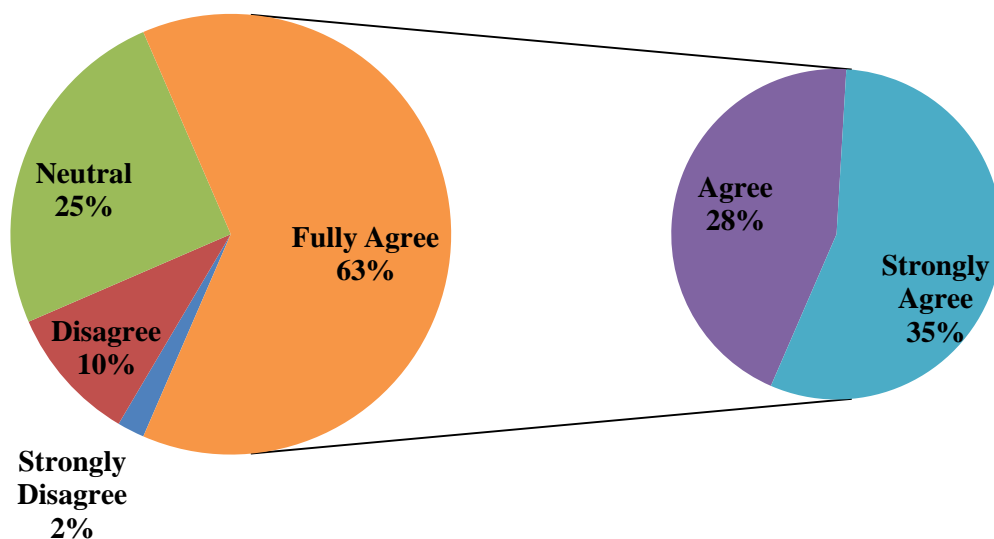
Fig # 17: Graph representing attitude of the respondents towards manual drug administration process.

Since the hospital was having all the clinical documentation done manually, role of clinical transformation becomes very crucial for any EHR system to survive. Veterans Affairs when introduced BCMA in the year 1998, there was a mix responses from the nursing staff as they were totally documenting clinical details for the patient in Patient Medication Administration Record (MAR) chart (Johnson Connie L *et al;* 2002). More than a decade old hospital maintaining all the clinical documents on paper, suddenly in a time span of 8 months won't be expecting all the end users to think that new system is better than the older manual system. The above graph represents the true picture of why the role of change management plays an important role for any EHR to be a success. More than 60 percent of the respondents still believe that manual drug administration process (Check fig 2) was better than the present BCMA process for administering drug.

Average rating to the Overall EHR System: 6.14 out of 10. (Question Number 12)

4.3 Research Hypothesis:

RQ1: What do individuals (who are adequately tech savvy) feel about manual drug administration process?

H1: Individuals who are adequately (moderate & above) tech savvy feel manual drug administration process is inadequate.

H0: Individual who are adequately (moderate & above) tech savvy don't feel that manual drug administration process is inadequate.

Manual drug administration process was better

Tech Savvy	N	Mean	Std. Deviation	Std. Error
Moderate	58	4.00	.838	.110
Satisfactory	20	3.45	1.395	.312
Extremely	22	3.77	1.270	.271
Total	100	3.84	1.080	.108

ANOVA

Manual drug administration process was better

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4.626	2	2.313	2.025	.138
Within Groups	110.814	97	1.142		
Total	115.440	99			

Table #4: Table showing results for Research question number 1.

RQ2: Do individuals with previous IT experience find BCMA process better than Manual Drug Administration process?

H1: Individuals with any kind of IT experience prior joining this organization doesn't find manual drug administration process better than BCMA System.

H0: Individuals with any kind of IT experience prior joining this organization find manual drug administration process better than BCMA System.

Group Statistics

	Previous IT system	N	Mean	Std. Deviation	Std. Error Mean
Manual drug administration process was better	yes	36	3.67	1.219	.203
	no	64	3.94	.990	.124

		t-test for Equality of Means				
		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Manual drug administration process was better	Equal variances assumed	-1.207	98	.230	-.271	.224
	Equal variances not assumed	-1.139	61.120	.259	-.271	.238

Table #5: Table showing results for Research Question number 2.

RQ3: Does more clinical experience leads to better accomplishment of the benefits realized from BCMA system?

H1: Nurses with more clinical experience has accomplished the benefits of the BCMA system

H0: Nurses with more clinical experience hasn't accomplished till date the benefits of the BCMA System

Total_Benefits Clinical Experience	N	Mean	Std. Deviation	Std. Error
<1 year	28	23.6429	4.89304	.92470
1 - 5 years	64	23.4375	4.63210	.57901
> 5 years	8	29.7500	3.49489	1.23563
Total	100	24.0000	4.89485	.48949

ANOVA

Total_Benefits	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	288.321	2	144.161	6.711	.002
Within Groups	2083.679	97	21.481		
Total	2372.000	99			

Table #6: Table showing results for Research Question number 3.

RQ4: What is the mindset of respondents with more clinical experience about the manual drug administration process with respect to BCMA process?

H1: Individual with more clinical experience doesn't think Manual Drug Administration Process is better than BCMA System.

H0: Individual with more clinical experience still thinks that the Manual Drug Administration Process is better than BCMA System.

Manual drug administration process was better

Clinical Experience	N	Mean	Std. Deviation	Std. Error
<1 year	28	3.79	1.197	.226
1 - 5 years	64	3.94	1.067	.133
> 5 years	8	3.25	.463	.164
Total	100	3.84	1.080	.108

ANOVA

Manual drug administration process was better

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3.476	2	1.738	1.506	.227
Within Groups	111.964	97	1.154		
Total	115.440	99			

Table #7: Table showing result for Research question number 4.

RQ5: Is there any relationship between problem faced by the users and benefit realized of the BCMA system?

H1: There is a significant relationship between problems faced & Benefits Realized of the BCMA System by Nurses.

H0: There is no significant relationship between problems faced & Benefits Realized of the BCMA System by Nurses.

Correlations

		Total_Benefits	Total_problem
Total_Benefits	Pearson Correlation	1	-.240[*]
	Sig. (2-tailed)		.016
	N	100	100
Total_problem	Pearson Correlation	-.240[*]	1
	Sig. (2-tailed)	.016	
	N	100	100

*. Correlation is significant at the 0.05 level (2-tailed).

Table #8: Table showing results for research question number 5

RQ6: What are the major problems been faced by the nurses in the hospital after BCMA implementation?

