Internship Training

at

Medanta- The Medicity

on

Impact of clinical pharmacist in a tertiary care hospital

by

Dr. Kanika Gupta

PG/15/037

Under the guidance of

Ms. Kirti Udayai

Post Graduate Diploma in Hospital and Health Management 2015-17

International Institute of Health Management Research New Delhi

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TO WHOMSOEVER IT MAY CONCERN

This is to certify that Dr. Kanika Gupta, student of Post Graduate Diploma in Hospital and Health Management (PGDHM) from International Institute of Health Management Research, New Delhi has undergone internship training at Medanta-The Medicity from March 2017 to April 2017.

The Candidate has successfully carried out the study designated to him during internship training and his approach to the study has been sincere, scientific and analytical.

The Internship is in fulfillment of the course requirements. I wish him all success in all his future endeavors.

Dr. A.K. Agarwal

Dean, Academics and Student Affairs

IIHMR, New Delhi

Ms. Kirti Udayai

IIHMR, New Delhi

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Date 17th May 2017

DISSERTATION COMPLETION LETTER

This is to certify that Dr. Kanika Gupta, student of PGDHM (Post Graduate Diploma in Healthcare Management), Batch 2015 -17 International Institute of Health Management and Research, Delhi has successfully completed her dissertation with us.

- Project Title - Effectiveness and impact of customized Clinical Pharmacology services
- Project Duration - 01st March 2017 to 30th April 2017

During the period of her dissertation with us she was found to be punctual, hardworking and inquisitive.

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Certificate of Approval

The following dissertation titled "**Impact of clinical pharmacists on a tertiary care hospital**" at "**Medanta-The Medicity**" is hereby approved as a certified study in management carried out and presented in a manner satisfactorily 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.

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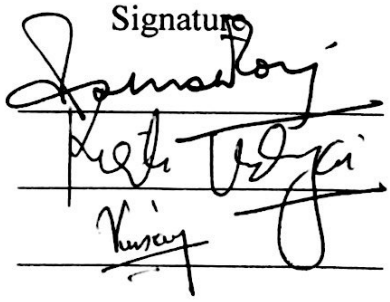
DR. ASHISH ROY	
Ms. KIRTI UDAYAI	
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Certificate from Dissertation Advisory Committee

This is to certify that Dr. Kanika Gupta, a graduate student of the Post- Graduate Diploma in Health and Hospital Management has worked under our guidance and supervision. She is submitting this dissertation titled "Impact of clinical pharmacist in a tertiary care hospital" at "Medanta-The Medicity" in partial fulfillment of the requirements for the award of the Post- Graduate Diploma in Health and Hospital Management.

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

16/5/17.

Ms. Kirti Udayai,

Assistant Dean

IIHMR, New Delhi

Dr. Rohit Jain

Deputy General Manager

Medanta-The Medicity

INTERNATIONAL INSTITUTE OF HEALTH MANAGEMENT RESEARCH, NEW DELHI

CERTIFICATE BY SCHOLAR

This is to certify that the dissertation titled "Impact of clinical pharmacist in a tertiary care hospital" and submitted by Dr. Kanika Gupta, PG/15/037, under the supervision of Ms. Kirti Udayai for award of Postgraduate Diploma in Hospital and Health Management of the Institute carried out during the period from 1st March 2017 to 30th April 2017 embodies my original work and has not formed the basis for the award of any degree, diploma associate ship, fellowship, titles in this or any other Institute or other similar institution of higher learning.

Dr. Kanika Gupta

Signature

FEEDBACK FORM

Name of the Student: Dr. Kanika Gupta

Dissertation Organization: Medanta-The Medicity

Area of Dissertation: Clinical Pharmacology

Attendance: 100%

Objectives achieved: Thorough process review and data analysis with highlights on success stories and areas of improvements

Deliverables: Extensive literature review, retrospective data collection and collation, in-depth analysis and correlation with improved process flow

Strengths: Process change management and positive outcomes

Suggestions for Improvement: NIL

Suggestions for Institute (course curriculum, industry interaction, placement, alumni): Improvise interaction with industry leaders and 100% placement opportunities

Signature of the Officer-in-Charge/ Organization Mentor (Dissertation)
DR. LALIT KANODIA

Date: 17th May 2017

Place: Gurgaon

Organization Profile

An overview

Medanta – The Medicity is one of India's largest multi-super specialty institutes located in Gurgaon, a bustling town in the National Capital Region. Founded by eminent cardiac surgeon, Dr. Naresh Trehan, the institution has been envisioned with the aim of bringing to India the highest standards of medical care along with clinical research, education and training. Medanta is governed under the guiding principles of providing medical services to patients with care, compassion, commitment.

Spread across 43 acres, the institute includes a research center, medical and nursing school. It has 1250 beds and over 350 critical care beds with 37 operation theatres catering to over 20 specialties. Medanta houses six centers of excellence which will provide medical intelligentsia, cutting-edge technology and state-of-the-art infrastructure with a well-integrated and comprehensive information system.

Medanta – The Medicity brings together an outstanding pool of doctors, scientists and clinical researchers to foster collaborative, multidisciplinary investigation, inspiring new ideas and discoveries; and translating scientific advances more swiftly into new ways of diagnosing and treating patients and preventing diseases. A one-of-its-kind facility across the world, Medanta through its research integrates modern and traditional forms of medicine to provide accessible and affordable healthcare.

Vision

"The Institute is governed under the guiding principles of providing affordable medical services to patients with care, compassion & commitment."

Mission

"Our mission is to deliver world class health care by creating institutes of excellence in integrated medical care, teaching and research. We aspire to create an ethical & safe environment to treat all with respect and dignity."

Highlights

- Medanta-The Medicity spread across 43 acres has 37 operating theatres, 1250 beds with over 350 critical care beds
- Medanta is a multi-super specialty Institute located in Gurgaon and is 10 minutes from the International Airport
- Medanta offers the widest spectrum of clinical care, education and research
- Medanta is led and managed by world renowned doctors committed to care with compassion.
- Medanta offers cutting edge technology and state-of the- art treatment facilities designed to deliver healthcare at an affordable cost.
- Medanta is driven by patient needs, comfort and trust.

Technology

- 256 Slice CT
- Brain Suite, Intra-Operative Imaging Operating Theater
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- Artis- Zeego Endovascular Surgical Cath Lab
- 4 Linear Accelerators (provision for IGRT/ IMRT) (radiation surgery)
- Tomotherapy

- Integrated Brachytherapy Unit with remote controlled HDR
- 3.0 Tesla MRI
- PET CT
- Gamma Camera
- Digital X-Ray, Fluoroscopy, Bone
- Densitometry
- 3D and 4D Ultra Sound
- Digital Mammography

Traditional Medical practices

An important objective of Medicity is to validate- and integrate with modern medical system, those medical practices in our traditional and complimentary systems of medicine such as Ayurveda, Unani, Siddha, Tibetian and Tribal Systems that are compatible with science.

Telemedicine

1. Fast upload of medical reports using advanced compression techniques
2. Video consultations using your Computer at your preferred timings
3. Access recommendations, reports and consultation details online

Dissertation Project

Impact of clinical pharmacist in a tertiary care hospital

Abstract

Introduction- The provision of drug therapy by a medical provider to a patient is a complex process. Medication error is an inevitable problem in a hospital and activation of clinical pharmacist role is of great importance in reducing the medication errors. The medication errors could be prescribing errors, indenting errors, dispensing errors, and administering errors. Objective- To evaluate the effectiveness and impact of the customized clinical pharmacology services managing medication management in a tertiary care hospital. Method- The methodology adopted was the retrospective, descriptive analysis of the process and the data on medication errors from November-2015 to January-2017. Results- The comparative analysis between the pre-and post-implementation indicated that the average indents/patient/day had reduced by 13.27%. The average dispensing time for routine and urgent orders had remarkably reduced by 65.45% and 66.3% respectively. The average number of urgent orders out of total had reduced by 20%. The percentage of medication errors had declined to 0.3% in January 2017. Conclusion- The study indicated that the clinical pharmacists played an important role in the operational impact in terms of reduction of daily transaction load on the hospital with an improved quality of medication services by identification, reporting and corrective actions.

Keywords: Medication Error, Clinical Pharmacist, Medication Management

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I would like to express my sincere gratitude to my mentor Dr. Lalit Kanodia for the continuous support of my study and related research, for his patience, motivation, and immense knowledge. His guidance helped me in all the time of research and writing of this thesis. I could not have imagined having a better advisor and mentor for my study.

