Dedicated Fax Machine to Increase Scrutiny of Medication Orders for Pediatric Hospital Inpatients

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ABSTRACT

Background: Some children are treated at hospitals that focus on adult care. When orders for children and adults are interspersed, it can be difficult to recognize the pediatric orders. As a result, pediatric patients are at greater risk of medication dosing errors. Pharmacists need to be able to immediately recognize pediatric orders and perform appropriate dose checks.

Objective: To determine if a dedicated fax machine for pediatric orders would lead to increased scrutiny of such orders by pharmacists.

Methods: Review and analysis of pediatric orders processed before and after installation of a dedicated fax machine for pediatric orders at a community hospital.

Results: The proportion of pediatric orders with appropriate dose-checking increased from 47.9% (57/119) before to 64.1% (109/170) after installation of the dedicated fax machine. For patients up to 12 years of age, appropriate dose-checking increased from 49.6% (56/113) to 74.5% (105/141).

Conclusions: Pharmacists' scrutiny of pediatric orders increased after installation of a dedicated fax machine for pediatric orders.

Key words: pediatrics, fax machine, medication safety

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RÉSUMÉ

Contexte : Certains enfants sont traités dans des hôpitaux spécialisés dans les soins aux adultes. Lorsque les ordonnances pour enfants sont intercalées entre celles pour adultes, il peut être difficile de les reconnaître. Il en résulte donc un risque accru d'erreurs de posologie pour les enfants. Les pharmaciens doivent être en mesure de reconnaître immédiatement les ordonnances pour enfants et d'effectuer une vérification congruente des posologies.

Objectif : Déterminer si l'emploi d'un télécopieur réservé à la réception des ordonnances pour enfants entraînerait leur examen plus minutieux par les pharmaciens.

Méthode : Un examen des ordonnances pour enfants exécutées avant et après l'installation d'un télécopieur réservé à la réception de celles-ci a été effectué dans un hôpital communautaire.

Résultats : La proportion d'ordonnances pour enfants ayant fait l'objet d'une vérification posologique congruente a augmenté, passant de 47,9 % (57/119) avant l'installation du télécopieur réservé à la réception des ordonnances pour enfants, à 64,1 % (109/170) après son installation. Chez les patients âgés de 12 ans ou moins, la vérification posologique congruente a augmenté de 49,6 % (56/113) à 74,5 % (105/141).

Conclusions : L'installation d'un télécopieur réservé à la réception des ordonnances pour enfants a entraîné leur examen plus minutieux par les pharmaciens.

Mots clés : enfants, télécopieur, sécurité des médicaments

INTRODUCTION

Many hospitals in Canada focus on caring for adults, yet also provide care for pediatric patients (neonates, infants, children, and adolescents). Pediatric patients tend to constitute a small proportion of patients in these hospitals. The relatively low number of pediatric patients often means limited availability of resources such as specialized staff, on-site pediatric-focused education, and staff dedicated to strategies for reducing pediatric medication errors. At the author's hospital, the pediatric population represents about 7% of patients and 1% or 2% of medication orders. Scrutinizing these orders appropriately is difficult when they are interspersed with adult orders.

Differences in age, weight, clinical condition, and organ function within the pediatric population result in significant differences in required doses.[1-4] Dosing errors represent the most common medication incidents for pediatric patients,[5,6] and 10-fold dosing errors (either 10 times or 1/10th the correct dose), are commonly reported.[1,5,7] Such errors may be even more extreme, as in the case of a 1000-fold dosing error that occurred at the author's hospital. In that case, a prescription for morphine 10 mg (milligrams) to be given orally every 3 h, a common adult order, was processed without question and appeared on the medication administration record for a neonate. However, the order was supposed to be 10 µg (micrograms) to be given orally every 3 h, which was a weaning dose for a neonate who had been exposed to narcotics in utero. The medication error was detected by nursing staff just before the drug was administered. This example highlighted the requirement that pharmacists be able to differentiate orders for pediatric patients, to ensure appropriate dose-checking.

At the author's hospital, which has 16 beds for general pediatrics and 18 beds for neonatal intensive care, all medication orders are received in the pharmacy by fax transmission. The current computer system does not offer dose validation functions or alert the pharmacist to pediatric orders. Inability to readily identify pediatric orders and to note the weight and age of pediatric patients was contributing to dosing errors. In 2006, 20 medication errors involving pharmacy were reported for pediatric inpatients. The types of errors frequently identified and not reported on incident reports included incorrect instructions for reconstitution of drugs, as well as situations in which the dose and suggested volume did not match the reconstitution instructions. Because reconstitution instructions differ for neonatal, pediatric, and adult patients, this type of error could lead to significant overdoses. Although not captured on incident reports, these errors have the potential to cause harm and were being reported verbally by nursing staff to pharmacy staff up to 10 times a day. The frequency of these errors and a couple of potentially fatal near-misses led to a recognition that a method of highlighting pediatric orders was urgently needed.

