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Badr Ali Gassar, PharmD student,
Karnataka College of Pharmacy,
Bangalore, India 560064

Email – taffy.hatim@gmail.com

Badr Ali Gassar, Balakeshwa Ramaiah,Mustafa Ali, Raju Koneri

EFFECTIVE METHODS TO DETECT MEDICATION ADMINISTRATION AND ITS RELATED ERRORS IN SURGICAL WARDS BY CLINICAL PHARMACIST AT A TERTIARY CARE HOSPITAL - A SINGLE BLINDED STUDY

Introduction

Medication error is a critical problem in all healthcare systems around the world. They are associated with life threatening complications, rise in patient treatment cost as well as prolonged hospitalization. [1,2] Medication errors mainly result in non-essential diagnostic evaluations and treatment which lead to prolong the duration of hospital stay and sometimes loss of patient's life. [1,3] Medication errors can be classified into four categories - prescription error, administration error, transcription error and dispensing errors. To minimize such errors medical team staff should be aware of various types of medication errors.[4] Observation and medication chart review methods are used to evaluate the administration errors in which a clinical pharmacist observes the nurse while administering the medication to the patient and record the dose, dosage form, time, proper medication given or not, as well as record the dose omitted.[5]

To evaluate the medication errors the observer should be aware of the nature and type of medication errors. The medication administration system involves the drug dose, drug dosage form, time of administration, and rational drug use.[6] Among all types of errors the administration errors and prescribing errors are most common and according to the American Society of Health-System Pharmacist' (ASHP), the types of medication errors under were categorized as prescribing errors, omission errors, wrong time errors, unauthorized drug errors, improper dose error, wrong dosage form errors, wrong administration or technique errors, drug duplicate errors, storage errors.[7-8] This article evaluated and analyzed the medication errors by using direct observation method as well as medication chart review method.

Majority of the medication errors were due to variable barriers such as lack of pharmacological knowledge, heavy workload, pharmacy delay in dispensing medicine. [9,10] One study conducted in England [(11)] reported a medication error rate of about 0.15% and nurses were responsible for 59 % of those errors. Other study showed around 71% of errors were due to improper prescription order whereas 29% related to dose calculation and it revealed the common types of errors were an improper prescription of medicine, wrong administration and improper time. [6] The aim of our research was to find out the impactful methods to detect medication errors in surgical wards by the clinical pharmacist at tertiary care hospital in a single-blinded observational research. [12] The National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP) Proposed medication error index was used to assess the severity of medication error included direct observation method as well as medication chart review method.[13] The complete study

was primarily focused on the errors that occur during drug administration and its related errors.

Methods

Our study included all patients admitted to the surgical ward both adult and geriatric patients irrespective of the diagnosis. It was conducted at the surgical wards in a 500 beds multi-specialty tertiary care hospital presented at south India. The data were collected using a data collection form that contains patient demographic details and criteria to identifying errors as well as its categorization and details of drugs involved in errors. All patients and medications information were recorded through the review of the medication chart, checking of prescriptions.

Direct observation was used to detect medication errors on each day upon observation, the clinical pharmacist as an observer was present at the nursing unit prior to medication administration. The observer witnessed the administration of 100 doses eight hours per day by nurses. During this process, patients were blinded and were not aware of the clinical pharmacist observation. The observed data were then cross checked with the medication chart to confirm the errors. The error was further discussed with both clinicians and nurses immediately to prevent the patient from being harmed. In medication chart review process, the charts with the same hospital reference number as that observed using direct observation method were being studied. The medication profile, lab investigation data, hospital formulary, drug storage and labeling, databases and hospital protocol files were thoroughly investigated to identify for any associated errors in the case. Then, the observer analyzed the collected data and finally reported the errors for the concerned clinicians. All the errors were further classified and the effectiveness of the method was demonstrated based on the nature, type and number of the errors reported by respective method.

Results

The total patients included in the study were 558 over a period of six months (from September -2016 to February -2017), 12572 dose administration were observed in this study. Rate of errors detected by direct observation was 22.5% while medication chart review showed 20%. Five thousand eight hundred thirty nine doses were the total opportunities of errors by direct observation and 6766 doses by medication chart review, 383 administration errors were detected by both methods. There were more administration errors (n=290, 75.70 %) by direct observation while during the chart review, there were 93 (24.20 %) errors. In case of factors contributing medication, 2404 total errors were detected in which 1033 (42.97 %) errors were identified by direct observation while there were 1371 (57%) errors observed by chart review method. Administration errors by direct observation method consider as the majority detected errors in this study. statistically the t-value and p-value were significant except with extra dose as well as omission dose errors. The details are shown in Table 1.