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List of abbreviations

ADE	Adverse Drug Event
ADR	Adverse Drug Reaction
BCMA	Bar-code assisted Medication Administration
CCU	Cardiac Care Unit
CPOE	Computerized Physician Order Entry
CPR	Cardiopulmonary Resuscitation
CTC	Cost to Company
CTVS	Cardio Thoracic Vascular Surgery
FDA	Food and Drug Administration
HIS	Hospital Information System
ICU	Intensive Care Unit
IP	In-Patients
M. Pharm	Master of Pharmacy
MAR	Medication Administration Record
NABH	National Accreditation Board for Hospital and Health care providers
OT	Operation Theatre
Pharm D	Doctor of Pharmacy
TAT	Turn Around Time

1 Introduction

The role of clinical pharmacists in the care of hospitalized patients has evolved over time, with increased emphasis on collaborative care and patient interaction. Clinical pharmacists are trained in therapeutics and provide comprehensive drug management to patients and providers (includes physicians and additional members of the care team). Pharmacist intervention outcomes include economics, health-related quality of life, patient satisfaction, medication appropriateness, adverse drug events, and adverse drug reactions.[1]

One commonly used definition for a medication error is:

Any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the health care professional, patient, or consumer. Such events may be related to professional practice, health care products, procedures, and systems, including prescribing; order communication; product labeling, packaging, and nomenclature; compounding; dispensing; distribution; administration; education; monitoring; and use.[2]

The objective of the study was to evaluate the effectiveness and impact of the customized clinical pharmacology services managing medication management in a tertiary care hospital.

The specific objective was to analyze, detect and quantify the impact of clinical pharmacist's services in terms of its operational efficiency, cost-effectiveness and quality of medication services.

The rationale for conducting the study was that the clinical pharmacist was a customized department dedicated on each floor in the tertiary care hospital with an impactful outcome.

2 Literature review

The provision of drug therapy by a medical provider to a patient is a complex process. Errors can occur at any step along the way, from prescribing to the ultimate provision of the drug to the patient. Common causes of medication error include incorrect diagnosis, prescribing errors, dose miscalculations, poor drug distribution practices, drug and drug device related problems, incorrect drug administration, failed communication and lack of patient education.[3]

Some of the factors associated with medication errors include the following:

- Medications which are sound alike and look a like
- Medications that are not commonly used or prescribed
- Commonly used medications to which many patients are allergic (e.g., antibiotics, opiates, and nonsteroidal anti-inflammatory drugs)
- Medications that require testing to ensure proper therapeutic levels are maintained (e.g., lithium, warfarin, theophylline, and digoxin)[4]

2.1 Error-Prone Processes

There are five stages of the medication process: (a) ordering/prescribing, (b) transcribing and verifying, (c) dispensing and delivering, (d) administering, and (e) monitoring and reporting.[5]

A few studies have indicated that one of every three medication errors could be attributed to either a lack of knowledge about the medication or a lack of knowledge about the patient.[6]

2.1.1 Prescribing/ordering

Prescribing/ordering stage is the initiating stage for the series of errors which may lead to wrong dosage, wrong drug, incorrect route being administered to the patient. One of the study concluded that the errors that occurred in the prescribing stage had 74 percent of errors related to written prescription and 15 percent due to verbal orders.[7]

A United Kingdom study found that 12% of all primary care patients may be affected by a prescribing or monitoring error over the course of a year, increasing to 38% in those 75 years and older and 30% in patients receiving five or more drugs during a 12-month period. Overall, 5% of prescriptions had prescribing errors.[8]

2.1.2 Transcribing, dispensing, and delivering

This stage includes two further steps i.e. transcription and verification and secondly dispensing and delivering which involves nurses and the pharmacists. At this stage, pharmacist can prevent the prescribing/ordering errors. The errors that can occur are the failure to transcribe the correct order, and inability to deliver the correct medication.[9]

2.1.3 Medication administration

The nurses are mainly involved in administration of medications including both dispensing and preparation. In a study, it was found that one out of every 3 errors were attributable to nurses. A report of FDA about study of deaths due to medication errors indicated that the most common type of error was a drug overdose and second was administrating the wrong drug to the patient. The study reported that the causes recognized for the deaths were due to miscommunication, and human factors (e.g., knowledge).[10]

The “rights” of medication administration include right patient, right drug, right time, right route, and right dose. The essential environmental conditions conducive to safe medication practices include

(a) the right to complete and clearly written orders that clearly specify the drug, dose, route, and frequency;

(b) the right to have the correct drug route and dose dispensed from pharmacies;

(c) the right to have access to drug information;

(d) the right to have policies on safe medication administration;

(e) the right to administer medications safely and to identify problems in the system; and

(f) the right to stop, think, and be vigilant when administering medications.[11]

Leape and colleagues reported more than 15 types of medication errors: wrong dose, wrong choice, wrong drug, known allergy, missed dose, wrong time, wrong frequency, wrong technique, drug-drug interaction, wrong route, extra dose, failure to act on test, equipment failure, inadequate monitoring, preparation error, and other. Of the 130 errors for physicians, the majority were wrong dose, wrong choice of drug, and known allergy. Among the 126 nursing administration errors, the majority were associated with wrong dose, wrong technique, and wrong drug. Each type of error was found to occur at various stages, though some more often during the ordering and administration stages.[12]

2.2 Strategies

Table 2.1: Strategies to prevent adverse drug events related to medication errors[13]

Stage	Safety strategy
1. Prescribing	• Computerized Provider Order Entry, especially when paired with Clinical Decision Support Systems • Medication reconciliation
2. Transcribing	• Computerized provider order entry to eliminate handwriting errors and illegible prescriptions
3. Dispensing	• Clinical pharmacists to oversee medication dispensing process • Use of "tall man" lettering and other strategies to minimize confusion between look-alike, sound-alike medications
4. Administration	• Adherence to the "Five Rights" of medication safety (administering the Right Medication, in the Right Dose, at the Right Time, by the Right Route, to the Right Patient) • Barcode medication administration to ensure medications are given to the correct patient • Minimize distractions to allow nurses to administer medications safely • Patient education and revised medication labels to improve patient comprehension of administration instructions

Several studies have explored ways to improve the quality of prescribing in primary care. However, outcomes are heterogeneous and few studies have specifically focused on medication errors. Reducing medication errors and improving medication safety requires a systems approach. Examples described in this section relate to few key interventions that can support the health care professionals in primary care in reducing medication errors and improving patient safety. Strategies employed include using clinical pharmacists, computer technology and educational programmes, Bar-coded medication administration.

2.2.1 Medication reviews and reconciliation

Medication reconciliation is the formal process of establishing and documenting a consistent, definitive list of medicines across transitions of care and then rectifying any discrepancies. It deals with new medication changes, deletions and additions following hospital admissions. A systematic review found that these systems reduced medication discrepancies, as well as potential and actual adverse drug events[14]

2.2.2 Automated information systems

Computerized provider order entry (CPOE) with decision support may be effective if targeted at a limited number of potentially inappropriate medications and is designed to reduce the alert burden by focusing on clinically-relevant warning.[15] There is substantial evidence which supports the use of CPOE to decrease the frequency of medication errors in the in-patient setting. One study found that the likelihood of error occurrence was decreased by 48% when an order was processed via CPOE.[16,17]

2.2.3 Education

As outlined in another monograph in this Technical Series, educating health care providers is a key element to improve safety in primary care. This holds true in reducing medication errors where education is often part of multicomponent interventions. A review of 47 studies found that educational interventions to improve the prescription and dispensing of antibiotics may impact on clinician behavior with improved adherence to guidelines.[18] Evidence regarding medication management education targeted at patients is lacking, but it is an important area for exploration.

2.2.4 Bar Code-assisted Medication Administration (BCMA):

BCMA systems reduce medication errors by electronically verifying the '5 rights' of medication administration—right patient, right dose, right drug, right time, right route—at the patient's bedside.[19]

Meadows 2002 [20] The two hospitals had reductions in medication error rates of 71% and 79%. Data used to measure these not described. Anderson 2004 key finding, 59%–70% reduction in MAEs. Positive effect on nurses' satisfaction.[21]

Current studies generally support the potential of bar code-assisted medication administration (BCMA) technology to reduce medication administration errors. Current studies do not indicate an increase in nursing time spent on medication administration when using BCMA technology.[22]

2.2.5 Clinical Pharmacist

The addition of clinical pharmacist services in the care of inpatients generally resulted in improved care. Interacting with the health care team on patient rounds,

interviewing patients, reconciling medications, and providing patient discharge counseling and follow-up all resulted in improved outcomes.

