

A Study of medication administration errors in a tertiary care hospital

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ABSTRACT

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Medication administration errors account for 34% of all medication errors and identified as one of the important reasons for patients' morbidity and mortality. NPSA statistics show that 59.3% of medication errors occur during the administration stage. Thus identifying and resolving the administration errors will improve the patient care and decreases the health care costs. National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP) taxonomy was used to analyse the frequency, types, severity and factors responsible for medication administration errors. The findings of the study reveal that the frequency of medication administration errors is 15.34%, omission errors (33.02%), improper dose (17.43%) and wrong time (12.84%) errors were the major types of errors occurred and the majority administration errors belonged to category C (112), B (46) and D (35). Frequent interruptions and distractions, lack of communication between health care professionals, performance deficit and work stress on duty nurses are identified as major factors responsible for administration errors.

Keywords: Medication Administration Errors (MAEs), National Coordinating Council for Medication Error Reporting (NCC MERP) taxonomy, National Patient Safety Agency (NPSA) and Patient Care.

INTRODUCTION

Medication use in hospitals is a complex process and depends on successful interaction among health care professionals functioning at different areas. Medication errors may occur at any stage of prescribing, documenting, dispensing, preparation, or administration.¹ Medication errors may contribute to morbidity, mortality and increased health care costs.² In 2007, National Patient Safety Agency (NPSA) statistics shows that 59.3% of medication errors occur during the administration stage.³ Medication administration errors are defined as any deviation from the physician's medication order as written on patient's treatment chart during medication administration to patient.² The plan for administering a medication begins with identifying the patient, the drug, the dose, the route, and the time.⁴ In 1995, the National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP) classified administration errors in to wrong drug, wrong route, wrong dose, wrong patient, wrong timing of drug administration, contra-indicated drug, wrong site, wrong dosage form, wrong infusion rate and expired medication. Such errors may occur intentionally or

unintentionally.² The elderly, and mentally ill patients are particularly more susceptible as they may be confused, resist medication administration, physically weak and require complex medication regimens.⁵ In a study conducted over a period of three and half years in UK at a psychiatric hospital, the most frequent types of errors observed were the improper dose, wrong drug, and dose omission.⁶ The drugs often associated with harmful events of medication errors in pediatric patients include morphine, insulin, vancomycin, potassium chloride, gentamicin, ceftriaxone, and heparin.⁴

In addition to the morbidity and mortality, medication errors also contribute to increased health care costs. The department of health in UK, estimated the direct and indirect health care expenditure due to medication errors as 2£ billion.¹ In US, an American health care system estimated the medication errors related expenditure as \$37 billion per year.⁷

Medication administration has become more complex as a result of the increasing number of medications available and new routes of administration. Nurse is considered as vital in medication administration process and the literature review states that poor calculation competency of nurses, poor adherence to protocols and poor knowledge of medications are the important reasons leading to medication administration errors.⁴

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An observational research study conducted in Newzealand conclude that, poor knowledge of nurses about medicines, dose calculations, and route of administration were the key elements contributing for medication administration errors.² The other contributing factors for MAE were identified as frequent distractions from work, peak work load, and inadequate communication between health care professionals. An observational multinational study conducted in 27 countries of five continents by Valentin A et al suggest that, increased work load, stress, and fatigue are the contributing factors for medication administration errors. In addition to the above, poor hand writing in prescriptions, drugs with similar packing are the system errors leading to medication administration errors.⁸ Therefore medication errors may compromise patient confidence in the health-care system.⁹ Worldwide intensive research was conducted to find the types, categories, contributing factors, and cost implications of medication administration errors in various health care settings however very little research was conducted in this area in India. Thus the present study was conducted to assess the frequency, types, severity and factors responsible for medication administration errors in a tertiary care teaching hospital.

MATERIALS AND METHODS

Study Setting

The present study was conducted at a South Indian 1200 bed multi specialty tertiary care teaching hospital for a period of nine months during November 2009 and August 2010 in inpatient wards of general medicine and surgery departments. Every day 200 patients are admitted either from the outpatient, emergency and casualty departments or transferred from the wards of other clinical specialties to the above departments. The present study was approved by the Institutional Human Ethics Committee.

