Impact of an Emergency Department Pharmacy on Medication Omission and Delay

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Objectives: The objective of the study was to evaluate the impact of adding a clinical pharmacist within a pediatric emergency department (ED) on medication omissions and delays, as well as medication errors on patients with prolonged ED stays of 8 hours or greater.

Methods: This is a retrospective review of medication omissions and delays on all patients admitted to a large, tertiary-care children's hospital through the ED during a month before the addition of a clinical pharmacist (April 2007), during a month immediately after the addition of a clinical pharmacist (April 2009), and 6 months after the addition of a clinical pharmacist (October 2009). The medication omissions and delays were separated for urgent and nonurgent medications. A subgroup was further analyzed to evaluate the rate of medication omissions and delays for admitted patients boarded within the ED for 8 hours or greater.

Results: Medication omissions and delays decreased immediately after the addition of a clinical pharmacist for urgent medications ($P = 0.007$) and nonurgent medications ($P < 0.0001$). This decrease persisted 6 months after the addition of a clinical pharmacist approaching significance for urgent medications ($P = 0.06$) and statistically significant for nonurgent medications ($P < 0.0001$). For the patients who were boarded within the ED for 8 hours or greater, 52.8% experienced a medication omission or delay before the addition of a clinical pharmacist, compared with 28.6% and 36.2% experiencing an omission or delay in medications administration immediately after or 6 months after the addition of a clinical pharmacist, respectively.

Conclusions: Medication omissions and delays are common within the ED. Admitted patients boarded within the ED for 8 hours or greater are at an increased risk for medications omissions and delays. The addition of a clinical pharmacist within an ED may reduce the number of medication omissions and delays occurring.

Key Words: medication errors, medication delays, medication omissions, pharmacy

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In April 2009, the US Government Accountability Office submitted a report to the Chairman of the Committee of Finance in the US Senate indicating that emergency departments (EDs) nationwide have become more overcrowded with longer wait times and lengths of stay over the last decade.[1] Being the frontline for an institution, the overutilization and overcrowding of emergency rooms are a major problem for delivering safe and effective patient care. It has been demonstrated that overcrowding leads to an increase in medication errors and adverse drug events.[2–8]

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Medication errors in EDs are a multifactorial problem. Overcrowding leads to an increased patient load for both physicians and ancillary staff, which may lead to an increase in errors. Studies have shown an association between ED overcrowding and delays in pain management,[2,3] as well as in needed medical therapy.[4]

In addition, admitted patients are being boarded in the emergency room longer than would otherwise be considered standard of care.[5] Emergency departments are quickly becoming an extension to the inpatient setting for patients while they wait for an available bed on their designated ward. Prolonged stays have been shown to be associated with more missed medications while in the emergency room, longer inpatient hospital stays, and a higher mortality during the hospital course.[6,7] Medically complex children presenting to the ED not infrequently require a complicated regimen of chronic medications that cannot be dismissed during a prolonged stay in the ED. This growing population is particularly vulnerable to errors in medication administration.[9]

Pharmacists have been shown, in inpatient settings, to improve the accuracy of medication administration. Pharmacies within hospitals not only dispense medications, but also are a direct resource for physicians and nurses at preventing medication errors.[10] The collegial relationship between a pharmacist and the physician leads to a decrease in medication errors in the hospital setting.[11–13] Carter et al[14] showed that pharmacists take a more comprehensive medication history than do other health care professionals.

It is possible that the beneficial role of an inpatient pharmacist could be applicable to the ED as well. One study has examined the pharmacist's role in ED medication reconciliation in an elderly population, with promising results.[15] We hypothesized that the introduction of an ED-based pharmacist in our pediatric ED would decrease medication delays and omissions. The purpose of this study was to compare delayed medications and missed medications for emergency room patients before and after the addition of a clinical pharmacist.

METHODS

This study is a retrospective review of all patients admitted to Children's Hospital of Los Angeles through the ED for the months of April 2007, April 2009, and October 2009. These months were chosen because April 2009 was the first month during which the ED was staffed full time by an ED-based pharmacist. April 2007 was used for the prepharmacist comparison, and October 2009 was chosen to determine the sustainability of any effect found after 6 months of ED pharmacy support. As the ED uses handwritten ordering and documentation, charts that could not be located in their entirety after 3 attempts were excluded. The institutional review board of the participating institution approved this study.

Emergency department charts were reviewed for the total number of medications dispensed, type of medication, indication for medication, and time of administration. Data were extracted entirely by the authors. Inpatient records, including medication

reconciliation, are computerized. These were examined for home medications and schedules, and omissions or delays in anticipated home medications while the patients were in the ED were recorded as well.