In India, Clinical Pharmacy curriculum can be completed through either Pharm D or Masters in Pharmacy (M. Pharm) from the field of pharmacology or clinical/pharmacy practice.

Clinical pharmacists are trained in therapeutics and provide comprehensive drug management to patients and providers. The role of clinical pharmacist doesn't only limit to dispensing of drugs, it involved working with the physicians and nurses.[1]

Bond and Raelh [23] reviewed data from 14 hospitals and found out that seven clinical pharmacy services were associated with reduced mortality rates:

a. Pharmacist-provided drug use evaluation,
b. Pharmacist-provided in-service education
c. Pharmacist-provided adverse drug reaction management
d. Pharmacist-provided drug protocol management
e. Pharmacist participation on the CPR team
f. Pharmacist participation on medical rounds
g. Pharmacist-provided drug admission histories

3 Role of clinical pharmacists

With the help of references and current practices at various hospitals, following points were drawn as the role of clinical pharmacists.

Ward rounds

The daily ward rounds by pharmacists provide an opportunity to:

- Investigate unusual drug orders or doses
- Assimilate additional information about the patient which may be relevant to their drug therapy including the allergy monitoring
- Detect and monitor ADRs.
- Information on new drugs and their monitoring
- Restricted antibiotic monitoring
- Drug interaction, Anticoagulant and Hypoglycemia monitoring
- Monitoring for drug administration by nurses.
- Drug dose adjustment in patients with compromised renal functions

Error monitoring

- Following errors are being continuously monitored through regular indent checking and drug chart review during the ward rounds:
    a) Prescription Errors
    b) Transcription Errors
    c) Administration Errors
    d) Dispensing Errors

- All these are regularly monitored and analyzed every month and continuous efforts are made to reduce these errors through anticipating, investigating and preventing errors and training of the concerned staff.

Restricted antibiotic monitoring

- Infection control committee in the hospital oversee the use of restricted antibiotics. Further monitoring and dose standardization are done by continuous monitoring by the clinical pharmacologist and the team of clinical pharmacists with the help of culture sensitivity reports.

Drug interaction monitoring

- During their regular ward rounds, pharmacists check for the compatibility of the various drugs prescribed to the patients.
- If there is any probability of the drug interactions, same is monitored through regular follow up of the patients with clinical and investigational monitoring.
- Any clinically significant drug interaction is reported and documented and same is conveyed to the treating clinician for necessary interventions and dose changes if required.
- Any food–drug interaction if present is also looked after in the same way.

Drug dosage monitoring

- Pharmacist monitor the drug dosage during their ward rounds.
- They check the renal profile, hepatic profile and other relevant investigations.
- They check the serum creatinine level of patients and calculate the dose according to patient Creatinine clearance.
- If any dosage adjustment is needed respective doctor is informed.

ADR monitoring

- The World Health Organization defines an ADR as “any response to a drug which is noxious and unintended, and which occurs at doses normally used in man for prophylaxis, diagnosis or therapy of disease, or for the modification of physiological function”.
- Regularly monitor the prevention, detection, assessment and management of adverse drug reaction (ADRs).

New drug monitoring

- The drugs recently added in pharmacy are monitored by clinical pharmacist.
- In new drug monitoring we are considering the safety profile of the drug for at least six months.
- Any prescription of the new drug is documented and monitored for its safety profile.
- If the drugs which are monitored are found to be safe for the use in patients, then the drug is added in our hospital formulary after approval by the drug committee.

Concentrated electrolytes

- As per hospital policy following drugs are included under high alert medication:
    a) Inj Magnesium Sulphate ≥ 50 %
    b) Inj Potassium Chloride
    c) Inj Sodium Chloride > 0.9 %
- These medications are kept under double lock at nursing stations of Emergency, Medical ICU, CTVS ICU, CCU and OT area only.

- Regular monitoring of use of these drugs are done to ensure their safe use in the hospital.

Anticoagulant monitoring

- Use of anticoagulants carry a great risk of bleeding tendencies. Continuous monitoring is required for the proper use and appropriate dose adjustments of the anticoagulants wherever required.
- Pharmacists during the ward round monitor the patients prescribed with anticoagulants and check for their lab investigations and if there is any dose adjustment required, same is conveyed to the treating clinician.

Hypoglycemia monitoring

- Use of hypoglycemic including various type of insulin are monitored in the hospital on regular basis.
- Any hypoglycemic event that occurs in the hospital is properly documented.
- Measures are implemented, like use of sliding scale for insulin prescriptions and continuous blood sugar monitoring for vulnerable patients, to reduce these hypoglycemic events.

Neonatal and pediatric dose calculation

- Data regarding neonatal and pediatric body weight are obtained on the daily basis and the same is documented in prescription audit department.
- Neonatal and Pediatric doses are calculated based on their body weight and body surface area and cross checked with the prescribed doses.

Crash cart and imprest stock

- To handle any emergency in the wards and other hospital areas there is a provision of "Imprest Stock" (which contain medications as per the requirement of that site) at every site, which is maintained by nursing department under supervision by pharmacy.
- To manage sudden cardiac arrest (Code Blue) there are "Crash Carts" at every accessible site of the hospital which contain the necessary medications, surgical, consumables, defibrillator and oxygen cylinders. This is also maintained by nursing department under supervision by the pharmacy and checked for expiry and quantity at least once a month.

4 Methodology

4.1 Study design

Retrospective, descriptive analysis of a process flow

4.2 Study area

Medanta- The Medicity, Gurgaon

4.3 Study duration

The analysis was conducted for period November 2015 to January 2017. This was conducted from the months of March 2017- April 2017.