Study procedure

A suitably designed documentation form was used to analyse the types, frequency and factors responsible for medication administration errors and the data was collected from the case notes, treatment charts, medication administration records and interviewing the in-patients admitted to surgery and general medicine wards. Demographic details of the patients, diagnosis and treatment recommended were documented. Medication administration of the in-patients was followed up on daily basis to identify the administration errors. Frequency

of medication administration errors was analysed by using the following formula.¹⁰

$$\text{Frequency of MAE} = \frac{\text{Number of Significant + Non significant MAEs}}{\text{Doses given + doses ordered but not given}} \times 100$$

NCC MERP taxonomy was applied to analyse the frequency and types of medication administration errors. The types of medication administration errors were classified in to omission error, improper dose, wrong medication, wrong strength, wrong dosage form, wrong technique, wrong route of administration, wrong rate, wrong time, wrong patient errors and other types.¹¹

Medication administration errors were categorised in to various categories as A, B, C, D, E, F, G, H and I categories based on NCC MERP. Current NCC MERP categorizes medication administration errors in to the 9 following categories.

Category A: Circumstances or events that have the capacity to cause an error

Category B: An error has occurred but the error did not reach the patient

Category C: An error has occurred that reached the patient, but did not cause harm to patient

Category D: An error has occurred that reached the patient and required monitoring to confirm that it resulted in no harm to the patient and/or required intervention to preclude harm.

Category E: An error has occurred that may have contributed to or resulted in temporary harm the patient and required intervention

Category F: An error has occurred that may have contributed to or resulted in temporary harm to the patient and required initial or prolonged hospitalization

Category G: An error has occurred that may have contributed to or resulted in permanent patient harm

Category H: An error has occurred that required intervention necessary to sustain life

Category I: An error has occurred that may have contributed to or resulted in the patient's death.

RESULTS

Medication records of 286 patients were reviewed and 218 medication administration errors were observed in 167 patients who received 1430 doses. The frequency rate of medication administration errors was found as 15.24%.

Among the 167 patients, 115 were male patients and 52 were female patients. Out of 218 medication administration errors, 112 errors (51.37%) were observed in surgery department and 106 errors (48.62%) were observed in medicine department.

According to the NCC MERP taxonomy, the medication administration error types were analysed. The most common types of errors observed were omission errors (failure to administer or failure to record the administration, (n=72) and improper dose (over dosage (n=38), followed by wrong time (n=28), wrong strength (e.g. dose was given in noon instead of morning dose (n=21), wrong rate (IV infusion rate was too fast, (n=18), wrong drug (drug other than the prescribed one, (n=12), and others (Patients refusal to take medication/not bought the medication, (n=14). The details of types of medication administration errors are given in Table No 1.

Table 1: Types of Medication Administration Errors

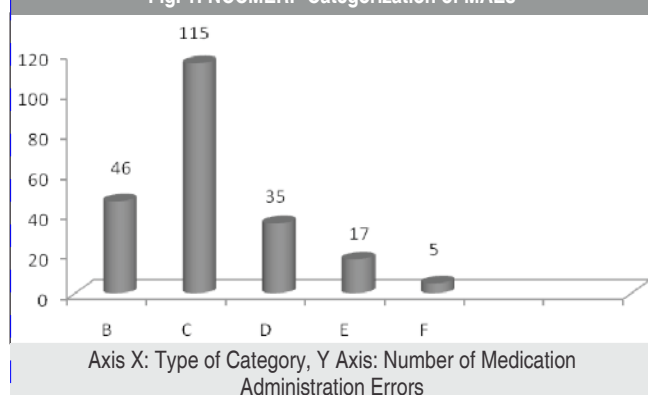
S.No	Types of errors	Percentage (%)
1.	Omission error	33.02
2.	Improper dose/quantity	17.43
3.	Wrong strength	09.63
4.	Wrong drug	05.50
5.	Wrong dosage form	01.83
6.	Wrong route	01.83
7.	Wrong rate: too fast	08.25
8.	Wrong duration	03.21
9.	Wrong time	12.84
10.	Others	06.42

Note: Others include (Patient refusal to take medication/ Unable to purchase/swallow medication etc)

Majority administration errors were belonged to the Category C (52.75%), Category B (21.10%) and Category D (16.05%) followed by the category E; (07.79) and category F; (02.29).

Details of categories of the medication administration errors according NCC MERP categorisation are presented in Fig. 1.

