

Reporting of Medication Errors by Pediatric Nurses

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Medication administration errors can threaten patient outcomes and are a dimension of patient safety directly linked to nursing care. Children are particularly vulnerable to medication errors because of their unique physiology and developmental needs. This descriptive study surveyed a convenience sample of 57 pediatric and 227 adult hospital nurses regarding their perceptions of the proportion of medication errors reported on their units, why medication errors occur, and why medication errors are not always reported. In this study, which focuses on pediatric data, pediatric nurses indicated that a higher proportion of errors were reported (67%) than adult nurses indicated (56%). The medication error rates per 1,000 patient-days computed from actual occurrence reports were also higher on pediatric (14.80) as compared with adult units (5.66). Pediatric nurses selected distractions/interruptions and RN-to-patient ratios as major reasons medication errors occurred. Nursing administration's focus on the person rather than the system and the fear of adverse consequences (reprimand) were primary reasons selected for not reporting medication errors. Results suggest the need to explore both individual and systematic safeguards to focus on the reported causes and underreporting of medication errors.

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PATIENT SAFETY IS a central concern of current health-care delivery systems, and several recent studies initiated by the Institute of Medicine (IOM) have reported the high incidence of medical error and large gaps in health-care quality including medication errors, postsurgical complications and infections, inadequate cancer screening, inadequate care following a heart attack, and patient death (Institute of Medicine, 1999, 2001). Of the approximately 44,000–98,000 patient deaths reported each year because of medical errors, 7,000 were attributed to medication errors (Institute of Medicine, 1999).

Medication administration errors are often used as indicators of patient safety in hospitals because of their common occurrence and potential risk to patients. Studies have reported approximately one third of adverse drug events are associated with medication errors that are viewed as preventable (Bates et al., 1995; Bates, Leape, & Petrycki, 1993). Interception of medication errors occurs more commonly in the early stages of medication processing (prescription and preparation), whereas errors originating in later stages of the process (administration) have fewer system checks and are at a greater risk for remaining undetected (Bates et al., 1995; Marino, Reinhardt, Eichelberger, &

Steingard, 2000). Because nurses administer most medications to patients in hospitals, medication errors can be directly affected by nursing care.

Children are particularly vulnerable to adverse outcomes from medication errors because of the need for weight-based drug dosing involving multiple calculations, dilution of stock solutions, immature physiological buffering systems (responses), and limited communication skills when experiencing side effects (Kaushal et al., 2001). Medication errors are 10-fold more likely to occur in children compared with adults, because even large errors in calculation of stock solution volumes may appear as a nonsuspiciously small volume (Koren, 2002). One study that examined medication errors in two academic pediatric

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hospitals found the rate of potential adverse drug events to be three times higher than previously reported in adult studies (Kaushal et al., 2001).

A recent comprehensive study funded by the Agency for Healthcare Research and Quality and conducted by Miller, Elixhauser, and Zhan (2003) evaluated patient safety problems involving pediatric procedures in the hospital setting using hospital discharge data from 3.8 million discharge records from 22 states for children under 19 years in the 1997 Healthcare Cost and Utilization Project. Children who experienced a patient safety problem while hospitalized had 2- to 6-fold longer length of stay, 2- to 18-fold higher rate of in-hospital mortality, and 2- to 20-fold higher total charges than children not experiencing a safety problem. The authors also suggested that the total number of patient safety problems would have been much higher if medication errors had been included in the study as one of the pediatric safety problems.

The occurrence of hospital-reported medical errors in hospitalized children was also analyzed in a study using discharge data from a 20% stratified sample of hospitals obtained from the Healthcare Cost and Utilization Project for the years 1988, 1991, 1994, and 1997 (Slonim, LaFleur, Ahmed, & Joseph, 2003). For all four study years, children with hospital-reported medical errors demonstrated higher associated lengths of stay and mortality rates. Significantly higher rates of hospital-reported medical errors were also found for children with special needs or dependence on medical technology. Although a statistically significant decreasing trend over the 4 years was noted for medical errors related to drug errors, the percentage of drug errors related to medication administration errors was not reported. However, the authors noted an important limitation of this study to be the likely underreporting of medical errors in administrative databases and emphasized the need for further investigation of all types of medical errors in the pediatric hospital population.