Unauthorized errors were the most frequent administration errors found (n=61, 21%), followed by wrong time (n=56, 19.3%), extra dose errors (n=43, 14.8%), wrong route (n=40, 13.7%), wrong dose (n=28, 9.56%), wrong form (n=23 7.9%), wrong technique errors (n=20, 6.8%), and omission (n=19, 6.55%). Administration errors by medication chart review method were least detected errors in this study. Extra dose errors were the most repeated administration errors found (n=37, 39.7%),

followed by wrong time (n=24, 25.8%), wrong dose (n=18, 19.3%), and omission (n=14, 15%).

The common observed errors during the study is represented in table 2.

Table 1: Rate and Frequency of all types of detected administration errors by direct observation and medication chart review methods (n=383)

Administration errors	Direct observation method	Medication chart review method	*t* -value	*p* value	Significance
	No. of errors (%)				
Unauthorized Dose	61 (21%)	0	10.79128	<.00001	Significant
Extra Dose	43(14.8%)	37 (39.7%)	0.762	0.231826	*Not* significant
Wrong Dose	28 (9.65%)	18 (19.3%)	2.07614	0.032308	Significant
Omission	19 (6.55%)	14 (15%)	1.31306.	0.112786	*Not* significant
Wrong Route	40 (13.7%)	0	5.01745	*0*.00036	Significant
Wrong Form	23 (7,9%)	0	11.5	<.00001	Significant
Wrong Techniques	20 (6.8%)	0	5.65685	*0*.000239	Significant
Wrong Time	56 (19.3%)	24(25.8%)	2.52622	0.015033	Significant
Total	290	93			

Table 2: Observed examples of administrative errors with incidents during the study period

Type of Error	Dosing type	Example
Dose omission	Parenteral dose	Injection promethazine Injection Magnex forte (cefoperazone +sulbactam)
	Oral dose	Tablet Losartan Tablet isosorbid Dinitrate
Unauthorized dose	Parenteral dose	Injection Potassium chloride Injection kamadol 50 mg /1ml
	Oral dose	tab .Telmisartan 40mg tab. Mteronidazole 400mg
Wrong route	Parenteral dose	Injection Promethazine administered by IV route instead of IM Insulin supposed to be given as SQUB but it administered as IV
Wrong technique	Parenteral dose	Injection Heparin 5000U administered without wiping at the site of inj. Injection Clexane 40mg administered without wiping at the site of inj.

Wrong time	Parenteral Dose	Injection Cefazolin 1 g injection supposed to be given at 5 pm while it has been given at 3:10 pm Amikacin injection supposed to be administer at 12pm while it administered at 1:10pm
	Oral dose	Tablet Diltiazem administered at 11am instead of 9am Tablet H.P.Kit given at 2:30pm instead of 9am.
Extra dose	Parenteral dose	Injection levocetrizin Injection promothazin has been administered after it has been discontinue
	Oral dose	Tablet augumentin found out of 10 tablets 6 has been administered while it has been already DC Injection omeprazole was prescribed while it has been administered as tablet form

Factors contributing to medication errors by direction observation detected more errors in this study. Bedside storage without prescription that contributed to error (n=526, 50.9%), other errors were - high alert medicine label (n=150, 14.5%), food drug interaction (n=133, 12.8%), drug duplication (n=110, 10.6%), major drug-drug interaction (n=58, 5.61%) improper medication storage (n=47, 4.54%), and non-formulary drugs (n=09, 0.87%). Factors contributing to medication errors by medication chart review method detected the errors which were not detected by direct observation method in this study. Documentation error were the most common frequent error (n=406, 29.6 %), followed by inappropriate abbreviation used (n=350, 25.52%). While food-drug interactions (FDI), major drug-drug interactions (MDDI), non-formulary drugs & drug duplication errors were mostly detected by this method rather than direct observation method. FDI (13.7%), MDDI (n=185, 13.4%), drug duplication (n=123, 8.98%) and non-formulary drugs (n=118, 8.60%). Few examples for factors contributing to medication error is shown in Table 3.

Table 3: Examples of factors contributing to medication error

Types of errors	Example
Major drug-drug interaction	**Non-significant** Medicine Action Furosemid + aspirin aspirin increases and furosemide decreases serum potassium Amlodipin + simvastatin amlodipine increases levels of simvastatin Potential for increased risk of myopathy/rhabdomyolysis. **Significant** Promethazine + metronidazole Increase the QT interval Augmentin + warfarin Amoxicillin may enhance anticoagulant effect of vitamin K antagonists **Serious** Digoxin + Carvedilol Tablet carvedilol increases levels of digoxin by enhancing GI absorption. and decreasing renal clearance as well as both increase serum potassium Dextromethrophan + Tramadol Increase serotonin levels.

