Original Article

Effective implementations to reduce medication administration errors in a tertiary care teaching hospital

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Abstract

Background: Medication Administration Errors (MAEs) can lead to unmet therapeutic objectives as these errors can directly harm the patient and affect the outcome of therapy. **Materials and Methods:** This was an implementation research planned to evaluate the effect of interventions on the prevalence and severity of MAEs over three years, from 2020 to 2022, at a tertiary care hospital where clinical pharmacists were allotted to look into medication-related activities. A medication error reporting form, developed by the pharmacologist, was used to collect MAE data. Analysis of this information aided in the planning of interventions to curtail the occurrence of such errors in the future. Interventions included drug and disease education leaflets, bedside training, vial/ampoule reading training, understanding different dose strengths, maintaining patient bedside boxes, antibiotic reconstitution leaflets for reference, and charts to guide safe drug administration. **Results:** The effect of these interventions was analyzed at the end of each year on the prevalence and nature of MAEs, where a decline of 38.97% was found in 2021 and a further 34.88% in 2022, considering the number of opportunities. The most prevalent was the wrong dose (~57%) errors commonly found with oral solid dosage forms and the cardiovascular group of drugs (42.5%). These MAEs were mainly of no harm category C (64%), while only 1.5% of them had caused harm (category E) to the patient, but none of these was sentinel. **Conclusion:** Interventions by clinical pharmacists successfully helped reduce MAEs and prevented patient harm in the further study period.

Keywords: Medication errors, drug administration, nurses, interventions, clinical pharmacists

Introduction

The purpose of any drug therapy is to achieve predefined therapeutic outcomes that improve a patient's quality of life while minimizing patient risk. Nursing staff are the main pillar of the patient care system as they are responsible for nursing assessment, drug preparation, and administration, then monitoring thereafter.

A medication error is any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is controlled by the healthcare professional, patient, or consumer. Such errors occurring, especially at the drug administration level, can lead to unmet therapeutic objectives as these errors can directly harm the patient and affect the outcome of therapy. Increased documentation and continuous workflow[(1)]. for nurses gives many opportunities for human errors. Additionally, there may be a chance of insufficient knowledge and disturbance in activity by patients or their relatives, or other co-workers in the hospital setup[(2)].

Authors from various studies[(3,4)] report many potential causes of medication administration errors, including lack of medication knowledge, increased workload, and environmental factors like interruptions, day of the week – first day, mid-week, or end of the week, time of administration, in their healthcare setups. Authors from Karnataka, India[(5)] report the frequency of medication administration errors as 15.34% in their tertiary care hospital, while others[(6)] from a teaching hospital in Paris, France, reports the rate as 27.6%. In the study from Saudi Arabia[(4)]. researchers have tried to identify the reasons for medication administration errors and found that inadequate staffing, unclear or illegible medication errors, confusion due to look-alike medicines and nurses getting pulled between teams and from other units were the major causes of such errors.

Eventually, as the number of such errors increases, the patients may lose faith and confidence in the healthcare system. Hence, this study was planned to evaluate the effect of interventions by clinical pharmacists on the prevalence and severity of medication administration errors over a three-year period at a tertiary care hospital.

Methodology

This was an implementation research conducted from January 2020 to December 2022 at a 851-bedded tertiary care

teaching hospital in Pune, India. Five trained clinical pharmacists were allotted patient care areas in a rotational manner every month for medication-related activities, of which medication error identification and reporting was an important part. The sample of patients for auditing the medication administration process for each month was calculated based on the bed occupancy using the formula given in the National Accreditation Board for Hospitals & Healthcare Providers (NABH) key performance indicators: Annexure: 5th Edition Hospital Standards 2020[7], for screening prescriptions for errors. Using this formula, the sample size estimate varied every month and ranged from 350-500 patients, covering all departments of the hospital and all nurses involved in patient care.

A medication error reporting form was prepared by the pharmacologist of the institute and was used for the collection of daily data, which was a continuous process throughout the study. After discussion with the supervising pharmacologist, details of medication administration errors were then entered every day on the forms and collated at the end of each month to understand the frequent errors, their causes, and outcomes. The frequency, types, severity, and factors responsible for medication administration errors were analyzed using the National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP) taxonomy.