Most hospitals use voluntary occurrence (incident) reports to detect and document adverse patient events in acute care hospitals, including medication errors. However, the voluntary nature of the self-reporting method has been shown to underestimate the actual occurrences, with only 10–55% of identified medication errors reported on adult units (Allan & Barker, 1990; Pepper, 1995; Wakefield, Wakefield, Uden-Homan, & Blegen, 1998; Wakefield, Wakefield, Uden-Homan, & Blegen, 1996; Walters, 1992). In the pediatric literature, few

studies exist, although from the limited information available, the reporting rate of medication errors appears to be higher (Antonow, Smith, & Silver, 2000; Kaushal et al., 2001).

Identifying medication errors implies that definitions of medication errors in written policy are perceived and adhered to in the same manner by all nursing staff. In an ethnomethodological study conducted by Baker (1997), nurse participant observation (including formal and informal interviews) was used as the method of data collection in three wards of a large, acute care hospital in South Wales, Australia, to improve understanding of how nurses define medication error. This study found nurses “redefine” medication error based on a set of unspoken criteria that accommodate the realities of nursing practice. In addition, experienced nurses were more likely than less experienced nurses and students to redefine medication error.

Even with agreement regarding the definition of a reportable error, accurate identification and reporting of medication errors are critical factors in the development and testing of medication error reduction interventions. Unfortunately, identification and reporting are often far less than complete. In a recent study comparing direct observation, chart review, and incident reports for detecting medication administration errors in 2,557 doses on which all three methods were used, 476 errors were reported during direct observation, 24 errors were noted in chart review, and 1 incident report was filed (Flynn, Barker, Pepper, Bates, & Mikeal, 2002). However, the nurses were unaware of virtually all of the errors observed, so could not have reported them.

Several survey studies have examined nurses' perceptions of medication administration errors reported in adult acute care settings. Nurses in two multihospital surveys ($N = 1,300$) estimated that about 57% of medication administration errors are reported (Wakefield et al., 1999). Of the 424 nurses responding to a survey conducted by Elnitsky, Nichols, and Palmer (1997), 14% did not believe incident reports were reliable and valid, 14% did not believe that taking their time to complete incident reports would prevent future incidents, and 25% believed their supervisors would use incident reports against them. Other studies have reported nurses' reasons for underreporting medication errors as: errors not recognized, errors recognized but judged to be harmless, fear of censure, and system factors discourage reporting of errors (Wakefield et al., 1996, 1998, 2001).

The purpose of this study was to estimate the proportion of medication errors that are actually reported by nurses in pediatric in-patient units, examine the documented medication error rates in light of the proportion of medication errors nurses say are reported, obtain nurses' reasons as to why medication administration errors occur, and reasons for not reporting. In addition, a major goal of this study was to specifically compare the pediatric nurse findings with previously reported adult and pediatric nurse findings related to reporting of medication administration errors.

METHODS

Sample

This study was a pilot study conducted as part of a nationwide study of nurse staffing and quality of care in 300 adult patient care units in 50 hospitals currently in progress (Blegen & Vaughn, NINR NR01 04937). Because of concerns about the accuracy of medication administration error data from voluntary reporting of occurrences, the investigators developed a questionnaire for distribution to staff nurses in hospitals asking them to estimate the extent of occurrence reporting related to medication errors on individual patient care units. This questionnaire was pilot tested in hospitals known to the investigators on the research team. A cover letter attached to each questionnaire explained that participation was voluntary and a returned questionnaire signified consent. All questionnaires were coded so that individual units could only be identified by the research team, and participants were asked not to place individual identifiers (signature) on the questionnaire to secure confidentiality. A prepaid self-addressed envelope was provided with each questionnaire to mail directly back to the research team. Patient care units included adult medical/surgical units and a range of clinical specialty acute care pediatric units.