Total medications to be given were defined as all medications given during the ED course and all scheduled or ordered medications that should have been given but were not. Urgent medications were defined as those mediations that were given in support of the patient's chief complaint or acute diagnosis (eg, antibiotics to treat acute infection). Delays in the initial dose and errors in dosing quantity were not reported. If a patient was being admitted for parenteral administration of a medication for an acute illness and received no doses in the ED, this was labeled as a missed urgent medication. Delays or misses of subsequent doses or urgent medications were reported based on intervals dictated by the *Children's Hospital of Los Angeles Pediatric Dosing Handbook and Formulary*, which is published by the institution and available on all computers and in hard copy in all areas. If a medication was ordered appropriately but not dispensed or dispensed in a delayed fashion, it was labeled as a miss or delay. Respiratory medications were not included in totals of delayed or missed medications because these medications are dispensed by a respiratory therapist and are not monitored by the clinical pharmacist.

All home medications were considered nonurgent, unless they were directly related to the patient's chief complaint. Medications that were recorded in the patient's inpatient medication list as chronic medications for which a dose was anticipated during the time in the ED were considered missed if not administered. Those that were administered at a time later than the scheduled time on the inpatient medication reconciliation list were considered delayed. Nonurgent medications that were discontinued or held for medical reasons were excluded.

A prolonged ED course was defined as an ED stay for 8 hours or greater after the admission request was placed. These patients were included in the total but also were further analyzed as a subgroup. Boarding times were defined as the number of minutes from the admission order to the time the patient left the ED. The numbers of delayed or missed medications in this subgroup were then analyzed and compared with those of all other patients.

Data from April 2007 were compared with data from April 2009 and data from October 2009 to assess for a change in the number of missed or delayed medications.

Statistical Analysis

The primary study end points, to be compared among the 3 surveyed months, are percent missed or delayed medications in the sample as a whole and in the prolonged-stay subgroup, and average length of delay for delayed medications. Each of the 2 months surveyed after placement of a satellite pharmacy in the ED (April 2009 and October 2009) was compared with the prepharmacy month of April 2007, using Fisher exact tests to compare proportions and analysis of variance for length of delay. Because of distributional irregularities, analysis-of-variance results were confirmed with nonparametric analyses to compare delays in medication administration. Statistical tests were 2-sided at $\alpha = 0.05$.

RESULTS

Figure 1 shows the chart availability for the 3 separate months being evaluated, in which 93.4%, 94%, and 97.1% of all charts were reviewed for April 2007, April 2009, and October 2009, respectively.

Overall, the number of medication delays or omissions decreased after the immediate addition of a clinical pharmacist working full time within the ED. These improvements persisted on the second postpharmacy month, 6 months after the addition of a full-time pharmacist.

Table 1 provides the data of missed and delayed medications for the prepharmacy month (April 2007) and postpharmacy months (April 2009 and October 2009), including those patients with a prolonged ED stay of 8 hours or greater. With the addition of a clinical pharmacist in the ED, there was a statistically significant improvement in the number of missed medications for both urgent and nonurgent medications and a trend toward improvement in delays in medication administration. There was no statistical improvement in the average minutes delay of urgent medications, but the average minutes delay of nonurgent medication in the postpharmacy months of

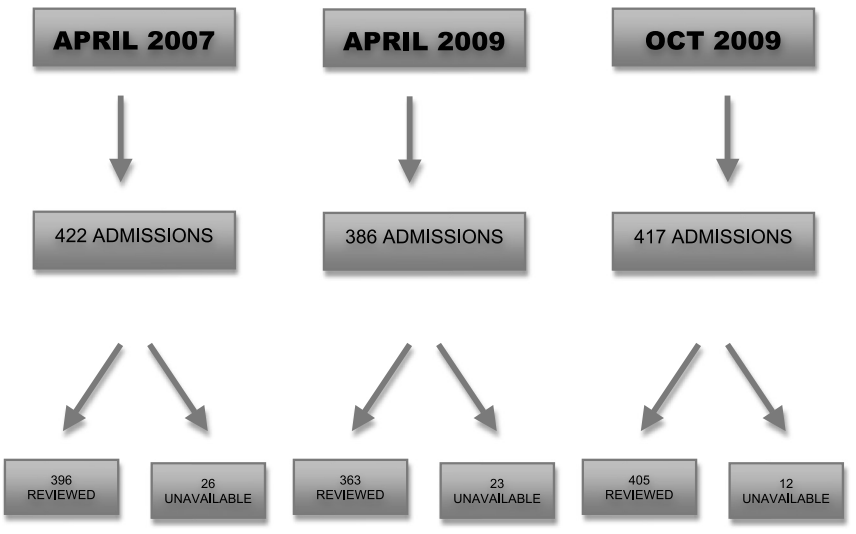

FIGURE 1. Chart availability for the 3 separate months evaluated.

