



Original Contribution

Clinical pharmacy services in the emergency department



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ABSTRACT

The emergency department (ED) is a fast-paced, high-risk, and often overburdened work environment. Formal policy statements from several notable organizations, including the American College of Emergency Physicians (ACEP) and the American Society of Health-System Pharmacists (ASHP), have recognized the importance of clinical pharmacists in the emergency medicine (EM) setting. EM clinical pharmacists work alongside emergency physicians and nurses at the bedside to optimize pharmacotherapy, improve patient safety, increase efficiency and cost-effectiveness of care, facilitate antibiotic stewardship, educate patients and clinicians, and contribute to scholarly efforts. This paper examines the history of EM clinical pharmacists and associated training programs, the diverse responsibilities and roles of EM clinical pharmacists, their impact on clinical and financial outcomes, and proposes a conceptual model for EM clinical pharmacist integration into ED patient care. Finally, barriers to implementing EM clinical pharmacy programs and limitations are considered.

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1. Background

1.1. Need for emergency medicine clinical pharmacists

Emergency medicine (EM) is a complex field. It demands management of diverse patient populations and medical problems that call upon a variety of clinical disciplines—from pediatrics to geriatrics and primary care to critical care. Utilization of time-sensitive and high-risk medications is common in the emergency department (ED). These complexities place the ED among the most high-risk patient care environments [1]. Including EM clinical pharmacists in treatment decisions and in implementation of therapy mitigates some of the risk and decreases medication errors [2–7]. EM clinical pharmacist services complement existing interprofessional teams of physicians, advanced practice providers, nurses, respiratory therapists, and prehospital providers.

Historically, hospital pharmacists focused on distributive functions (e.g., medication procurement, preparation, and delivery to the patient bedside). Today's clinical pharmacists focus on patient care that optimizes medication therapy and thereby promotes health, wellness, and disease prevention. Clinical pharmacists provide expertise in the therapeutic use of medications and assume responsibility and accountability for managing therapy in direct patient care settings while collaborating with other healthcare professionals [8]. Their contributions to patient care and improved outcomes have been well documented and include reductions in patient mortality, hospital readmission rates, and medication errors [2,4,5,9–12]. They have also been shown to be highly valued team members in an EM environment [13,14].

1.2. History of emergency medicine clinical pharmacists

The introduction of clinical pharmacists in the ED was first reported in the 1970s [15–17]. Initial publications described their role in terms of

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medication distribution but also noted the provision of cognitive and consultative services based on the EM clinical pharmacist's unique knowledge of pharmacology and therapeutics. In the first physician survey of EM clinical pharmacist services in a single center study, all respondents (physician and nurses) supported the EM clinical pharmacist as an integral team member, and 87% supported pharmacist delivery of care to certain patients after physician diagnosis [15]. In medical resuscitations, the role of the pharmacist included recognition as a drug therapy consultant for clinicians [18].

In more recent years, the role of the EM clinical pharmacist has expanded to include an increasing emphasis on comprehensive direct patient care services. Such services are centered on bedside patient assessment with the EM medical team and timely provision of patient-specific and disease-specific pharmacotherapy recommendations. EM clinical pharmacists aid in medication selection, optimal dosing and delivery, provision of drug information to patients and the interprofessional medical team, research and scholarly activities, and administrative and operational responsibilities to optimize the efficiency of care delivered to ED patients [19].

In 2005, the Agency of Healthcare Research and Quality (AHRQ) funded a project titled “Emergency Department Pharmacist as a Safety Measure in Emergency Medicine” (HS015818). The goal was to optimize the role of the EM clinical pharmacist and to develop a toolkit to aid institutions in the justification and creation of EM pharmacy services. This program, related publications from the grant, and an offshoot mentorship program [20] ultimately increased the national visibility and understanding of the value clinical pharmacists present in the ED, and this has contributed to the rapid expansion of their services over the past decade [13,21–23].