Useable responses were received from 284 RNs (227 adult nurses and 57 pediatric nurses) from 33 acute care units (27 adult and 6 pediatric) in 11 hospitals in 2 states (40% response rate). Three hospitals were from a Midwestern rural consortium working for more than 10 years on quality management processes, the remaining eight hospitals were from urban areas in the Rocky Mountain region of the United States. Of the six pediatric units, three were from a children's hospital, two were from consortium hospitals, and one was from a nonconsortium hospital. The size of the partic-

Table 1. Nurse Respondent Characteristics

Variables	Pediatric	Adult
Age (years)*	38	41
Years of experience	13	12
Hours worked per week	35.6	36
% RNs working 12-hr shifts	63	55
% RNs working day shift	47	48
% RNs with basic baccalaureate degree*	59	34
% RNs current baccalaureate or higher*	68	49

*Differences are significant at $p < .05$.

ipating hospitals ranged from 120 to more than 500 acute care beds. Respondents were on average 41 years old, had 12 years of experience, and worked 36 hr/week. Characteristics of nurse respondents from adult and pediatric units were similar in all areas except nursing education. More nurses working on pediatric units had a baccalaureate basic education (59% pediatric, 34% adult) and currently had a baccalaureate or higher degree (68% pediatric, 49% adult) (see Table 1).

Instruments

The questionnaire contained three sections related to medication administration errors, and one section asking for demographic information. The first section asked the nurses to estimate the percent of medication errors actually occurring on their units that were reported. Medication errors were categorized as 18 types of errors: 9 nonintravenous and 9 intravenous errors. A final item asked each participant to estimate the overall proportion of medication errors reported on their unit. A 10-category response scale was used ranging from 0–9% to 90–99%. The second section of the questionnaire, reasons for not reporting, asked the nurses to check their level of agreement (1–5 scale with 5 as *highest agreement*) with each of four management-related (named “administrative reasons” in previous publications) and seven individual/personal potential reasons why medication errors may not be reported on their unit. This portion of the questionnaire was adapted from a questionnaire developed by Wakefield et al. (1996, 1998, 1999, 2001). A score for each subscale was calculated as the mean of the individual items. These scales were determined to be reliable with Cronbach's alpha interitem correlation coefficients of .74 for the four-item management-related reasons subscale and .84 for the seven-item individual/personal fear reasons subscale (Blegen & Vaughn, 2002).

The third section of the questionnaire contained 13 items assessing reasons medication administration errors occur developed by the members of the research team. The research team consisted of two nurse researchers and one health services researcher with expertise in patient safety and adverse occurrence processes, three graduate prepared nurses who were currently active in acute care adult and pediatric clinical areas, and a measurement and testing consultant. Multiple reasons that adverse occurrences happen were identified from previous research studies that the team members had participated in, other published literature, and clinical experiences. These lists were reviewed multiple times for redundancy and completeness. The questionnaire included an "other" category, and respondents were encouraged to add reasons. Very few reasons were added and most overlapped with items already on the list.

A final section of the questionnaire asked for information that described the nurses who responded to the survey including age, education, years of experience, hours per week work, and length of shift worked. In addition to the questionnaire data, unit-level data containing documented unit medication error rates (errors/1,000 patient-days), using administrative data derived from occurrence reports, were collected for the most recently completed quarter (October to December 2000).

RESULTS

This report focuses on the responses from nurses on pediatric units. Analysis by type of unit was not performed because there were too few

units of any particular specialty. Comparisons with responses from adult units are used to enhance interpretation.

Estimated Reporting Rates for Medication Administration Errors

Staff nurses marked the percentage of each type of medication error listed they estimated to have been reported from their unit in the last three months. Overall, pediatric nurses estimated that 67% of all medication errors on their patient care units are reported. This finding is considerably higher than the 56% reported for all medication errors by adult nurses ($p < .05$).