4.4 Sample

All the In-patients (IP) excluding ICUs, Emergency, and OTs

4.5 Method

4.5.1 Mapping of the medication process activity

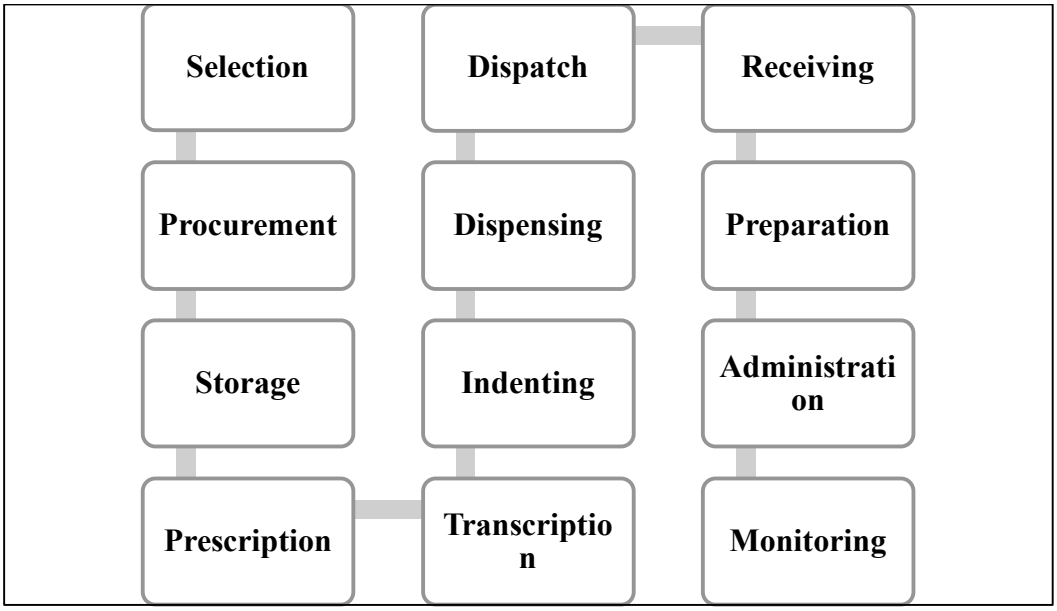

Fig 4.1: Medication process system overview

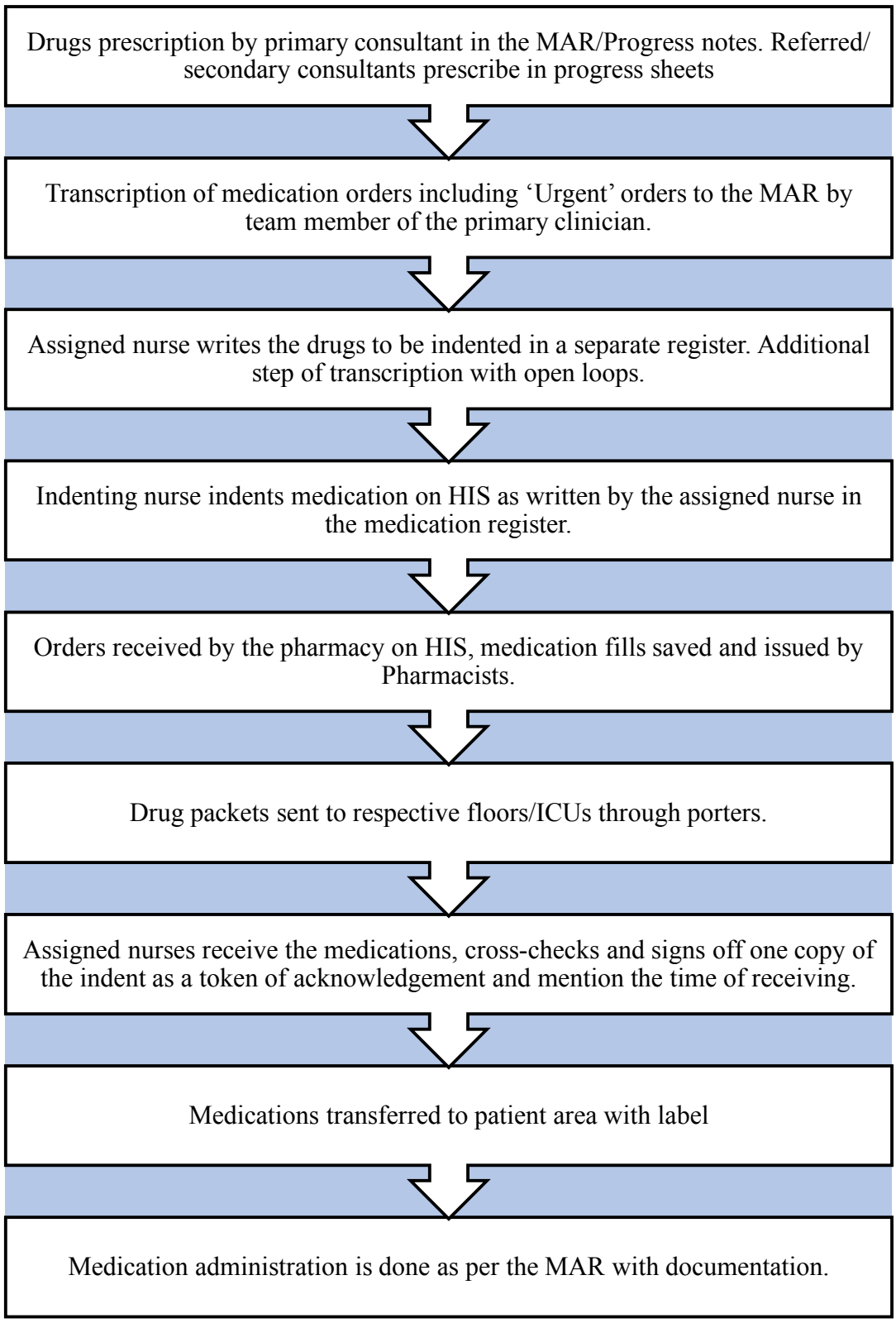

Fig 4.2: Pre-pilot Medication process

4.5.2 Gap analysis

a) Over-processing: The multiple steps of transcription were involved in the previous medication flow which was leading to increase in the number of various types of errors.
b) Nursing activities: Indenting medications, inventory management are directly nursing tasks and are not a part of their core competencies. Moreover, it was leading to reduction in time from patient care.
c) Large processing time: There were multiple transcription steps, manual process of writing indents, sending and receiving medications.
d) Irrationality in transaction: Multiple, duplicate orders were being placed leading to unnecessary wastage of resources.
e) Identification of errors: There was no way to identifying and reporting the medication errors occurring on day to day basis.

4.5.3 Identifying improvement area

The aim of improvising the medication process was to ultimately improve the patient care. The following were the projected advantages with the improved process flow:

a) Reduction in process steps: The new process was expected to be leaner. The steps of transcription by nurses was removed as it was directly ordered in the HIS by the pharmacist which would reduce the number of transcription errors.
b) Transcription by clinical pharmacist: The clinical pharmacist is trained to handle the medications and therefore any error that may occur will be identified by the pharmacist. The pharmacist will first review the medication and then transcribe to place an order.

c) Improved identification and reporting of medication errors: The identification of transcription errors, prescription errors was predicted to reduce. The dispensing would be done by the pharmacist by identifying the order correctly when it arrived on the floor which would bring down giving wrong medication to wrong patient.

d) Rationalization of nursing tasks: The main objective of nursing is to provide unperturbed patient care. The task of ordering, maintaining inventory etc. deflects the nursing care towards patient. With the advent of clinical pharmacist, the work would be taken up by them and nurses could provide patient care with increased patient satisfaction.

e) Ward stock inventory to be managed by clinical pharmacist

4.5.4 Re-structured process flow

An improvised medication process flow was defined with the introduction of the role of clinical pharmacist which was first done as a pilot on a single floor for analysis.

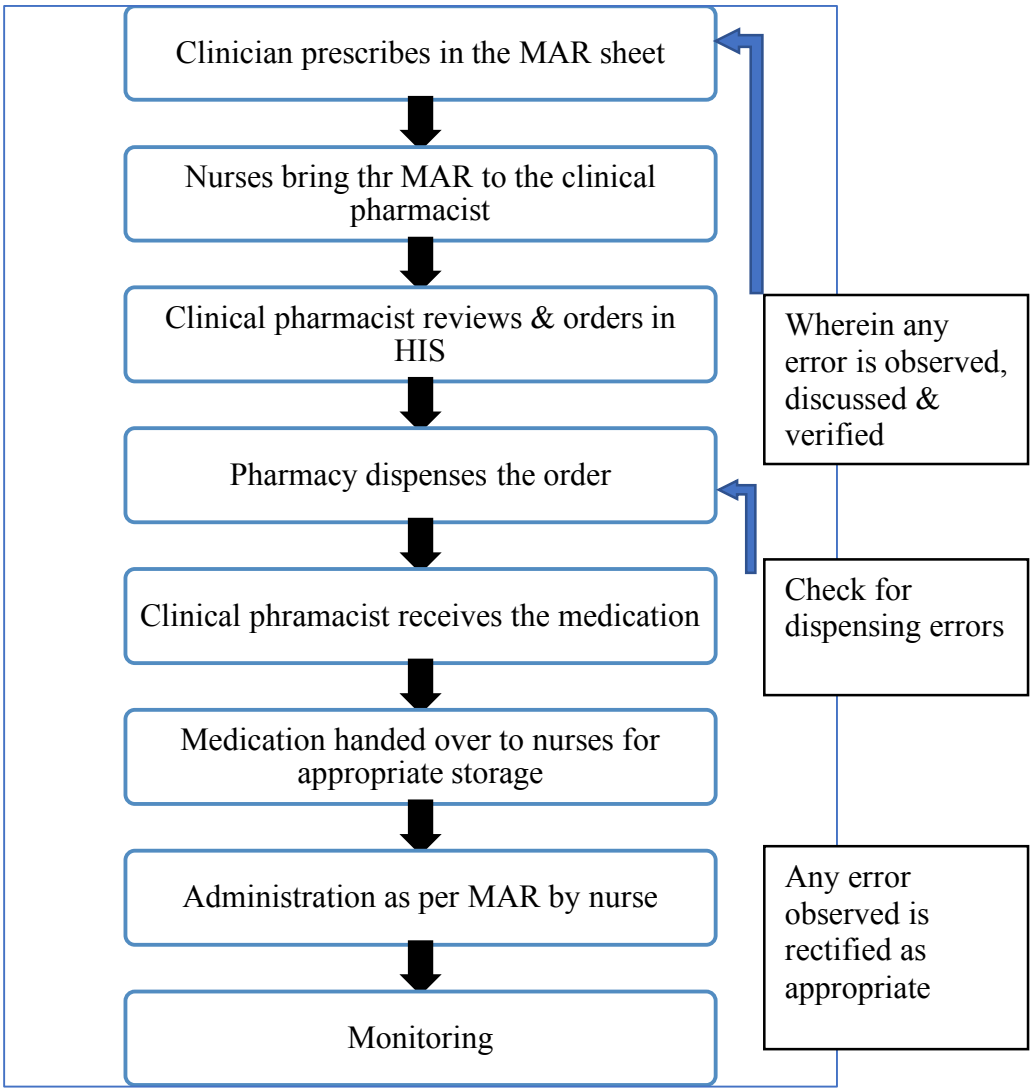

Fig 4.3: Re-structured process flow

4.5.5 Pilot implementation

A pilot phase was implemented for two months during the months of December 2015- January 2016 for 106 beds on one identified floor. Three dedicated pharmacist were appointed and trained for conducting the medication management activities. They worked in two shifts covering 8 AM to 8 PM. Pilot phase was analyzed for improvement being brought upon by changing the process in terms of:

- Reduction in the number of average indents/patient/day,
- Average dispensing Turn-around Time (TAT),
    - Urgent orders
    - Routine orders
- Percentage of 'Urgent' orders out of total orders
- Identification and reporting of different types of medication error
- Percentage of medication errors

The formula used for the calculation of percentage of medication errors was adopted from National Board of Accreditation for Hospital and Health care providers (NABH), 3rd edition:

$$(\text{Total number of medication error} \div \text{Total In} - \text{patient days}) \times 100$$

4.5.6 Expansion of activities

With the pilot phase, the outcome and impact was analyzed and discussed with Pharmacy and Drug Therapeutic Committee of the hospital. The concept was

then replicated on all the other areas of the hospital with 24-hour coverage by the trained clinical pharmacists.

4.5.7 Limitation of methodology

The limitation of the study was that the clinical pharmacist were not implemented in the ICUs as they require 1:1 patient staff ratio which was not feasible.

5 Results

5.1 Pilot Study

The aim of conducting a pilot study was to understand the feasibility of the project. The analysis of data from the months of December 2015 and January 2016 had shown the following results:

Initially the average indents/day were 282, which had reduced to an average of 215/day. The number of indents/patient/day had reduced from 2.89 to 2.1. The number of 'Urgent' orders reduced from 55% to 38%. The average dispensing time for routine medications was 59 minutes from a sample data of 10% of total routine indent for the concerned floor, while the hospital average TAT for routine medications in the month was November-2015 was 165 minutes.

5.2 Status - Pre-implementation:

The baseline data was collected before beginning the study to understand and analyze the indicators as mentioned in the methodology.

Table5.1: November-2015 baseline data

S. No.	Parameter	November 2015
1	Avg. indent / day	2716
2	Avg. inpatient days	667
3	Avg. indents / patient / day	4.07
4a	Avg. TAT - Routine (Dispensing); min	165
4b	Avg. TAT - Urgent (Dispensing); min	62
5	Avg. ' Urgent ' (% of total orders)	45

The number of average indents/patient/day was as high as 4.07 in November-2015. The average TAT for routine orders and urgent orders dispensing time (minutes) was 165 and 62 respectively. The percentage of Urgent orders out of total orders was 45%.

Table 5.2: Data of November-2015 of different types of medication errors

	IP days	Prescription	Indenting	Dispensing	Administration	Total	%
Nov-15	22017	15	0	0	2	17	0.08

It is evident that the number of prescription errors were highest amongst the other types of errors. The percentage of medication error was only 0.08%.

5.3 Status - Post implementation:

After complete implementation of clinical pharmacist in all the included area, the data was collected and analyzed for its overall impact on operational efficiency with the help of indicators defined. The data from the month of January 2017 depicts:

Table 5.3: January-2017 post-clinical pharmacist implementation data

S. No.	Parameter	January 2017
1	Avg. indent / day	2148
2	Avg. inpatient days	608
3	Avg. indents / patient / day	3.53
4a	Avg. TAT - Routine (Dispensing); min	57
4b	Avg. TAT - Urgent (Dispensing); min	21
5	Avg. ' Urgent ' (% of total orders)	36

The number of average indents/patient/day was 3.53. The average TAT for routine and urgent order dispensing time (in minutes) was 57 and 21 respectively. The average number of percentage of Urgent orders out of total orders was 36%.

Table 5.4: Data of January-2017 of different types of medication errors

	IP days	Prescription	Indenting	Dispensing	Administration	Total	%
Jan-17	19083	40	10	2	5	57	0.3

The number of prescription errors were the highest i.e. 40 followed by indenting errors, administration and dispensing errors. The percentage of medication errors was 0.3%.

5.4 Comparison of pre-and post-implementation data:

Table 5.5: Comparison of pre-and post-clinical pharmacist indicators

S. No.	Parameter	Nov-15	Jan-17	% Reduction
1	Avg. indent / day	2716	2148	-20.91
2	Avg. inpatient days	667	608	-8.85
3	Avg. indents / patient / day	4.07	3.53	-13.27
4a	Avg. TAT - Routine (Dispensing); min	165	57	-65.45
4b	Avg. TAT - Urgent (Dispensing); min	62	21	-66.13
5	Avg. ' Urgent ' (% of total orders)	45	36	-20.00
6	Percentage of medication errors	0.08%	0.3%	-

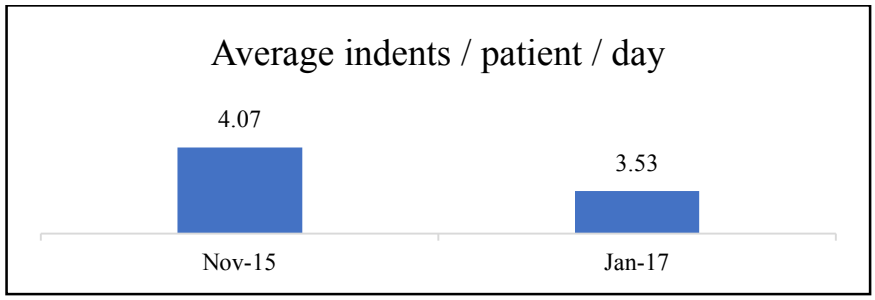

Fig 5.1: Average indents/patient/day

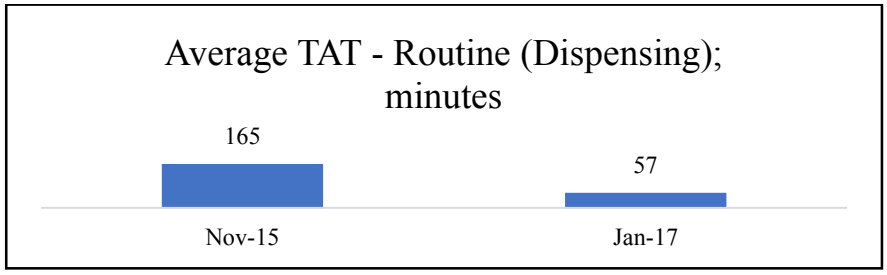

Fig 5.2: Average TAT for routine orders

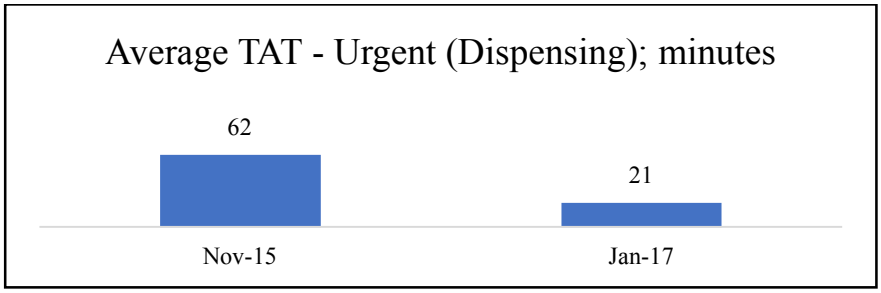

Fig 5.3: Average TAT for urgent orders

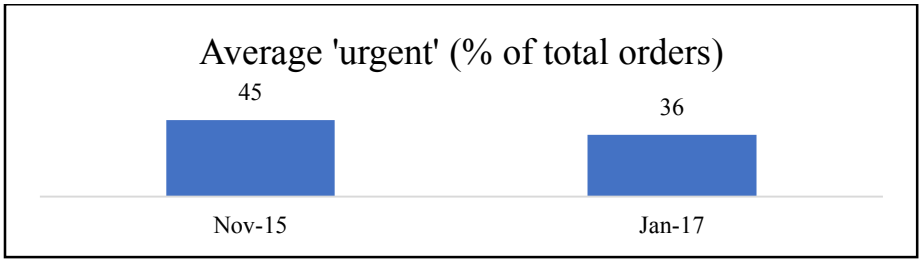

Fig 5.4: Average ‘urgent’ orders (% of total)

