

INCIDENCE OF INTRAVENOUS MEDICATION ERRORS IN A SOUTH INDIAN TERTIARY CARE HOSPITAL

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Abstract:

Background: The use of medications in the hospital is a complex process which is dependent on the successful interaction of the health care professionals. Intravenous medication errors are one such which compromise patient confidence in the health-care system, increase health-care costs and has high incidence but limited evidence. **Objective:** The study reports the incidence of intravenous errors in preparation and administration. Specifically, the study was done to explore and measure the frequency of IV medication errors by direct observation and identify clues to their causes. **Methodology:** The study design is a prospective observational study which enrolls patients given intravenous therapy in the department of general medicine and ICUs in a tertiary care hospital. Error categories were categorized and error rate of drug classes was measured. **Results:** In a period of 6 months, 161 (N) samples were observed. Five error types (improper aseptic conditions, wrong diluents, improper mixing, wrong dose/volume, and wrong time) accounted for 78.88% of errors. Improper aseptic conditions were the most frequent and accounted for 39.13%. The least type of errors was wrong dose errors-7.45%. The other categories wrong diluents, improper mixing and wrong time accounted for 9.93%.10.55% 13.04% respectively. **Conclusion:** This study found a high rate of intravenous medication errors of moderate significance. Changes in practice should be considered to make intravenous therapy safer for patients. The findings of this study suggest that it is necessary to engage pharmacists in IV dose preparation and administration.

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INTRODUCTION:

The goal of drug therapy is the achievement of defined therapeutic outcomes that improve a patient's quality of life while minimizing patient risk. There are inherent risks, both known and unknown, associated with the therapeutic use of drugs and drug administration devices. The incidents that result from such risk have been defined as drug misadventuring, which includes both adverse drug reactions and medication errors. This study focuses on medication errors that should be preventable through effective system controls involving pharmacists, physicians, patients and other prescribers, nurses, risk management personnel and others in organizational setting [1].

A **medication error** is an unintended failure in the drug treatment process that leads to, or has the potential to lead to, harm to the patient. According to National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP), "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" [1, 2]

Medication errors compromise patient confidence in the health-care system; increase health-care costs and has high incidence but limited evidence. The problems and sources of medication errors are multidisciplinary and multifactorial [3]. Medication errors may be committed by both experienced and inexperienced staff, including pharmacists, nurses, supportive personnel, students, clerical staff, patients, administrators and others. Errors occur from lack of knowledge, substandard performance and mental lapses, or defects or failures in systems. Many medication errors are probably undetected. The outcome(s) or clinical significance of many medication errors may be minimal, with few or no consequences that adversely affect the

patient. Tragically, however, some medication errors result in serious patient morbidity or mortality. Thus, medication errors must not be neglected, and effective systems for ordering, dispensing, and administering should be established with safeguards to prevent the occurrences of errors [4]

Medication errors are of various types-prescribing errors, dispensing errors, administering errors and patient compliance errors [2]. Medications administered intravenously act on the body very quickly. Any error that occurs during the process of preparation and administration of a medication is referred to as an intravenous medication error. There are two kinds of intravenous medication administration.

1. An **IV “push”** is a one time, rapid injection of medication into the bloodstream.
2. An **IV infusion** is a slow “drip” of medication into the vein over a set period of time, to deliver a constant amount of therapy.

Often, an IV “line” is created to allow easy treatment. Improper IV administration can lead to complications like Phlebitis or inflammation of the veins, infiltration, air embolism and deep vein thrombosis. As IV medications tend to act on the body quickly, toxicity, side effects, and allergic reactions will therefore happen fast. Thus, a patient on IV medication should be under observation at all times [14].

The aim of the present study is to report the incidence of errors in preparation and administration of intravenous medications, to explore and measure the frequency of IV medication errors by direct observation and identify clues to their causes.

MATERIALS AND METHOD

Study Setting and Study Population:

The present study is a prospective observational study which was conducted on a total of 161 cases from

Malla Reddy Hospital in Quthbullapur, Rangareddy, Telangana. The study was conducted between November 2015 and April 2016.