Unit Medication Error Rates

The medication error rates per 1,000 patient-days computed from the administrative data on occurrences were higher on pediatric as compared with adult units (14.80 pediatric units; 5.66 adult units). This finding was also consistent with higher levels of estimated reporting on pediatric as compared with adult units.

Reasons for Not Reporting Medication Errors

Each nurse respondent was asked to agree or disagree with four management-related and seven individual/personal potential reasons that medication errors are not reported based on a 1- to 5-point scale with 5 as the *highest level of agreement*. Nurses from pediatric units agreed with both management-related and individual reasons for not reporting medication errors (3.13 management-related, 3.40 individual/personal) (see Table 2). Of the four management-related reasons listed in

Table 2. Reasons Medication Errors Are Not Reported, Mean \pm Standard Deviation

Reasons Errors Are Not Reported (1–5 Scale)	Total Sample	Pediatric Units	Adult Units
Management-related reasons	3.14 \pm 0.84	3.13 \pm 0.85	3.14 \pm 0.84
No positive feedback is given for passing medications correctly			
Nurse administration focuses on the person rather than looking at the system			
Too much emphasis is placed on medication errors as a measure of the quality of care			
Responses by nursing administration do not match the severity of the error			
Individual/personal reasons	3.32 \pm 0.85	3.40 \pm 0.82	3.31 \pm 0.86
Nurses could be blame if something happened to the patient			
Nurses believe other nurses will think they are incompetent			
Nurses fear adverse consequences from reporting			
Patient might develop negative attitude			
Nurses fear reprimand from physician			
Nurses fear losing their license			
Nurses want to avoid potential publicity of medication errors in the media			

Note: Differences not significant, $p < .05$.

Table 2, pediatric nurses tended to have the highest level of agreement with “nurse administration focuses on the person rather than looking at the system.” From the seven individual/personal reasons listed in Table 2, pediatric nurses tended to have the highest level of agreement with “nurses fear adverse consequences from reporting” and “nurses believe other nurses will think they are incompetent.”

An interesting finding in this section of the study was the similar level of agreement with both types of reasons for not reporting medication errors by nurses from adult units (3.14 management-related, 3.31 individual/personal) despite the higher level of estimated and actual reporting rates of medication errors by pediatric nurses (see Table 2). In addition, the more strongly nurses on pediatric units agreed with management-related and individual/personal reasons for not reporting medication errors, the lower the estimates of errors reported (see Table 3). The estimated proportion of errors reported was correlated at $-.439$ ($p < .05$) with management-related reasons for not reporting and at $-.423$ ($p < .05$) with individual/personal fears reasons for not reporting. Although this same association was found for adult units, the association was stronger in pediatric units.

Reasons Medication Errors Occur

Nurse respondents were asked to select the two most important of 14 potential reasons that medication errors occur on the patient care units other than transcription error and physician handwriting (Table 4). Pediatric nurse respondents most frequently checked distractions and interruptions (50%), RN-to-patient ratios (37%), volumes of medications administered (35%), and not double-checking doses (28%).

Similar to the pediatric nurse respondents, adult nurses most frequently cited reasons for medication administration errors as distractions and interrup-

Table 4. Reasons That Medication Errors Occur (in Addition to Transcription Error and Physician Handwriting)

Reasons That Medication Errors Occur	% of Respondents Choosing
Distractions and interruptions	50
RN-to-patient ratio	37
Many medications on multiple patients	35
Not double-checking doses	28
Medication not delivered or wrong dose delivered from pharmacy	25
Long shift/overtime	12
Unit or patient crisis when administering medications	10.5
Unclear packaging and labeling	10.5
Poorly designed medication administration record	9
Unavailability of intravenous pump	7
Malfunctioning equipment	7
Lack of sufficient information about the medication	5
Lack of adequate information about the patient	3.5

tions (46.9%), inadequate RN-to-patient ratios (37.2%), volume of medications administered (31.4%), and not double-checking doses (28%). Although lack of information about the patient, lack of information about the drug, and poor package design have been reported in previous studies as major factors in medication administration errors (Leape et al., 1995; U.S. Pharmacopeia, 2000), none of these reasons were selected by more than 11% of nurse respondents in this study.

