Clinical pharmacy services in an emergency department

ROLLIN J. FAIRBANKS, DANIEL P. HAYS, DAVID F. WEBSTER, AND LINDA L. SPILLANE

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Since the Institute of Medicine published "To Err Is Human: Building a Safer Health System," health care providers have increased their focus on patient safety and committed significant resources to the reduction of medical errors.[1] In that report, medication errors were cited as a significant and underrecognized cause of adverse outcomes. Drug complications account for 19% of adverse events overall, and 4% of all hospitalized patients experience medication errors.[2] Other data suggest a similar frequency of adverse drug events in the emergency department (ED) setting.[3]

Numerous factors affect the potential for medication errors in the ED. By nature, the ED is a relatively chaotic and sometimes stressful environment. This is further complicated by overcrowding, which results in patients boarding (remaining in the ED after hospital admission because of a shortage of inpatient beds) for inordinate amounts of time.[4-6] It is common for both the physician and nursing staff to be involved in the care of multiple patients at the same time with frequent interruptions.[7] There is an increased reliance on oral orders in the ED, which further increases risks to patient safety. In addition, the medical record is often incomplete and does not contain an adequate medical history, including a current medication list and allergy information.

In November 2000, we proposed, pilot tested, and implemented an ED-based clinical pharmacist program. In this report, we describe the program and our experience with the program, including the strategies used to overcome barriers and costs of the program.

Program description. *Setting.* This program was implemented in the ED of a level-1 trauma center at an academic medical center with 739 licensed inpatient beds. The ED has 120 beds and a patient volume of 90,000 visits per year. The department hosts an emergency medicine (EM) residency program and pediatrics EM fellowship. Patient care is provided by 30 EM residents, 39 attending physicians, 21 midlevel providers (both nurse practitioners and physician assistants), and 110 nurses. Approximately 500 medication doses are ordered and administered in the ED on a daily basis. Historically, our pharmacy has been remote from the ED, and pharmacists interacted with the ED staff via telephone. Most medications needed to treat patients were stocked in the ED and administered without pharmacist review. As a result, review of orders before dispensing and administration occurred only for medications not stocked in the ED. Formulary restrictions and medication-use guidelines were not always followed. Patient education was generally provided by nurses and only when time allowed. Given the lack of dedicated pharmacy services in the ED, there were frequent medication delivery problems and delays in receiving ordered medications.

Program details. The ED clinical pharmacy specialist (CPS) position was assigned to a clinical pharmacist with a doctor of pharmacy degree who is in the ED Monday through Friday from 10 a.m. to 6 p.m. The CPS was given a dedicated computer with network access and online references and carried a portable telephone to be easily accessible to nursing and physician staff in the ED.

Specifically, the roles of the ED CPS include

1. *Clinical consultation.* The CPS regularly attends rounds in the ED and provides information to nurses and physicians regarding their patients. Common tasks include providing dosage recommendations for patients with renal impairment, toxicology information, antibiotic recommendations, alternative regimen recommendations, special

ROLLIN J. FAIRBANKS, M.D., M.S., is Senior Instructor, Department of Emergency Medicine; DANIEL P. HAYS, PHARM.D., is Clinical Pharmacy Specialist, Departments of Pharmacy Services and Emergency Medicine; DAVID F. WEBSTER, M.B.A., B.S.Pharm., is Associate Director of Pharmacy Services, Department of Pharmacy Services; and LINDA L. SPILLANE, M.D., is Associate Professor, Department of Emergency Medicine, University of Rochester Medical Center, Rochester, NY.

Address correspondence to Dr. Hays at the Departments of Pharmacy Services and Emergency Medicine, University of Rochester Medical Center, Box 638, 601 Elmwood Avenue, Rochester, NY 14642 (Daniel_Hays@urmc.rochester.edu).

administration instructions, therapeutic substitution information, and advice regarding medication restrictions (including nonformulary or "black-boxed" medications). The CPS also attends shift-change rounds with the attending and resident physicians and answers questions as needed.