Problem Faced	Pearson Correlation Coefficient	Level of Significance (2- tailed)
1. System Related Problems	**0.030**	**0.769**
a. Software doesn't work properly	0.169	0.092
b. Automatic discontinuation of Drugs	-0.123	0.222
2. Process Related Problems	**-0.388**	**0.000**
a. *Inadequate no. of COWs Used in Wards*	-0.444	0.000
b. Takes longer time for medication administration	-0.161	0.110
3. Physician Related Problems	**-0.055**	**0.587**
a. Timely Medication Order not done by Physician	-0.195	0.052
b. Inappropriate Medication Order	0.122	0.226
4. *Pharmacy Related Problems*	**-0.265**	**0.008**
a. *Dispense drugs incorrectly*	-0.415	0.000
b. Pharmacy sends drugs very late	0.003	0.972
5. Barcode Related Problems	**0.015**	**0.880**
a. *Scanner doesn't work properly*	-0.294	0.003
b. Barcode strip is tampered	0.092	0.361
c. Barcode wrongly printed	0.116	0.250
d. Medication is not barcoded	0.227	0.023

Table #9: Table showing results for research question number 6

Software related problems N = 100 (in %)

■ Strongly Disagree ■ Disagree ■ Neutral ■ Agree ■ Strongly Agree
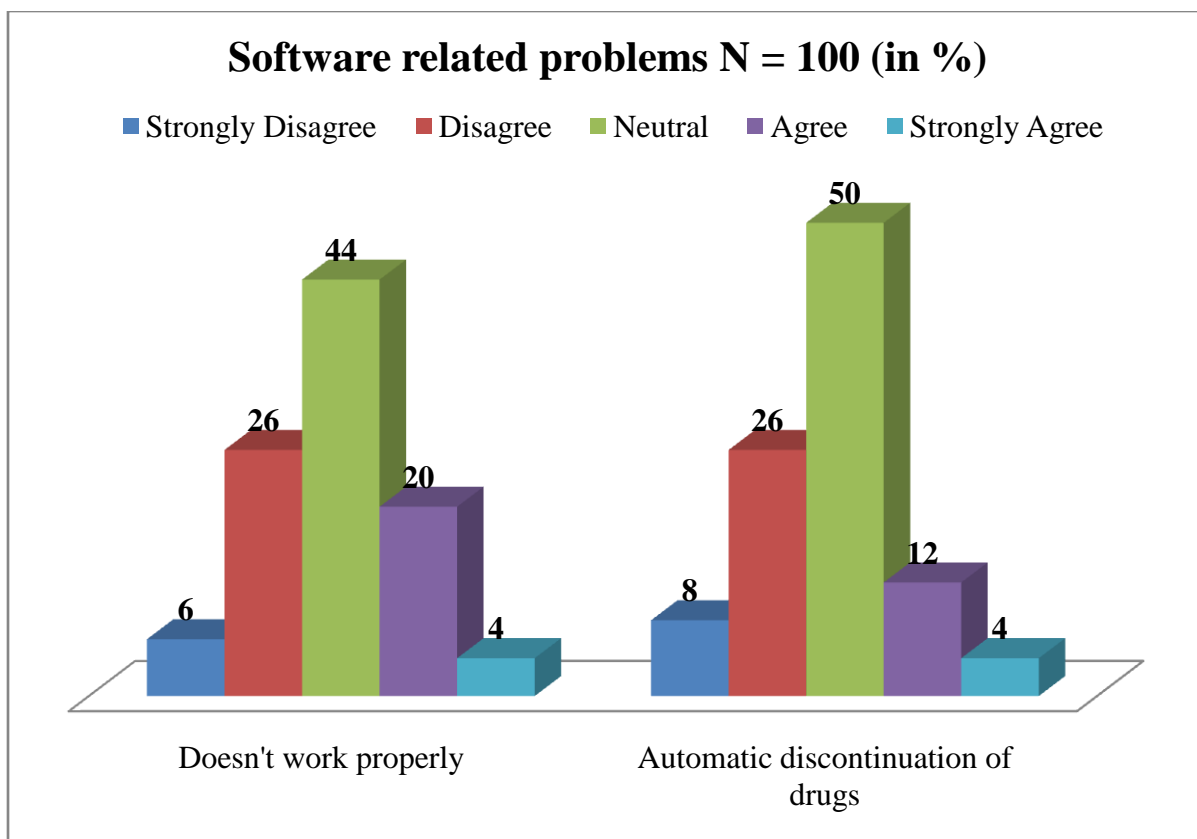
Fig #18: Graph showing no. of responses for software related problems

Software related issues are one of the major issues that one organization can face at the early stages of the implementation. BCMA, a part of VistA EHR been used by the veterans from the year 1994 at Veterans Hospital seems to be the less effected problem for the nurses. Questions under software related problems constituted: Software doesn't work properly & there is an automatic discontinuation of drugs which is not known to them (Patterson Emily S, *et al;* 2002). Most of the responses were neutral (44% and 50 %) respectively for software related issues faced by them.
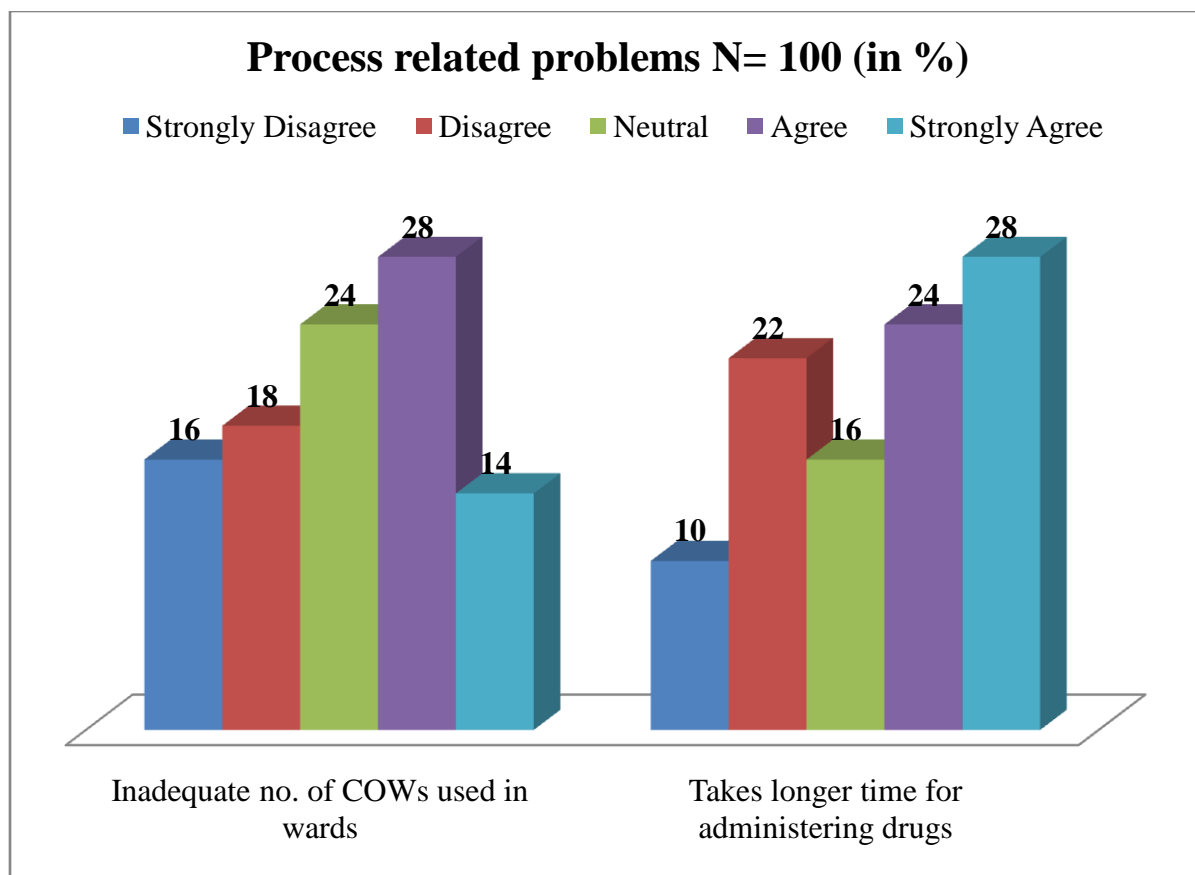
Fig #19: Graph showing no. of responses for process related problems

Not only software sometimes processes in the hospital play a major role in the acceptance of the system. As described earlier, there is less number of COWs present in the wards (8 for the whole floor as compared to 1:1 in ICUs). The same Computer on Wheels are been used for patient related ordering which sometimes leading to delay in administration of drugs in the system. Most of the nurses think that there are inadequate numbers of COWs present in the wards (42 out 100). Also most of the nurses think that BCMA process is consuming more time as compared to manual system which has also been confirmed by Gooder V in her study done on Nurses' perception. It is also because in manual drug administration there was only one step they had to follow and that is to administer the drug first and then write the details in the medication chart of the patient. Whereas in BCMA they have to follow certain checks and then administer the drug to patient.