1.3. Non-pharmacist organizational support

In December 2013, the American Society of Health-System Pharmacists (ASHP) Section of Clinical Specialists and Scientists Advisory Group on Emergency Care (SAG EC) began drafting an American College of Emergency Physicians (ACEP) resolution to recognize EM clinical pharmacists as valuable members of the interdisciplinary EM team and to create a policy statement supporting clinical pharmacy services in the ED. The SAG EC is a volunteer group of practicing EM clinical pharmacists whose responsibilities include advancement of EM pharmacy practice and creation of educational content [24]. In October 2014, SAG EC and the American College of Clinical Pharmacy, Emergency Medicine Practice and Research Network (ACCP EMED PRN), in collaboration with and support of the ACEP's New York Chapter, submitted resolution 44 (14) to the ACEP Council. Titled “Support for Clinical Pharmacists as Part of the Emergency Medicine Team,” the resolution was adopted with strong support after a presentation to the ACEP Council Reference Committee. A formal policy statement followed in June 2015 [25]. It represented the first time that ACEP formally recognized the critical role EM clinical pharmacists play in ensuring efficient, safe, and effective medication use in the ED and advocated for dedicated clinical pharmacists within the ED.

Furthermore in October 2017, the American College of Medical Toxicology (ACMT) published a statement that clinical pharmacists are integral to the care and safety of adult and pediatric ED patients [26]. The organization highlights the benefits of EM clinical pharmacists in time dependent emergencies, optimization of pharmacotherapy, safety, and cost avoidance and supports 24-hour staffing of dedicated EM clinical pharmacists in EDs.

One additional mention is that clinical pharmacists have been elected to leadership positions in interprofessional societies that relate to EM such as the American College of Toxicology and the Society of Critical Care Medicine.

2. Current state assessment

2.1. Current roles and responsibilities

EM clinical pharmacists play a variety of roles in practice sites, ranging from large academic and community centers to small and rural EDs. An updated guideline for EM pharmacist services published in 2011 defined the role of the clinical pharmacist in the ED, suggested goals for pharmacy services to meet institutional needs, and established best practices [27]. Activities of EM clinical pharmacists have most recently been summarized by a 2015 national survey study [19]. An extensive list is available in Table 1. Fig. 1 introduces a conceptual model of integration of EM clinical pharmacists into ED patient care and maps these activities in relation to ED patient flow; the majority take place at or

Table 1
Activities of emergency medicine clinical pharmacists [19,27,28].

Bedside clinical activities ● Emergency department resuscitation team (cardiopulmonary arrest, trauma and burn resuscitation, myocardial infarction, stroke, sepsis) ● Direct bedside care during high risk medication use (rapid sequence intubation, procedural sedation) ● Pharmacotherapy consultation ○ Drug information ○ Medication selection ○ Medication dose (based on patient specific factors; age, weight, route of administration, renal function) ○ Medication therapy monitoring
● Drug interaction analysis ● Drug identification ● Drug compatibility for admixing or administration ● Error and adverse event reporting ● Patient counseling and education ● Toxicology recommendations ● Targeted disease state counseling (e.g., anticoagulation, anaphylaxis) ● Antimicrobial stewardship activities including microbiological culture and susceptibility follow-up ● Prospective medication order review and verification ● Assistance with medication procurement/preparation (advanced knowledge of medication storage and distribution and institutional policies and procedures) ● Medication administration ● Vaccine administration ● Emergency preparedness ● Facilitation of medication histories ● Oversight of pharmacist extenders (e.g., technicians, students)
Training and education ● Medication therapy updates and education on optimal medication therapy for ED team members (often takes place at the bedside or in the ED) ● Education through conference and pharmacology rotations for EM attendings and residents ● Implementation and execution of post-graduate EM pharmacy residency training programs ● Participation in interdisciplinary simulation
Performance improvement ● Guideline/protocol/process development ● Formulary management ● Medication dispensing cabinet optimization ● Optimization of medication procurement workflows ● Medication safety initiatives ● Participation in root cause analysis (RCA) and failure mode and effects analysis (FMEA) ● Assistance with adherence to regulatory and institutional medication use policies
Scholarly activities ● Interdisciplinary EM clinical research ● Identification of patients for enrollment of investigational drug studies recruiting in the ED ● Participation in interdisciplinary research committees that review ED related research protocols ● EM related research grant preparation ● EM medical resident research projects or quality improvement projects ● Participation in articles, book chapters, case reports, or other collaborations with EM physicians