To increase pharmacists' ability to immediately identify pediatric orders, a trial of a dedicated fax machine for pediatric orders was proposed. The objective of the study reported here was to determine if the dedicated fax machine actually increased pharmacists' scrutiny of pediatric orders.

METHODS

In November 2006 a fax machine installed in the pharmacy was programmed to receive orders only from the pediatric wards and the neonatal intensive care unit (NICU). At the same time, a pharmacy technician reprogrammed the fax machines on the pediatric wards and in the NICU to send documents directly to the dedicated pediatric fax machine in the pharmacy. Programming was confirmed by sending test faxes from the ward fax machines. The emergency department had 2 pediatric beds, but it was not possible to include those beds in the study described here. The dedicated pediatric fax machine was stocked with blue paper to help pharmacy staff members identify pediatric orders once they had been removed from the fax machine. Pharmacy staff members were informed that, from that time forward, pediatric orders would arrive on the dedicated fax machine. No additional instruction or education was provided.

Medication orders were processed according to usual procedures. Oral and topical medications, as well as parenteral drugs to be prepared by nursing staff, were dispensed according to a traditional system, with 5-day supplies; parenteral medications prepared by pharmacy staff were dispensed daily. Not all orders from the NICU were entered into the pharmacy computer system, as the NICU does not use pharmacy-generated medication administration records; however, all orders from the NICU were to be reviewed by a pharmacist.

For this study, the clinical pharmacy specialist for pediatrics performed a retrospective audit of the pediatric orders. A sample of records was obtained by randomly selecting 9 days' worth of orders from up to 2 months before and 6 to 8 months after installation and programming of the dedicated pediatric fax machine. The pediatric medication orders were reviewed to determine the total number of orders received and processed and whether doses had been checked. A dose was deemed to have been checked if a notation such as "dose ok" or a milligram per kilogram or milligram per square metre calculation appeared on the order. Doses were considered to be in the acceptable range if they matched recommen-

dations in the *BC Children's Hospital 2002/2003 Pediatrics Drug Dosage Guidelines*,[8] the 2005–2006 *Drug Handbook and Formulary* of the Hospital for Sick Children, Toronto,[9] or the pediatric dosage recommendations of Lexi-Comp,[10] Neofax,[11] or Micromedex.[12] Missed orders were those that had been received by the pharmacy department and filed, with no evidence that the order had been reviewed, processed, or filled by a pharmacy staff member. For the pediatric ward, missing orders were confirmed by receipt of a refaxed order and missing medication memo request from nursing staff. All orders were screened for the correct patient, drug, and route. In addition, the appropriateness of formulations (i.e., use of pediatric formulations) and label instructions were reviewed. Descriptive statistics were used to compare the scrutiny of orders before and after implementation of the dedicated pediatric fax machine.

RESULTS

In total, 119 orders were identified for the 9 randomly selected days before installation of the dedicated fax machine and 170 for the 9 randomly selected days after installation of the dedicated unit (Table 1). The proportion of orders missed by pharmacists declined from 8.4% (10/119) before to 3.5% (6/170) after implementation of the dedicated fax machine, and the proportion of orders for which the dose was checked increased from 47.9% (57/119) to 64.1% (109/170). For patients up to 12 years of age, dose-checking increased from 49.6% (56/113) to 74.5% (105/141). Among the orders for which doses were not checked, 3 orders received before implementation of the dedicated fax (one each for gentamicin, morphine, and clarithromycin) had doses that were too high. The proportions of orders for which doses were too low were similar: 1.7% (2/119) before and 1.2% (2/170) after implementation of dedicated fax machine. All of the orders processed before and after installation of the dedicated pediatric fax machine had the correct patient and the correct drug; one order received before installation of the dedicated fax machine had the incorrect route. Incorrect formulations and label instructions declined from 9.2% (11/119) before to 4.1% (7/170) after implementation of the dedicated machine.