Physician related problems N = 100 (in%)

■ Strongly Disagree   ■ Disagree   ■ Neutral   ■ Agree   ■ Strongly Agree

Timely medication order done: Strongly Disagree 12, Disagree 10, Neutral 32, Agree 46, Strongly Agree 0

Inappropriate medication order: Strongly Disagree 4, Disagree 34, Neutral 34, Agree 26, Strongly Agree 2
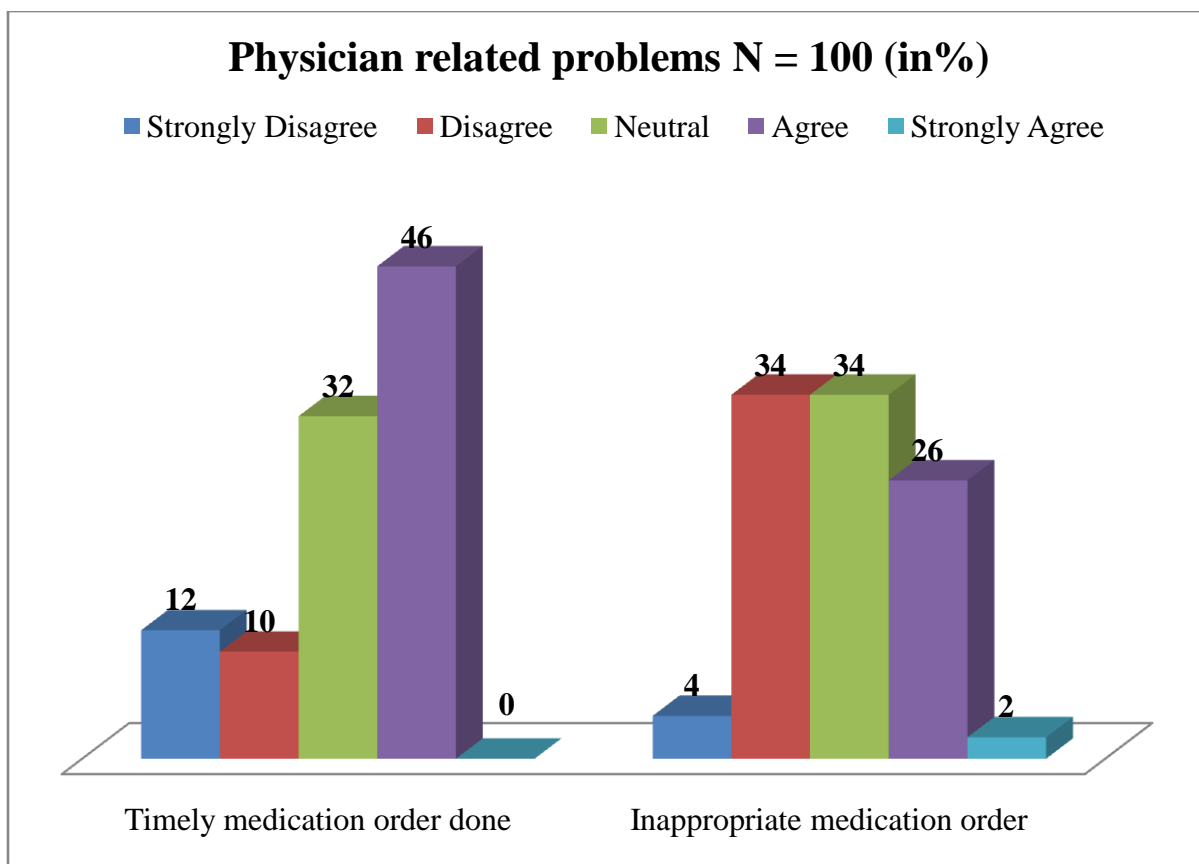
Fig #20: Graph showing no. of responses for physician related problems

Before the implementation of EHR system, Nurses use to order drugs of the patient by indenting them in the HIS. After implementation of EHR system, only physicians have rights to give any orders for the patient. One of the written by Pennsylvania Patient Safety Authority in December 2008 has mentioned that ordering phase plays a very vital role in administration process. National Patients' safety authority mentions in its 2007 statistics that ordering errors constitutes of 7 – 20 percent of the total medication errors. The above response confirms from the respondents side that they are not facing any problems from the physicians' end and physicians are providing timely medication orders in CPRS and there are only few inappropriate drug ordering (here it signifies that verbally they have said something but gave some other drug order).

Pharmacy Related problems N = 100 (in%)

■ Strongly Disagree ■ Disagree ■ Neutral ■ Agree ■ Strongly Agree
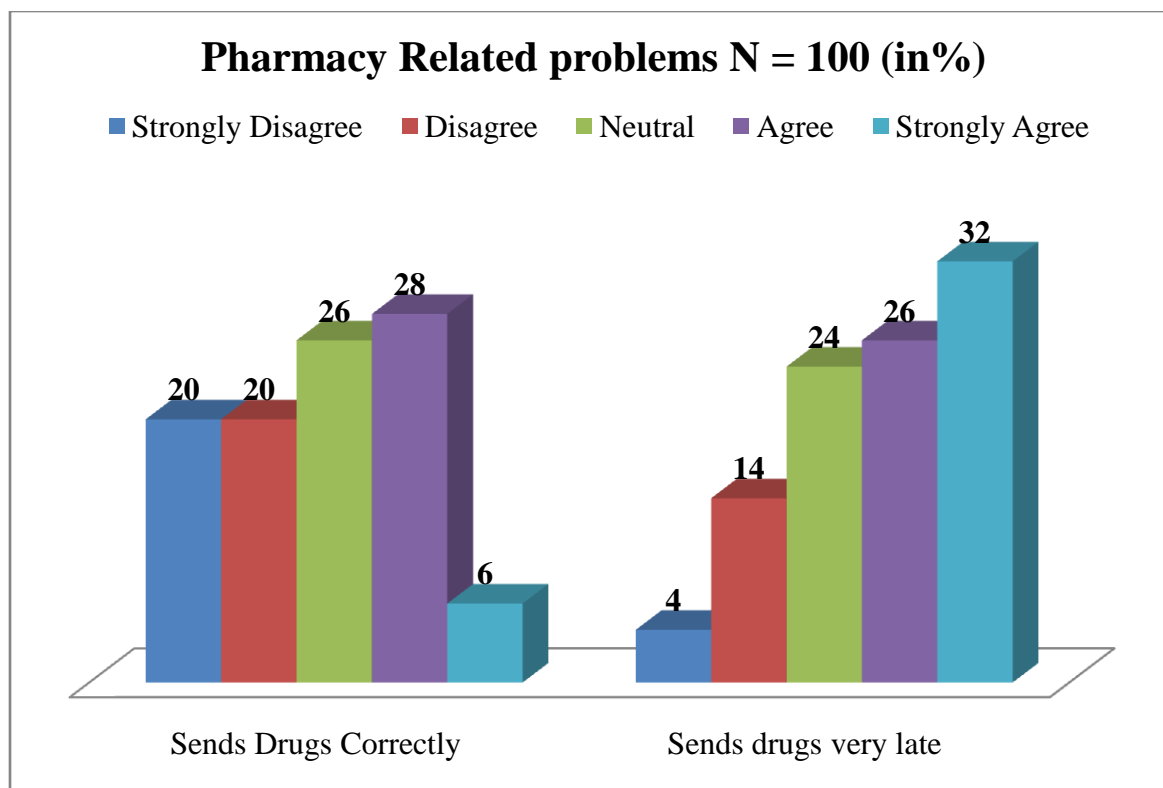
Fig # 21: Graph showing no. of responses for pharmacy related problems