Inclusion and Exclusion Criteria:

Inclusion criteria: Patients given any medication intravenously, patients between 18 and 65 years of age, patients of either gender. Exclusion criteria: pregnant and lactating women, pediatrics and geriatrics, patients with psychiatric disorders and other chronic conditions.

Data Management and Analysis:

The data were divided as descriptive and differential statistics by using the latest GRAPHPAD PRISM software VI.

Ethical consideration:

The study protocol was approved by Human Ethics Committee of Malla Reddy Institute of Pharmaceutical Sciences.

Results:

In our study, the data was collected from five different wards-Male general medicine, female general medicine, male surgery ward, female surgery ward and intensive care unit month-wise for six months. The data collected was categorized into six main categories of errors namely-improper dilution (mixing), wrong diluents, wrong dose/volume, wrong time, violation of aseptic conditions and wrong administration technique with the total number of errors 127(N) i.e., 78.88% (fig. 1 & table 1). Among all the error categories, violation of aseptic conditions accounted for about 39.13% of errors which is the highest, followed by wrong time 13.04%, improper dilution 10.55%, wrong diluents 9.93% and wrong dose 7.45% (lowest).

Figure 1: Distribution of errors during the study period

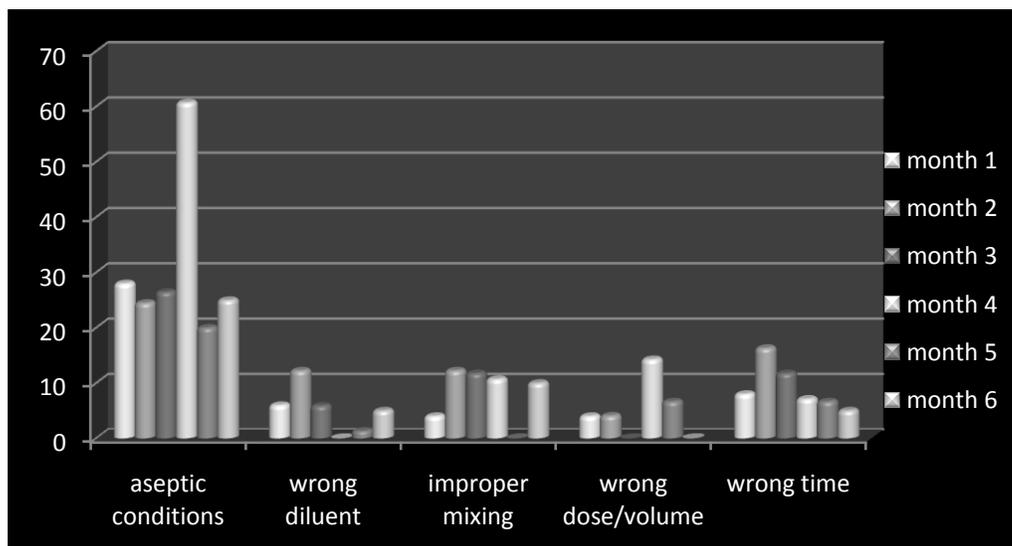


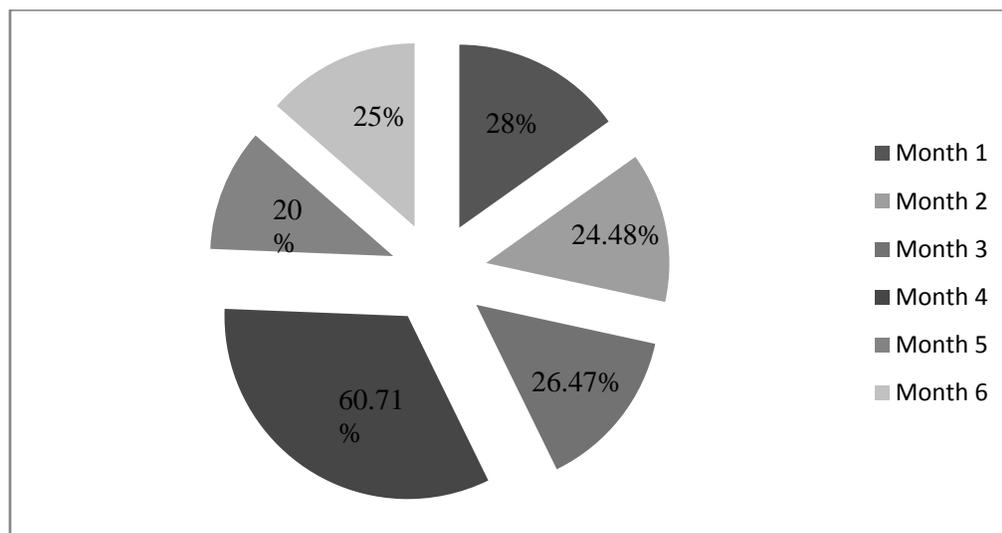
Table 1: Categorization of errors

Error Category	Month 1	Month 2	Month 3	Month 4	Month 5	Month 7	Total %
Improper Aseptic conditions	28%	24.48%	26.47%	60.71%	20%	25%	39.13%
Wrong diluents	6%	12.24%	5.88%	0%	13.33%	5%	9.93%
Improper mixing	4%	12.24%	11.76%	10.71%	0%	10%	10.55%
Wrong dose/volume	4%	4.08%	0%	14.28%	6.66%	0%	7.45%
Wrong administration time	8%	16.2%	11.76%	7.14%	6.66%	5%	13.04%

