Effect of Nursing Education on Optimization of Medication Reconciliation in the Pediatric Emergency Department

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OBJECTIVE This study was conducted to evaluate the impact of education on optimizing medication histories in a single-center pediatric emergency department.

METHODS This was a prospective, 2-phase study of 200 patients ages 21 years and younger who presented to the pediatric emergency department in January and February 2017. In phase I of the study, 100 patients were interviewed by both a nurse and a pharmacist. Between phases I and II, the pharmacist educated each nurse and disseminated standardized education materials. In phase II, 100 additional patients were interviewed by both a nurse and a pharmacist. Discrepancies were quantified in both phases of the study. The primary outcome was the distribution of total discrepancies in medications identified. Total discrepancies were defined as a composite of medication name, dose, route, frequency, and time of last dose.

RESULTS A total of 200 medication histories were collected over phases I and II. In phase I ($n = 79$), the pharmacist identified 185 medications, 88 of which were also identified by the nurse. In phase II ($n = 82$), the pharmacist identified 180 medications, 95 of which were also identified by the nurse. The distribution of discrepancies per patient and per medication was significantly reduced in regard to dose, route, and frequency documentation.

CONCLUSION Although improvement was observed, barriers beyond a knowledge deficit exist to limit accuracy of medication histories collected by nurses.

ABBREVIATIONS ED, emergency department

KEYWORDS emergency service, hospital; medication history; medication reconciliation; nurses; pediatric; pharmacists

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Introduction

The Institute of Medicine 1999 report indicates that at least 44,000, and up to 98,000, patient deaths occur annually as a result of medical errors.¹ Medication-related errors contribute significantly to this report, and a prospective cohort study² revealed a rate of 0.3 prescribing errors per patient per day, of which 7.5% were deemed serious. A similar prospective cohort study,³ with a pediatric focus, found an error rate of 0.1 prescribing errors per patient per day, of which 19.5% were deemed serious. Of note, these 2 aforementioned studies also highlight a statistically significant gap in potential adverse drug events between adult and pediatric inpatients, 0.35% and 1.1%, respectively.³

Medication reconciliation is the process of comparing a patient's medication orders to all of the medications that they have been taking and evaluating those that are appropriate to continue with respect to the patient's acute illness.⁴ The Joint Commission recommends that

medication reconciliation be performed at every point in transition of care in which new medications are ordered or existing orders are rewritten.⁴ Effective medication reconciliation can prevent medication errors that may result in major injury or death.

The process of medication reconciliation involves developing a list of current medications as well as a list of medications to be prescribed. The clinician then compares the medications on the 2 lists, makes clinical decisions based on the comparison, and communicates the new list to appropriate caregivers and to the patient.⁴ If this process is completed inaccurately, repercussions may include missed essential medications, unintended medications administered, discrepancies in doses, routes, and timing, as well as potentially unrecognized drug-drug interactions.⁵

Obtaining an accurate medication history, a critical step in medication reconciliation, proactively optimizes the reconciliation process. It is reported that over half

of all patients admitted to the hospital will have at least 1 medication-related discrepancy in their medication history.⁶ A review article on medication discrepancies at transitions in pediatrics estimates high rates of discrepancies ranging from 22% to 72.3% of patients.⁷

In the setting of the emergency department (ED), there are several barriers to achieving an accurate medication history.⁸ The ED is a fast-paced, high-acuity, stressful environment. At this critical transition of care, ED staff members are required to contact multiple sources to obtain accurate information, including family members, pharmacies, and outside physicians. Without a standardized process for facilitating medication history, errors can be made; however, pharmacists are able to obtain more accurate home medication lists than other providers.⁹

The study by Coffey et al¹⁰ evaluated the use of a pharmacy student in obtaining medication history at the time of admission on 272 admitted pediatric patients. Twenty-two percent of these patients were found to have at least 1 unintentional discrepancy, 6% of which had a high likelihood of causing discomfort or deterioration.

Research has also been completed to quantify discrepancies in the admission medication history and medication reconciliation process at a pediatric institution. This prospective, pilot study by Provine et al¹¹ identified a total of 309 discrepancies in 100 medication histories completed by a pharmacist compared to other health care providers. Few studies exist on the medication reconciliation process in pediatric EDs, and a standardized approach may improve patient safety.¹²

The objective of our study was to implement pharmacist involvement in the pediatric ED medication history process and to evaluate the impact of educational tools for nursing staff on the quantity of discrepancies identified by a pharmacist.