When it comes to drug administration process, pharmacy department has a very pivotal role to play in the whole process. Pharmacy after coming up of VistA, using pharmacy module and HIS not only has to verify the drug orders from the doctors but also bill the drugs to the patient and also dispense it at right time to the nursing station so that there is no delay in the drug administration process. Most of the people think that pharmacy department is not sending the drugs correctly to the nursing station as ordered. Also they are late in dispensing the drugs from the pharmacy to the nursing station. Dispensing errors according National Patients' safety authority ranges from 10 to 15 percent of the overall medication errors.

Barcode related problems N =100 (in %)

■ Strongly Disagree ■ Disagree ■ Neutral ■ Agree ■ Strongly Agree
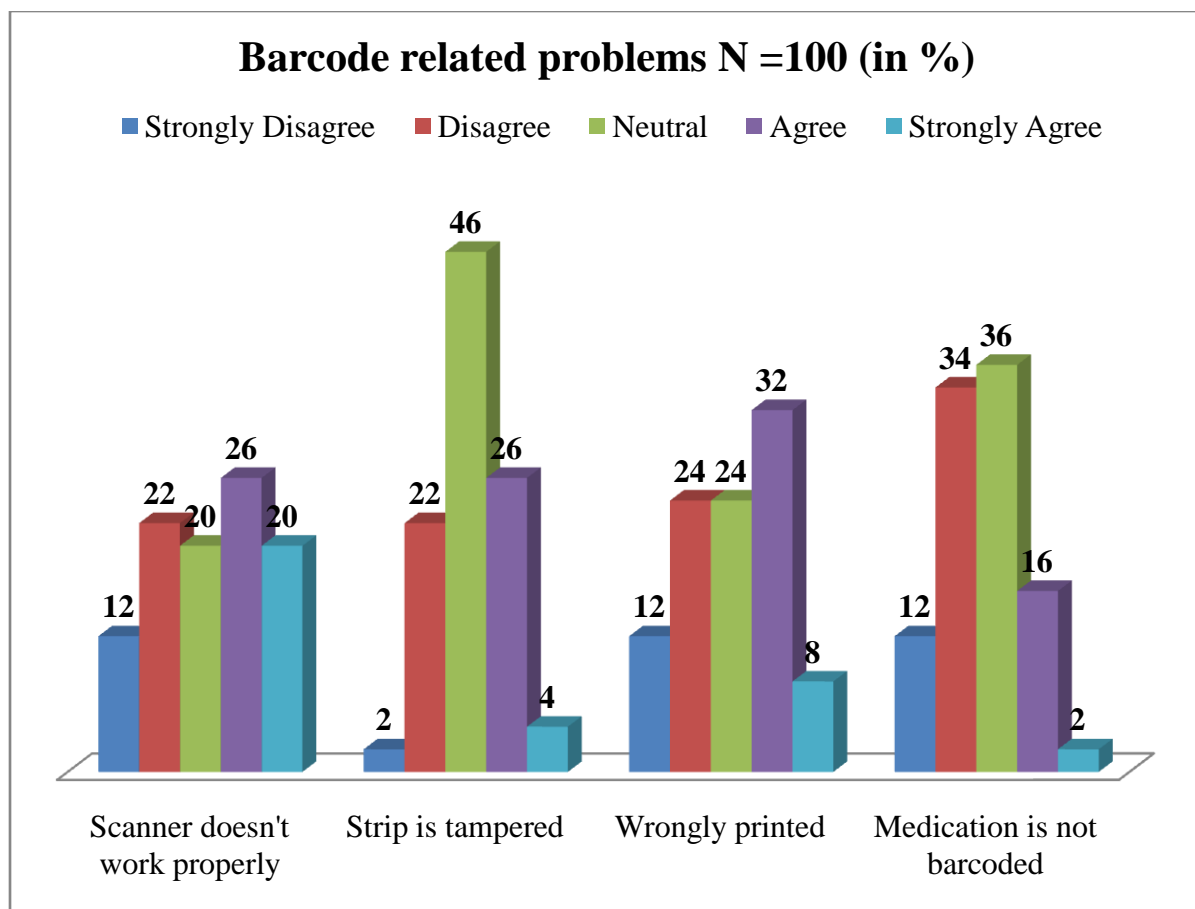
Fig #22: Graph showing no. of responses for barcode related problems

Barcode is one of the final requirements for the completion of medication administration in BCMA. Most of the studies are focusing on issues that are directly linked to pharmacy, processes, physicians etc. But sometimes the small barcode in the medication may have a significant role to play in completion of the process. Most of the responses have been mix responses and therefore the root cause would be very difficult to understand. Barcode scanner seems to be one of the major problems for the nurses as most of them think that scanner doesn't work properly.

