Improved Outcomes and Cost Savings Associated With Pharmacist Presence in the Emergency Department

Hospital Pharmacy
2017, Vol. 52(6) 433–437
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DOI: 10.1177/0018578717717395
journals.sagepub.com/home/hpx

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Abstract

Purpose: The study sought to determine whether the inclusion of a pharmacist on the emergency department (ED) resuscitation team was associated with improved compliance with the Advanced Cardiac Life Support (ACLS) guidelines and patient survival. The study also evaluated cost avoidance associated with a pharmacist providing clinical services to the ED. **Methods:** Cardiac arrest event records were evaluated for compliance with ACLS guidelines as well as for whether or not a pharmacist was involved as a member of the resuscitation team. Pharmacists documented all interventions performed while physically present in the ED which were utilized to associate cost avoidance. **Results:** When a pharmacist assisted as a member of the resuscitation team, a significant increase in the percentage of medications administered in compliance with the ACLS guidelines was noted (78% vs 67%, $P = .0255$). An increase in survival to hospital admission (25% vs 17.8%, $P = .0155$) was also noted though no significant increase in survival to hospital discharge (15% vs 4.4%, $P = .6392$) was observed. Over a 5-month period, pharmacists in the ED performed 1200 interventions, which created US\$98 362 in cost avoidance. This extrapolates to approximately US\$320 000 per year in cost avoidance. **Conclusion:** Inclusion of a pharmacist as a member of the resuscitation team improved compliance with medications administered according to the ACLS guidelines and increased survival to hospital admission, though survival to hospital discharge was unaffected. The presence of a pharmacist in the ED was associated with approximately US\$320 000 in cost avoidance per year, if not more.

Keywords

emergency department, clinical pharmacist, cardiac arrest

Introduction

Since the 1970s, emergency departments (EDs) throughout the country have utilized clinical pharmacists to improve patient care and control costs.^{1,2} Though once a luxury in academic settings, clinical pharmacists in the ED are becoming more common in many institutions throughout the country as health systems realize the value of a pharmacist in this setting.³ The American College of Emergency Physicians even released a policy statement advocating for the incorporation of a clinical pharmacist into the ED multidisciplinary team noting that “pharmacists serve a critical role in ensuring efficient, safe, and effective medication use in the ED.”⁴ Studies have also demonstrated significant cost savings associated with clinical pharmacists practicing in the ED.⁵

The purpose of this study was to show that by assisting with the management of cardiac arrest in the ED, a clinical pharmacist could improve the quality of patient care delivered by improving compliance with Advanced Cardiac Life Support (ACLS) guidelines. The study also sought to demonstrate the potential cost avoidance associated with having a pharmacist physically present in the ED.

Methods

This study was conducted in a 46-bed community teaching hospital ED which saw approximately 65 000 patients annually at the time of the study. The institution trains approximately 10 pharmacy residents and approximately 36 family practice medical residents on an annual basis with residents from both groups routinely rotating through all medical specialties in the hospital. Prior to this study, the institution provided clinical pharmacy services to the ED via a pharmacist operating from a satellite office which was physically separated from the ED. Pharmacists functioning in this capacity did not routinely respond to emergent situations in the ED and typically interacted with the ED staff over the phone.

Starting on July 30, 2012, postgraduate year 1 pharmacy practice residents were assigned to be physically present in

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the ED and provide clinical pharmacy coverage to the department from 2:30 p.m. to 11:00 p.m. Monday through Friday. ED coverage rotated among the residents in 5-week blocks, such that a new resident was assigned to the ED every 5 weeks. Prior to the ED rotation, all residents completed a 2-day, hands-on ACLS provider course and had experience in assisting with cardiac arrest resuscitation as part of their daily responsibilities in other parts of the hospital.

Activity logs documenting all pharmacy interventions and number of hours worked in the ED were completed by each resident on a daily basis. Data collection for ACLS compliance began on August 1, 2012, but data collection on pharmacist interventions associated with cost savings began on October 8, 2012, to allow time for the ED staff to become accustomed to interacting with the pharmacy residents in this capacity. This study design was approved by the Columbus Regional Health Institutional Review Board.

The primary endpoint of this study was to evaluate the pharmacist's impact on medication compliance with ACLS guidelines while serving as a member of the cardiac arrest resuscitation team. Secondary endpoints included evaluating the impact of the pharmacist on compliance with ACLS guidelines in regard to defibrillations administered, the composite of medications and defibrillations administered, the percentage of resuscitation attempts performed without deviation from the ACLS guidelines, and survival to hospital admission and hospital discharge. Additional secondary endpoints included an evaluation of the number and types of interventions performed by a pharmacist in the ED, as well as cost avoidance associated with those interventions.