While analyzing drugs that were most commonly involved in administration errors, their specific dosage forms, pharmacological classes, dose calculations for administration, and monitoring parameters were the areas of focus. Every month, the analysis of these MAEs revealed loopholes in the medication administration system, which were collated, and policies were formed to improve them in six-monthly meetings. This aided in planning interventions to curtail the occurrence of similar errors in the future, which were implemented in the daily ward rounds, monthly training sessions, and nursing induction programs. The intervention activities planned included drug and disease education leaflets for nurses, bedside training for dose calculations, vial/ampoule reading training, understanding different dose strengths, maintaining patient bedside boxes, antibiotic reconstitution leaflets for reference, and charts to guide safe drug administration. These strategies were in addition to the regular informative sessions on look-alike and sound-alike drugs, high-risk and emergency medicines, verbal drug orders, narcotics and psychotherapeutics, chemotherapeutic medications, checking and record keeping for inventory control of medicines and monitoring of patients after drug administration.

Data analysis

Data was entered and analyzed in Microsoft Excel. The number of opportunities (potential chances or possibilities for the occurrence of the error) calculated for each year depended on average bed occupancy in the year and was considered as the denominator. For example, if a patient is prescribed four medications two times a day, there are eight opportunities for medication errors in a day in this patient. The number of medication administration errors was considered a numerator, and the prevalence and nature of medication administration errors were expressed as frequencies and percentages. The effect of the interventions was analyzed at the end of each year estimating the percent change in the proportion of medication administration errors.

Results

The study site was an 851-bedded multispecialty hospital where the average bed occupancy was around 260 per month during the study period. The number of opportunities for medication errors ranged from 317-473 during the year 2020 to 2022.

We found an appreciable reduction in medication administration errors during the study period, which were 38.97% less in 2021 compared to 2020 and further reduced by 34.88% in 2022 compared to 2021. Figure 1 shows the prevalence of MAE declining from 2020 to 2022, considering the number of opportunities for errors.

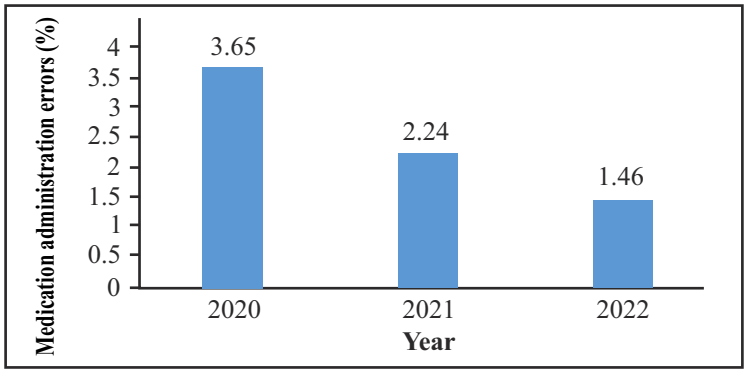

Figure 1: Percentage of medication administration errors at study site over three years 2020-2022

As seen in Table 1, the most prevalent medication administration errors during the study period were wrong dose (less dose- 31.11% and extra dose- 25.8%) and wrong time errors (19.74%). Pharmaceutical forms associated with these errors were oral solid (64.8%), followed by injectable forms (34.3%), and very few with oral liquid formulations.

Table 1: Types of medication administration errors during the study period (2020-2022)

Type of medication administration error	MAE (%)
Less dose	31.11
Extra Dose	25.8
Wrong time	19.74
Wrong drug	16.09
Wrong frequency	4.29
Wrong diluent	0.85
Wrong duration	0.85
Wrong route	0.85
Wrong dosage form	0.42

MAEs with oral solid dosage forms where either less or extra dose was administered due to different strengths. Combinations of drugs available were associated either with antihypertensive drug combinations and their different strengths available or prophylactic antiplatelet and hypolipidemic drug combinations. With the injectable drugs, dose calculation errors were common with Injection Heparin, Tramadol, Thiamine, Furosemide, and Dexamethasone, where per ml dose needs to be understood before administration; while the liquid formulations involved in these errors were look-alike and sound-alike (LASA) drugs where syrup ALCIT-NF® (Disodium Hydrogen Citrate) and syrup Ascoril LS® (Levosalbutamol + Ambroxol Hydrochloride + Guaifenesin) were look-alike amber colored bottles of 100ml; and syrup Dixin paed® (Digoxin) was mistaken with its sound-alike Dexcin eyedrops® (Dexamethasone sodium Phosphate + Boric acid + Neomycin) by the nursing staff.

Wrong time errors were reported with medicines that need to be given at specified timings in relation to the day or food - Thyroxine in the early morning and antidiabetic drugs before meals.