Direct Benefits N = 100 (in %)
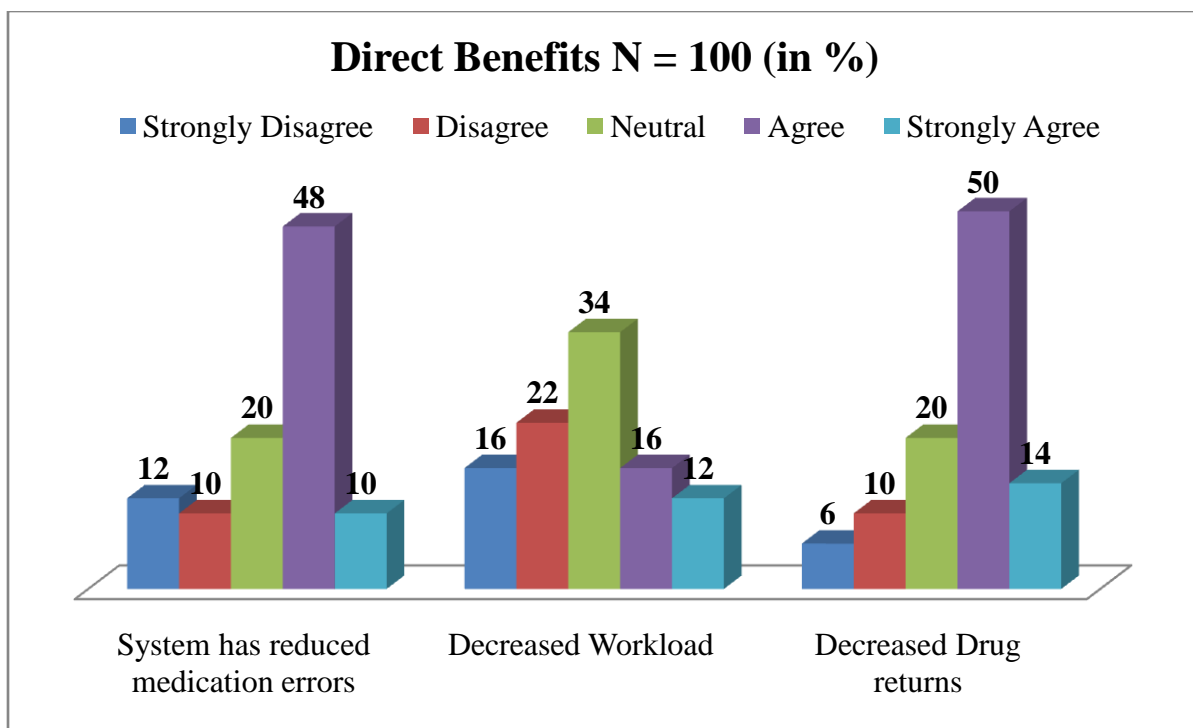
Fig #23: Graph showing no. of responses for direct benefits with respect to BCMA system

Benefits are always been classified into direct benefits; indirect benefits and strategic benefits. Direct benefits may be referred to as those benefits for the end users who are affecting their day to day work. Indirect benefits are those benefits which are not affecting them but they might be indirectly concerned with those benefits. Strategic benefits are those which are affecting the organizational goals. Respondents think system has reduced medication errors and drug returns to pharmacy (because of Unit Dose Dispensing). But they think that after the system has come it hasn't been able to reduce the workload.

Indirect Benefits N=100 (in %)
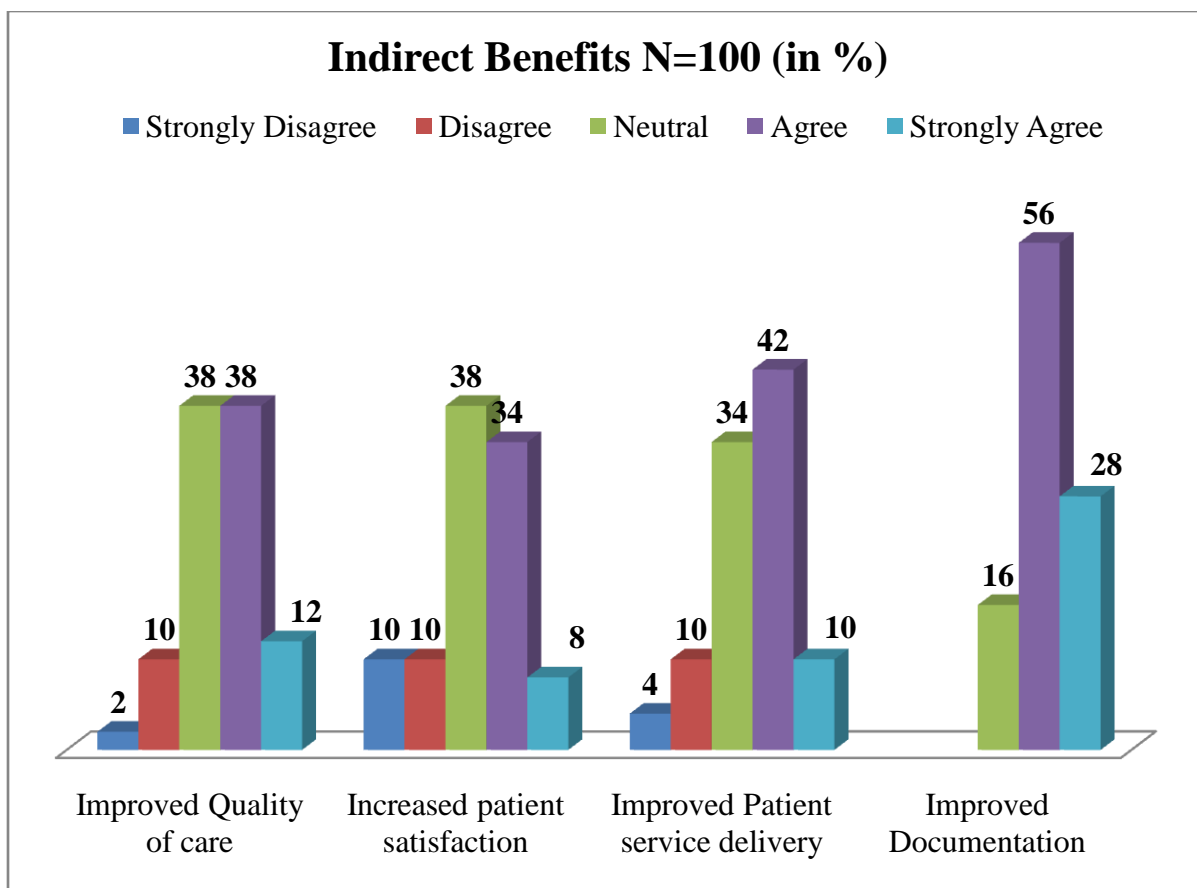
Fig #24: Graph showing responses for indirect benefits with respect to BCMA system

Benefits as far as literature is concerned would be much more as described here. Here in this study the seven benefits of BCMA were categorized into Direct & Indirect Benefits to the end users. As far as any system is concerned, it is always necessary to know the perception of the end user about the system. As expected, respondents know the overall benefits of the system in spite of the problems faced. All the respondents think positive about the above mentioned benefits of the system. Now it's time for the organization to work upon the problems faced by them and reduce it as minimal as possible to make it a huge success in Indian Healthcare industry.

CHAPTER 5

DISCUSSION

DISCUSSION

The implementation of BCMA embedded in the VistA EHR system has played a major role in the reduction of medication errors as far as literature is concerned. This study majorly focuses on the end user's problems they are facing after the implementation of the EHR system and especially with BCMA. After the implementation we often rate the overall system with the outcomes of the system rather than the issues that the end user might face. The study has tried to find out the issues and also what do the end users have thought about the systems' benefit in their own terms. Study majorly focuses on the 6 major research questions which would be discussed in this part only.

Research Question #1:

With all the respondents are adequate in computer knowledge, it becomes very easy for greater adoption of these ICT systems by the end users in the hospital. To test the hypothesis, anova test was applied between General Computer Knowledge and Attitude towards manual drug administration process at 95% CI. With the level of significance = .138 which is greater than 0.05 therefore H1 is rejected and H0 is accepted.

H0: Individual who are adequately (moderate & above) tech savvy don't feel that manual drug administration process is inadequate.