ACLS Compliance

A retrospective chart review was performed of all adult patients aged above 18 years experiencing cardiac arrest in the ED between August 1, 2012, and January 31, 2013. Patients were excluded if they were noted to be deceased immediately upon arrival to the ED or if resuscitation was not attempted by the ED staff. Prior to this study, all clinical pharmacists at the institution were ACLS certified and were responsible for responding to cardiac arrest events occurring in their clinical areas. Per hospital policy, cardiac arrest events occurring in the ED were not announced over the hospital's emergency alert system, as is the standard procedure in other areas of the institution, but were communicated only to members of the resuscitation team present in the ED.

As part of their clinical responsibilities, the pharmacy resident in the ED was responsible for responding to these cardiac arrest events and assisting with the resuscitation attempt. If the pharmacy resident was present during the resuscitation attempt, the patient's medical record number was provided to the primary investigator by the resident to be included in the "PharmD Present" arm of the study. A record

of all patients experiencing cardiac arrest in the ED during the study period was provided to the primary investigator, and those patients who had not been included in the "PharmD Present" group were assumed to not have had a pharmacist present during their resuscitation attempt and thus were placed in the "No PharmD" group.

The cardiac arrest records were evaluated for compliance with the recommendations in the 2010 version of the American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care which was the standard of care at the time of the study.⁶ Noncompliant interventions were the same as those used in the study by Draper and Eppert, which included the following errors: incorrect dose of drug or energy level of defibrillation, delay in medication therapy or defibrillation, omission of medication therapy or defibrillation, and deviation from the ACLS guidelines by means of administration of medication or defibrillation that is not recommended.⁷ These data were evaluated for compliance with ACLS guidelines for medications administered, defibrillations administered, and the composite of medications and defibrillations administered. If all medication and defibrillation interventions performed during the resuscitation attempt were considered to be compliant with the ACLS guidelines, then the resuscitation attempt was deemed to have had no deviations from the ACLS guidelines.

A pulse sustained longer than 20 minutes was considered return of spontaneous circulation (ROSC) using the Utstein definition.⁸ Patients who achieved ROSC and reexperienced cardiac arrest after at least 20 minutes of spontaneous circulation were analyzed as separate resuscitation attempts. If a patient regained a pulse and then subsequently lost a pulse again within 20 minutes, this was evaluated as a single resuscitation attempt. Patients were also evaluated for survival to hospital admission and survival to hospital discharge using the Utstein definitions.⁸ Chi-square and Fisher's exact tests were performed where appropriate. A *P* value of .05 or less was considered statistically significant.

Cost-Effectiveness and Common Clinical Activities

All interventions performed by the pharmacy residents during the study period were compiled and analyzed. Data on cost avoidance associated with specific interventions were provided to the primary investigator by representatives of Quantifi (Pharmacy One Source, Bellevue, Washington). Quantifi is an intervention documentation program that utilizes primary literature to determine cost avoidance associated with various interventions performed by pharmacists. Cost avoidance data from Quantifi are calculated based on average drug costs as well as the costs of adverse events. Based on proprietary data provided by Quantifi, cost avoidance of US\$0 to US\$214 was assigned to each activity performed by the resident. Cost avoidance during the 18-week

Table 1. Demographic and Patient Characteristics.

Characteristic	PharmD Present (n = 20)	No PharmD (n = 45)	P value
Age, mean (SD)	55.3 (± 17.2)	55.7 (± 18.3)	.9346 ^a
Gender, male, n (%)	8 (40)	29 (64.4)	.0662 ^b
Arrest began prior to arrival, n (%) ^c	15 (71.4)	36 (70.6)	.9432 ^b
Initial rhythm VF/VT, n (%) ^c	4 (19.1)	4 (7.8)	.2199 ^d
Duration of resuscitation attempt, min (SD) ^c	22.9 (± 24.7)	16.7 (± 12.2)	.2843 ^a

VF/VT = Ventricular Fibrillation or Ventricular Tachycardia.

^a2-tailed t test.

^bChi-square.

^cSeveral patients arrested multiple times.

^dFisher exact test.

study was extrapolated to an annual cost avoidance provided by a single full-time pharmacist.