Institutional Support and Professional Contributions:

- 1) Formulary management
- 2) Care pathway development
- 3) Education for interdisciplinary care team
- 4) Medication safety and quality improvement initiatives
- 5) Emergency preparedness participation
- 6) Research and scholarly endeavors

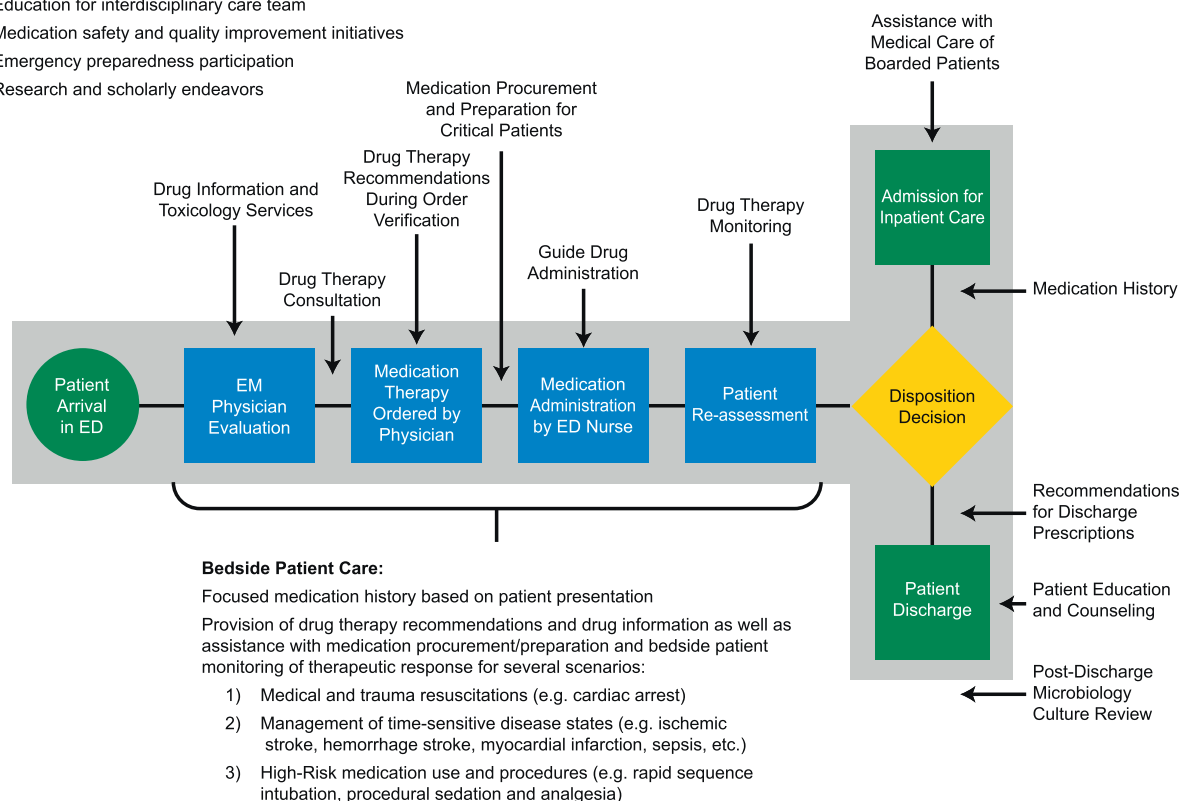


Fig. 1. Clinical pharmacist workflow in the emergency department.

near the bedside and involve face-to-face discussions with patients, physicians, nurses, and other team members.