As described earlier that the EHR system has been implemented in the mid 2011, it is very hard to accept that new system with day 1 gets accepted as compared to the manual drug administration process which was there from last 10 years. As described earlier, Gooder V. in her study conducted in a 280 bedded hospital has also confirmed that initially new systems' especially BCMA has a negative impact on nurses' as they were first following manual drug administration system and suddenly they have to shift to the electronic system. The study also confirms that as time passes by, the nurses' attitude towards the system also changes and they would also feel BCMA system to be better than the manual drug administration system.

Research Question #2:

As shown earlier, 36 percent of the total respondents were having some kind of IT experience prior joining this organization. People with any kind of IT system usually think IT system to be better than the manual system. Independent sample t test was applied between previous IT experiences of the end user prior joining the organization with the attitude of manual drug administration process earlier followed in the organization at 95% CI. Level of significance (P) was found out to be 0.230 which is greater that 0.05; therefore leading to reject H1 and accepting H0 (Null Hypothesis)

H0: Individuals with any kind of IT experience prior joining this organization find manual drug administration process better than BCMA System.

Research Question #3:

Clinical experience of any individual would help the individual to understand the benefits of the system. People who have experiences in working at different setups would better understand what all benefits one could get from the ICT system implemented in the hospital. To verify this Anova test was applied between the clinical experience of the respondents and total benefits they all have realized from this new BCMA system implemented in the hospital at 95% CI. As the level of significance was found out to be 0.002 which is less than 0.05; therefore for this research question H1 is accepted and H0 is rejected.

H1: Nurses with more clinical experience has accomplished the benefits of the BCMA system

There are various studies that predict that nurses are satisfied with the BCMA system (Hurley *et al,* 2007; Coyle & Heinen, 2005; Rough, Ludwig & Wilson, 2003). BCMA with a history of more than 15 years (Johnson Connie L *et al,* 2002) the system itself have been tested well in Veterans Affairs and its benefits is well known to everyone as far as US healthcare is concerned. But as far as Indian Healthcare is concerned here experiences of an individual counts a lot as compared to the evidences from the literature. Keeping in mind the Indian scenario, this research question has definitely again proved that BCMA is far more better & its benefits have been properly realized by the Nurses' in the organization.

Research Question #4:

As discussed in the previous research question, individual with more clinical experience has accomplished the benefits of the system till date. Research Question #4 deals with the attitude of the individuals with more clinical experience about the manual drug administration process. To test this research hypothesis, 2 way anova was performed between clinical experience of the individual and attitude towards manual drug administration process. Level of Significance was found out to be equal to 0.227 which is greater than 0.05. Therefore the null hypothesis is accepted and H1 is rejected.

H0: Individual with more clinical experience still thinks that the Manual Drug Administration Process is better than BCMA System.

Research Question #5

Problems faced by the individuals always play a greater impact of the benefits realized of the system. Literature suggests us that problems faced in BCMA system leads to less satisfaction to the end users. The following research question deals with the relationship between problems faced by the individual and benefit realized by the end user. To find this relationship, correlation was done between the overall problems faced by the users and overall benefits realized by the same. At 95% CI (Significance level 0.05) it was found out that there was a strong correlation between problems faced and benefits realized by the users. Pearson Correlation Coefficient is -0.240 at significance level 0.016 which shows if there are more problems been faced by the users, then the overall benefits would also get affected.

Patterson Emily S, *et al,* 2002 & Gooder V; 2011 confirms that nurses gets frustrated in their day to day work of medication administration in the initial stages when the system is either not working properly or one of the processes is not followed properly in the whole system. Also Gooder V hypothesized that more frustration within the nurses leads to less satisfaction from the system itself. In next research question we would be finding out what are the major problems the nurses are facing after the implementation of the BCMA system.

Research Hypothesis #6

Information technology plays a very pivotal role in supporting the core services of the healthcare provider i.e. patient care. It could be there administrative work which is been supported well by Hospital Information System (HIS) application or there clinical work which could be well supported by a fully integrated EHR system. But ICT system never takes the place of any individual in this healthcare industry and especially the clinical staff. Often when we all are implementing any ICT system in a large setup, we often forgot that there might be some issues regarding the process itself that could lead to a downfall of an ICT system. In this present study the problem that nurses face were divided into 5 categories which are as follows:

a) System Related Problems
b) Process Related Problems
c) Physician Related Problems
d) Pharmacy Related Problems
e) Barcode Related Problems

As discussed earlier in research question #5, problems have a negative relationship with respect to the total benefits realized by the nurses about the system. To know the major problems faced by the end user, correlation was applied with the total benefits realized and was found out that Process Related (P = 0.000; Pearson's Coefficient =-0.388) & Pharmacy Related Problems (P =0.008; Pearson's Coefficient = -0.265) are the major problems concerned with the nurses. Also when individually analyzed, it was found out that Nurses feel that problems in Medication Administration are occurring due to:

a) Inadequate number of COWs used in wards (P = 0.000; Pearson Coefficient = -0.444)
b) Pharmacy dispenses drugs incorrectly (P = 0.000; Pearson Coefficient = -0.415)
c) Scanner doesn't work properly (P = 0.003; Pearson Coefficient = -0.294)

The implementation of new technologies into healthcare systems can be a complicated enterprise. Due to substantial investment of capital required to purchase and implement these systems, discussion of negative outcomes is often not appreciated or encouraged.

Implementation of new technologies requires an honest & sincere evaluation of the impact these new systems have on previous practice in order to maximize the benefits & minimize the issues to provide quality and cost effective service to the people.

As this study is a cross sectional, prospective study it is difficult to find out the perception of the people before the implementation of the system. As BCMA deals with the medication errors therefore one of the major limitations of this study is not getting any data from the organization regarding the medication errors before and after the implementation. Some of the problems or benefits may not be covered up during this study which might be well prevalent in the healthcare organization after the implementation of ICT system. But all together people have accepted this system very well which can be predicted by the overall rating to this system. Within such a small span of time, nurses have rated it over 6 out 10 which is a good achievement as far as hospital is concerned. This study has shown that whatever changes an ICT system brings in the healthcare organization not only depends on Technology itself but also people (end users) and processes play a pivotal role in the success of the overall system.

Next part of Discussion deals with the SWOT analysis of BCMA system which is implemented in this healthcare organization. This analysis would not only help the present organization to perform better with the implemented system but also helps in better implementation of this system in other hospitals they are planning to implement this integrated system. As BCMA is a very new concept as far as Indian Healthcare is concerned, the analysis would try to help other organization to assess their organization about the usage of this tested and successful system in the world.

Pros of BCMA System

1) Improves the accuracy of medication administration process: The 5 R's of medication administration to the patient that includes "Right Patient"; "Right Medication"; "Right Dose"; "Right Route" & "Right Time" can be easily followed by the nurses' using the integrated BCMA system of VistA.

2) Enhancement of patient safety and patient care: According to National Patient Safety Agency's 2007 statistics 59.3 percent of medication errors occurring at the administration phase which is very much reducible with the usage of BCMA. Also studies confirm that within a longer span of usage of this system, there is definitely a reduction in the overall errors in medication errors (Johnson Connie L *et al,* 2002).

3) Data analysis and reporting becomes easy: BCMA has been designed in such a way that even the end users are able to see all the reports that are related to daily medication administration process. For example: Nursing Supervisor or even nursing team lead can generate daily, weekly, monthly report of what all medication have been received by the patients in their ward etc.