Fig. 1: NCCMERP Categorization of MAEs



The system related factors responsible for medication administration errors identified as prequent interruptions and distractions (33%), poor communication among health care professionals (23%), inadequate training (8%) and inadequate staff (8%) and others (14%). The details of factors responsible for MAE are presented in Table No 2.

Human factors responsible for medication administration errors were studied. Predominant human factors responsible for MAE were identified as performance deficit (42.20%), stress (21.10%) and fatigue and lack of sleep (8.71%) and the list of human contributing factors causing medication administration errors are presented in Table No 3. Types of dosage forms highly involved in medication administration errors were injectable drugs (49.54%) and tablets (33.94%). The types of dosage forms involved in MAE are presented in Fig. 2.

Table 2: System related factors responsible for MAEs

Sl. No.	Contributing factors	Percentage (%)
1	Lack of Lighting	6.0
2	High Noise level	8.0
3	Frequent interruptions & distractions	33.0
4	Lack of training	8.0
5	Lack of staffing	8.0
6	Lack of Communication between HCPs	23.0
7	Others*	14.0

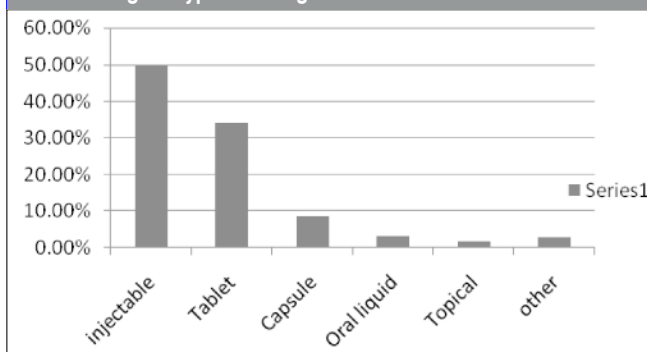
*Others = Patient refusal to take medication/ Unable to purchase/swallow medication etc

Table 3: Human Factors responsible for MAEs

S.No	Human factors	Percentage (%)
1	Knowledge deficit	05.50
2	Performance deficit	42.20
3	Miscalculation of dosage or infusion rate	05.96
4	Stress	21.10
5	Fatigue/ lack of sleep	08.71
6	Poor communication among health care professionals	01.83
7	Others*	14.67

* Others include (Patient refusal to take medication/ Unable to purchase/swallow medication etc).

Fig. 2: Type of Dosage forms Involved in MAEs



DISCUSSION

Medication use is a complex process that involves co-ordination among various health care professionals. Medication errors may happen at any stage of patient care like prescribing, transcribing, dispensing, and administration.¹ Studies have corroborated that medication administration errors may contribute to morbidity, mortality and increased health care expenditures.^{1,7} A study has calculated a medication error cost as USD 5000.¹² Medication administration errors may take place at the time of administration due to prescriber's medication order deviation. As per National Health Service (NHS) of UK statistics, medication errors may affect 850,000 people each year and incur the health care expenditure up to £2 billion.¹ In USA, American Health System calculated the morbidity, mortality and health care expenditure associated with medication errors. The statistics reveal that medication errors had caused 88,000 deaths and incurred \$37 billion as health care expenditure annually.⁷ In a US based study, it was estimated that medication administration errors have accounted for 34% of medication errors.⁵ National Patient Safety Agency (NPSA) shows that 59.3% of medication errors occur at administration stage having high potential for morbidity and mortality and increased health care costs.³ Administration errors are one of the most common types of medication errors affecting approximately 5 percent of all administered doses.⁶

In the health care team, nurse is responsible for medication administration to the patients and is therefore considered as the key faulty component for medication administration errors.³ The findings of many international studies showed that, performance deficit, poor calculation competency, poor adherence to protocols, poor knowledge of medications and complacent behaviour of the nurses are the main reasons for medication administration errors.¹³ Other system related causes for administration errors include physicians poor handwriting, similar packing of medications.

As medication errors are resulting in damage to patient's health and influence the health care budgets, it is worth studying the types, frequency, impact of medication errors and the factors responsible for administration errors. The literature review suggests limited research has been carried out in India in this area. The present study focuses on scientific understanding the medication administrations errors in a tertiary care teaching hospital and to suggest initiatives to improve the patient safety.