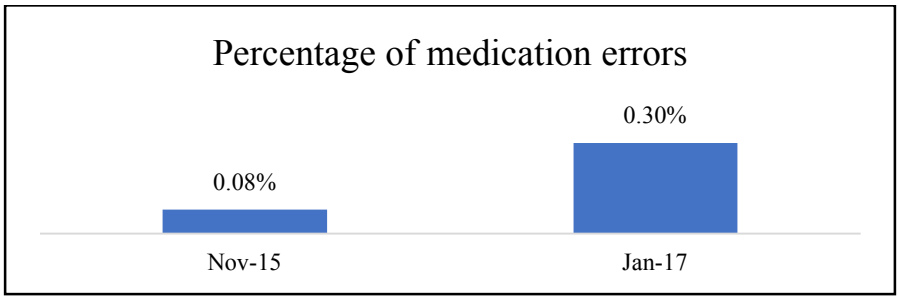

Fig 5.5: Percentage of medication orders

The analysis was done for the impact of clinical pharmacist with respect to medication errors for the defined indicators. A comparison was drawn from the month of November 2015 and January 2017. The data that was collected in November 2015 was the one when there were no defined steps and protocol for identification and reporting of medication errors, only a random sampled audit of less than 5% patients was being carried out solely for audit purpose.

The data collected in January 2017, was collected after clinical pharmacists were completely executed in all the designated locations. The data shows a significant reduction by 20.91% in the numbers of average indents/day. There was a decline by 13.27% in average indents/patient/day. The average TAT- routine and urgent (dispensing time in minutes) had remarkably reduced by 65.45% and 66.3% respectively. The average number of urgent orders had reduced by 20%.

The percentage of medication errors in Novemeber-2015 was 0.08% and in January-2017, 0.3%.

5.5 Trend analysis of medication errors

Table 5.6: Trend analysis of types of medication errors from November-15 to January-17

	IP days	Prescription	Indenting	Dispensing	Administration	Total
Nov-15	22017	15	0	0	2	17
Dec-15	22818	48	3	0	7	58
Jan-16	21953	43	0	1	4	48
Feb-16	21659	73	0	1	9	83
March-16	22155	227	2	0	12	241
April-16	22720	328	2	4	40	374
May-16	24037	277	2	4	17	300
June-16	19266	210	0	0	32	242
July-16	18136	261	2	13	23	299
Aug-16	14720	151	2	8	14	175
Sept-16	22083	109	2	25	21	157
Oct-16	19387	97	1	10	16	124
Nov-16	18768	69	6	15	17	107
Dec-16	18996	54	17	5	4	80
Jan-17	19083	40	10	2	5	57