2. *Patient education.* The CPS seeks patients with complicated medication lists, assesses the lists for potential problems, and talks to the patients to ensure that they understand their regimen. The CPS is also directly referred to patients by the providers who have identified problems or needs.
3. *Order screening.* The CPS reviews written orders, focusing on allergies, drug interactions, indications, and dosages. When a problem is identified, the CPS approaches the ordering clinician and offers suggestions for an alternative therapy.
4. *Dispensing drugs.* The CPS will often obtain medications from the ED's automated dispensing system (Pyxis, Cardinal Health) and, if the medication is not available in the ED stock, personally retrieve it from the central hospital pharmacy.
5. *Preparation of medications.* The CPS prepares medications for administration in emergency situations.
6. *Stocking medications.* Although the CPS is not primarily responsible for stocking medications, the CPS ensures appropriate stocking and an adequate supply of medications.
7. *Resuscitation response.* The CPS responds to all trauma alerts, cardiac arrests, and "near arrests" and has become an integral part of the resuscitation teams. In this capacity the CPS prepares medications for administration, recommends medications, and retrieves medicines not readily available in the emergency cart.
8. *Staff education.* The CPS contributes regularly to the education of medical students, pharmacy residents, emergency medicine residents, other residents who conduct rotations in the ED, and nursing staff.
   a. *Resident education.* The CPS attends a weekly EM resident conference, gives regularly scheduled talks, and assists residents in preparing relevant talks and helps them search evidence-based answers to pharmacy-related questions assigned by the faculty. The CPS has also developed a clinical pharmacology elective for residents and students. This role helped establish the CPS as an authority among the EM residents, who as a result are not only receptive to CPS input in the clinical setting but often seek the CPS for advice.
   b. *Nursing education.* The CPS conducts nursing continuing-education sessions on topics such as new medications, changes to the hospital formulary, drug warnings, and drug–drug interactions.
   c. *Patient Education.* The CPS interviews select patients upon admission to evaluate their medication history and provides education to ensure proper understanding of medication use at discharge.
9. *Care of boarded patients.* At our institution, the care of these patients is the responsibility of the inpatient physician team and the ED nurses. The CPS reviews the daily medication administration record on each chart and, when necessary, provides recommendations to the nurse or physician.
10. When a patient is transferred to one of the inpatient units, the CPS coordinates with the pharmacist responsible for the appropriate unit if the patient has special needs.
11. *Emergency preparedness.* For example, when nerve agent antidote kits were obtained, the CPS worked with nursing leadership to distribute the kits and briefed the nursing and physician staff on their use.

Funding. The department of pharmacy services had to add a full-time-equivalent position, including salary and benefits. This was justified by the cost saving measures, changes in prescribing practices, and error reduction that the CPS was expected to provide, based on previous reports.[8] Ongoing funding was partly dependent on our ability to demonstrate the success of the program. As a result, quality assurance logs were maintained by the CPS using ASHP's CliniTrend software. These data were used to estimate cost savings to the institution based directly on changing the medication, route of administration, dosage, and avoiding the inappropriate choice of medications. Although we did not conduct a formal cost analysis, detailed data were collected during 14 randomly selected days of the phase-in period. Cost values derived from CliniTrend during this period revealed an average cost saving of $589 per day.

Staffing shortages. Another challenge in the program's implementation was a regional pharmacist shortage that affected the department of pharmacy services. Although full-time funding had been secured, the position began as a part-time position until the institution could recruit another full-time pharmacist to fill the void left by the new position.

Acceptance by medical and nursing staff. The long-term success of this type of program depends on the acceptance and support of both the medical and nursing staff. Once funding was achieved, this became our greatest challenge.

In order for the CPS to be successful, the staff must not only be receptive to feedback and suggestions from the pharmacist but will ideally seek the pharmacist for help. Some initial hesitancy was encountered, particularly on the part of the nursing staff, who felt that pharmacist intervention encroached on their domain of practice. However, it soon became clear that the CPS could alleviate certain nursing

duties, including drug dispensing, drug preparation, and patient education. The nurses also gave the CPS the deciding authority when they were uncomfortable with a resident physician's order. It allowed the nurses to feel more comfortable in refusing to give an inappropriate medication without feeling subordinate.

Physician acceptance was another important challenge to this program. In the initial phase of the program, the CPS shadowed EM residents to gain first-hand experience with current prescribing trends and the patient population and identify potential weaknesses in the medication-use system. This also helped the pharmacist develop personal relationships with the residents, which became an important factor as the program gained acceptance. Another factor that facilitated acceptance among both the resident and attending physicians was the CPS's role in resuscitations, traumas, and respiratory arrests. The CPS anticipated and suggested medications, and it soon became clear to the physician staff that the CPS was a great resource. For example, physicians often commented that rapid sequence intubation (RSI) occurred twice as fast when the CPS was present. This is likely due to multiple factors, including the CPS's ability to anticipate the need for RSI drugs and because the presence of the CPS frees up the nurses to perform other critical duties.

Experience with the program. Over 24 months, the department of pharmacy services tracked interventions and measures of direct medication savings. By modifying prescribing practice, the CPS directly reduced the amount of certain high-cost medications. For example, when a physician ordered i.v. azithromycin to treat community-acquired pneumonia in a patient that could tolerate oral medications, the CPS suggested oral azithromycin. The use of ondansetron, propofol, cisatracurium, and eptifibatide was also substantially reduced in this manner. The gross cost savings associated with these medication changes was estimated to be over $100,000. This estimation was based on the calculated difference between the intended drug and the optimized therapy. The data were derived from the CPS logs over one year. The figure does not account for the cost of the CPS position itself.