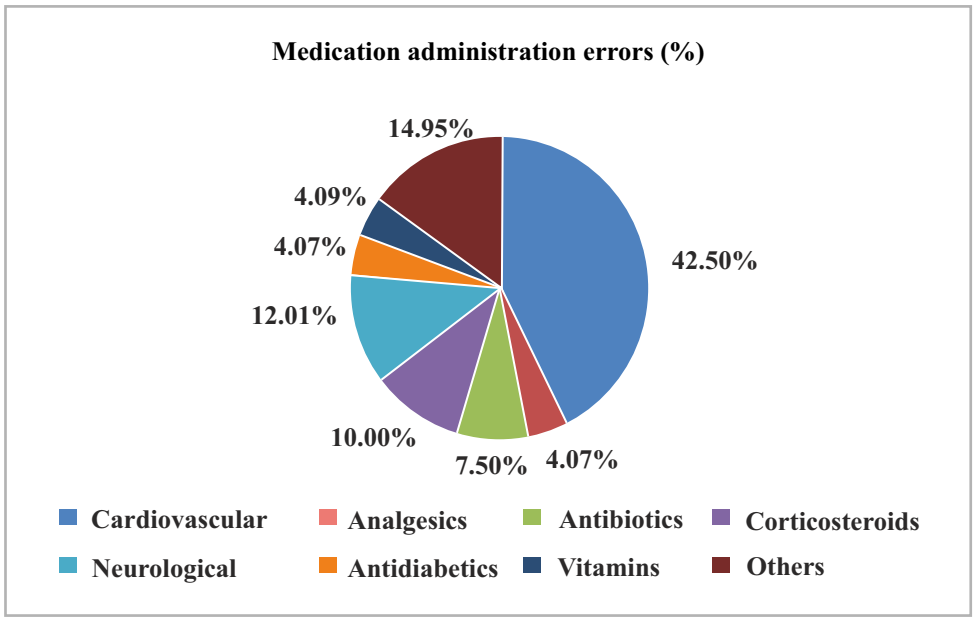

Figure 2: Classes of drugs associated with medication administration errors during the study period (2020-2022)

MAEs during the study period were mostly found with a cardiovascular group of drugs (42.5%), as seen in Figure 2, which occurred in the medicine department, followed by intensive care units of the study set-up. Figure 3 depicts that MAEs reported in the study period were mainly of no harm category C (64%) and category D (34.5%), while very few of them had caused harm to the patient and were category E errors (1.5%), but none of these was sentinel.

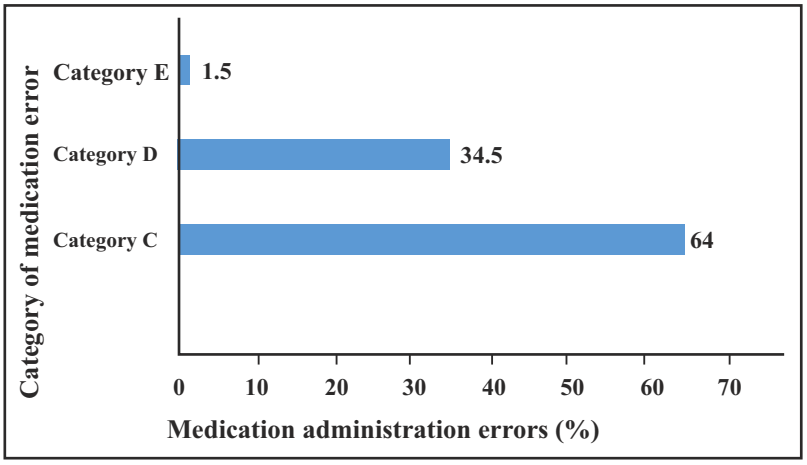

Figure 3: Harm-wise category of medication administration errors during the study period (2020-2022)

Note: Category C: error reached patient but did not cause harm; Category D: error reached patient & required monitoring/intervention to prevent harm; Category E: error that may have caused temporary harm

Discussion

This prospective study over a three-year period was conducted to evaluate the effect of various interventions on the prevalence of medication administration errors in a tertiary care hospital in western Maharashtra, India. The observations showed a considerable decline in medication administration errors from 3.65% in the year 2020 to 1.46% in the year 2022, considering the number of opportunities. Studies have reported a prevalence of 8%, 10.5% to 13.7% MAEs in their study set-ups in various countries around the globe[3,6,8].

