

Causes, reporting, and prevention of medication errors from a pediatric nurse perspective

AUTHORS

Ebru Kilicarslan Toruner

PhD, RN

Assistant Professor, Gazi University Health Sciences
Faculty, Nursing Department 06500 Ankara, Turkey.
ebrutoruner@gazi.edu.tr, ebrudan@yahoo.com

Gulzade Uysal

MSN, RN

Research Assistant, Baskent University Health Sciences
Faculty, Nursing Department 06810 Ankara, Turkey

ACKNOWLEDGEMENTS

The authors wish to thank Tugba Sahin, Hasibe Gumus, Fatma Altinpinar and Fatma Boyraz for their assistance to this study.

KEY WORDS

Medication errors, child, pediatric nursing, reporting

ABSTRACT

Objective

The aim of this study was to determine the perspective of pediatric nurses regarding the causes, reporting, and prevention of medication errors.

Design

A descriptive, cross-sectional study.

Setting

Nurses were selected from inpatient pediatric wards of 4 hospitals in Turkey.

Subjects

119 pediatric nurses agreed to participate in the research and completed semi-structured questionnaires. These data were collected and analyzed. The average age of the nurses was 24.7 ± 3.58 years; the majority was women (96.6%).

Results

Pediatric nurses stated that the most common causes of medication errors were long work hours (68.1%) and a high patient/nurse ratio (58.8%). Although the majority of nurses (88%) made use of a medication error notification system, many errors were not reported and nurses cited potential blaming of nurses in case of adverse outcome for the patient (52.95%), loss of trust (50.45%), and fear of disciplinary proceedings (42%) among the causes of lack of notification. With regard to avoidance, nurses most commonly cited the need for adequate information regarding the safe use of medications (45.4%).

Conclusions

This is the first study in Turkey to address the pediatric nurse perspective regarding medication errors. The results argue that there is a need for ongoing training of pediatric nurses concerning safe medication administration and that the causes and underreporting of medication errors warrant further investigation.

INTRODUCTION

Assuring patient safety is of highest priority for medical practitioners, and medical errors are one of the most common threats to patient safety (Prot et al 2005; Wong et al 2004). In addition to adverse economic consequences, medication errors, one of the most common types of medical errors, are also a source of morbidity and mortality (IOM 2000).

Medication error is defined as 'disregarding the status of forming a damage, or risk, any avoidable incidence to occur during the process from medication request to patient monitoring' (AAP 2003). According to the Institute of Medicine (IOM), 400,000 cases of avoidable patient injury due to medication errors take place annually in hospitals in USA. The cost of these errors amounts to at least \$3.5 billion (IOM 2006). In addition, between 44,000 and 98,000 hospital patients have been estimated to die annually as a result of medication errors (IOM 2000).

The incidence and potential for causing injury are significantly higher for medication errors among pediatric patients than for adult patients (The Joint Commission 2008; Fortescue et al, 2003; Kaushal et al 2001). Ferranti et al. (2008) have ascertained that the rate of pediatric medication errors is three-fold higher than in adults. This is thought to reflect both the physiological and developmental features of children as well as the lack of accurate medication dosages for pediatric patients (Stratton et al 2004; AAP 2003). The exact rate of medication errors differs according to the definitions and methods used in different studies (Engum and Brecler 2008). Stratton et al (2004) studied the rates of notification of medication errors by adult and pediatric nurses and reported that the frequency of medication errors was 14.8 per 1000 patient days in pediatric services but only 5.66 in adult services.

Multiple steps are involved in determining the type and dosage of medication to be administered. These include the primary prescription, the request for supply, receipt of this request, identification and retrieval of the material requested, and supply to the practitioner; administration and monitoring add further levels of complexity (Lucas 2004; Greengold et al 2003). Medication errors in pediatric patients can occur at any step in the process (Antonow et al 2000).

Medication errors in drug administration predominantly take place during prescribing, although errors commonly take place involving incorrect diagnosis, incorrect dosage, the wrong patient and incorrect drug selection (this latter most commonly in cases of known patient allergy to the prescribed drug) (Fijin et al 2002; Kaushal et al 2001).

