Prescription Errors in NICU: Prevalence and Results of an Intervention Program

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Abstract

Aim: To assess the prevalence and characteristics of prescription errors in neonatal inpatients and measure the effect of an intervention program to reduce prescription errors

Materials and Methods: This was a preintervention and postintervention cross-sectional study conducted at a level-3 neonatal care unit. Sample prescriptions that were ordered by physicians during the study period were collected. A single, multifaceted intervention was performed mainly through an educational program on prescription of medications by medical and nursing staff. The prevalence of prescription errors during each phase, type of identified errors, and adverse effects due to medication errors were studied.

The first group sampling was done in May 2013 and comprised 48 patients with 368 prescriptions. An educational program was conducted subsequently. The second group sampling was done in September 2013 and comprised 69 patients with 511 prescriptions.

Results: Both groups had similar baseline characteristics. The prevalence of prescription errors was significantly lower during the postintervention phase of the study. Among other outcome measures, the most frequent errors were the omission of name and signature of the prescribing physician and omission of prescription order date and time, which significantly reduced in the postintervention phase.

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Conclusions: Intervention through a comprehensive program for preventing errors, including all healthcare personnel involved in the treatment process, helped to achieve a significant reduction in the prevalence of prescription errors.

Key Words: Medication errors, prescription, intervention, checklist, cultural change, patient safety

Introduction

In clinical practice, medication errors are a commonplace mainly because of their association with human nature and the complex nature of medical management itself. The Greeks believe that the main objective of any physician should be not to harm patients. However, in modern medical practice, errors are quite frequent.[1-3] Some of these errors do not have any consequences, but some others cause injuries, and while a few others can even cause death.

In general, medication errors are dealt with either by covering up or taking punitive action against the accused. However, these approaches restrict the physician from recognizing the errors and analyzing the reasons behind the errors. This also creates difficulty in generating a structured patient safety–oriented approaches among healthcare professionals.[4,5] Stelfox et al,[6] in their review article, have extensively reviewed literature regarding patient safety issues. The most frequent error in the medical field occurs in medication prescription. Medication errors were the most frequent cause of iatrogenic adverse events with error rates varying widely from 1.5% to 30% among several studies.[7-12] Although the frequency is similar for age groups ranging from pediatric to adult, the risks of errors with a potential for harm are thrice as high for children[13] than for adults. Prescription errors that result in patient harm also end up in escalation of costs of medical care.[14,15] The most common are errors related to prescription of medication, followed by errors in the administration of prescribed medication, especially IV solutions.[16-18] Most studies published to date are only generally descriptive in nature, and just a few of them assess the outcome of an intervention in the prevention of prescription errors.

Aim

To assess the prevalence and characteristics of prescription errors in neonatal inpatients and measure the effect of the intervention program on reduction of medication errors

We also assessed the outcome of a comprehensive preventive strategy on the number of prescription errors over a certain period.

Materials and Methods

This preintervention and postintervention cross-sectional study of a sample of prescriptions that were ordered by physicians was conducted at a level-3 NICU of Surya Children's Hospital (Mumbai, Maharashtra, India).

The study was approved by the institutional ethics committee.

Intervention

A single, multifaceted intervention by means of a comprehensive educational program was conducted. The program was focused on the promotion of a change in culture toward medical errors and on building a patient safety–oriented attitude in all NICU healthcare staff.

The specific strategies developed to reduce prescription errors included improving the environmental conditions (eg, reducing interruptions such as telephone calls), active interaction with other professional pharmacists during rounds, and implementation of the "10 steps to reduce medication errors" with the help of a checklist.[19]

A checklist card was adapted from literature and given to everyone on the medical team and a copy of it was

placed where medications were prescribed, prepared, and administered.[19]

10-Step checklist to reduce prescription errors

1. Do not write a prescription order during suboptimal environmental conditions and during time frames that are prone to distractions.
2. Always verify that the prescription order corresponds to the correct patient, and the patient's name appears in the medication sheet.
3. When writing a prescription order,
   - use clear and legible handwriting—writing in capital letters is recommended;
   - indicate the generic name of the drug;
   - state the dose, dosage frequency, suggested dilution, the route of administration, and the suggested infusion time;
   - do not use any abbreviations; and
   - explicitly indicate the time and date.
4. Explain whether there is any drug incompatibility when used with other medications or if any dilution is required.
5. Discuss and plan with the nursing staff involved in the care of a neonate about the most suitable time to administer any medication and confirm that the patient has in fact received that medication at the planned time.
6. Write or revise prescription orders daily.
7. Use capital letters while writing/modifying indications written the same day, and tell the nursing staff personally.
8. Repeat the medication calculations 2 or 3 times when a medication requires many dilutions, and write the dilution explicitly.
9. In conclusion,
   - reconfirm everything that has been written,
   - verify the dose calculation,
   - check that nothing is missing, and
   - sign the prescription order and write the full name clearly.
10. Every single prescription, without any exception, must be rechecked by another physician before indicating it, and this doctor must write "checked by <his/her name>."