Food drug interaction	Atorvastatin/simvastatin +grapefruit and lemon grapefruit juice may increase the plasma concentrations of atorvastatin. ACE inhibitors as captopril,enalpril +bananas (potassium) As captopril increase K+ level and banana is contain K thus increase the k level result in irregular heart neat and heart palpitations Levothyroxine +walnuts ,soybeanflour (high fiber) High fiver foods can prevent the body from absorbing thyroid medications
High alert medicine label	High alert medicine unlabelled Injection Pethidine Injection Clexane
Improper medication storage	Heparin injection 5000u found in a improper storage after administered of 2500 u Injection Emeset found broken
Drug Duplication	Amlokin (amlodipin +atenolol) *versus* Stamol (amlodipin) Glucoryl-M (glimepride 2mg+metformin500mg) *versus* metformin
Inappropriate abbreviation	S/C supposed to be written as SQUB PCM supposed to be full name paracetamol
Non-formulary drugs	Tablet Ticagrelor 90mg Tablet Ivabradine 7.5mg
Bedside storage without prescription	Tablet linezolid 600 mg Tablet Amlodipine

The detected medication errors were evaluated for the severity using the Index for categorization of medication errors (NCCMERP, 2005). The severity rating is represented in Table 4. The detected errors both in direct observation and medication chart review method in administration errors and factors contributing to medication error were categorized as (C= error reached the patient with no harm. The other levels of severity such as (error with permanent harm, error resulted in death) were not identified in this study.

Table 4 NCCMERP based severity categories of detected medication errors

FCE = Factors contributing errors

Harm category	Administration errors			FCE		
	Direct observation n=290 / (%)	Medication chart review) n=93 / (%)	Total n=383 / (%)	Direct observation n=1033 (%)	Medication chart review n=1371 (%)	Total n = 2404 (%)
No error (A)	-	-		-	-	
Error didn't reach the patient (B)	1 /(0.1)	-	1/(0.1%)	-	-	

Error reach the patient with no harm **(C)**	289 /(99.65)	93 / (100)	382 / (99.73)	975 / (94.3)	1371/ (100)	2346 /(97.51)
Error require monitoring**(D)**	-	-		58 /(5.61)	-	58 /(5.61)
Error with temporary harm **(E)**	-	-		-	-	
Error require hospitalisation **(F)**	-	-		-	-	
Error with permanent harm **(G)**	-	-		-	-	
Error require intervention to sustain life **(H)**	-	-		-	-	
Error resulted in death **(I)**	-	-		-	-	

Discussion

Medication errors are serious issues that affects healthcare system around the world.[6] This problem could result in many patient complications and in some cases it could lead be life-threatening. All health care teams have a responsibility in ensuring patient safety. In this article we have evaluated the effective methods that can be used to identify the medication errors in surgical ward in tertiary care hospital. The drug administration process is considered to be one of the most important steps in the drug delivery system that contributes to adverse drug events. Many methods are helpful to detect the medication errors such as medication chart review, direct observation, voluntary report ...etc. Comparing the results of this study with previous studies are not straight forward due to many differences between the studies conducted in this field.

This study involves shadowing of nurses and monitoring errors. One Study [13] showed the wrong time, omission dose and wrong techniques contributed to 10.84%, 0.60%, and 4.80%, respectively

Another study showed [14] a total of 686 administration errors (AE) were found. Among them omission errors were 108 (15.74%), wrong route, wrong dose and wrong time were 24(3.49%), 59 (8.60%) and 76 (11.70%), respectively. Administration after discontinued order (unauthorized drug) was found to be (4.95%). Yet another study [15] showed the greater frequency of administration errors was from wrong administration time (30.70%), while unauthorized drug contributed to (14.20%), the wrong techniques and omission were found to be 15.10% and 24.40%, respectively.

From previous two studies [16,17] done in India it was found that the dose omission (44.10%) contributed to higher frequency, whereas the other study showed wrong administration time (28.60%), on the other hand the minimum frequency errors was unauthorized drug (19.70%) and wrong route (3.80%). Our study showed AEs by direct observation method was the most common detected error. Unauthorized errors were - the most frequent administration errors found (n=61, 21%), followed by wrong time (n=56, 19.30%), extra dose errors (n=43, 14.80%), wrong route (n=40, 13.79%), wrong dose (n=28, 9.6%), wrong form (n=23, 7.90%), wrong technique errors (n=20, 6.8%), and omission (n=19, 6.5%). Whereas the AEs by medication chart review method detected least errors. The extra dose errors were the most frequent administration errors found (n=37,

39.70%), followed by wrong time (n=24, 25.80%), wrong dose (n=18, 19.35%), and omission (n=14, 15%).