4) Patient specific information: BCMA has a unique feature of showing only one patient medication at a single point of time. Nurse at one time can select only one patient which maintains the rate of confusion for the nurse as low as possible.

5) Proper Documentation been maintained: BCMA has been integrated with CPRS so that each and every action done by the nurse gets documented in CPRS. Therefore we don't have to extract any details from VA fileman (database for VistA EHR). Also there is a real time data availability of the action taken between all the three systems i.e. CPRS (Ordering); Pharmacy Module (Verification) & BCMA (Drug Administration).

6) Improve communication between care providers: In the previous manual drug administration the physicians were facing a major problem of communication of

medication administration from the nurses. Either they have to call the nurse of the specific patient to know whether the drug has been given or come all way to nursing station to see patient medication administration chart. Even nurses working in shift have to remember whether the previous nurse gave drug as per schedule time. After the implementation of the system, every clinical staff can see every detail of the drug administration to the patient.

Cons of BCMA System

1) IV option not been utilized in BCMA: BCMA not only has a functionality for unit dose medication like tablets, capsules etc but also has a functionality for IV fluids to document the details of each and every thing related to fluids used for the patient. IV fluids are continuously been used for the patients and especially for ICU patient. The rate at which the fluid is infused in patient constantly changes as per requirement provided by the physician. For example an IV fluid was ordered to be infuse @ 15 ml/hr. Nurse starts the infusion as per ordered. But after 2 hours physician might ask to either increase or decrease the infusion rate of the IV fluid which could be easily documented in IV option available in BCMA. But the organization has disabled this option and has made every drug to be available under Unit Dose functionality. To document IV related details nurses has been trained to use "Edit Med Log" option in Unit Dose.

2) No real time alert for nurses in the system: As described in many literatures BCMA has a biggest disadvantage and that is it does not provide any alert for the nurses about the medication administration for the patient. Even CPRS provides related notifications to the user, but BCMA doesn't provide any alert or notification for the nurses for the details regarding drug administration of the patient. Therefore they have to remember at what time the drugs have to be administered to the patient or regularly check the details in CPRS.

Opportunities for BCMA System

1) Establishment of Green Field Hospitals: Green field hospitals have been termed to those hospitals where from day 1 ICT systems are working for both clinical and administrative work. Medication administration is still been followed as manual process in many hospitals who have ICT systems for their day to day work & processes. BCMA system with any integrated EHR system can be the best rated solution for a newly built hospital to start up with.

2) Part of course curriculum for nurses' during their graduation: With the starting up of 21st century, it is believed that Indian Healthcare is gradually shifting towards the ICT of healthcare. BCMA system in future could be a part of course curriculum for nurses to get to know the practical jinx of what they are reading about medication administration i.e. 5 rights of medication administration.

3) Improvement of Hospital Image: As described earlier, most of the medication errors occur during the administration phase. Wrong medication with wrong dose to wrong patient at wrong time would have greater incidence if manual processes are followed. With the reduction in medication errors it not only would increase the patient care and safety in the healthcare organization but also would improve the hospital image which would directly improve the revenue generation for the hospitals as more people would prefer to come where there are less medication errors.

4) Help the hospital to get accreditation like JCI: The current hospital is a NABH accredited hospital. With the coming up of BCMA system, International standards like JCI would be far easier for the hospital to get as VistA EHR (with BCMA) is a world renowned EHR solution.

Challenges for BCMA System

1) Hospital staff prior using manual drug administration process would resist: Many literature has confirmed that hospital clinical staff play a very resistant role before the implementation of any ICT system. The major fear that they have is the increase in accountability for an individual. It becomes the duty of the change managers to make the end user realize about the long term benefits of the system. Also for this, organization can provide monetary benefits to the users so that they can adapt these systems perfectly.

2) Less computer knowledge: One of the major reasons of less adoption of the ICT systems is the lack of general computer knowledge of the end user and BCMA is no less gets separated from this. General computer knowledge like speed of typing, use of mouse and other keyboard buttons. Organization should encourage more general computer workshops for the individuals so that they get familiar with the IT systems.

3) Process dependency with other stakeholders: Medication administration as discussed before depends on the ordering of the drugs, verification of the orders and dispensing of the drugs. Therefore an individual dealing with Medication Administration process has to play a pivotal role to make BCMA & EHR system successful. Physicians are giving bulk orders for different patients together which may lead to wrong order for any patient. Also pharmacy receives bulk medication orders which may lead to greater confusion within the pharmacy department itself which ultimately affect the BCMA functionality as a whole. Also during the study it was observed that Doctors were sometime not ordering the correct drug and complaint that they were not able to find the drug but it was there in the system but physicians were not typing the accurate spelling of the drug.

4) Time consumed in pharmacy for dispatching: After the implementation of EHR system, there has been an increase in manual processes in pharmacy department. Whenever a drug order comes after verification of the drug there is label print from one of the printer. Pharmacist takes the label and goes to pull out the drug from the shelf. If barcode is there attached with the drug then they dispatch it to billing otherwise they take a barcode print from the barcode printer and attach the barcode to the medication. The total turnaround

time for order verification till dispatch which includes billing constitutes of 3 – 6 minutes but it was observed that the dispatching is taking 10 – 15 minutes.

5) Nurses using workaround more frequently: During observation, it was noticed that nurses scan the drugs at nursing station especially during the cart fill run. Nurse using workaround tries to administer the drugs as they were having the following practices:

   a) Scanning the upper half of the medication (which is only for the pharmacy billing)
   b) Nurses were not using COWs during administration in wards: During medication administration in wards they were first administrating to the patient and after that they were using workaround to administer that drug in the system. This is also due to less availability of COWs in the wards.
   c) Pharmacy providing wrong barcode to the right drug also leading to use of workaround by nurses.
   d) Use of workaround is consuming their more time than usual process in BCMA.

CHAPTER 6

CONCLUSION

CONCLUSION

The recent focus on patient safety has yielded a variety of new tools and technologies aimed specifically at improving the quality of patient care at the bedside by integrating the physical process of care delivery with medication information and software applications that provide decision support and quality & safety checks. In hospital environment, patient safety tools and technologies must translate into the correct administration of medications at the patient bedside. As far as strategic view is concerned, the key element of patient safety at bedside is the process of Medication Administration. Bar Code Medication Administration (BCMA) system one of the great achievements for VA, developed in the year 1994 has demonstrated in its journey that it plays a very pivotal role in medication administration process at patient bedside. Medication administration process not only depends on how the administration of medication has been done to patient, but the dependency with the right drug ordered and right drug dispensed to the patient also plays a vital role in this regard. This present study has tried to find out the perspective of the end users of BCMA system about the whole new medication administration process, the major issues they are facing and benefits of the system they have realized.

Hospital after the implementation of the ICT systems thinks about the outcome which sometimes leads to forget the real ground issues that the end users might be facing after the implementation. This present study deals with the same by knowing the present issues the users are facing. Due to confidentiality issues, hospital records can't be shared with this study. Whenever people talk about BCMA, they think about the reduction in medication errors after the implementation of the system. This has been one of the limitations of this study as it could not capture the data before the implementation of the system. The study confirmed that users have realized the benefits of the current system in a very short span of time but still some of the issues are left which can be minimized by following recommendations.

