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Original Article

Utility of a clinical pharmacist in the pediatric intensive care unit to identify and prevent medication errors

Ramaning Loni, Siddu Charki[1], Trimal Kulkarni[1], Mahesh Kamale[2], Laxman H. Bidari[2]

Department of Pediatrics, Aditya Birla Memorial Hospital, Pune, Maharashtra, [1]Department of Pediatrics, Shri BM Patil Medical College and Hospital, [2]Dr. Bidari"s Ashwini Hospital and Postgraduate Centre, Vijayapura, Karnataka, India

Abstract

Background: Medication errors (MEs) in the pediatric intensive care units (PICUs) are common, predictable, serious, and preventable. Patients in the intensive care unit (ICU) are more vulnerable to increased MEs due to the complexity of underlying critical illness.

Aim: The aim of the study was to determine the incidence, types, adverse effects, and outcome of MEs identified by a clinical pharmacist in the PICU.

Subjects and Methods: This prospective observational study was conducted in the PICU of Dr. Bidari's Ashwini Hospital, Vijayapura, using daily observation of medical records from February 17, 2018, to November 30, 2019, using NCC-MERP guidelines to define the ME.

Results: The incidence of MEs was 250/1000 patient days. Prescription errors were most common with 59.3% (3007), followed by administration errors with 21% (1100). Dispensing and transcription errors were 10.4% (528) and 8.6% (441), respectively. In prescription error, dosage error was predominant with 76% (2286), followed by documentation error in 15% (451), In transcription errors, incorrect drug dose was the most common error with 47% (208), followed by the wrong drug in 23% (102). In the case of dispensing errors, a supply of incorrect medicines was most common with 61% (321), followed by the unavailability of medicines with 24% (126). In administration errors, medicines given at the wrong time duration were observed in 55% (603), followed by orders not carried by nurses at an appropriate time in 23% (255). National coordination committee for ME reporting and prevention index severity classification includes Category B, the most common with 61% (3096) incidence, followed by Category C with 34% (1725).Total 23 patients developed probable adverse side effects. The mortality was only 1% (28) in this study, which was crude mortality of our PICU.

Conclusions: (i) Prescription errors were the most common MEs followed by administration errors. (ii) The role of the clinical pharmacist was vital in identifying and avoiding the existing burden of MEs in the PICU. (iii) Reinforcement of structured training of the medical and paramedical staff is essential regarding the safe medication practices.

Keywords: Clinical pharmacist, medication errors, pediatric intensive care unit

Address for correspondence: Dr. Ramaning Loni, Aditya Birla Memorial Hospital, Chinchwad, Pune - 411 033, Maharashtra, India.
E-mail: raj2031979@gmail.com

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INTRODUCTION

Medication errors (MEs) in the pediatric intensive care units (PICUs) are common, predictable, serious, and preventable.[1] The prevention of MEs forms a quality control measure for ensuring patient safety and avoiding patient harm.[1,2] Patients admitted to an intensive care unit (ICU) experience 1.7 times more medical errors each day when compared to non-intensive care patients, and some may be life-threatening.[1,2] MEs in the United States alone (inpatient department and outpatients) may account for more than 7000 deaths yearly.[3] The costs of MEs and the incidence of adverse drug events (ADEs) are extremely high.[4] MEs can lead to high morbidity, unnecessary hospital stay, diagnostic investigations, and even iatrogenic mortality.[4,5]

The magnitude of MEs is definitely higher in intensive care setup due to the complexity of the underlying disease condition and other factors.[4,5] The goal of the World Health Organization with its global patient safety challenge strategy is to reduce the severe patient harm associated with MEs by 50% within the next 5 years duration as the children have the highest risk of drug-related preventable harm. To help this global campaign, it is essential to know the actual burden of the errors and related ADEs in seriously ill children admitted to the PICU.[6] The incidence of MEs has been reported to be 100–400/1000 patient days in children.[7] Medications errors can any happen at many stages from prescription, dispensing, transcription, and till the administration of medications. There is a need for the development and optimization of patient safety profiles and policies to block the drug-related patient harm. The rate of MEs declined with structured training before and after pediatric cardiopulmonary resuscitation (CPR), but documentation errors could not be eliminated completely in a study done by Sankar *et al*.[8] The cognitive burden in the form of physical stress and social burden on the duty doctors are the main contributing factors associated with prescription and transcription errors.[9]

Even though lot of research is available on MEs in children, to improve the quality of care and patient safety in our hospital, this study was undertaken.