During the study period, frequency of medication administration errors was calculated as 15.24%. In many overseas studies, the frequency of medication administration errors range from 14 to 59%. In two observational studies conducted in an acute settings have found the medication administration error frequency rates as 14.9% and 32.4%.² In a prospective cohort study, the frequency of medication administration errors was found as 38%. Analysis of MEDMARX data base suggests the frequency of medication administration errors as 59.5%. The error frequency rate in the present study closely matches with the findings of the international studies. The higher the frequency of medication administration errors occur results in higher chances of morbidity and mortality in the patients.

NCC MERP taxonomy was used to analyse the categories of the medication administration errors. The medication administration errors of the present findings were analyzed and classified in to various categories. In our study the most common types of errors observed were omission errors (failure to administer or failure to record the administration, n=72) and improper dose (over dosage, n=38), followed by wrong time (n=28), wrong strength (e.g. dose was given in noon instead of morning dose, n=21), wrong rate (IV infusion rate was too fast, n=18), wrong drug (drug other than the prescribed one, n=12), and others (Patients refusal to take medication/not bought the medication, n=14). Our observations are in consistent with the findings of previous studies.⁸

In a prospective observational multinational study involving 113 ICUs from 27 countries across five continents, including Australia the most common administration errors include wrong time of administration (n = 386), missed medication (n = 259), followed by wrong dose (n = 118), wrong drug (n = 61) and wrong route (n = 37).⁸ Similarly in another observational study of MAEs conducted by Camilla Haw et.al. in old-age psychiatric inpatient wards at St. Andrew's Hospital, UK identified 148 administration errors through

treatment chart review. The most common types of errors detected were belong to omissions errors (133), Improper dose errors (over doses, 9), wrong time errors (5) and administration of a discontinued medication (1). The MAEs detected were reported using hospital's medication error reporting system.⁵

In the present study NCC MERP taxonomy was used to assess the severity of the medication administration errors on patient outcomes. As per the taxonomy, Category A to D is considered as mild, E and F is moderate and G to I is severe in nature. The medication administration errors were analyzed and classified in to various categories. Most of the errors were belonged to the Category C (52.75%), Category B (21.10%) and Category D (16.05%) followed by the category E; (07.79) and category F; (02.29). In a descriptive and retrospective study conducted over a period of 5 years to assess the administration errors made by nursing students, categorized the medication administration errors using NCC MERP taxonomy. Most of the administration errors belonged to the Category C (70.57%) and Category D (23.29%).¹³

Frequent interruptions and distractions (32.56%), lack of communication between the health care professionals (HCPs) (23.39%), other factors (13.76%), lack of staffing and noise level (08.25%) and lack of training (7.79%) are identified as the system related factors responsible for medication administration errors in our study.

An observational multinational study identified heavy workload, stress and fatigue are the contributing factors causing 32% ($n = 272$) of the administration errors followed by lack of knowledge ($n = 81$, 9%), violation in protocols ($n = 76$, 9%) and problems with handover processes ($n = 53$, 65%).⁸

Zane Robinson et al, in their study identified performance deficit (51.01%) and knowledge deficit (26.52%) as the common contributing factors responsible for medication administration errors. The common human factors responsible for medication administration errors were also studied. They were identified as performance deficit (42.20%), stress (high work load etc) (21.10%), others (14.67%), and fatigue (08.71%) are the commonest human factors responsible for medication administration errors.¹²

In our study, the dosage forms which are involved in most MAEs include injectable drugs (49.54%) and tablets (33.94%). In a study conducted by Fanak Fahimi et al. in ICU and medical wards of a large hospital in Tehran observed that the majority of administration errors occurred during bolus

administration (43.4%), followed by wrong infusion rate (23%).¹³ The increased frequency of the medication administration errors is may be due to various contributing factors. The findings of our study were also similar to that of the findings of Tehran study.

Adequate training and motivation to nurses, computerized physician order entry system (CPOE) and medication administration record system will help in preventing the medication administration errors by nurse. Introduction of Medication Error reporting system in the hospital will help in preventing the medication errors.

CONCLUSION

The findings of the present study concludes that, omission of the dose, improper dose, wrong time, and wrong strength were identified as common medication administration errors. Majority errors belong to NCCMERP category C and interruption and distractions during the work, performances deficit, and stress are the common risk factors contributing for medication administration errors.

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