Violation of aseptic conditions (pre- preparation): Intravenous therapy procedures according to the guidelines say that aseptic requirements like hand washing before the procedure and cleaning ampoules, vials and IV infusions closures are pre-preparation procedures. It was found that there were neither general written nor guidelines on IV drug preparation and administration in each ward. New staff nurses learnt the skills from their seniors. It should not

be assumed that the risk of infection is small because of the intravenous drugs are generally being prepared for immediate use. Recent research in a German hospital following the deaths of 2 patients from meningitis caused by contamination of contrast media found other contaminated multiple doses vials in ward areas, poor handling and storage of these medications.

Figure 2: Errors in aseptic conditions (violation)



Improper dilution/Wrong diluents (pre-preparation): Although few drugs are available with diluents, others have to be diluted with appropriate diluents. The use of wrong diluents may cause a reduction in the drug solubility leading to powdered particulates being administered to the patient. This can also lead to reduction in the drug stability and activity and possible drug precipitation. E.g.-Ranitidine and promethazine should be taken aware of that they must be diluted prior to administration. Drugs to be administered within a specific time should be noted as drugs were found to be less potent on effective when the suggested administration time deviates. Medications like corticosteroids, diphenhydramine need diluents. Ketorolac

needs to be administered very slowly. Drugs to be diluted and administered slowly are famotidine, levothyroxine and antibiotics. Medications observed during the study which were diluted are heparin (bolus), digoxin, metoprolol, antiemetics and anticonvulsants. E.g.-Wrong diluent was used for pantoprazole which has to be diluted with 10 ml NaCl solution as per the leaflet instruction on the medication instead 10 ml WFI was used. Few samples were diluted with inappropriate amount. E.g.-Augmentin and penicillin were the drugs which accounted for these errors. Ranitidine and promethazine was to be diluted prior to administration but these drugs were given as bolus without dilution.