2.2. Emergency medicine clinical pharmacy programs

The benefits of EM clinical pharmacists has received international recognition (e.g., Canada, Spain, United Kingdom, France, Qatar, Australia) [29–34]. In the United States, EM clinical pharmacy programs have shown marked growth over the last 15 years. A 2003 national survey of the ASHP pharmacy residency directory reported that only 3.4% (4/119 respondents) had dedicated pharmacists assigned to the ED, and 10.9% had pharmacists whose primary responsibility was to provide pharmacy services to the ED [35]. A similar study conducted 10 years later found that 16.4% (68/414 respondents) reported dedicated EM clinical pharmacists within the ED [36]. Likewise, a 2006–07 survey of 99 EM physician residency programs reported that 30% of respondents had dedicated EM pharmacists within the ED [23].

The most recent national survey of clinical pharmacy practice in ED settings took place in January 2015. It received a total 233 responses (58% response rate) [19]. Over two thirds of institutions (68%) reported more than 8 h of dedicated pharmacist coverage during weekdays, nearly half (49%) reported more than 8 h on the weekends, and most provided swing (1300–0000) or midday (0900–1900) coverage to focus on the high volume of patients during such hours [19]. Additionally, almost 10% of institutions reported 24-hour coverage on weekdays and weekends [19].

2.3. Training opportunities

As pharmacists expand from distributive functions to more direct patient care roles, educational and training requirements have

increased. Beyond a professional doctorate degree, pharmacists are increasingly obtaining advanced certifications that reflect detailed knowledge in an array of specialties, receiving board certification through the Board of Pharmacy Specialties accrediting body, and completing general and specialty post-graduate residency training [37,38]. Post-graduate residency addresses the need for cognitive and skill-based training unique to the field and environment of emergency medicine (e.g., knowledge of a broad range of diseases and treatments, understanding ED workflow and practices, proficiency in working with the interdisciplinary ED team, execution of time-sensitive medication tasks like rapid medication preparation, comprehension of ED-specific treatment goals).

The first residency programs specific to emergency medicine pharmacy (Postgraduate Year Two, PGY2) emerged in the early 2000s, and a total of three programs were accredited by 2007. Less than ten years later, the number had increased tenfold. By 2016, there were 36 ASHP-accredited PGY2 EM specialty pharmacy residency programs and by 2017 there were 46 programs and several more seeking accreditation status. Residency program fill rates were 100% and 98% in 2016 and 2017, respectively, highlighting continued interest in this specialty among pharmacy graduates [39]. Training for EM clinical pharmacy services is also occurring in Postgraduate Year One (PGY1) residency programs, which are traditionally non-specialized, and as electives in schools/colleges of pharmacy. A recent national survey of schools/colleges of pharmacy and PGY1 residency programs reported EM pharmacy clinical rotation opportunities at 83% and 74.1% of responding programs, respectively [40].

Growth in clinical pharmacists working in the ED has nonetheless outpaced the number of PGY2 EM Specialty Pharmacy Residencies. This has given rise to alternative pathways to training. Some EM pharmacy programs now include an extensive orientation that entails

shadowing clinical staff within the ED, understanding the job description of the EM clinical pharmacist, reviewing the services of the role, integration into daily operations using ED specific information and clinical topics, pharmacy operations, and hospital policies [41]. In 2007, ASHP developed the “Patient Care Impact Program (PCIP): Introducing an Emergency Pharmacist to Your Institution,” which provided experiential training and mentorship by EM clinical pharmacy specialists and an EM physician during initiation of EM clinical pharmacy services [20]. Over 80 participants have completed this program [42].

3. Supporting research

Reports of improved clinical, safety, and financial outcomes in EDs with EM clinical pharmacy services abound. A selection of various publications is discussed below.

3.1. Clinical and consultative services

EM clinical pharmacists play an essential role in improving the clinical care provided in EDs, as highlighted in Table 2. The results document improvement in areas such as disease-state specific outcomes measures, compliance with organizational and national clinical practice guidelines, medication use evaluations, ED or hospital readmissions, and antimicrobial stewardship.