Materials and Methods

We conducted an institutional review board–approved prospective chart review of medication reconciliations completed by an ED provider and a pharmacist in the pediatric ED at Morristown Medical Center in January and February 2017. Patients interviewed by both a nurse and pharmacist in the pediatric ED, ages 21 years and younger, were included. Patients not on any home medications, as confirmed by a nurse and by a pharmacist, were excluded. A nurse, as part of the hospital's standard of care, first interviewed patients who presented to the ED. Next, a pharmacist interviewed the same patients as part of the pharmacist's piloted involvement in the pediatric ED. Data were obtained through a pharmacy resident rotation log. Medication histories were documented and revised in hospital's ED electronic medical record in compliance with standard procedures. After 100 medication histories were collected by a nurse and pharmacist, the pharmacist

Figure 1. Medication history pocket card distributed to nurses as part of education period between phases I and II of study.

Questions	
☐	What medications do you fill for your child at the pharmacy for regular or as-needed use?
☐	What over-the-counter medications (<i>medications that do not require a prescription</i>) does your child take on a regular or as-needed basis?
☐	Does your child take any vitamins or supplements?
Documentation	
☐	Medication name and strength
☐	Medication dose
☐	Medication route
☐	Medication frequency
☐	Time of last dose
☐	Pharmacy name and location (<i>may facilitate access to vital medication information for other health care providers</i>)

educated nurses on obtaining accurate medication histories and implemented a standardized tool to interview patients and their caregivers. Education included preliminary findings from phase I of the study along with specific examples of medication errors that resulted from omissions in MH. The tool was distributed in the form of a pocket card (Figure 1), which listed standardized questions and a documentation checklist. These questions were selected from pharmacist experience in eliciting information from caregivers.

Following the educational period, 100 additional medication histories were collected by a nurse and pharmacist. The pre-education period was collected as “phase I” data, and the posteducation period was collected as “phase II” data.

The primary endpoint was the distribution of discrepancies, defined as inaccuracies or omissions in medication histories identified. Total discrepancies were a composite of medication name, medication dose, medication route, medication frequency, and time of last dose. Secondary endpoints included each of the individual components of the primary composite endpoint as well as discrepancies in documentation of allergies and allergic reactions. The time spent per medication history by the pharmacist was also documented.

Continuous data were analyzed with an independent 2-sample *t*-test, categorical data with a Fisher's exact test, and ordinal data with a Mann-Whitney *U* test. Descriptive statistics were used to report baseline characteristics.

Table 1. Baseline Patient Characteristics for Phases I and II of the Study (n = 161)

Variable	Phase I (n = 79)	Phase II (n = 82)	p value
Age, yr, mean $\pm$ SD	9.43 $\pm$ 6.50	9.49 $\pm$ 6.45	0.955
Female, n (%)	43 (54)	51 (62)	0.341
Total medications, median (range)	2 (1–10)	2 (1–6)	0.646

Results

A total of 200 patients were included for study evaluation with 100 patients in each phase. In phase I, 79 patients met study inclusion criteria, and 21 patients were excluded. In phase II, 82 patients met study inclusion criteria, and 18 patients were excluded. Patients were excluded if not on any home medications, as confirmed by a nurse and by a pharmacist. There were no statistically significant differences in patient characteristics between the 2 phases (Table 1).

The nurses identified at least 1 medication correctly in 44 of 79 patients and 53 of 82 patients in phases I and II, respectively. The nurses recorded that 35 patients in phase I and 29 patients in phase II were not taking any home medications, which resulted in a total of 102 medication omissions. Of the patients for whom a medication was correctly identified, 88 medications were identified by the nurse and 39 were omitted in phase I, and in phase II, 95 were identified by the nurse and 44 were omitted. This resulted in a total of 182 omitted medications between both phases of the study and all patients identified for inclusion.

The total number of discrepancies was 1293 of which

714 discrepancies were identified in phase I, and 579 discrepancies were identified in phase II (Figure 2). The distribution of total discrepancies per patient was reduced post education (4 [2.3, 7.0] to 2 [1.0, 4.0], $p = 0.0023$) (Figure 3). The distribution of total discrepancies per medication was also reduced post education (3 [1.4, 4.0] to 1.5 [1.0, 2.8], $p = 0.0002$) (Figure 4). Improvement in documentation was observed in regard to medication dose ($p = 0.0002$), route ($p < 0.001$), and frequency ($p = 0.023$). Identification and documentation of medication name and time of last dose also improved; however, these findings were not found to be statistically significant (Tables 2 and 3).