Secondary medication errors are associated with inappropriate administration of the correct drug. These include errors of route of administration, dosage, timing, patient identity, failure to administer the drug, improper placement of infusion pumps, and absence of recording of drug administration (Tang et al 2007; Hronek and Bleich 2002; Ferner et al 2001). The most frequent errors of medication administration are failure to administer the drug and incorrect drug scheduling (Otero et al 2008; Tang et al 2007; Frey et al 2002; Ross et al 2000). Several factors contribute to the high rates of medication errors in pediatric patients. These include failure to read the prescription, distraction, high patient/nurse ratio, and the availability of drugs with a very similar name to the drug prescribed (Stratton et al 2004; Lefrak 2002).

Medication errors can occur both as a result of human mistakes as well as from systemic errors (AAP 2003) and this complicates effective monitoring of drug administration. It is however recommended that whenever a medication error has taken place the details of the mistake should be provided to the relevant supervisor, and such notification is important for understanding the causes of the errors and to allow steps to be taken to reduce such errors in the future (Fernald 2004).

Several studies have addressed the rates and causes of medication errors in adult patients, and these studies have often been based on reports from nursing staff (Wakefield et al 2001, Wakefield et al 1999). Nurses in particular are important in assessing such errors because they are generally in a position to notice medication errors at first hand, and can thereby take steps to reduce the risk of incorrect drug administration. Their special position is often reinforced by their professional knowledge concerning the medications administered as well as their responsibility for preparing and controlling the medications and for monitoring the effects of the treatment (O'shea 1999). However, few studies have examined medication errors from the perspective of pediatric nurses (Stratton et al 2004).

To the best of our knowledge this is the first study in Turkey that addresses medication errors from the perspective of pediatric nurses. The aim of this research was to review the causes of errors from the point of view of pediatric nurses, the factors affecting error notification, and their suggestions as to how to avoid such errors. A comprehensive overview of medication errors from a pediatric nursing perspective will help to develop procedures to reduce the rate of such errors and to put in place safeguards to improve child safety and increase the quality of care.

METHODS

Prior to initiating this research all necessary permissions were obtained from the hospitals and Institutional Ethics Committees concerned. The design was for a descriptive cross-sectional study; data collection was performed between January and December 2009. All nurses working in pediatric wards of four hospitals in different cities were invited to participate in the study. The target population comprised 165 nurses working day/night in pediatric wards. Of these, 124 volunteered to participate (75%). Sampling selection was not addressed. In a preliminary study five of these pediatric nurses were provided with draft versions of the questionnaires and were interviewed in detail; their suggestions and comments were taken into consideration in assembling the final version of the questionnaire. These five nurses were excluded from the full-scale study; the final study group therefore comprised 119 pediatric nurses.

The questionnaire was assembled based on previous forms employed to ascertain medication errors encountered by nurses servicing pediatric clinics (Kaushal et al 2009; Stratton et al 2004; Fontan et al 2003; Frey et al 2002; Wilson et al 2002; Alparslan and Erdemir 1997). The semi-structured form comprised a total of 22 questions, of which 11 recorded the socio-demographical features of the nurses. The remaining 11 questions addressed medication errors, the nurses' views on the causes of the errors, and their suggestions regarding notification, monitoring, and steps to avoid future medication errors.

The questionnaires were provided to the nurses for completion by researchers. Also, an envelope was supplied to provide privacy in completion of the questionnaire. Participants were also provided with a summary of the aims and scope of the research project and their written consent was obtained in all cases. During data collection and analysis all personal information concerning the participants remained confidential and this information was not used for any purpose unrelated to the research project itself.

In compiling and analyzing the data the Statistical Package for Social Sciences (SPSS) Version 12 was employed for descriptive analysis of the nurses' perspectives regarding medication errors and their demographics. All responses were separately and independently categorized by two researchers. In cases where the response type and/or rating differed between the two researchers adjudication was obtained from a senior investigator. The percent and frequency distributions of each variable and/or category were determined. The independent t test was used for data normally distributed. Statistical significance was set at $P < 0.05$.

FINDINGS

The average age of the participating nurses was 24.7 ± 3.58 years, and the majority of these were women (96.6%). 55.5% of the nurses were working in pediatric inpatient wards. More than half of the nurses (69.9%) stated that they had been working in a pediatric inpatient ward for 1–5 years. 52.1% of the nurses stated that they were caring for 1–5 patients per shift, more than half of the nurses (63%) stated that a typical shift involved continuous work for 48–50 hours (Table 1).