SUBJECTS AND METHODS

This prospective observational study was conducted in 20-bedded secondary level care, PICU from February 17, 2018, to November 30, 2019 (22 months), catering general pediatric critical care, pediatric cardiac critical cases, and all other pediatric subspecialties patients also. Daily review of medical records was performed by a full-time clinical pharmacist in the PICU. The following records were reviewed: doctor's order sheet, daily plan sheet, transcription sheet, nursing charts and notes, and drug dispensing by in-house pharmacy outlet. All data were reviewed by a clinical pharmacist, consultant pediatric intensivist, and senior consultant pediatrician to confirm the type of the errors. All the verbal orders given during emergencies like cardiac arrest were entered in the drug order sheet within a few hours of the administration and checked by the consultant on duty on the same day. The clinical pharmacist intervened to prevent MEs in conjunction with medical staff. The clearance from the ethical committee of the hospital was approved.

ME is defined as 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 [Figure 1].[10]

Harm

It includes impairment of the physical, emotional, or psychological function or structure of the body and/or pain resulting therefrom.

Monitoring

Monitoring is done to observe or record relevant physiological or psychological signs.

Intervention

It may include a change in therapy or active medical/surgical treatment.

Intervention necessary to sustain life

It includes cardiovascular and respiratory support (e.g., CPR, defibrillation, intubation, etc.).

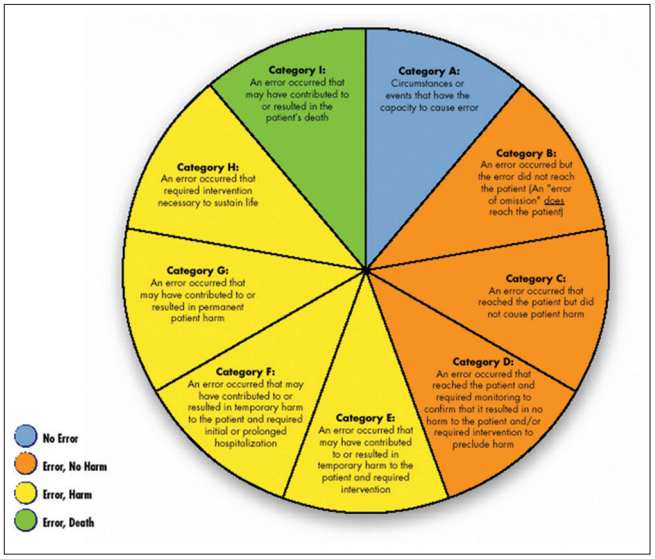

Figure 1: NCC -MERP Index for Categorizing Medication Errors[10]

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According to the NCC MERP index [Figure 1], the severity of MEs has categorized into A to I Category, i.e., from no error, no harm, to error resulting in the death or might have contributed to death of the patient.

Aim and objective

The aim and objective of the study was to determine the incidence and types, ADEs, and outcome of MEs in the PICU

Inclusion criteria

All children admitted to the PICU in the age group between 1 month of life to 18 years of age were included in the study.

RESULTS

The incidence of MEs was 250/1000 patient days. Prescription errors were most common with 59.3% (3007), followed by administration errors with 21% (1100). Dispensing and transcription errors were 10.4% (528) and 8.6% (441), respectively [Figure 2]. In prescription error, the dosage error was predominant with 76% (2286), followed by documentation error in 15% (451), and drug interaction and therapeutic duplication errors in 4% (120) each, respectively, with least one, medical reconciliation error in 1% (30) [Figure 3].

In transcription errors [Table 1], the incorrect drug dosage was the most common error with 47% (208), followed by the wrong drug in 23% (102), improper dilution in 21% (90), missing the drug to transcribe in 8% (36) with the least one, route of administration not written with 1% (05). In case of dispensing errors, wrong medicines supplied due to improper handwriting was the common with 61% (321), followed by unavailability of medicines with 24% (126), and delayed dispensing of medicines in 12.6% (67), whereas wrong patient medicines supply was the least with 2.4% (14) [Figure 4]. In administration errors, medicines given for wrong time duration observed in 55% (603), followed by orders not carried by nurses at an appropriate time in 23% (255), inappropriate dilution in 9% (101), oxygen therapy not started in time or continued beyond the stop order in 8% (87), wrong intravenous (iv) fluid chosen in 4.5% (48), iv medications continued through an iv catheter which was extravasated in 0.5% (06) [Table 2]. The National Coordination Committee for Medication Error Reporting and Prevention Index Severity Classification