The average time spent per patient by the pharmacist for all patient histories ($n = 200$) was 11 minutes. The source of information for included patients was primarily the caregiver (87%), and the patient's outpatient pharmacy was contacted in 21% of all instances. The time spent per patient by the nurse was not recorded, and there was no documentation of the nurse contacting the patient's outpatient pharmacy. Two allergies and 6 allergic reactions were omitted in phase I, and 5 allergies and 12 allergic reactions were omitted in phase II.

Figure 2. Total medication history discrepancies by category for phases I and II of study (n = 161).

Figure 3. The distribution of discrepancies per patient, reported as median values and interquartile ranges, for phases I and II of the study.

Figure 4. The distribution of discrepancies per medication identified, reported as median values and interquartile ranges, for phases I and II of the study.

Discussion

Overall, identification of discrepancies decreased and completeness of nurse-documented medication histories improved after nursing education was conducted by the pharmacist. Although documentation significantly improved, a clinically significant amount of discrepancies persisted despite education. Documentation of allergies and allergic reactions worsened, although these were not targeted elements of the nursing education. These findings suggest that additional barriers exist for nurses in collecting medication histories. Discussion with nurses revealed that patient load and additional responsibilities limited the time and

priority they were able to place on medication history collection. Familiarity with dose ranges of less commonly prescribed medications limited nurses' screening ability of the accuracy of the caregiver's report.

Omitted medications were consistently identified by the pharmacist in both phases of the study. A majority of these were over-the-counter supplements and pain medications, although a limited number of prescription medications were also omitted. A majority of patients were also treated and discharged directly from the ED with only a minority of patients in each phase admitted for inpatient care.

A limitation of this study was the inability to quan-

Table 2. Distribution of Discrepancies per Patient With Error Types Identified per Patient in Phases I and II

Error Type	Phase I*	Phase II*	p value†
Medication name discrepancy‡	1 (0–8)	1 (0–4)	0.683
Medication name incorrect§	1 (0–1)	1 (0–1)	0.307
Dose discrepancy‡ in identified medications§	1 (0–5)	0 (0–3)	0.002
Route discrepancy‡ in identified medications§	1 (0–5)	0 (0–2)	<0.001
Frequency discrepancy‡ in identified medications§	1 (0–6)	0 (0–3)	0.023
Time of last dose discrepancy‡ in identified medications§	1 (0–7)	1 (0–5)	0.660

* Data presented as median (min-max).

† All p values calculated by using Mann-Whitney U test.

‡ An error indicates the information is either incorrect or omitted.

§ Excludes omitted medications.

Table 3. Distribution of Errors per Medication With Error Types Identified per Patient in Phases I and II

Error Type	Phase I*	Phase II*	p value†
Medication name discrepancy‡	0.367 (0–1)	0.333 (0–0.667)	0.143
Medication name incorrect§	0 (0–1)	0 (0–0.5)	0.302
Dose discrepancy‡ in identified medications§	1 (0–1)	0 (0–1)	0.003
Route discrepancy‡ in identified medications§	0.375 (0–1)	0 (0–1)	<0.001
Frequency discrepancy‡ in identified medications§	1 (0–1)	0 (0–1)	0.014
Time of last dose discrepancy‡ in identified medications§	1 (0–1)	1 (0–1)	0.458

* Data presented as median (min-max).

† All p values calculated by using Mann-Whitney U test.

‡ An error indicates the information is either incorrect or omitted.

§ Excludes omitted medications.

tify the clinical impact of discrepancy identification. Although discrepancies were followed up on with the nurse and medical team, the potential for patient harm was not measured. Additionally, owing to the structure of the study period, time constraints permitted only convenience sampling of patients whom the pharmacist was able to interview for study inclusion. There were patients who presented during the study period who were only interviewed by a nurse. Also, the pharmacist who completed the medication histories accessed the nurses' history before speaking with the patient. This access may have influenced documentation as well as patient and caregiver recall.

This study highlights a need for rapid communication of information from caregiver to the hospital team. Quick digital access to patients' home medication lists may facilitate this access in the future. Recognition of current barriers may guide development of these technologic improvements.

Conclusions

This study demonstrates that a pharmacist, with a dedicated role to collect medication histories, consistently uncovered omitted medications while completing medication histories. Education of nurses improved documentation; however, a clinically significant amount of discrepancies and omissions persisted despite this education. This demonstrates that barriers beyond that of a knowledge deficit exist to limit accuracy of medication histories collected by nurses. Potential barriers include dedicated time and ease of access to digital information. Overcoming these barriers, potentially with pharmacist involvement, could have a positive impact on patient care in the pediatric ED.

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