CHAPTER 7

RECOMMENDATIONS

Recommendations

1) Use of tablet PCs in wards for medication administration or for ordering of drugs: As VistA EHR is a client server based application therefore the application can also be used in a tablet PC either dedicated for ordering of medication or for administration. With the upcoming of tablets like aakash (Cost around Rs. 3000), the availability of either COWs or tablet PCs with the nurses would ensure that BCMA is been used properly & there are less workarounds been preferred in wards (as compared to ICUs where COWs are available with each bed).

2) Unit dose packaging system to be followed properly: With the upcoming of VistA EHR system in the organization, the medication now is dispensed using unit dose concept i.e. sending drugs only for 24 hrs to the nursing station. For less errors, pharmacy should start with unit dose packaging system which includes cutting the drugs into single tablets or capsules and keep it in plastic bags whenever they are receiving drugs in there department. When there are bulk orders the pharmacist spend some time in cutting those strips into unit dose. When they are taking print out of the barcode, 4 barcode gets generated at one time. While pasting one, they sometime forget to attach the other 3 barcode to three unit drugs. This leads to wastage of barcode. It can be well taken under control if managed properly and follow a unit dose packaging system whenever drugs come to pharmacy.

3) Regular feedbacks from nurses should be taken and appreciated by the management.

4) Use of COWs by physicians to order drugs at the patient bedside: Physicians should use COWs at patient bedside for ordering the drugs as it would not be providing bulk orders for pharmacy. When consultants are coming up for their rounds in the morning, it usually takes 5 – 10 minutes to see the patient, then ordering of drugs (including lab/radiology investigations, referrals or procedures orders) and continuing with the writing of concerned notes for the patient. This all process would take 15 – 20 minutes for a single patient. If physicians would start using this process, it would reduce the receiving of bulk orders in pharmacy which may lead to less process errors

from the pharmacy department as some medicines are STAT orders (within 30 minutes of ordering) or NOW orders (within 60 minutes of ordering).

5) Pick list to be planned properly: Pick list is the time for delivering medication all patients to a specific nursing station for next 24 hours. When pick list process in pharmacy department, it takes usually 2 hours to complete the delivery to the ward which includes pulling of drugs from the drugs, packing of the drugs, billing of drugs and delivering of drugs. Pick list timings are fixed for different wards which is been decided by the nursing supervisor of that ward and pharmacy executive. At present most of the wards are having pick list timings during the morning hours or just after lunch. During evening shifts there are very few pick list (one or two wards) are there. Pick list should be planned in such a way that at a time there are not more than 2 wards pharmacy department would be delivering.

CHAPTER 8

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CHAPTER 9

LIST OF

APPENDICES

Bar Coded Medication Administration: Issues & Benefits Realized by Nurses in a Multi Specialty Hospital

Dear Respondent,   Questionnaire ID: _____

Greetings of the day!!! I, Anindam Basu Post Graduate student pursuing PGDHHM in Healthcare IT (2nd Year) from International Institute of Health Management Research, Dwarka, New Delhi is conducting study on "Bar Coded Medication Administration: Issues & Benefits Realized by Nurses in a Multispecialty Hospital" as a part of my course curriculum and so I request you to spare some of your precious time for the study.

All responses will be kept strictly confidential. Completed surveys will be used for data entry and analysis. No individual data or responses will be reported. Only the aggregated data will be used. Please check ($\sqrt{}$) one (1) response for each question. **Please give your honest opinion.**

Q1. Name of the Respondent: _____ (Optional)

Q2. Gender   ( ) Male;   ( ) Female**.**

Q3. Present Working Location: _____

Q4. Your Age Group: ( ) 18 – 30; ( ) 31 – 40; ( ) 41 – 50; ( ) 51 – 60; ( ) Over 60

Q5. Clinical Experience: ( ) < 1 year;   ( ) 1-5 years; ( ) > 5 years.

Q6. Have you used any IT systems prior joining this organization? ( ) Yes;   ( ) No

    If Yes then approximately how much time   _____years & _____months

Q7. How knowledgeable (tech savvy) do you consider yourself about the following:

	1	2	3	4	5
	Not at all	**Very Less**	**Moderately**	**Satisfactory**	**Extremely**
Computer in General	( )	( )	( )	( )	( )
Internet usage	( )	( )	( )	( )	( )
HIS	( )	( )	( )	( )	( )
E- Care	( )	( )	( )	( )	( )

Q8. When did you receive training on BCMA? (Select any one appropriate answer)

(   ) Prior to EHR implementation   (   ) New Employee orientation

(   ) Unit Orientation   ( ) Other _____

Q9. Problems been faced by the end user

Following are some of the problems that might be faced by you. Please (√) the appropriate option.

SD: Strongly Disagree; **D:** Disagree; **N:** Neutral; **A:** Agree; **SA:** Strongly Agree

Problems	SD	D	N	A	SA
• **Software doesn't work properly**					
• **Timely Medication Orders Done by the Physicians**					
• **Inappropriate Medication order by physician**					
• **Adequate COWs used in wards**					
• **Pharmacy dispense drugs correctly**					
• **Pharmacy send drugs very late**					
• **Barcode scanner doesn't work properly**					
• **Barcode strip is tampered**					
• **Barcode is wrongly printed**					
• **Medication is not bar-coded**					
• **It takes me longer time for administering medication**					
• **There is Automatic Discontinuation of Drugs**					
• **Other Problems [Optional]**					

Other   Problem

_____

_____

Q10. Benefit Realization of the system

This part deals with the benefits of the system to you or the hospital after its implementation

Please (√) the appropriate option. SD: Strongly Disagree; **D:** Disagree; **N:** Neutral; **A:** Agree; **SA:** Strongly Agree

Benefits	SD	D	N	A	SA
• **System has reduced medication errors**					
• **Improved Quality of Care**					
• **Increased Patient Satisfaction**					
• **Improved Patient Service Delivery**					
• **Improved Documentation**					
• **Decreased Workload**					
• **Decrease in drug returns**					
• **Other Benefit (Please specify below)**					

Other   Benefit

_____

_____

Q11. Do you think Manual Drug Administration process was better?

   SD ( );   **D** ( );   **N** ( );   **A** ( );   **SA** ( )

Q12. How much will you rate the overall EHR system out of 10? ____/10.

Q13. Any Suggestions/ Comments for the EHR system:

THANK YOU FOR YOUR PRECIOUS TIME

<u>Interview Questionnaire</u>

The following interview was a part of the tool use to collect the relevant data for the dissertation. The interview was conducted with **Chief Nursing Officer** & **Clinical Pharmacologist** of the Hospital.

Q1: What is the bed capacity of this hospital?

Q2: At present how many nurses are there in the hospital?

Q3: What is the Nurse – Patient Ratio in the Hospital?

Q4: What is the approx number of prescription ordered in a day by Doctors?

Q5: Currently how many pharmacists are there in this setup for Inpatient pharmacy?

Q6: What are the major problems faced by the pharmacists after the implementation of EHR?

Q7: What changes has happened to the workflow for Medication Administration to patient after the Implementation of EHR in the Hospital?

Q8: After the Implementation of BCMA system in the Hospital do you think medication errors have reduced? If yes then according to you how much approximately it has been reduced.

Q9: Any suggestions/comments/changes you would like to have for the current EHR system in the Hospital?