Table 1: Transcription errors

Type of error	Numbers	Percentage
1.Wrong drug	102	23%
2.Incorrect drug dosage	208	47%
3.Improper drug dilution	90	21%
4.The Route of administration not written	05	1%
5.Misses the drug to transcribe	36	8%
Total	441	100

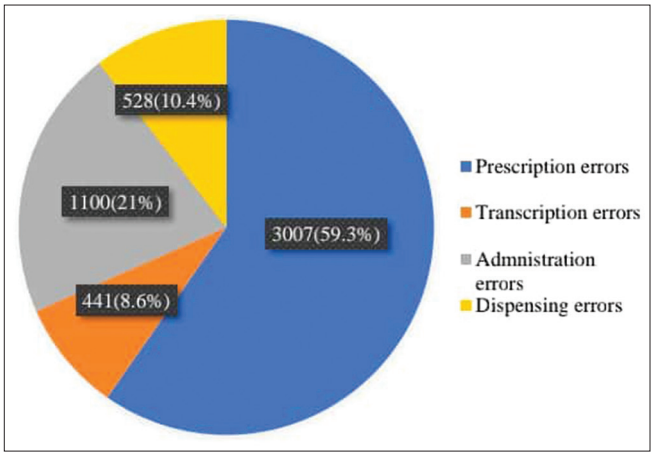

Figure 2: Prescription errors were most common with 59.3% (3007), followed by administration errors with 21% (1100). Dispensing and transcription errors were 10.4% (528) and 8.6% (441), respectively

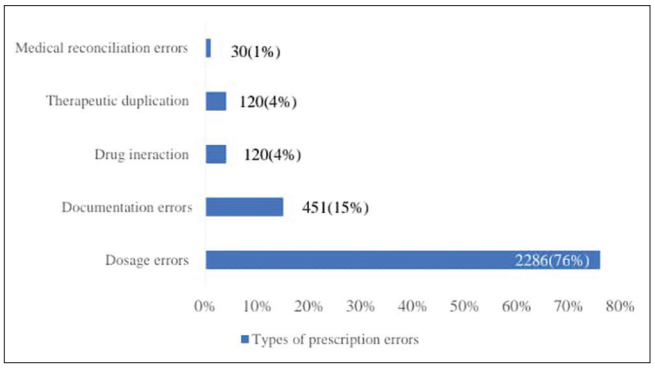

Figure 3: In prescription error, dosage error was predominant with 76% (2286), followed by documentation error in 15% (451), and drug interaction and therapeutic duplication errors in 4% (120) each, respectively, with least one, medical reconciliation error in 1% (30)

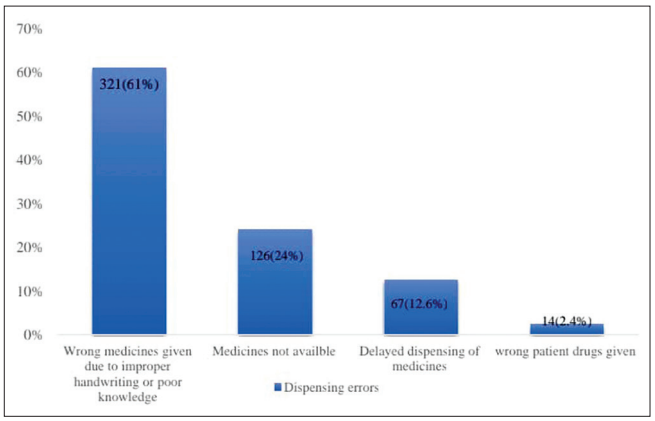

Figure 4: The wrong medicines supplied due to improper handwriting was the common with 61% (321), followed by unavailability of medicines with 24% (126), and delayed dispensing of medicines in 12.6% (67), whereas wrong patient medicines supply was the least with 2.4% (14)

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includes Category B, the most common with 61% (3096) incidence, followed by Category C with 34% (1725). A total of 23 patients developed ADEs (Probably) like electrolytes disturbances in the form of hypernatremia in 4 patients, hyperkalemia in 3 patients, renal complication like acute kidney injury, pRIFLE injury stage in 7 children, and thrombocytopenia in 4 patients, QTc prolongation in 3 children, and hypotension in 2 patients due to MEs, but all of them improved [Table 3]. These complications are not completely explained either by medication errors itself or due to the underlying disease condition.

The mortality was only 1% (28) in this study, which was crude mortality of our PICU and 99% (2792) of the children admitted in the PICU improved and discharged.