Classification of prescription errors

Medication errors are defined as errors in drug ordering, transcribing, dispensing, administering, or monitoring. The most common medication errors are related to prescription. In our study, medication/prescription errors were defined based on the standard definition and classification of medication errors provided by the American Society of Health-System Pharmacists.[20]

Prescription errors were classified as follows:

0. No error
1. Wrong medication (contraindicated for the patient or belongs to another)
2. Wrong dosing: wrong total daily dose or wrong bolus dose and wrong maintenance dose, which also includes errors such as using milligrams instead of micrograms
3. Omission of
   - a drug that was being administered and not stating that it was suspended
   - a written prescription of an administered medication (verbal orders)
   - time for which an administered drug was prescribed
4. Inappropriate route of administration
5. Error in dosing interval
6. Inadequate dilution of a drug or solution
7. Inadequate indication or omission of the infusion time of a drug
8. Inadequate IV infusion rate
9. Illegible order

Study procedure

During the preintervention and postintervention phases of the study, 368 and 511 prescriptions was assessed, respectively. The physician and nursing healthcare staff were unaware about the study being conducted. Prescription error identification was performed by 2 trainee fellows who were specially trained for this purpose. Both these fellows reviewed every medica-

tion chart together. The reviewers were not blinded to patient identification in the medication chart. They collected the data only from patients' medical charts and medication prescription sheets. No direct observation data were collected. All data were recorded in a structured pro forma.

The first cross-sectional or preintervention phase analysis was performed in May 2013, before the preventive intervention measures were taken. The second or postintervention phase took place in September 2013, after the implementation of an intervention program to prevent prescription errors. During both the phases of the study, the methodology was the same, and the same researchers performed the assessment.

Outcome variables

The primary outcome variable was prevalence of prescription errors during each phase. The secondary outcome variables were patient's demographic data, time of the prescription order, number of written prescription orders during each phase of the study, the type of identified errors, and adverse events if any because of prescription errors.

Statistical analysis

Data were presented in a descriptive format. Medication error rates were estimated per 100 prescriptions. All the information was noted by using 2 x 2 contingency tables to estimate the odds ratio (OR) with type I-α error level set at 0.05 and a 95% confidence interval (CI) to consider the statistical analysis valid. A *P* value < .05 was considered statistically significant. Statistical analysis was performed using SPSS version 17.0 for Windows (SPSS Inc, Chicago, IL, USA).

Results

In the first cross-sectional or preintervention phase analysis, a total of 368 prescriptions of 48 patients were assessed. In the second cross-sectional or postintervention phase analysis, a total of 511 prescriptions of 69 patients were analyzed.

There was no significant difference in the baseline characteristics of patients in the preintervention and postintervention groups (Table 1). Tables 2, 3, and 4 reveal outcome measures in both groups.

It was inferred that prevalence of prescription errors was significantly lower in September 2013 compared with May 2013 (85% versus 52% [*P* < .0001]; OR = 5.3 [95% CI: 3.8–7.4]) (Table 2).

Table 1. Baseline Characteristics of Patients

Parameter	Preintervention Phase (*n* = 48)	Postintervention Phase (*n* = 69)
Gestational Age, wk		
Mean ± SD	34.26 ± 4.04	32.64 ± 4.16
Median (IQR)	35 (31.71–37.93)	32.5 (29.96–35.86)
Birth Weight, g		
Mean ± SD	2033.96 ± 798.9	1729 ± 846.48
Median (IQR)	2185 (1450–2630)	1540 (1032.5–2160)
Female, *n* (%)	21/48 (43.7)	28/69 (40.6)
Male, *n* (%)	27/48 (56.3)	41/69 (59.4)

Table 2. Prescription Errors

Error	Preintervention Phase, *n*/*N* (%)	Postintervention Phase, *n*/*N* (%)	OR (95% CI); *P* Value
Prescription	313/368 (85)	265/511 (52)	5.3 (3.8–7.4); < .0001

Table 3. Types of Preintervention and Postintervention Errors

Type of Error	Preintervention Phase, *n*/*N* (%)	Postintervention Phase, *n*/*N* (%)
Omission of Prescription	2/313 (0.63)	4/265 (1.5)
Omission of Drug Order	0/313 (0)	1/265 (0.38)
Illegible Order	79/313 (25.2)	37/265 (14)
Omission of Date and Time of Prescription	283/313 (90.41)	194/265 (73.2)
Omission of Name and Signature	300/313 (95.84)	180/265 (67.92)
Omission of Route of Administration	12/313 (3.8)	5/265 (1.9)
Wrong Route	0/313 (0)	1/265 (0.38)
Wrong Dosing	6/313 (1.92)	1/265 (0.38)
Wrong Dosing Interval	1/313 (0.32)	1/265 (0.38)
Omission of Infusion Time and Dilution	4/313 (1.3)	6/265 (2.3)
Wrong Dilution	10/313 (3.2)	10/265 (3.8)
Wrong Prescription	1/313 (0.32)	0/265 (0)

Table 4. Preintervention and Postintervention Prescription Errors According to Time Shifts

Shift Timing	Preintervention Phase, *n*/*N* (%)	Postintervention Phase, *n*/*N* (%)	*P* Value
Morning	288/336 (85.7%)	251/494 (50.8%)	.001
Evening	12/16 (75%)	4/4 (100%)	0.54
Night	13/16 (81.2%)	10/13 (76.9%)	1.0
Total	313/368	265/511	< .0001

Omission of the name and signature of the prescribing physician and omission of prescription order date and time were the most frequently occurring errors. These errors reduced significantly in the second phase (Table 3).