Table 1: Characteristics of the Nurses

Characteristics	n	%
Age		
18-25	69	58
26-33	50	42
Gender		
Female	115	96.6
Male	4	3.4
Ward		
Pediatric inpatient ward	66	55.5
Intensive care ward	53	44.5
Years of work experience		
Less than 1 year	43	36.1
1-5 years	76	69.9
Caring of patient number		
1-5 patients	62	52.1
6-10 patients	57	47.9
Working hours per week		
48-50 hours	75	63
51 hours and more	44	37
Total	119	100

As shown in Table 2, nurses' opinions regarding the primary causes of medication errors were predominantly long work hours (68.1%), a high patient/nurse ratio (58.8%), and unavailability of medications in dosages and forms appropriate for pediatric patients (56.3%).

Table 2: Nurses' Opinions Regarding the Primary Causes of Medication Errors (n=119)

Causes of Medication Errors	n*	%
Long work hours	81	68.1
High patient/nurse ratio	70	58.8
Unavailability of medications in dosages and forms appropriate for pediatric patients	67	56.3
Insufficient information about pediatric medication administration	59	49.6
Read the prescripts/orders inaccurately or incorrectly	46	38.7
Insufficient information about patient	19	16.0
Inadequate records about medication preparation and administration	18	15.1
Sending wrong medication and dosages from pharmacy	16	13.4
Inappropriate environment to prepare medications	13	11.0
Other**	9	7.6

* Participants gave more than one answer.

** Distraction and interruptions, medications were needed to administer immediately, inadequate information about interactions of medications

Only 88% of participants made use of a medication error notification system, and this was predominantly (71.4%) by means of verbal notification (Table 3).

Table 3: Nurses Opinions About Notifying Medication Errors (n=119)

Opinions About Notifying	n	%
Types of medication error notification *		
Written	85	71.4
Verbal	41	34.5
Use of a medication error notification system		
Sometimes	16	13.4
Usually	32	26.9
Always	57	47.9
No idea	14	11.8
Causes of medication errors not to notify *		
To be blamed if something happened to patient	63	52.9
To lose credibility of the team	60	50.4
To be punished	50	42
To lose credibility of the patient	49	41.2
To think that it will not remain confidential	43	36.1
To lose the job	41	34.5
To be labeled as incompetent by other nurses	40	33.6
To be unaware of obligating the notification	19	16
Not to know how to notify	17	14.0

* Participants gave more than one answer.

From the compiled results it was estimated that, overall, only 47.9% of medication errors were notified. Among the reasons given for not notifying errors, potential blaming of nurses was the most common response (52.9%). The rate of notification was significantly higher among intensive care nurses than among service nurses ($t = 5.98$; $P = 0.01$), and also among nurses looking after 1–5 patients ($t = 4.78$; $P = 0.01$) than for nurses caring for an average of 6–10 patients (Table 4). There were no statistically significant differences in notification rates according to age, years of work experience, or working hours ($P > 0.05$).

Table 4: Notification Situations of Nurses According to Their Characteristics (n=119)

Characteristics of Nurses	Written Notification			
	n*	%	t∞	p
Age				
18-25	47	55.3	0.76	0.44
26-33	38	44.7		
Ward				
Pediatric inpatient ward	37	43.5	5.98	0.01**
Intensive care ward	48	56.5		
Years of working experience				
Less than 1 year	30	35.3	0.45	0.64
1-5 years	55	64.7		
Caring of patient number				
1-5 patients	54	63.5	4.78	0.01**
6-10 patients	31	36.5		
Working hours per week				
48-50 hours	56	65.9	0.57	0.57
51 hours and more	29	34.1		

* Participants gave more than one answer.

** Significant at $p < 0.05$

∞ Group comparisons independent t-test.

Regarding avoidance of medication errors, a substantial proportion of nurses (45.4%) emphasized the importance of formal instructions accompanying medications that provide details of recommended use including typical dosage schedules, patient exclusions and potential adverse reactions (Table 5). This suggestion was followed by reducing the patient/nurse ratio (19.3%) and reducing work hours (16.8%) (Table 5).