Results

ACLS Compliance

From August 1, 2012, to January 31, 2013, there were 20 patients who experienced cardiac arrest when a pharmacist assisted as a member of the ED resuscitation team ("PharmD Present"). One patient experienced 2 episodes of cardiac arrest representing a total of 21 separate cardiac arrest events evaluated. These patients were compared against a control of 45 patients who experienced cardiac arrest in the ED when no pharmacist was present ("No PharmD"). Five patients experienced multiple episodes of cardiac arrest accounting for 51 separate cardiac arrest events evaluated. There were no statistical differences between either group in regard to age, sex, location of onset of cardiac arrest, initial presence of a shockable rhythm, and the duration of the resuscitation attempt (Table 1).

A total of 153 interventions (119 medications, 34 defibrillations) were performed in the "PharmD Present" group and 248 interventions (231 medications, 17 defibrillations) were performed in the "No PharmD" group. The percentage of medications administered in compliance with the ACLS guidelines significantly increased when a pharmacist assisted with the resuscitation attempt as compared with when no pharmacist was present (78% vs 67%, respectively; $P = .0255$; Table 2). Also, compliance for the composite of both medications and defibrillations administered was significantly increased when a pharmacist was present as well (76% vs 65%, $P = .0268$). Despite a greater percentage of resuscitation attempts performed without any deviation from ACLS guidelines in the "PharmD Present" arm, this difference was not statistically significant (43% vs 27%, respectively; $P = .2000$). There were no statistical differences between groups for compliance with defibrillations administered (68% "PharmD Present" vs 47% "No PharmD," $P = .1557$). Survival to hospital admission was statistically higher in the "PharmD Present" group compared with the "No PharmD" group (25% vs 17.8%, respectively; $P = .0155$) though there

was no difference in survival to hospital discharge (15% vs 4.4%, respectively; $P = .6392$).

Cost-Effectiveness and Common Clinical Activities

From October 8, 2012, to February 8, 2013, the pharmacy residents provided clinical services in the ED for 636.75 hours and performed 1200 interventions with cost avoidance of US\$0 to US\$214 assigned with each intervention. The most common interventions performed include drug therapy consults, drug therapy recommendations or modifications, answering drug information questions, and assisting with medical emergencies (Table 3). When the cost avoidance data were applied to the interventions, it estimated that the pharmacy residents provided US\$98 362 in cost avoidance to the health care system during this 4-month period which was extrapolated to an annual cost avoidance provided by a single full-time pharmacist of US\$321 308 per year.

Discussion

ACLS Compliance

Attempting to resuscitate a patient in cardiac arrest is a very stressful situation, and errors are likely to occur unless a systematic multidisciplinary approach is utilized. Studies have demonstrated that medication errors occurring during cardiac arrest resuscitation attempts occur frequently and have higher rates of morbidity and mortality associated with them compared with errors occurring in other areas of medicine.⁹ Studies have also demonstrated a decrease in errors during cardiac arrest resuscitation attempts when pharmacists are part of the resuscitation team, which supports the Institute for Safe Medication Practices' recommendation that institutions "include ACLS- and/or PALS-trained pharmacists on code response teams whenever possible," though to our knowledge the benefits of a pharmacist on the ED resuscitation team have never been assessed prior to this study.^{7,9}

This study found a significant increase in the percentage of medications administered in compliance with ACLS guidelines when a pharmacist was present during the cardiac arrest resuscitation attempt (78% vs 67%, $P = .0255$) which is

Table 2. ACLS Compliance.

Outcome	PharmD Present	No PharmD	P value
Medication interventions compliant with ACLS guidelines, n (%)	93 (78)	154 (67)	.0255 ^a
Defibrillation interventions compliant with ACLS guidelines, n (%)	23 (68)	8 (47)	.1557 ^a
Composite of medication and defibrillation interventions compliant with ACLS guidelines, n (%)	116 (76)	162 (65)	.0268 ^a
Resuscitations without any deviation from ACLS guidelines, n (%)	9 (43)	14 (27)	.2000 ^a
Survival to hospital admission, n (%)	8 (25)	5 (17.8)	.0155 ^b
Survival to hospital discharge, n (%)	2 (15)	3 (4.4)	.6392 ^b

Note. ACLS = Advanced Cardiac Life Support.

^aChi-square.

^bFisher exact test.

Table 3. Pharmacist Interventions Documented During the Study Period.