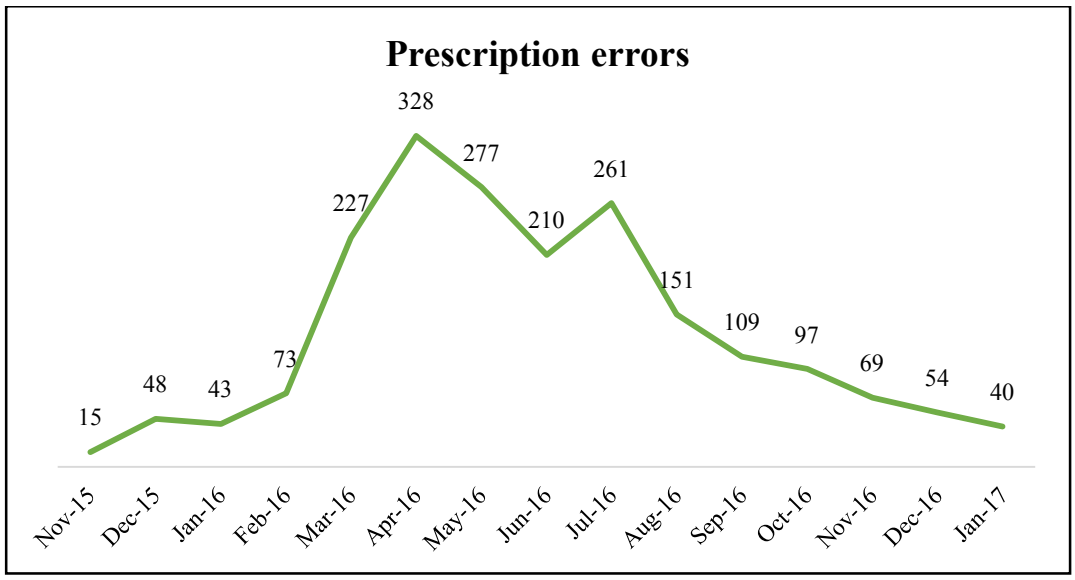

Fig 5.6: Trend analysis of prescription errors

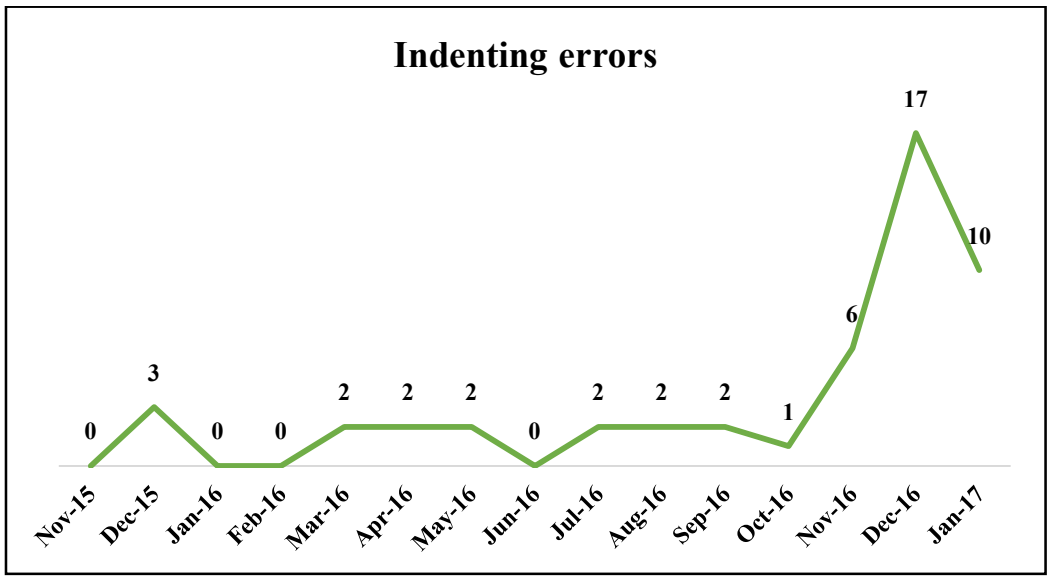

Fig 5.7: Trend analysis of indenting errors

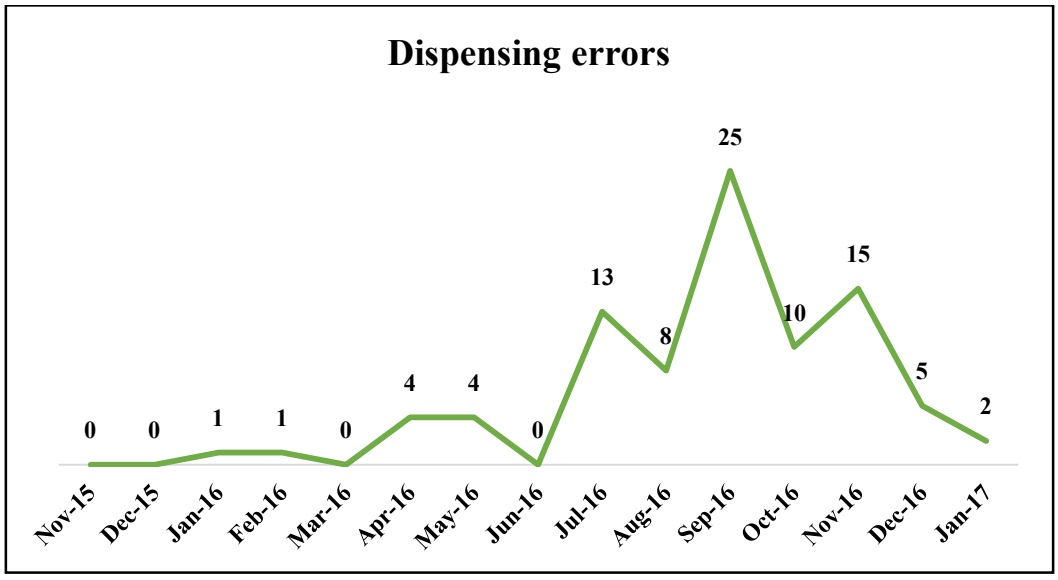

Fig 5.8: Trend analysis of dispensing errors

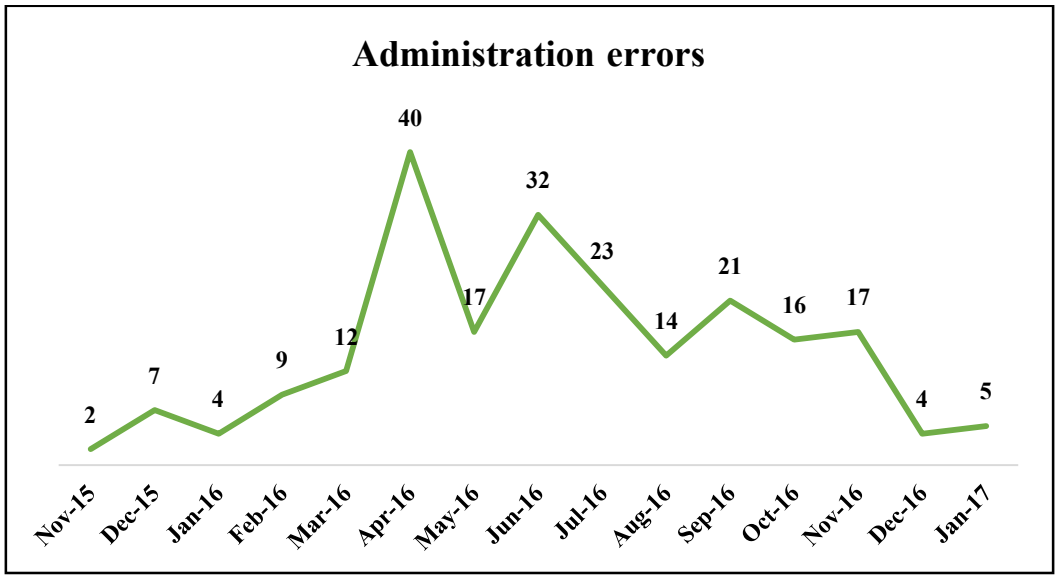

Fig 5.9: Trend analysis of administration errors

A trend analysis was conducted on the data on different types of medication errors from November 2015 till January 2017. Complete data was studied to see the impact on numbers before the clinical pharmacist were deployed, during the pilot phase and post clinical pharmacist implementation in the hospital. A continuous monthly monitoring was conducted to analyze the different types of errors and the percentage of medication errors. The total data for medication errors per in-patient days was collected/month and the trend in percentage change of medication errors was observed. The clinical pharmacists were positioned from the month of February after the pilot was conducted from December-15 to January-16. The data depicts that the number of prescription errors were the highest, followed by administration, dispensing and lastly indenting errors over the observed duration. Initially, the total number of errors were 17 in the month of November-15 with the highest peak in the month of April-16 with 374 errors which had gradually come down to 80 medication errors by the last month and 57 by January-17 which was the lowest value observed after the implementation.

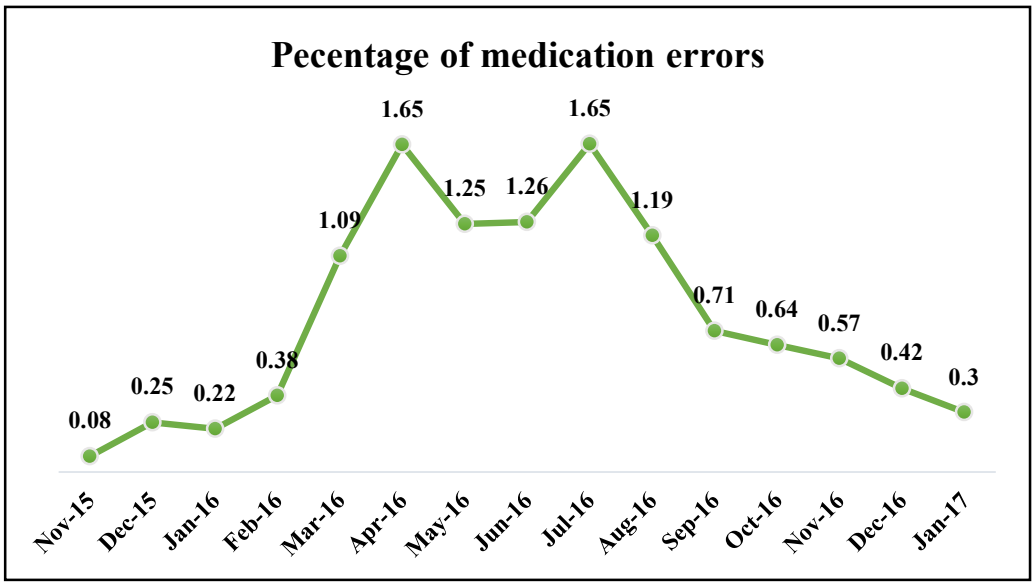

Fig 5.10: Trend analysis of percentage of medication errors

In the initial period, the medication errors were only 0.08% in November-15. March onwards an escalating trend in medication errors was observed with the highest peak reported in april-16 with 1.65% of medication errors. However, the percentages started to decline September onwards i.e. 0.71% and was 0.3% by the month of January-17. The fall in percentage signifies that there was a positive impact of clinical pharmacists over the period.

6 Discussion

It was observed that clinical pharmacists play an important role in the reduction of medication errors evolving from pharmacist site and nursing department. Identification of patterns and reporting of medication errors will lead to preventive interventions. This study supports the use of clinical pharmacists in the inpatient setting to improve the operational efficiency, cost-effectiveness, and quality of medication services.

Leape and colleagues[9] showed that a clinical pharmacist participating in an intensive care unit team led to "a statistically significant 66% decrease in preventable ADEs due to medication ordering." In the study by Leach RH and colleagues[24] suggested that ward-based clinical pharmacists may benefit inpatient medication use safety and quality. From the fig 5.10, it was observed that at the beginning of the study, the percentage of errors reported were only 0.08%, which gradually increased to a maximum of 1.65% in the month of April-16. There was no protocol defined in the hospital for identifying and reporting the medication errors because of which the percentage of errors were on a lower side. After the clinical pharmacist role was activated, there was a gradual rise in the numbers of errors specially prescription error identification which indicates that the clinical pharmacists could track the errors in the primary stage making them near-miss errors and averting them to convert to administration errors. The percentage of medication errors had reduced to only 0.3% by January-17.

The study is in tandem with the report of DC National Academy[25] which proposed that clinical pharmacists have a significant role in addressing quality issues in

hospitalized patients. The clinical pharmacist can be a vital part of the in-patient care team. The findings of this study are supported by a large observational study by Bond et al[23] that identified 17 clinical pharmacy services in hospitals associated with improvement in mortality, drug costs, and cost of care. In 4 trials, clinical pharmacist recommendations led to reductions in the number of unnecessary medications and number of daily doses, improved medication appropriateness and medications lacking an indication or known adverse drugs events ADRs, and fewer drug interactions.[26] The addition of clinical pharmacist services in the care of inpatients generally resulted in improved care with no evidence of harm. Interacting with the health care team on patient rounds, interviewing patients, reconciling medications, and providing patient discharge counselling and follow-up all resulted in improved outcomes, such as reduced adverse drug events or medication errors; improved medication adherence, knowledge, and appropriateness; and shortened hospital length of stay.[1]

This study depicts the improvement in the process flow of the medication services in a step-wise manner (refer fig 4.2) which was not perceived in any of the other studies. The mapping of the skeleton of the medication process was completed at first, following which the complete medication process being used in the hospital prior to the new implementation was done. After that the gap analysis was done, a re-structured process was defined (refer fig 4.3). There was a reduction in the transcription steps, decreased load of administrative work by nurses and increased monitoring by the clinical pharmacist to identify an error and rectify it.