Figure 3: Graph showing errors in using wrong diluents and improper dilution

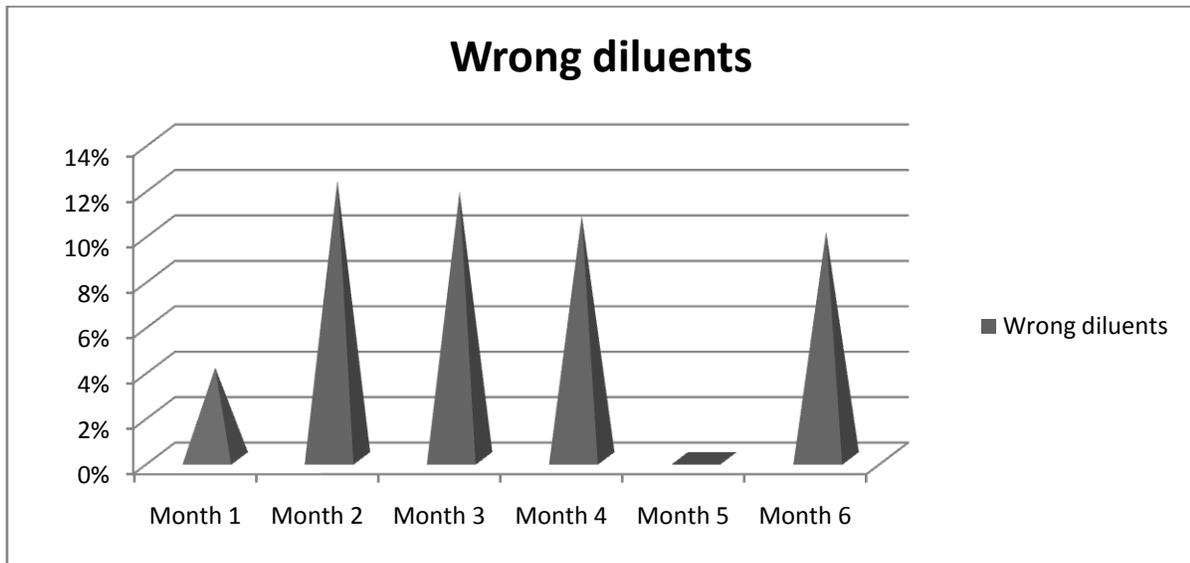
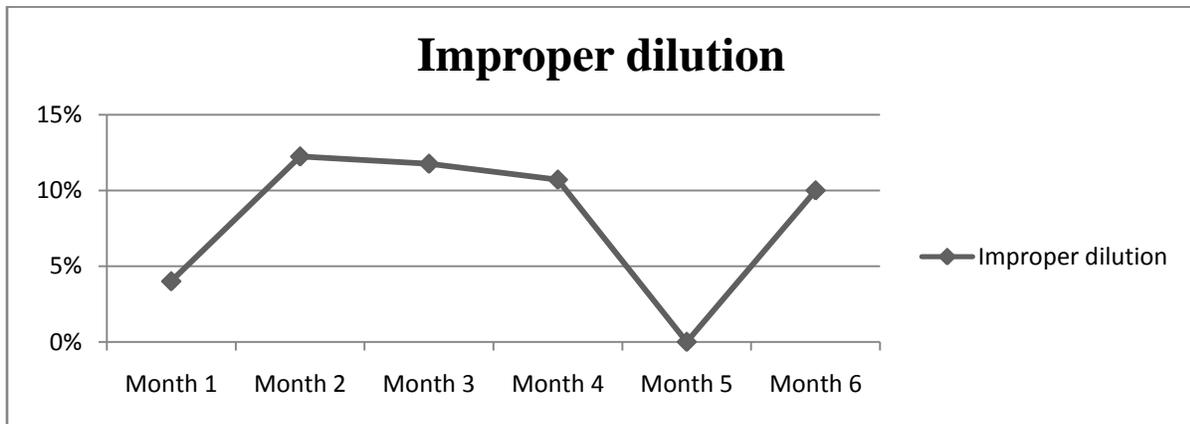


Figure 3(b): Improper dilution



Wrong time: Administration time at 8.00am was found to be significantly associated with a higher rate of IV drug administration error. This could be due to the fact that majority of the drugs, despite their dosing intervals were administered at that point of time. Also the working shifts of staff nurses are divided into three: 7.00am to 2.00pm,

2.00pm to 9.00pm and 9.00pm to 7.00am. During the morning shift, the wrong administration time could possibly be explained by this chance, whereby the staff nurses need to pass over the duties to another, therefore insufficient time to prepare and administer the drug on time.