Category	No. of interventions	Cost avoidance (US\$)
Drug therapy consults	303	46 359
Drug therapy recommendation or modifications	193	14 977
Drug information	162	8109
Order/allergy clarification	163	24 939
Medical emergencies	126	—
Medication reconciliation/patient education	99	153
ADR/allergy prevented	32	3725
Other	122	100
Total	1200	98 362

ADR = Adverse Drug Reaction.

consistent with the result by Draper and Eppert in the inpatient setting.⁷ Medication-related issues, including compliance with guideline recommendations, likely represent the largest component of the cardiac arrest resuscitation attempt that a pharmacist can have an significant impact on, as opposed to appropriateness of defibrillations, which was not statistically different between groups (68% vs 47%, $P = .1557$). Overall, the percentage of cardiac arrest resuscitation attempts performed without any deviation from the ACLS guidelines did increase when a pharmacist was present, though this was not statistically significant (43% vs 27%, $P = .2000$). This may be in part due to the small sample of resuscitation attempts and other factors that the pharmacist is unlikely to have a major impact on, like administering defibrillations in accordance with the guideline recommendations.

Medication errors that occur during resuscitation attempts increase both morbidity and mortality, though there is a lack of data demonstrating an effect on these important outcomes with the presence of a pharmacist.⁹ In this study, there was a statistically significant increase in survival to hospital admission when a pharmacist was present (25% vs 17.8%, $P = .0155$), though this benefit did not sustain throughout the admission, as there was no difference in survival to hospital discharge

between groups (15% vs 4.4%, $P = 0.6392$). While survival to hospital discharge is arguably the more important of these 2 endpoints, improving survival to hospital admission is a step in the right direction. There are likely other factors including post-cardiac arrest management that could have impacted survival in this study, so it is unclear how much of an impact the pharmacist may have actually had on this outcome.

Cost-Effectiveness and Common Clinical Activities

There have been numerous articles over the years that have demonstrated the ability of a clinical pharmacist to decrease health care costs by recommending appropriate use of medications.¹⁰⁻¹³ During the study period, the pharmacy residents completed 1200 interventions, with cost avoidance ranging from US\$0 to US\$214 per intervention. Some interventions such as IV to PO conversions, discontinuing unnecessary therapy, and starting deep vein thrombosis prophylaxis or stress ulcer prophylaxis were not associated with cost avoidance based on the proprietary data provided by Quantifi, though these types of interventions have been associated with cost savings to the health care system by preventing medical complications or selecting less expensive alternatives.¹⁴ For the interventions that were associated with cost avoidance, we estimated that the pharmacists in the ED avoided US\$98 362 in costs during the study period, which would average to approximately US\$321 308 annually with a single full-time pharmacist. Because not all interventions performed in this study had an associated cost avoidance, it is likely that the true annual cost avoidance would be higher than we estimated.

Conclusion

In this study, the inclusion of a pharmacist as a member of the ED resuscitation team improved the quality of patient care delivered to patients experiencing cardiac arrest by means of improving medication compliance with ACLS guidelines. The presence of a pharmacist on the ED resuscitation team was also associated with a decrease in mortality, though this needs to be explored further. Also, pharmacists in the ED can make a substantial financial impact as well, with this study

demonstrating approximately US\$320 000 per year in cost avoidance associated with a single pharmacist in the ED. Study limitations include inability to assess post-cardiac arrest management making it unclear how much of an impact the pharmacist may have had on survival. Also, cost avoidance data were not available on several commonly performed clinical tasks, such as responding to medical emergencies, IV to PO conversions, and discontinuation of unnecessary therapy. We presume these interventions would provide some form of cost avoidance to the institution, though the magnitude of this was not assessed. Finally, the financial aspects of this study are expressed in cost avoidance provided to the institution and not in actual cost savings which would be directly reflected on the institution's financial performance. When trying to financially justify expanding clinical services, cost avoidance data may be helpful for some institutions, though other institutions may prefer to see actual cost savings data instead which we were unable to obtain.

Authors' Note

At the time of the study, Dr. McAllister was a postgraduate year 1 pharmacy practice resident at Midtown Medical Center in Columbus, Georgia. The results of this study were presented at the Southeastern Residency Conference in Athens, Georgia, on April 26, 2012.

Author Contributions

MWM and JGC conceived and designed the study. MWM drafted the manuscript and completed the data analysis, and both authors contributed substantially to its revision. MWM takes responsibility for the paper as a whole.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

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