This study showed a positive impact on decreasing the transaction load on the hospital on day to day basis which was unique to the study and not seen in the

literature available. This was evident through the average number of indents/patient/day which was 4.07 in November 2015, and post-implementation, it was 3.53 in January 2017. The percentage of the urgent orders was 45% in November 2015, which had reduced to 36% post implementation.

The impact of clinical pharmacist didn't only limit to the scope of medication errors and improvement in the medication process but also had a positive financial effect overall. The number of medication staff working on each floor was calculated, which was been taken care by nursing prior to the implementation. The same was done for deploying clinical pharmacist throughout the hospital. The number of 'nursing' medication staff deployed were 86 against the requirement of clinical pharmacist, which was calculated to be 55 based on future deployment plan. The analysis on the cost resulted in potential reduction of ₹1,90,000/month on CTC (Cost to Company) basis. There are various published studies evaluating the cost of incorporating clinical pharmacists have generally demonstrated a net hospital cost benefit in terms of cost avoidance and use.[27-29] The same has been reviewed by De Rijdt et al [30]. Cost- saving clinical pharmacy interventions were found to comprise a small percentage of clinical pharmacy interventions, but they generated substantial savings which were consistent with the study conducted.

The physicians decide on drug therapy, and pharmacists and nurses implement these decisions. The presence of clinical pharmacists on rounds may lead to more informed clinical decisions by physicians, as well as interception of errors before medication orders are finalized. Their presence on the wards should facilitate communication between clinical staff and the pharmacy. Moreover, the clinical pharmacists could independently conduct the transcription process, assist nurses with drug preparation

and administration, and monitor the drug preparation, storage, inventory management and distribution systems. They also could be involved in developing education programs and drug therapy protocols.[31]

As a visible improvement can be seen in the operational efficiency and the quality of medication services, there are multiple future avenues where the role of clinical pharmacists could be pragmatic with respect to BCMA, antibiotic stewardship and strong pharmacovigilance with better adverse drug reaction reporting. The clinical pharmacist could be incorporated into monitoring of focused new drugs, hypoglycemia drugs, anticoagulants where they can add value to therapeutics. Patient counselling on the medications could be taken up by the clinical pharmacist, including the participation in the discharge counselling.

7 Conclusion

The clinical pharmacist's impact in terms of operational efficiency on the hospital had remarkably improved. It led to an improved quality of identification, reporting and corrective actions towards the medication errors. Overall integrating clinical pharmacy services improves overall medication services including medication safety.

Bibliography

1. Kaboli PJ, Hoth AB, McClimon BJ, Schnipper JL. Clinical Pharmacists and Inpatient Medical CareA Systematic Review. Arch Intern Med. 2006;166(9):955-964. doi:10.1001/archinte.166.9.955
2. National Coordinating Council for Medication Error Reporting and Prevention. What is a medication error?[Accessed October 1, 2007]. www .nccmerp.org/aboutMedErrors.html.)
3. Cohen Michael R., Medication Errors, 2nd edition. (Washington, DC: American Pharmaceutical Association, 2007), 55-66.)
4. Hughes, R. G., & Blegen, M. A. (2008). Medication Administration Safety. Patient Safety and Quality: An Evidence-Based Handbook for Nurses. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/21328757
5. Institute of Medicine. Preventing medication errors. Washington, DC: National Academy Press; 2007
6. O'Shea E. Factors contributing to medication errors: a literature review. J Clin Nurs. 1999;8:496–504. [PubMed]
7. Duthie E, Favreau B, Ruperto A, et al. Advances in patient safety: from research to implementation. 3 . Rockville, MD: Agency for Healthcare Research and Quality; Feb, 2005. Quantitative and qualitative analysis of medication errors: the New York experience. AHRQ Publication No. 05–0021
8. Avery A, Barber N, Ghaleb M, Franklin BD, Armstrong S, Crowe S, et al. Investigating the prevalence and causes of prescribing errors in general practice: the PRACtICe study. London: General Medical Council; 2012.

9. Leape LL, Cullen DJ, Clapp MD, et al. Pharmacist participation on physician rounds and adverse drug events in the intensive care unit. JAMA. 1999;282:267–70. [PubMed]
10. Phillips J, Beam S, Brinker A, et al. Retrospective analysis of mortalities associated with medication errors. Am J Health Syst Pharm. 2001;58:1835–41. [PubMed]
11. Massachusetts Nurses Association (MNA) Nurses' six rights for safe medication administration. Paper presented at MNA Congress on Nursing Practice; Canton, MA. 2006. Available at: www.massnurses.org/nurse_practice/sixrights.htm.)
12. Leape LL, Bates DW, Cullen DJ, et al. Systems analysis of adverse drug events. JAMA. 1995;274:35–43. [PubMed]
13. Medication Errors | AHRQ Patient Safety Network. (n.d.). Retrieved April 9, 2017, from https://psnet.ahrq.gov/primers/primer/23/medication-errors
14. Mueller SK, Sponsler KC, Kripalani S, Schnipper JL. Hospital-based medication reconciliation practices: a systematic review. Arch Intern Med. 2012;172:1057- 69.
15. Lainer M, Mann E, Sönnichsen A. Information technology interventions to improve medication safety in primary care: a systematic review. Int J Qual Health Care. 2013;25:590-8.
16. Radley DC, Wasserman MR, Olsho LE, Shoemaker SJ, Spranca MD, & Bradshaw B. Reduction in medication errors in hospitals due to adoption of computerized provider order entry systems. Journal of the American Medical Informatics Association. 2013;3:470-476.

17. Forrester SH, Hepp Z, Roth JA, Wirtz HS, & Devine EB. Cost-Effectiveness of a Computerized Provider Order Entry System in Improving Medication Safety Ambulatory Care. Value in Health. 2014;17: 340-349.
18. Roque F, Herdeiro MT, Soares S, Teixeira Rodrigues A, Breitenfeld L, et al. Educational interventions to improve prescription and dispensing of antibiotics: a systematic review. BMC Public Health. 2014;14:1276
19. American Society of Health-System Pharmacists, Section of Pharmacy Informatics and Technology. ASHP statement on bar-code-enabled medication administration technology. Am J Health Syst Pharm. 2009;66(6):588–90. doi: 10.2146/ajhp080414. [PubMed] [Cross Ref]
20. Meadows G. Safeguarding patients again medication errors. Nurs Econ. 2002;20(4):192–4. [PubMed]
21. Anderson S, Wittwer W. Using bar-code point-of-care technology for patient safety. J Healthc Qual. 2004;26(6):5–11. [PubMed]
22. Hassink, J., Jansen, M., & Helmons, P. (2012). Effects of bar code-assisted medication administration (BCMA) on frequency, type and severity of medication administration errors: a review of the literature. European Journal of Hospital Pharmacy, 191136, 489–494. https://doi.org/10.1136/ejhpharm-2012-000058
23. Bond, C. A., Raehl, C. L., & Franke, T. (1999). Clinical pharmacy services and hospital mortality rates. Pharmacotherapy, 19(5), 556–64. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/10331818
24. Leach RH, Feetam C, Butler D. An evaluation of a ward pharmacy service. J Clin Hosp Pharm. 1981 Sep;6(3):173–82. [PubMed] [Reference list]

25. Crossing the Quality Chasm: A New Health System for the 21st Century. Washington, DC National Academy Press; 2001. [cited 2001 March]. Available from: http://www.nap.edu/html/quality_chasm/reportbrief.pdf.
26. Dager WE, Branch JM, King JH. et al. Optimization of inpatient warfarin therapy: impact of daily consultation by a pharmacist-managed anticoagulation service. Ann Pharmacother 2000; 34567- 572
27. Schumock GT, Meek PD, Ploetz PA,Vermeulen LC. Economic evaluations of clinical pharmacy services 1988-1995. Pharmacotherapy 1996; 161188- 1208.
28. Cowper PA, Weinberger M, Hanlon JT. et al. The cost-effectiveness of a clinical pharmacist intervention among elderly outpatients. Pharmacotherapy 1998; 18327- 332.
29. Mutnick AH, Sterba KJ, Peroutka JA, Sloan NE, Beltz EA, Sorenson MK. Cost savings and avoidance from clinical interventions. Am J Health Syst Pharm 1997; 54392- 396.
30. De Rijdt T, Willems L, Simoens S. Economic effects of clinical pharmacy intervention. A literature review. Am J Health-Syst Pharm. 2008; 65:1161–72
31. Rainu K. David W. Christopher L. Medication error and adverse drug events in pediatric inpatients. JAMA 2001; 16: 2114-2120.