Table 5: Pediatric Nurses Opinions Regarding Avoidance of Medication Errors (n=119)

Opinions for prevention	n*	%
Training about safety medication administration	54	45.4
Reducing patient/nurse ratio	23	19.3
Reducing work hours	20	16.8
Increasing the team communication	12	10.1
Taking the orders correctly and adequately	8	6.7
Arranging the environment	7	5.9
Providing appropriate dosages and forms for pediatric patients	6	5.0

* Participants gave more than one answer.

DISCUSSION

Medical errors, that prominently include errors associated with drug administration, are potentially avoidable. Nurses are in a special position regarding assurance of patient safety and avoiding medication errors, and their perspectives on patient safety warrant careful consideration. In the present study we compiled and analyzed the opinions of pediatric nurses regarding the causes of medication errors, the methods used for error notification, and on avoidance of such errors.

Nurses most commonly cited long working hours, high patient/nurse ratio, lack of appropriate guidelines for drug administration to pediatric patients, insufficient knowledge of the medication, and inaccurate or poor reading of prescriptions as the primary causes of medication errors by pediatric nurses. One half of the pediatric nurses sampled (50%) cited distraction as a major cause of medication errors, in addition to errors in recording the prescribed drugs and difficulties interpreting the handwriting of the prescribing practitioner. Nurses thereafter included the patient/nurse ratio (37%), the exact quantity/dosage of medication to be administered (35%) and the absence of a double-check of medications (28%) among the causes of medication errors (Stratton et al 2004).

In Lefrak's study (2002), insufficient communication with personnel, order-of-magnitude errors in numbers followed by multiple zeros or with fractional numbers, unreadable handwriting, distraction during preparation or administration of medications, availability of drugs with similar names, dosage assessment, and lack of knowledge were included in the causes of medication errors. In the studies of O'Brodovich and Rappaport (1991) and Wilson et al (2002), lack of dosage guidelines for pediatric patients and workload were singled out among the most common causes of medication errors. These findings are supported by the results of the present study. In another study, higher patient/nurse ratios and longer working hours adversely affected the working environment, leading to distraction, reduced quality of care, and medication errors (Beyea et al 2003; Worthington 2001). In addition, the availability of different preparations of the same drug combined with diverse formulations for pediatric and adult administration were reported to increase the risk of error (Payne et al 2007). Future studies addressing avoidance of errors in pediatric medicine should therefore focus on nurse workloads and on developing appropriate guidelines for the use of specific medications in a pediatric setting.

Notification of medication errors is important for error management and for reducing the possibility of future errors (Fernald 2004). In the present study we examined the methods and rates of medication error notification. Although in some cases notification of medication error was performed in writing, in the majority of cases notification was verbal. Importantly, our study indicates that only about one half of medication errors were subject to formal notification. However, rates of notification differed between different nurse groups, and intensive care nurses and nurses caring for 1–5 patients made notifications significantly more often than service nurses or nurses looking after 6–10 patients, respectively ($P < 0.05$ in both cases). Reduced patient/nurse ratios such as in intensive care units can therefore enhance primary care and improve reporting of medication errors. Although verbal notification remains an option in recording medication errors, it will be important to improve the rate of reporting by provision of clear guidelines regarding error notification supported where appropriate by in-service training provided by the institution.

Based on nurses' reports, failure to notify medication errors was common place. Reasons cited by pediatric nurses included the perceived likelihood that the nurse would be blamed in case of adverse outcome for the patient, possible loss of patient trust, and potential reprimand and/or disciplinary proceedings. In the study of Stratton et al (2004), accusation and fear of losing the trust of the patient were prominent causes cited for not notifying cases of medical error. In the studies of Marino et al (2000), Ross et al (2000) and Fernandez (2003) fear of adverse attitudes of their colleagues and/or managers were cited among the most common causes of lack of notification.

In accordance with other studies, nurses' views on steps to avoid future medication errors highlighted the need for additional information and/or guidelines regarding drug administration. Regular briefing of pediatric nurses on safe medication administration and proper training of newly engaged nurses have been suggested as routes to reduce medication errors (Prot et al 2005; Schneider et al 1998).

To date few studies have addressed the perspective of pediatric nurses regarding the causes of medication errors, notification rates, and potential strategies for avoidance. To the best of our knowledge this is the first study carried out on this topic in Turkey. Although the findings from the study cannot be generalized owing to its small size, this study will help to devise future research into the causes and medication errors and the development of potential avoidance strategies from the perspective of pediatric nurses.