DISCUSSION

Study results indicated a difference in medication error rates between pediatric and adult units, based on documented occurrence reports of 14.80 per 1,000 patient-days on pediatric versus 5.66 per 1,000 patient-days on adult units. However, findings from this study also suggest that medication administration error occurrences are underreported. The overall average estimate of medication error reporting on pediatric units was 67%. This is in contrast to the 56% found on adult patient units. These estimates on adult units are similar to some studies reported in the literature (Wakefield et al., 1996, 1998, 1999) whereas higher than the 0.07–0.22% of actual errors cited in observational studies (Allan & Barker, 1990; Barker & Allan, 1995; Flynn et al., 2002; Pepper, 1995). However, observational studies included errors that staff nurses had not recognized (the majority of errors), as well as those of which they were aware.

Table 3. Relationships Among Estimates of Reporting and Reasons for Not Reporting

Type of Reason	Correlation With Medication Error Reporting		
	Total Sample	Pediatric Units	Adult Units
Management-related reasons	-.253	-.439†	-.210†
Individual reasons	-.238*	-.423†	-.206†

*Correlations $p < .05$.

†Correlations $p < .01$.

Results of this study suggest that nurses working on pediatric units are more likely to report medication administration errors than nurses on adult units are. As might be expected with the differences in reporting, the medication error rate (per 1,000 patient-days) computed from documented occurrence reports was higher on pediatric (14.80) than on adult units (5.66). The pediatric sample size was notably small in the study ($n = 57$), yet the pediatric reporting percentages are consistent with the few published pediatric studies of adverse events that include medication administration errors (Antonow et al., 2000; Kaushal et al., 2001).

In a survey questionnaire administered to 72 RNs from a 38-bed infant unit at a 232-bed pediatric teaching hospital, the estimated extent of medication error underreporting was determined by comparing survey findings with incident reports (Antonow et al., 2000). Results found 65% of medication errors were reported. Kaushal et al. (2001) conducted a prospective cohort study that examined 1,120 patients during a 6-week period from one academic pediatric hospital and one academic hospital that treated both pediatric and adult patients (adults comprising <5% of patients treated on pediatric units). Of the 616 medication errors noted, 78 (13%) occurred during the stage of nurse administration. This represented an overall medication administration error rate of 19.83 per 1,000 patient-days. It is important to note, however, that in this study, medication errors were detected by the medication order sheet, medication administration record (MAR), and chart review, in addition to voluntary incident reports.

Additional studies are needed that explore medication errors in pediatric acute care settings to determine if the higher rate of medication error reporting and documented computed medication error rates are characteristic of most pediatric hospital units. There are special circumstances related to the physiological and emotional development of children that pose a different type of risk involving medication errors as compared with adults. Knowledge of this greater risk may promote more vigilance and more reporting.

Systems and processes in the pediatric environment of care or pediatric hospitals are likely contributing factors influencing the rates of medication error reporting and need to be studied. The IOM's *Quality Chasm* report (2001) conceptualized quality as a systems property where poor patient quality care is not because of a lack of effective treatments, but the results of poorly de-

signed and inadequate health-care systems. In this study, pediatric, as compared with adult, units did have overall higher medication error reporting rates despite nearly the same results regarding reasons medication errors are not reported. Maybe this finding is related to unique organizational factors found specifically in pediatric acute care settings. For example, nurses on pediatric units were more highly educated, and it is possible that level of education may influence quality management processes in conjunction with other pediatric patient considerations. Unfortunately, level of education was not reported in the two other pediatric studies cited previously and therefore this variable cannot be compared.