The program has yielded educational advances for both the EM and pharmacy departments. The CPS delivers about four lectures per year to the EM residents. Last year, 4 of the 30 residents selected the clinical pharmacology elective. This rotation provides academic preparation and hands-on training in pharmacokinetics, antimicrobial management, dosing, and drug interactions. A new EM and critical care pharmacy residency was developed and is offered to pharmacists who have completed a general practice residency. This advanced practice residency focuses on the medications used in the acute and critical care environments. Currently in its first year, the program boasts two advanced practice residents and expects to obtain ASHP accreditation shortly. Finally, the CPS has been integrated into the structured nursing continuing-education program and provides regular educational sessions for the nursing staff.

Since the inception of the CPS program, the department of pharmacy services has become more involved in EM clinical research. For example, in a recent etomidate versus midazolam study in procedural sedation, the CPS coauthored the proposal, prepared the medications for blinding, helped with randomization, patient enrollment, and data collection, and will share authorship of the journal article. This kind of collaboration has far-reaching benefits for both the pharmacy services and EM departments. The CPS is also an active member of the EM research committee, which relies on the CPS's expertise regarding pharmaceutical issues.

There is indirect evidence of a reduction in medication errors since the initiation of the CPS position. The hospital uses a voluntary reporting system (DoctorQuality, Inc.), which provides a means for staff to document near-misses or adverse events. While there were 19 medical errors reported since the inception of the CPS program, none has occurred while the CPS was on duty. Furthermore, there are a number of documented cases in which the CPS prevented the administration of contraindicated medications. In one instance, a first-year EM resident ordered ampicillin–sulbactam for a patient who had a documented true penicillin allergy. This medication was available in the ED Pyxis machine, and the patient's nurse retrieved the medication. During routine order screening, the error was identified by the CPS, who intervened just as the nurse was preparing to administer the drug to the patient.

Other examples of CPS intervention include suggesting a reduction in tobramycin dosing for an elderly patient with an elevated serum creatinine level and correcting the concentration of an i.v. dose of epinephrine from 1:1,000 to 1:10,000.

The CPS program has gained overwhelming acceptance among nurses, attending physicians, and residents. These providers routinely seek advice from the CPS and refer patients to him. The CPS reported only positive and receptive reactions from practitioners when he approached them with unsolicited advice. The same is true to an overwhelming extent among the nursing staff.

Discussion. The ED is a hectic environment where even simple things can be overlooked. The acute issues at hand can potentially mask some of the chronic issues that patients may also have. By having a dedicated resource, the medical team has more time to attend to its patients.

Traditionally, error reduction in the ED has focused more on the responsibility of the individual health

professional and less on the medication-use system.[9] As an alternative to this "name, blame, and train" structure, a systems approach to error reduction can create multiple layers of protection that correct or obliterate the effect of human error, before it reaches the patient.[9,10] Dedicated pharmacists in the ED offer one such layer of protection.

The health-system pharmacist's role has evolved over time, moving from traditional medication dispensing responsibilities to involvement in direct patient care. It has been shown that pharmacists as members of patient care teams can reduce the number of adverse drug events.[11] Pharmacist involvement has also been shown to decrease institutional medication expenses.[12-14]

Although some hospitals have programs that allow pharmacists to respond to the ED for cardiac arrests or trauma team activations, few have reported programs that involve a clinical pharmacist assigned exclusively to the ED. Notable exceptions are hospitals in Detroit[15] and Chicago,[16] where clinical pharmacy programs were reported in EDs in the 1980s. Published reports have asserted that ED-based pharmacists can increase patient safety.[2,9,15,16]

In a recent survey of hospitals with pharmacy residencies, 3% had a dedicated satellite ED pharmacy, and 10% reported having pharmacists who were primarily responsible for the ED.[17] However, it was not reported whether these pharmacists were physically located in the ED. Since the survey had a fairly low response rate and only examined hospitals with pharmacy residencies, it is possible that these small percentages misrepresent the number of designated ED pharmacists nationally.

Our experience may not be generalizable to other hospital systems. Our outcome measures were subjective and, even when quantitative, were not acquired under the structure of a research design. For example, we refer to the decrease in errors entered into our reporting system, but these data cannot be used to measure outcomes because the system is voluntary and because the reporting system did not exist before initiation of the CPS program.

Our experience suggests that the implementation of a full-time, dedicated ED CPS is both feasible and desirable in the tertiary-care teaching hospital setting.

Conclusion. Provision of clinical services in the ED by a pharmacist appears to have improved medical care, imparted knowledge to ED personnel, and reduced institutional expenditures.

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