CONCLUSION

The rate of medication errors is largely governed by human factors that, despite current developments in informatics and computer technology, are not easily amenable to monitoring. Errors in medication administration compromise patient safety and can increase morbidity and mortality. Pediatric patients are relatively vulnerable compared to adults, reflecting their incomplete physiological development, and children are therefore more likely to be adversely affected by medication errors. Pediatric nurses have a key role in monitoring, notifying and avoiding medication errors. The perspective of pediatric nurses regarding medication errors is therefore an important foundation point for developing strategies to avoid medication errors.

REFERENCES

- Alparslan, O. and Erdemir, F. 1997. Pediatrik servislerinde kullanılan antibiyotiklerin sulandırılması, saklanması ve hastaya verilmesi konusunda hemşirelerin bilgi ve uygulamalarının belirlenmesi (Determine the knowledge and practice of nurses on dilution, storage and administration of antibiotics in the pediatric departments). *Cumhuriyet Üniversitesi Dergisi Hemşirelik Yükseköğretim Dergisi* (Journal of Cumhuriyet University School of Nursing), 1(1):41-52.
- American Academy of Pediatrics (AAP). 2003. Prevention of medication errors in the pediatric inpatient setting. *Pediatrics*, 112:431-36.
- Antonow, J., Smith, A. and Silver, M. 2000. Medication error reporting: A survey of nursing staff. *Journal of Nursing Care Quality*, 15:42-48.
- Beyea, S.C., Hicks, R.W. and Becker, S.C. 2003. Medical errors in the OR – A secondary analysis of Medmarx. *AORN Journal*, 77:122,125–129,132-134.