Distractions, interruptions, and RN-to-patient ratios were the two most commonly selected reasons for medication administration errors in this study. This finding is consistent with results from a recent survey conducted in the September issue of *Nursing 2002* and the 2001 MedMARx data summary report (U.S. Pharmacopeia, 2002). Registered nurses participating in the *Nursing 2002* survey were asked to respond to a poll regarding their experiences related to medication administration and error reporting. Nurse participants ($n = 775$) chose five major reasons for what caused or increased the risk of medication errors: distractions and interruptions during medication administration, inadequate staffing and high nurse/patient ratios, illegible medication orders, incorrect dosage calculations, and similar drug names and packaging (Cohen, Robinson, & Mandrack, 2003).

The 2001 MedMARx data summary report (U.S. Pharmacopeia, 2002) analyzed 105,603 medication error records submitted by 368 voluntary facilities. The two major contributing factors involving medication errors were noted as distractions (47%) and staffing issues (43%). Of the total medication errors submitted, 3,361 pediatric records were analyzed (birth to 16 years). Contributing factors involving medication errors were not reported specifically for the pediatric records; however, the majority of the errors from the pediatric records originated in the stage of administration (51.7%). This finding is higher than the 37% errors originating in the stage of administration for the 2001 MedMARx data overall, as well as the 13% reported in the previously described study by Kaushal et al. (2001).

The finding that nurses perceive distractions/interruptions, RN-to-patient ratios, and inadequate staffing as primary reasons for medication admin-

istration errors is especially important considering the current nursing shortage and restructuring of nursing care delivery in most hospitals across the country and also warrants further investigation. Are nurses actually making more medication administration errors because of the manner in which patient care is structured and delivered (a perception of nurses who have seen their patient acuity and RN-to-patient ratios increase) or are there other system-wide hospital processes that are responsible for the occurrence and reporting of medication errors?

Recognition of reasons that medication errors are not reported is crucial to finding interventions that support reporting of all errors, including those related to medication administration. This study found that nurse respondents agreed with both individual/personal and management-related reasons for not reporting medication errors and suggests the need to develop a unit/hospital culture supportive of reporting errors.

Implications for Nursing Practice

The results of this study indicate the need to improve the accuracy of medication error reporting by nurses and to provide a hospital environment conducive to preventing medication errors from occurring. Reasons that medication errors occur included both system factors such as staffing and medication administration procedures as well as patient needs and condition. If nurses perceive medication errors as occurring because of distractions and interruptions, hospital managers and administrators need to examine the work environment. Designing safe work environments at the unit level that reduce environmental stressors such as noise and lighting while improving overall structural organization of the unit to facilitate patient care delivery may be an important factor for a hospitalwide plan to reduce the occurrence of medication administration errors.

The most important step in reducing medication errors appears to be in knowing the accurate rate of occurrence. Occurrence data can only be used to identify problems and develop solutions provided it is a true reflection of the type and number of medication errors that actually happen. Accuracy can only be improved in an environment that encourages and supports the reporting of medication errors.

Creating an environment conducive to reporting errors requires a systems approach to patient safety. Errors must be made visible. Nurse managers must demonstrate positive responses to staff members for reporting medication errors and commit to a quality management process that is perceived by nurses as designed to improve patient safety as opposed to discover mistakes. Nurses must be involved and believe in this process. In the 2001 MedMARx data summary report (U.S. Pharmacopeia, 2002), the majority of institutions responded to medication error correction by focusing on the individual involved in the error as opposed to factors in the system. Ongoing multidisciplinary analysis of medication errors at the unit level may be one method of examining error from a systems perspective while also reducing individual blame and fear.

In summary, the findings from this study point to the need to further examine how hospital administration is addressing the problem of medication error underreporting and the role of the unit nurse in preventing medication errors through participation in quality management processes. Nurses who perceive adverse consequences for reporting errors will not provide hospital administrators with accurate data to solve problems. Alternate methods may need to be created for reporting medication errors and a supportive unit culture must be present when errors occur if patient safety is to be improved in the pediatric hospital setting.

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