There was a significant reduction of potentially harmful prescription errors such as illegible order, wrong prescription, and wrong dosing in the second phase of the study. No adverse events were identified in either of the 2 phases.

In the postintervention phase, a reduction of errors was observed in the morning and night shifts. However, errors were more in the evening shift during the postintervention phase. However, this was not statistically significant probably because of the small sample size (Table 4).

Discussion

The working environment inside any intensive care unit, especially NICU, is complex and loaded with many challenges. This gets further complicated in a severely ill newborn. Newborns have physiologically immature systems. Many sick newborns require multidisciplinary care that needs coordination and complex communication. Technologies used in intensive care are rapidly evolving and a healthcare worker needs to be aware of it. This makes the NICU highly vulnerable to medical and mediation errors. Some of these errors may end up causing harm to the patients. Also, there are patient handovers with each shift change between various caregivers such as consultant doctors, resident doctors, nursing staff, and pharmacists. Many times, admission and discharges also happen at a rapid pace.

In a premature newborn admitted in the NICU, there is a rapid change in body weight during the hospital stay. This change in weight necessitates frequent readjustment of drug doses. Physiologic maturation and changing pharmacokinetics (absorption, distribution, metabolism, and excretion) in newborns further enhance the risk of medication errors and harm.[10,21-25] Newborns admitted in the NICU are prone to 10- to 100-fold dosing errors because of the complex nature of calculations involved with medications that require dilution of stock drugs.[26]

We conducted a cross-sectional study to assess the prevalence and characteristics of prescription errors in neonatal inpatients and measure the effect of interventions to reduce medication errors. The study was performed in 2 phases. The first phase evaluated the prevalence of prescription errors in hospitalized neonates to assess the real scope of the problem before the intervention.

Otero et al[19] reported that the error rate during the first phase was very high compared with that reported in other studies in literature. This difference may be due to the differences in the classification systems employed. Certain other studies report similar rates before and after intervention programs. Kaushal et al[16] observed a medication error rate of 5.7% in 2 academic pediatric hospitals. Marino et al[27] observed a medication error rate of 24%. Jain et al[28] observed a medication error rate of 9.6% in emergency department and NICU settings.

Otero et al[19] observed that the most frequent errors were the omission of the prescription order time, as in our study. Jain et al[28] and other studies[10,29] showed that most common prescription errors are dose related and these may vary from 14% to 82%. However, in our study, these errors were 1.92% in the preintervention phase, which reduced further in the postintervention phase.

Many studies have reported more errors in the evening and night shifts,[29,30] whereas one study has reported more errors in day shift.[16] In our study, errors were more in the morning shift followed by night, and then evening shift, though the difference was not significant. However, in the postintervention phase of our study, a reduction of errors was observed in various time shifts.

During the postintervention phase of the study, a significant reduction in prescription errors was observed.

Previous research shows disparate results—Bates et al[31] did not find positive results of a team intervention on the rate of prescription errors; Cohen et al[32] showed that changes in the attitudes of healthcare personnel toward patient safety can be achieved through a comprehensive intervention program; Otero et al[19] showed that an intervention program mainly focused on the promotion of a cultural change in the approach to prescription errors can effectively diminish medication errors in neonates and children; Cimino et al[33] reported a significant decrease in preventable adverse drug events during a brief postintervention period with the implementation of low-cost, low-technology interventions.

The intervention in our study was specifically focused on promoting a cultural change among professionals about the approach toward prescription errors. Covering up errors and believing that only incompetent or irresponsible healthcare professionals make mistakes and promoting punitive measures against them have been the predominant behaviors in clinical practice.[6] We all are now aware that "to err is human."[6] To make progress, one needs to be open to accepting errors and change the systems to make them safer. An important change in the attitude toward prescription errors was achieved during our study. All healthcare professionals in our hospital became aware and accepting of the various prescription errors and willingly adopted patient safety–oriented practices.

Our study had certain limitations. The study was conducted at one institution in one region. The reviewers who identified the errors were not blinded. No adverse effects related to medication errors were found, perhaps because a cross-sectional study is not the best design to identify a causal association between the error and the adverse event. Finally, with the need to bring about a cultural change regarding prescription errors, as the main objective of the intervention, it could have been prudent to extend the time between the preintervention and postintervention phases because it is a slow, complex, and difficult task to implement all the learnings from the intervention program within a short duration.

Conclusion

According to the results of this study, an intervention through a comprehensive program for the prevention of prescription errors, including all healthcare personnel involved in the medication process, achieved a significant reduction in the prevalence of medication errors. Similar programs could increase safety of hospitalized neonates and infants, a group more vulnerable to complications because of prescription errors.

Acknowledgment

The authors thank the parents of all the neonates/infants who were part of this study.

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