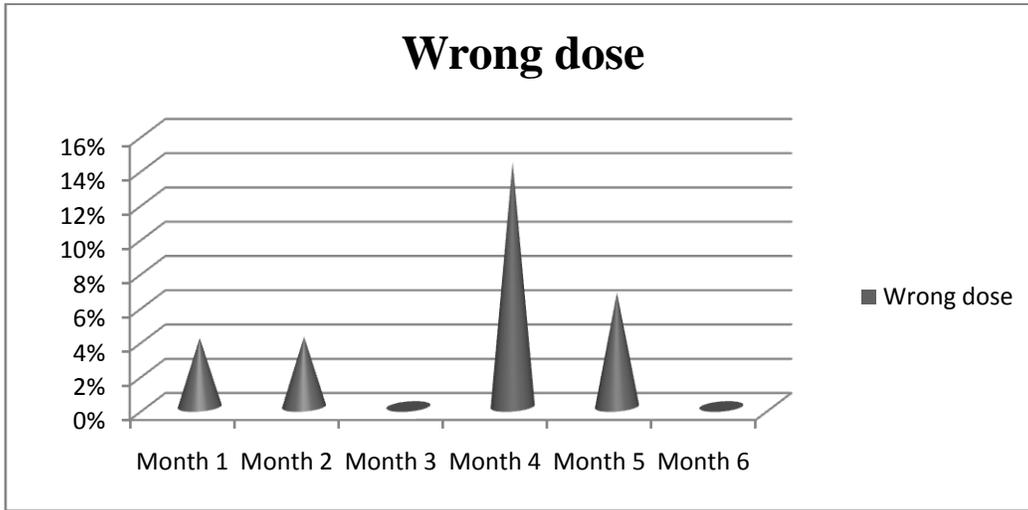
Figure 4: Wrong time errors



In this study, inappropriate amount of drug syringed out from the vials/ampoules were considered as errors including spillage or leak. For example the syringe plunger was accidentally over pressed while removing the air thereby fraction of the drug solution was spilled out or the patency

of the IV peripheral line was not checked, thus some of the drug lost out of the loosen cannula during administration. Drugs observed which followed this category are cloxacillin, ranitidine, cefotaxime, omeprazole, phenytoin, Tramadol.

Figure 5: Wrong dose errors

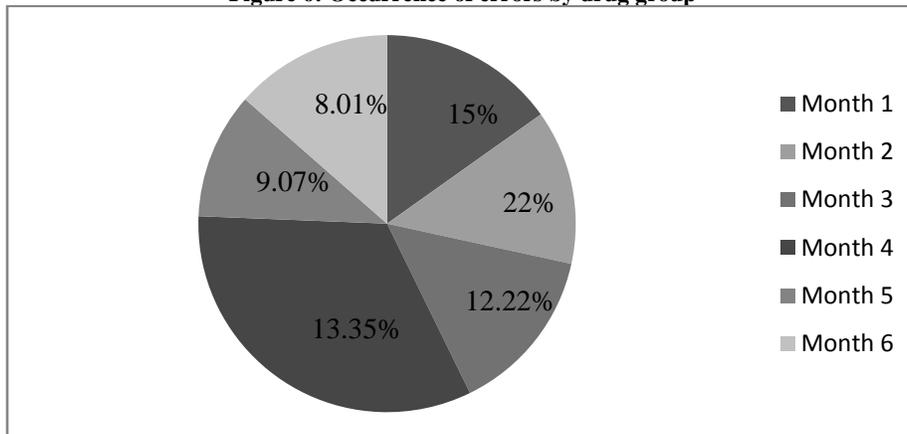


Errors by drug group: The number of errors occurred during the study period were categorized according to their drug groups as follows:

Table 2: Categorization of errors by drug group

DRUG GROUP	TOTAL ADMINISTRATION IV ERRORS
Anticonvulsants	15%
TPNs	22%
Paracetamol	12.22%
Diuretics	13.25%
Anti infectives	9.07%
Antiulcerant	8.01%