TABLE 1. Data on Missed and Delayed Medication Prepharmacy and Postpharmacy Implementation

	April 2007 n (%)	April 2009 n (%)	*P*	October 2009 n (%)	*P*
Total admissions reviewed	396	363		405	
Total medications dispensed	723	874		851	
Urgent medications dispensed	547 (75.6)	712 (81.5)		716 (84.1)	
Nonurgent medications dispensed	176 (24.4)	162 (18.5)		135 (15.9)	
Urgent medications dispensed	547 (75.6)	712 (81.5)		716 (84.1)	
Missed antibiotics	15 (2.7)	7 (1.0)	0.03	3 (0.4)	<0.001
Missed nonantibiotics	2 (0.4)	2 (0.3)		1 (0.1)	
Delayed antibiotics	12 (2.2)	7 (1.0)	0.17	17 (2.3)	0.85
Delayed nonantibiotics	0 (0)	1 (0.1)		0 (0)	
Missed or delayed	29 (5.3)	17 (2.3)	0.007	21 (2.9)	0.06
Average minutes delay	53	65	1.00	62	0.70
Nonurgent medications dispensed	176 (24.4)	162 (18.5)		135 (15.9)	
Delayed nonurgent medications	35 (19.9)	11 (6.7)	<0.001	21 (15.5)	0.37
Missed nonurgent medications	125 (71.0)	62 (38.3)	<0.001	43 (31.8)	<0.001
Missed or delayed	169 (90.1)	73 (45.0)	<0.001	64 (47.4)	<0.001
Average minutes delay	218	125	0.03	140	0.08
Prolonged ED stay (≥8 h) awaiting bed	36 (9.1)	63 (17.4)		47 (11.6)	
Delayed or missed medications	19 (52.8)	18 (28.6)	0.02	17 (36.2)	0.18

April 2009 and October 2009 decreased by approximately 43% and 36%, respectively.

DISCUSSION

Two key points our results demonstrate are that the addition of a satellite clinical pharmacist within our ED improved medication omissions and delays and that medication errors within EDs, even with a clinical pharmacist, are still a major problem.

The greatest apparent impact of the addition of a clinical pharmacy was seen on the decreased number of missed and delayed nonurgent medications. Most of these nonurgent medications were scheduled home medications for chronic problems unrelated to their current ED visit, yet many were important medications such as anticonvulsants or immunosuppressants. On presentation, ED patients may possibly have more immediate issues that require the attention of the health care providers, so these less urgent medications may unfortunately be overlooked. The addition of a clinical pharmacist demonstrates the ability to decrease these medication errors through medication reconciliation.

Even with the addition of a clinical pharmacy, medication errors are still a major problem in EDs. Although there was a dramatic reduction of medication errors after the introduction of a clinical pharmacist, more improvement is needed. For patients with prolonged ED stay of 8 hours or greater, more than half had either medication delays or omissions before pharmacist introduction. This number decreased to 28.6% and 36.2% for the 2 postpharmacy months, which is still a large number of medication errors for patients. Many EDs are not designed to function as an inpatient environment, and the solution to the issues related to prolonged stays in the ED is both complicated and controversial.

Several limitations existed for this study. Although there was a large pool of admitted patients and medications dispensed over the 3 months evaluated, there was a relatively small number of urgent medications dispensed. This possible sample size bias may have muted the potential impact of having a clinical pharmacist on the reduction of urgent medication errors. The data shows that, immediately after the addition of a clinical pharmacist in April 2009, there was a significant decrease in medication delays or omissions ($P = 0.0066$), and 6 months after the addition of a pharmacist in October 2009, this decrease was approaching significance ($P = 0.0598$). With a larger sample of urgent medications dispensed, the impact of the clinical pharmacist on urgent medication dispensing errors could possibly be more evident.

The months chosen to see the impact prepharmacy and postpharmacy were separated by 2 years. This decision was made because the clinical pharmacist did not work within the ED on a regular basis when first implemented. To demonstrate the impact, the months used were chosen when the clinical pharmacist worked within the ED regularly. Within the 2 years, there may have been more that changed within the ED than just adding a clinical pharmacist. The data shows a similar number of admissions over the 3 months evaluated but an increase in the total number of medications dispensed in the postpharmacy months. Data collection was a snapshot of total admissions through the ED, which may have missed subtle differences in the illness severity of the patients.

In addition, this is a single-center trial and reports improvements in our institution and delays or misses in our medication dispensing. Our patient population is medically complex, and our prepharmacist error rates were similar to those of other studies with a medically complex population. However, this data may not be easily extrapolated to a pediatric population in a community ED with less chronic medical issues and shorter ED lengths of stay.

CONCLUSIONS

Medication errors are unfortunately commonplace within an ED, especially in patients who are boarded in the ED for 8 hours or greater. The addition of a clinical pharmacist within an ED may enable a reduction of medication errors by working closely with health care providers and medication reconciliation. More emphasis by physicians, nurses, and pharmacists needs to be put on limiting medication errors on patients. Implementing a satellite clinical pharmacist within an ED is one way at improving medication errors and patient safety.

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