DISCUSSION

In this study, use of a dedicated pediatric fax machine with coloured paper led to increased scrutiny of pediatric medication orders. Pediatric patients are more likely to experience medication incidents,[13] because of huge variations in weight, from less than 0.5 kg to more than 100 kg. As such, each dose must be calculated individually, taking into account the patient's age, maturity, clinical condition, weight or body surface area, and available formulations.[1-4] In addition, with their lower physiologic reserves, pediatric inpatients may have limited ability to buffer errors such as overdoses.[6,14]

Several error-prevention strategies have been implemented at other hospitals. One approach requires a variety of human resources, including presence of a clinical pharmacist, pharmacists' participation in patient rounds, monitoring by pharmacists of ordering and transcribing, and increased communication among health care professionals.[2,14] With a limited number of pharmacists who specialize in pediatrics practising in adult hospitals, it can be difficult to fulfill all of these desired roles for pediatric patients. Therefore, the dispensing pharmacist has an increased role in scrutinizing pediatric orders for appropriate dosing. However, in hospitals that

Table 1. Receipt and Handling of Medication Orders for Pediatric Patients Before and After Installation of a Dedicated Fax Machine

	No. (%) of Orders							
Patients by Age Group	**Received**		**Missed**		**Dose Checked**		**Dose Too High**	
All patients								
Before fax	119		10	(8.4)	57	(47.9)	3	(2.5)
After fax	170		6	(3.5)	109	(64.1)	0	
0–11 months of age								
Before fax	48	(40.3)	3	(6.3)	26	(54.2)	2	(4.2)
After fax	38	(22.4)	2	(5.3)	32	(84.2)	0	
1–12 years of age								
Before fax	65	(54.6)	6	(9.2)	30	(46.2)	1	(1.5)
After fax	103	(60.6)	3	(2.9)	73	(70.9)	0	
13–17 years of age								
Before fax	6	(5.0)	1	(16.7)	1	(16.7)	0	
After fax	29	(17.1)	1	(3.4)	4	(13.8)	0	

focus on caring for adults, the dispensing pharmacist often has limited knowledge about pediatric inpatients. In addition, some adult-focused pharmacists may perceive that orders written by a pediatrician do not need dose validation. Dispensing pharmacists at the author's hospital receive no training or orientation on reviewing pediatric orders and performing dose validation. Each dispensary pharmacist reviews 250 to 300 orders per shift, of which only a handful are pediatric orders. In addition, the dispensing pharmacist has no opportunity to directly observe the consequences to the patient of pharmacy-related medication errors and thus may not realize the significance of such errors. The lack of pediatric focus, appropriate training, and exposure to pediatric patients and their medication orders leads to a lack of compliance with the dose-validation procedures that are routinely performed in pediatric hospitals. Cina and others[15] found that pharmacists' accuracy in detecting errors was only 79%; therefore, standardized processes are beneficial in reducing incidents.[16]

Another approach to reducing error involves technology, for example, computerized physician order entry, electronic decision support, prescription transmission systems, and medication administration records[14,17]; these options may be suitable for some sites. In addition, the use of robots for dispensing, automated dispensing machines, unit-dose systems, bar-coding for patients and medications, and "smart" IV devices have also been suggested.[14,17] Although technologic advances may help to reduce some medication errors, they will not eliminate all errors. The potential for the use of technology to generate errors must also be considered.[18] For example, at the author's hospital, receiving all orders by fax transmission was considered a technologic advance when it was first implemented. However, there was little consideration of the possibility that pediatric dosing errors would be missed. Adding a second fax machine dedicated to pediatric orders increased the proportion of pediatric orders checked by a pharmacist from 47.9% to 64.1%; when teenagers were excluded, the proportion increased from 49.6% to 74.5%. Although optimal dose checking (i.e., checking of all doses for pediatric patients and validation against standard milligram per kilogram or milligram per square metre doses) was not achieved with this small change, the decrease in the number of orders missed and the increase in the number of orders with doses checked were both greater than anticipated. The frequency of errors involving incorrect instructions and formulations was reduced from 9.2% to 4.1%, which was perceived as a substantial decrease. To further increase the number of orders that are appropriately checked by dispensary pharmacists, additional changes need to be considered, including an educational component on how to perform dose validation and discussion of medication errors and their consequences.

The limitations of this study included the limited number of orders reviewed, the difference in numbers of orders examined for the 2 periods (before and after implementation) when stratified by age, and the review of only those pediatric orders that were received from the pediatric wards and the NICU (pediatric orders from the emergency department were not included). In addition, the focus was on appropriate pharmacist scrutiny of pediatric medication orders; any effects on patient outcomes were not examined.

The complexity of dosing for pediatric patients requires a system that will ensure appropriate scrutiny of orders. In hospitals that focus on adult care, the system must help pharmacists to recognize pediatric orders requiring dose checks, precise measurements, and appropriate formulations. Scrutiny of pediatric orders by pharmacists increased after implementation of a dedicated fax machine. However, because of a lack of pediatric focus and lack of familiarity with dose-validation procedures, this intervention was not enough on its own to achieve 100% dose validation. An educational component outlining a procedure for reviewing pediatric orders and describing the significance of medication errors in this population may increase compliance with dose validation.

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