3.2. Medication safety

Medication errors are common in EDs and may arise during clinical decision-making, prescribing, transcribing, dispensing, or administration of medications [2]. Including clinical pharmacists on the ED team leads to increased error interception and fewer medication errors. ED

pharmacists are well equipped to correct the majority of prescription-related errors, especially those containing multiple medication orders and those prescribed by EM residents [3]. A prospective multicenter study of four geographically diverse academic and community EDs found EM pharmacists caught 364 medication errors during a 1000-hour study period [4]. Most errors were identified during consultative activities and review of medication orders. Improper dosing proved to be the most common type of error corrected [4]. Another prospective multicenter observational study found EM pharmacists caught 504 medication errors during an 800-hour study period [5]. The most common were incorrect dosing, drug omission, and incorrect frequency—alarmingly, almost half (47.8%) of intercepted errors were scored as serious for having potential to cause organ injury or alter life function [5]. Additional prospective studies in United States and Canada have also demonstrated EM pharmacists intercept and significantly decrease medication errors [2,3,5]. Retrospective studies have likewise shown EM pharmacists decrease medication errors [6,7] and increase medication error surveillance and reporting [56].

Medication errors are clinically significant, though many such errors do not result in harm to the patient; those that result in harm are referred to as adverse drug events [1]. Although it is clear that the presence of a pharmacist reduces the occurrence of medication errors, more research is needed to determine whether this results in a clinically significant reduction in clinically significant adverse drug events (ADE). To this end, we encourage rigorous evaluations of outcomes to fully describe the impact of EM clinical pharmacist practice.

Medication errors remain the most common error in medicine. Some result in no patient harm while others can be devastating and costly [1]. Adding EM pharmacists to the ED has shown to increase identification, interception, and correction of many medication errors, including some that may cause permanent patient harm or death. Additionally, EM clinical pharmacists have contributed to significant increases in medication error event reporting which is necessary for systems optimization to reduce patient morbidity and mortality from medication errors [58].

3.3. Financial implications

Allocating pharmacists to the ED requires balancing the desire to improve emergency care with the availability of health system resources. Research shows improvements in cost efficiency resulting from reductions in adverse drug events, adherence to evidence-based guidelines, timely implementation of medication therapies, and increased use of cost-effective drug therapies. A selection of cost-avoidance data is listed in Table 3.

Table 2
Impact of emergency medicine clinical pharmacists on clinical outcomes.

Topic	Findings
Acute myocardial infarction	● Reduction in door-to-cardiac catheterization lab time of 13.1 min and in door-to-balloon time of 11.5 min [43]
Acute ischemic stroke	● Reduction in median door-to-rtPA of 20 min [44]
Sepsis	● Reduction in median time to appropriate antimicrobial administration of 44 min [45] ● Increase in percentage of patients receiving guideline adherent empiric antibiotics of 23.6% [46]
Antimicrobial stewardship	● Reduction in median time to review positive cultures and time to patient or physician notification of 1 day [47] ● Increase in percentage of interventions for inappropriate antimicrobial therapy based on culture data of 30% [48] ● Reduction in percentage of unplanned readmissions to the ED after culture review of 12% [49] ● Reduction in percentage of inappropriate revision of antibiotics after culture review of 31.9% [50] ● Reduction in percentage of return ED visits among uninsured after culture review of 12.9% [51]
Rapid sequence intubation	● Decreased mean time to post-intubation sedation by 19 min and to analgesia by 23 min [52] ● Intervention on a total of 10.1% of discharge prescriptions for error prevention and optimization of therapy [53]
Transitions of care	● Reduction in ED return visits by 50% for patients who were given free to-go antibiotics targeted at treatment for urinary tract infection, pyelonephritis, cellulitis, or dental infection at ED discharge [54] ● Improved medication and disease state education, identification of adherence issues, and medication therapy optimization in patients with chief complaints of asthma exacerbation, chronic obstructive pulmonary disease, or chronic heart failure [55]
Dose optimization	● Increase in percentage of patients receiving optimal phenytoin loading dose of 32% [56]
Vaccination	● Four-fold increase in rate of influenza vaccination [57]

Table 3
Financial impact of emergency medicine clinical pharmacist program.