Figure 6: Occurrence of errors by drug group



Discussion:

The American Society of Health system Pharmacists (ASHP) guidelines suggests that medication errors occur more frequently in the inpatient hospital setting and they compromise patient confidence in the health-care system [2, 15]. A study conducted by Qian Ding et al. in a Chinese hospital reported an overall error rate of 12.8% on the study ward for a period of ten days with most of the errors including TPNs and there was no pharmacist's role in ensuring the accuracy of IV medication preparation and administration processes [5]. This has suggested that there is serious need to incorporate pharmacists in IV medication related processes [16]. In our study, a total of 161 IV medication preparation and administration processes were examined of which about 127 samples included one or the other error accounting for an overall percentage of 78.88 (Fig 1) and TPN errors were 22% (Tab. 2) which were the highest. A study conducted by Michael Deters et al. revealed dosing error as the main type of IV errors [6]. In our study dosing error rate was found to be 7.45% (Fig 5), the lowest of all the error categories yet contributed to compromised patient outcome. In an observational study conducted by Fanak Fahimi et al. on the drugs with the highest rate of use in the ICU concluded that the maximum number of errors were related to preparation and administration processes and the most common type of error was injection of bolus doses faster than the recommended rate [7, 8, 13]. In our study, wrong time error accounted for about 13.04% (Fig 4) which also had an impact (moderate) on patient's treatment outcome, violation of aseptic conditions 39.13% (Fig 2) usage of wrong diluents accounted for 9.93% and improper dilution 10.55% (Fig 3a & 3b). Rothschild JM et al. found that medical wards and ICUs were the most error prone places in all hospital wards [9]. Medication errors occur more commonly in ICUs because patients in an ICU receive a larger number of medications. Studies have indicated, the more medications prepared and administered and the longer the hospital stay, the higher the risk of error [10, 11]. In our study, medical wards and ICUs were given more priority followed by surgical wards.

There are some drawbacks to this study. Firstly, we focused only on the incidence of errors in intravenous medication preparation and administration as the drug reaches the patient's blood stream rapidly. But medication errors itself is a broad area which needs a focus on each and every sector. Secondly, we did not consider pediatric and geriatric patient population. A significant number of errors occur even in pediatrics and geriatrics. As validation of these measures is an ongoing process, future studies should examine all possible sectors of MEs, compare the impact of these errors on patient health and an effort to develop systems like Computerized prescription order entry (CPOE) in order to minimize medication errors before reaching the patient [12, 17].

Conclusion:

Basically the goal of any drug therapy is achievement of defined therapeutic outcomes and improvement of the patient's quality of life and minimization of risks. There are inherent risks both known and unknown associated with therapeutic use of drugs and drug administration devices.

The incidents or hazards that result from such risks have been defined as "drug misadventuring which include both adverse drug reactions and medication errors. This study was thus useful in providing etiology for certain conditions and can be taken as reference to cross check if drug therapy outcome was appropriate and to gauge patient's quality of life. This created awareness among inexperienced and experienced nurses about intravenous medication errors and their possible preventions.

During the observational period, the nurses were either unaware of the existence of the errors or they were aware without reporting because they did not think the errors were serious in nature. The findings of this study suggest that it is necessary to engage pharmacists in IV dose preparation and administration. Thus, this study significantly emphasized the role of a pharmacist in monitoring, detecting and preventing intravenous medication errors.

Author's Contribution:

Vinitha Kandala wrote the proposal. Pisati Tejaswini and Nagasri participated in data collection. Pisati Tejaswini and Vinita Kandala analyzed the data and drafted the paper. Dr.Mehraj Fatima approved the proposal with great revisions, and revised subsequent drafts of the paper. All authors read and approved the final paper. All authors contributed equally to this work.

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Abbreviations:

ME-Medication errors
 IV-Intravenous
 TPN-Total parenteral nutrition
 ICU-Intensive care unit
 ADE-Adverse drug event
 WFI-Water for injection

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