A study showed [18] that the administration errors included wrong dose (1%) omission dose (2,8%), wrong route (0.20%) and wrong time (1.40%). By comparing this study with previous study [19] they found that the unauthorized drug (4.14%), extra dose (1.33%), wrong dose (14.66%), omission dose ((42.66), wrong route (0.74%), wrong form (2.66), wrong techniques (0.14%) and wrong time (33.62%) were commonly reported errors. According to one systematic review, observation method was very sensitive to identify medication errors. Flynn et al.,[5] conducted a study in which they compared different methods for detecting medication errors in 36 hospitals and skilled nursing facilities. The study discovered the accuracy of direct observations reported by pharmacists was more valid than self-reporting incidents by other medical staffs and investigators reviewing charts. In this article disguised direct observation method and medication chart review method were chosen to detect medication errors and based on both methods, the data were collected and compared.

Nurses make up a large and important section of the healthcare providers, most common medication errors are linked to the delay in treatment delivery. The number of incidents recorded in this study by direct observation was lower in comparison with similar studies, while the number of incidents documented in this study by medication chart review was higher. A total of 558 patients participated in this study, resulted in 5839 occurrences by direct observation whilst Lisby et al documented lower events of 2467 for a total of 64 patients in their study. Our study had few limitations - such as we were not able to record MEs on public holidays and Sundays as well as pediatric and pregnant patients were not included.

Conclusion

Two detection methods to observe medication errors (observation and medication chart review) proved to be significant and reliable. The direct observation method was able to capture a higher number of medication errors primarily related to administration errors 75.70% compared to the medication chart review which showed only 24.30% of total administration errors. While in superficial information related to medication error the medication chart review method was able to capture the higher number of errors.

References

1. Haftay B et al. Prevalance of medication prescribing errors in the elderly. *Int. J. Pharm. Sci. Res* 2015; 5(2): 981-985.
2. Buck ML et al. Medication rates in infants and children, improving pediatric medication safety part. *Paediatr Pharm* 2008; 14: 1-5.
3. Grober E, Bohnen J. Defining medical error. *Can J Surg* 2005; 48(1): 39-44.
4. Phillips J et al. Retrospective analysis of mortalities associated with medication errors. *Am J Health Syst Pharm* 2001; 58 (19): 1835-1841)
5. Flynn EA, Barker KN. Medication error research. In: Cohen MR, ed. Medication Errors. Washington, DC: American Pharmaceutical Association; 1999:6.1-6.30. 9. Barker KN, Felkey BG, Flynn EA, Carper JL. White paper on automation in pharmacy. Consult Pharm. 1998;13:256-293.
6. Karna K et al. Study and evaluation of medication errors in tertiary care teaching hospital-A baseline study. *Int J Pharm Pharm Sci* 2012; 4(5): 587-593.

7. Majid AK et al. The roles of clinical pharmacy in reducing medication errors. *Asian J Pharm Clin Res* 2012;3(9):76-83.
8. Barker KN et al. Medication Errors Observed in 36 Health Care Facilities. *Arch Intern Med*. 2002;162(16):1897-1903. doi:10.1001/archinte.162.16.1897
9. Ehsani SR et al. Medication errors of nurses in the emergency department. *J Med Ethics Hist Med* 2013; 6: 11. PMID: 24427488
10. Webster CS, Anderson DJ. A practical guide to the implementation of an effective incident reporting scheme to reduce medication error on the hospital ward. *Int J Nurs Pract* 2002; 8(4): 176-83.
11. Ross LM, Wallace J, Paton JY, Stephenson T. Medication errors in a pediatric teaching hospital in the UK: five year operational experience. Arch Dis Child 2000; 83(6): 492-7
12. Penjvini S. Investigation of the rate and type of medication errors of nurses in Sanandaj hospital. *Iran J Nurs Res* 2006; 1(1): 59-64. [In Persian]
13. Lisby M et al. Errors in the medication process: frequency, type, and potential clinical consequences. *Int J Qual Health Care* 2005; 17(1):15-22.
14. Patanwala AE et al. A prospective observational study of medication errors in a tertiary care emergency department. *Ann Emerg Med* 2010; 55(6):522-6.
15. Mohammadi A et al .Medication errors and their relationship with job and demographic characteristics. Jentashapir *J Health Res* 2014; 5(3):141-151
16. Karna K et al. The impact of educational intervention strategies in reducing medication errors. *IRJP* 2012; 3 (11).
17. Karthikeyan M et al. A systematic review on medication errors. *Int J Drug Dev. Res* 2015; 7:4.
18. Sravya et al. Medication errors as a major concern to health care A Case Report. *Int. J. Pharm. Biol. Sci* 2013;4 (10): 3057-3059
19. 19. Berdot S et al. Evaluation of drug administration errors in a teaching hospital. *BMC Health Serv. Res* 2012;12:60.
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