DISCUSSION

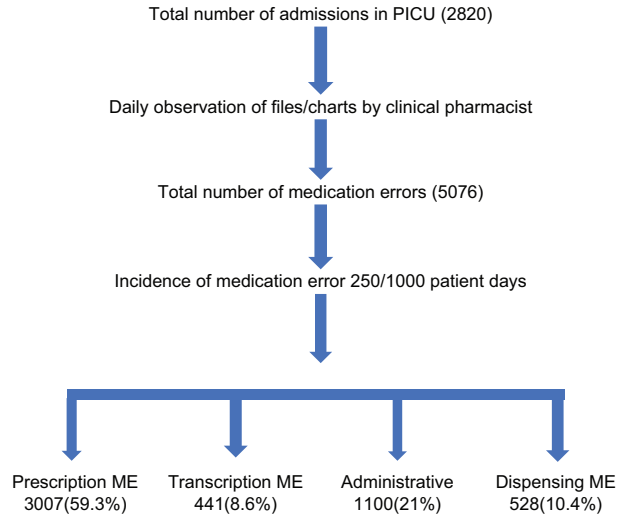
The incidence of MEs [Flow Chart 1] in our study was 250/1000 days or 1.8 MEs per medical record audited, which is comparable to the other studies showing a ME rate of 100–400/1000 patient days in children using direct observation of medical records which is frequently used tool for identifying MEs.[7] The daily chart review or direct observation method is a widely established methodology for identifying MEs in the medical field as compared to other tools like self-reporting.[11] Different studies have proven that pharmacist-led medication reviews have decreased the number of hospital admissions.[12] A systematic review of 38 studies of primary care interventions that were designed to reduce drug-related adverse events proved that most fruitful interventions included a medication review conducted by a pharmacist or other clinicians and medication review by a primary care physician as one component of multicomponent interventions.[13]

In our study [Figure 2], the incidence of prescription, administration, dispensing, and transcription errors was 59.3%, 21%, 10.4%, and 8.6%, respectively, as compared to the study done by Zakharov *et al*.,[14] where prescription, administration, and dispensing errors were 36.8%, 43%, and 20.2%, respectively. The prescription and transcription errors (usual responsibility of medical staff) accounted for 69% of the total MEs, whereas administration errors (usual responsibility of nursing staff) of 21% with the least by pharmacy outlet responsible for dispensing errors of 10.4%.

The most common ME in our study was a prescription error (59.3%) which is comparable to other studies showing prescribing error between 40% and 71.4% in 16 studies.[15,16] The most frequent prescription sub error was dosage

Table 2: Administration errors

Types of error	Numbers	Percentage
1.Medicines given in short time or longer time from prescribed time duration	603	55%
2.Orders not carried by nurses at appropriate time	255	23%
3.Inappropriate dilution	101	9%
4.Oxygen therapy not started in time or continued beyond the stop order	87	8%
5.wrong iv fluid	48	4.5%
6.Medications as iv continued though intracath was extravasated	06	0.5%
Total	1100	100



Flow Chart 1: Flow chart of the study

Table 3: Adverse drug events

System	Type of adverse events with numbers	Reason for error
1.Metabolic	Hypernatremia (04)	IV Sodium bicarbonate therapy, using NS as diluent in most of times
	Hyperkalemia (03)	Tacrolimus, use of Kcl in the maintenance fluids in excessive time, Acute kidney injury
2. Renal	AKI (p RIFLE) Injury stage (07)	Vancomycin use, other nephrotoxic drugs, diuretics etc.
3.Cardiovascular	QTc prolongation (03)	Combination of QTc prolonging drugs such as Azithromycin, fluconazole, and anti-emetic drugs (Domperidone)
	Hypotension (02)	Use of diuretics freely along positive pressure ventilation
4.Hematological	Thrombocytopenia (04)	Heparin/Warfarin therapy Ranitidine Cyclosporine
Total	23	

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error, with 76% out of total prescription errors which are comparable to many other studies.[17-19] In some studies, they have found administration error as the most frequently occurring ME, whereas, in our study, administration error was the second most common with 21%. The transcription error [Table 1] noticed in 8.6% of total errors in which the incorrect drug dose was written by staff, it is more as compared to the study done by Haghbin *et al*.[16] with 4.88%. In dispensing error with 10.4% in our study, wrong drugs supplied due to poor handwriting/poor knowledge about the drugs were most common, which is comparable to other studies.[17,20]

In administration error, the common subtype was medications given for the wrong time duration in 55% of cases [Table 2]. This could be because of nurses who do not adhere to strict drug orders or negligence toward timing importance.