- Engum, S.A. and Breckler, F.D. 2008. An evaluation of medication errors - The pediatric surgical service experience. *Journal of Pediatric Surgery*, 43:348-352.
- Fernald, D. 2004. Event Reporting to a primary care patient safety reporting system, A report from the ASIPS Collaborative. *Annals of Family Medicine*, 2(4):327-332.
- Ferner, R.E., Langford, N.J., Anton, C., Hutchings, A., Bateman, D.N. and Routledge, P.A. 2001. Random and systematic medication errors in routine clinical practice: A multicentre study of infusions, using acetylcysteine as an example. *British Journal of Clinical Pharmacology*, 52:573-577.
- Ferranti, J., Horvath, M., Cozart, H., Whitehurst, J., Eckstrand, J. 2008. Reevaluating the safety profile of pediatrics: A comparison of computerized adverse drug event surveillance and voluntary reporting in the pediatric environment. *Pediatrics*, 121:1201-1207.
- Fijin, R., Van den Bernt, P., Chow, M., DeBlacey, C., DeJong-Van den Berg, L. and Brouwers, J. 2002. Hospital prescribing errors: Epidemiological assessment of predictors. *British Journal of Clinical Pharmacology*, 53:326-331.
- Fontan, J.E., Maneglier, V., Nguyen, V.X., Loirat, C. and Brion F. 2003. Medication errors in hospitals: Computerized unit dose drug dispensing system versus ward stock distribution system. *Pharmacy World and Science*, 25:112-117.
- Fortescue, E.B., Kaushal, R., Landrigan, C.P., McKenna, K.J., Clapp, M.D. and Federico, F. 2003. Prioritizing strategies for preventing medication errors and adverse drug events in pediatric inpatients. *Pediatrics*, 111:722-29.
- Frey, B., Buettiker, E.V., Hug, E.M., Waldvogel, K., Gessler, E.P. and Ghelfi, E.D. 2002. Does critical incident reporting contribute to medication error prevention. *European Journal of Pediatrics*, 161:594-599.
- Greengold, N., Shane, R., Schneider, P., Flynn, E., Elashaff, J., Hoying, C., Barker, K. and Bolton, L.B. 2003. The impact of dedicated medication nurses on the medication administration error rate. *Archives of Internal Medicine*, 163:2359-2367.
- Hronek, C., Bleich, M.R. 2002. The less-than-perfect medication system: A systems approach to improvement. *Journal of Nursing Care Quality*, 16:17-22.
- Institute of Medicine (IOM). 2006. *Preventing medication errors: Quality chasm series, Committee on Identifying and Preventing Medication Errors*, in P. Aspden, J. Wolcott, J.L. Bootman, L.R. Cronenwett (ed). Academy Press: Washington DC.
- Institute of Medicine (IOM). 2000. *To err is human: Building a safer health system*, in L.T. Kohn, J.M. Corrigan, M.S. Donaldson (ed). National Academy Press: Washington DC.
- Kaushal, R., Bates, D.W., Landrigan, C., McKenna, K.J., Clapp, M.D. and Federico, F. 2001. Medication errors and adverse drug events in pediatric inpatients. *Journal of the American Medical Association*, 285:2114-2120.
- Lefrak, L. 2002. Moving towards safer practice: Reducing medication errors in neonatal care. *Journal of Perinatal and Neonatal Nurses*, 16:73-84.
- Lucas, A. 2004. Improving medication safety in a neonatal intensive care unit. *American Journal of Health System Pharmacy*, 61:33-37.
- Marino, B.L., Reinhardt, K., Eichelberger, W.J. and Steingard, R. 2000. Prevalence of errors in a pediatric hospital medication system: Implication for error proofing. *Outcomes Management for Nursing Practice*, 4(3):129-35.
- O'Brodovich, M. and Rappaport, P. 1991. A study pre and post unit dose conversion in a pediatric hospital. *Canadian Journal of Hospital Pharmacists*, 44(5):45-50.
- O'shea, E. 1999. Factors contributing to medication error: A literature review. *Journal of Clinical Nursing*, 8(5):496-503.
- Otero, P., Leyton, A., Mariani, G. and Ceriani, J. 2008. Medication errors in pediatric inpatients: Prevalence and results of a prevention program. *Pediatrics*, 22:737-743.
- Payne, C., Smith, C., Newkirk, L. and Hicks, R. 2007. Pediatric medication errors in the postanesthesia care unit: Analysis of MEDMARX data. *AORN Journal*, 85:731-740.
- Prot, S., Fontan, J.E., Alberti, C., Bourdon, E., Farnoux, C. and Macher, M.A. 2005. Drug administration errors and their determinants in pediatric inpatients. *International Journal of Health Care Quality*, 17:381-389.
- Ross, L.M., Wallace, J. and Paton, J.Y. 2000. Medication errors in a paediatric teaching hospital in the UK: Five years operational experience. *Archives of Disease in Childhood*, 83:492-497.
- Schneider, M.P., Cotting, J. and Pannatier, A. 1998. Evaluation of nurses' errors associated in the preparation and administration of medication in a pediatric intensive care unit. *Pharmacy World and Science*, 20:178-182.
- Stratton, K.M., Blegen, M.A., Pepper, G. and Vaughn, T. 2004. Reporting of medication errors by pediatric nurses. *Journal of Pediatric Nursing*, 19(6):385-392.
- Tang, F.I., Sheu, S.J., Yu, S., Wei, I.L. and Chen, C.H. 2007. Nurses relate the contributing factors involved in medication errors. *Journal of Clinical Nursing*, 16:447-457.
- The Joint Commission. 2004. *Preventing Pediatric Medication Errors*. Sentinel Event Alert. www.jointcommission.org/sentinel/alerts/sentinel_event/alert/sea_39.htm (Accessed 04.05.09).
- Wakefield, B.J., Blegen, M.A., Uden-Holdman, T., Vaughn, T., Chrischilles, E., and Wakefield, D.S. 2001. Organizational culture, continuous quality improvement and medication administration error reporting. *American Journal of Medical Quality*, 16:128-134.
- Wakefield, D.S., Wakefield, B.J., Uden-Holman, T., Borders, T., Blegen, M.A., and Vaughn, T. 1999. Understanding why medication administration errors may not be reported. *American Journal of Medical Quality*, 14:81-88.
- Wilson, T. and Sheikh, A. 2002. Enhancing Public Safety in Primary Care. *British Medical Journal*, 324:584-587.
- Wong, I.C., Ghaleb, M.A., Franklin, B.D. and Barber, N. 2004. Incidence and nature of dosing errors in pediatric medication: A systematic review. *Drug Safety*, 27:661-670.
- Worthington, K. 2001. The health risks of mandatory overtime. *American Journal of Nursing*, 101:96.