Study	Finding
Ling 2005 [60]	Four month period with 646 interventions by EM clinical pharmacist estimated cost avoidance of \$192,923 (annualized to \$578,769)
Lada 2007 [61]	• Most common interventions captured were formulary changes, correcting a subtherapeutic dose or frequency, drug therapy consultation, and documenting allergies. Four month period with 1393 interventions by EM clinical pharmacist in 1042 ED patients found cost avoidance of \$1,029,776 (annualized to \$3,089,328)
Aldridge 2009 [41]	• Most common interventions captured were drug information, dose adjustment, nursing questions, formulary interchanges, and suggest initiation of drug therapy. Six month period with 9568 interventions by EM clinical pharmacists showed cost savings of \$845,592 (annualized to \$1.7 million)

Pharmacy departments generally fund EM clinical pharmacists, but some EM departments, physician groups, and schools/colleges of pharmacy contribute partial funding [19]. Other organizations reallocate pharmacists to the ED after evaluating clinical priorities for the health system [59]. Part of the AHRQ grant cited earlier was to develop a justification toolkit for EM clinical pharmacy services in the ED. This web-based resource (available at <http://www.ashp.org/emergencycare.aspx>) includes a selection of literature on clinical and safety outcomes.

4. Barriers to implementation

As with any new program or service, there are practical challenges to starting a dedicated EM pharmacist role. Common obstacles include approval and funding support by hospital leadership, staffing beyond traditional business hours, obtaining needed clinical support staff, defining the role of EM pharmacist, and altering the workflow of the ED to include the pharmacist [20]. For many institutions, the largest initial barrier may be the financial cost of including a pharmacist in the ED.

EM clinical pharmacists may seem an expensive resource [19]. The average annual salary for hospital-based pharmacists in the United States is around \$120,000 [62]. Because EM clinical pharmacists do not provide a direct source of revenue, it is imperative for EM physicians and administrators alike to value the many quality and efficiency benefits (and related savings) that EM clinical pharmacists provide.

The studies noted above lead us to firmly believe that the cost of adding dedicated clinical pharmacists to the ED is more than offset by increases in patient safety (and savings) that their presence brings about. As value-based reimbursement and new payment models focus less on service quantity, the safety and efficiency value of the pharmacist relative to salary cost may further increase.

5. Limitations

The primary literature cited does not reflect the entire body of published literature relating to EM clinical pharmacists. Instead, the authors chose to intentionally highlight key literature citations that focus on the history of EM clinical pharmacists and how pharmacist involvement in the interdisciplinary team impacts outcomes, safety, and cost. Also, tertiary literature and research abstracts from professional society meetings were not reviewed. The goal was a general overview of EM clinical pharmacy programs, not a formal systematic review. In this respect, exclusive use of electronic indexing databases without a predefined search strategy may have potentially resulted in the omission of additional relevant literature.

Much of the available literature on EM clinical pharmacists is from observational reports and surveys of current practices. Clinical outcomes data has become more prevalent with the significant growth in EM clinical pharmacist presence over the last 10 years. Although we have been unable to locate any randomized controlled trials of EM clinical pharmacists, several clinical outcomes data and disease-specific management studies describe improved outcomes associated with EM pharmacist involvement (Table 2). Additionally, the majority of the observational studies available have evaluated surrogate markers of safety and efficiency but have not consistently evaluated the full and direct impact on clinically significant outcome measures. As we encourage growth in dedicated EM clinical pharmacist roles, we challenge new and existing programs to evaluate these clinically significant outcome measures to further contribute to this body of knowledge.

6. Conclusion

Growth in EM clinical pharmacist presence in EDs represents an important advancement in patient care. With numerous studies demonstrating a positive impact on quality and efficiency of care, EM clinical pharmacists should be viewed as an essential member of an effective and efficient emergency medicine practice. While the specific roles of

an EM clinical pharmacist may vary based on institutional needs and resources, all health systems should consider ways to support a dedicated EM clinical pharmacist or EM pharmacy residency training program.

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Conflict of interest disclosure

SM, NA, ZC, VB, MC, JK, KL, CP, MP, ES report no conflicts of interest.

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