The ME severity according to the NCC-MERP categorization [Figure 5] (an error has happened but not entered the patient body) was the most common category (B) with 61%, followed by Category C (an error has happened and entered the patient body but did not lead to any harm) with 34%, while the Category A (circumstances or situations that can lead to an error) 2.4% and Category D (error happened and reached the patient but needs monitoring and or interventions) with 2.6% were the least. Our study is comparable to other studies showing no harm in more than 78% of the studies.[18,19,21,22] Category D contributed little with only 2.6% of the errors where we monitored the child for error-related adverse events.

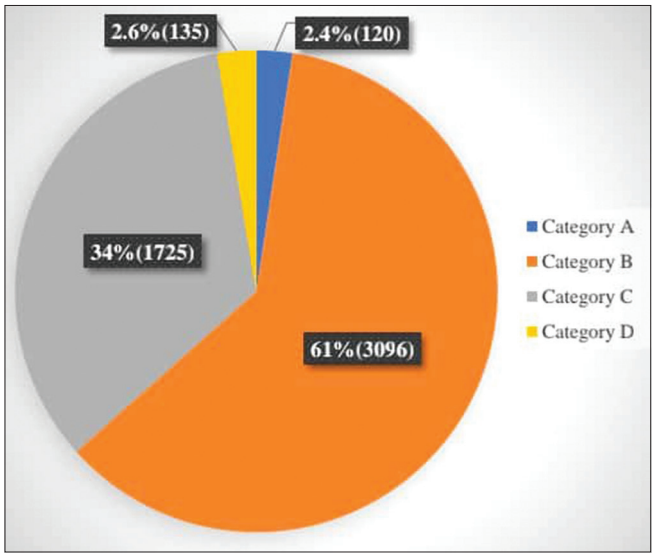

Figure 5: National Coordination Committee for Medication Error Reporting and Prevention Index Severity Classification includes Category B, the most common with 61% (3096) incidence, followed by Category C with 34% (1725)

The observed ADEs were noticed in 0.81%[23] of the total of 2820 patients and less than 0.1% of the total MEs. The ADE rate in our study (0.81%) is very much less as compared to the study done by Kaushal *et al*.,[24] which has reported 2.3% of pediatric inpatients. These ADEs are not entirely explained by MEs alone but by the underlying disease processes too. The ADE included hypernatremia in 4 patients, hyperkalemia in 3 patients, renal complication like acute kidney injury, pRIFLE injury stage in 7 children, and thrombocytopenia in 4 patients, QTc prolongation in 3 children, and hypotension in 2 patients due to MEs, but all of them improved [Table 3]. All of the above ADEs belonged to Category D of the NCC MERP severity classification. These are comparable to other studies.[24,25] These errors could be preventable in more than one-third of the total MEs by not only using computerized physician order entry, bar code system, centralized drug delivery, and structured training program but also using clinical pharmacist assistance.[25-27]

In 92% of MEs, clinicians accepted the advice and suggestions by the clinical pharmacist, but in only 8%, we had biased decisions due to bias in the literature itself.

Almost 99% (2792 patients) of the study population survived, but only 1% (28) of them died as they had underlying critical illness and multi-organ dysfunction syndrome and all of them had mild MEs severity that means they belonged to Category B (17 patients) and Category C (11 patients) as per the NCC-MERP severity categorization. This is our crude PICU mortality rate [Figure 6].

CONCLUSIONS

- Prescription errors were the most common MEs followed by administration errors

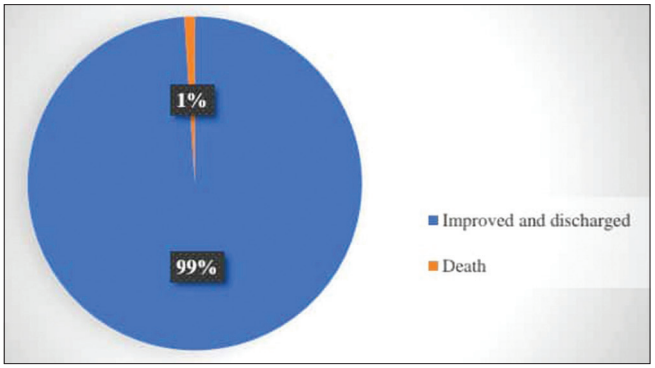

Figure 6: The mortality was only 1% (28) in this study, which was crude mortality of our PICU and 99% (2792) of the children admitted in the PICU improved and discharged

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- The role of the clinical pharmacist was vital in identifying and avoiding the existing burden of MEs in the PICU.
- Reinforcement of structured training of the medical and paramedical staff is essential.

Limitation of the study

The causative factors are not studied, and recognizing the exact incidence of the ADEs was difficult to evaluate.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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