The current study reports wrong doses followed by wrong time errors as the most common drug administration errors in the study setup. Authors from Brazil have also reported wrong dose and omission type errors in their study conducted in three Brazilian hospitals by direct observation of the nursing staff, preparing and administering intravenous medication[9]. On the other hand, Berdot et al.[6] and Chua et al.[10] report wrong time errors as the principal type of error, followed by errors of omission or incorrect technique. A systematic review by Assunção-Costa et al. mentions the primary errors in medication administration in various studies of Latin America as related to time, dose, omission, and route of the drug[11].

Authors all over the world have reported errors more frequently with injectable forms than any other forms of drugs[12]. Our study found that MAEs were common with oral solid dosage forms (64.8%), where either less or extra dose was administered due to different strengths and combinations of drugs available (Table 1). Such errors were more commonly seen with the cardiovascular group of drugs (Figure 2), which are available in different strengths and combinations. This might confuse the nurses during the drug administration process if the drug labels are not read properly or there is a lack of awareness about such preparations. Authors of similar studies have also mentioned that cardiovascular medicines were more commonly involved in MAEs than other pharmacological classes of drugs at their study sites[6,13,14]. As an intervention to avoid similar errors in the future, we trained the nurses to read the drug information on the drug box/strip to check for the drug/s content and its dose strength before administering the drugs.

For the dose calculation errors, bedside and group training sessions of all nursing staff were planned for vial and ampoule readings for dose calculation so that patients receive appropriate doses and harm can be prevented. Chua et al.[10] have shown an association between medication administration errors and the injectable route of administration compared to the oral route, while nurse workload was mentioned as a risk factor of medication administration errors by Tissot et al.[15] who did not find any such association between injectable administration and errors.

Wrong time errors (Table 1) were reported when the drugs were not given at the prescribed time due to the nursing strategy of administering the drug during their patient care rounds. To avoid such errors, it was decided to enter drug dosing time in the nursing chart for drugs that need to be

administered at specified timings and act accordingly.

MAEs reported from our site did not cause patient harm as most of these errors were of "No Harm" category C (64%) and D (34.5%) according to NCCMERP classification, while minimal harm occurred only in 1.5% of the errors. Our results are the same as those reported by Garcia-Ramos et al.[16] and Berdot et al.[6] but Chua et al.[10] have reported 10.4% of their administration errors as potentially life-threatening. Berdot et al. reported that there were no potentially life-threatening errors, but 6% of medication administration errors could be classified as serious or having a significant impact on patients (mainly omission). Garcia-Ramos et al. mention that 98% of the errors in their study did not harm the patients, and 57.7% were reported as "Category C"[16].

Timely identification and reporting by clinical pharmacists and then analysis of these errors has helped us develop strategies/interventions for educating and training nurses to reduce MAEs. These activities were led by the clinical pharmacists under the supervision of the pharmacologist in the hospital. Calabrese et al.[14] mention that they encountered fewer medication administration errors compared to the published literature and give credit to pharmacists involved in the process. Some of the authors suggest the implementation of surveillance systems, which might help to decrease medication errors[17]. Theory-based recommendations for interventions designed to minimize intravenous MAEs in hospitals have also been suggested.

Limitations

As the data depended on the number of patients admitted every month, the sample size could not be equal for all years of the study. The study was a continuous process; interventions were planned according to the observations and then implemented routinely in daily rounds and monthly training of nurses. Hence, other confounding factors were not taken into account.

Conclusion

Medication administration errors (MAEs) were found to be prevalent and mainly related to dose errors of oral solid dosage forms. Interventional strategies developed in the study setup helped reduce these MAEs in the further 2-year period, and hence, their prevalence decreased from 3.65% in 2020 to 1.46% in 2022, considering the number of opportunities. The majority of these MAEs were of category C, and prompt intervention by clinical pharmacists prevented patient harm due to these errors.

Acknowledgement

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Conflict of Interest: Nil

Source of Support: Nil

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Ethical consideration

As medication error reporting is mandatory in a NABH-accredited hospital, Institutional Ethics Committee permission and Clinical Trials Registry-India (CTRI) registration were not sought. Only permission from hospital authorities was obtained to analyze and publish the results.

Authors' Contribution

PD: Conceptualization, suggesting about data collection and interventions accordingly, Manuscript drafting and finalization; AC: data collection, guiding other clinical pharmacists in the same, Data Analysis and Results preparation, implementation of the interventions at the study site.

Data availability statement

Data will be available with corresponding author on request

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