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Doubling Pharmacist Coverage in the Intensive Care Unit: Impact on the Pharmacists' Clinical Activities and Team Members' Satisfaction

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Abstract

Background: National professional organizations have recognized pharmacists as essential members of the intensive care unit (ICU) team. Critical care pharmacists' clinical activities have been categorized as fundamental, desirable, and optimal, providing a structure for gauging ICU pharmacy services being provided. **Objective:** To determine the impact the addition of a second ICU pharmacist covering 30 adult ICU beds at a large regional medical center has on the complexity of pharmacists' interventions, the types of clinical activities performed by the pharmacists, and the ICU team members' satisfaction. **Methods:** A prospective mixed-method descriptive study was conducted. Pharmacists recorded their interventions and clinical activities performed. A focus group composed of randomly selected ICU team members was held to qualitatively describe the impact of the additional pharmacist coverage on patient care, team dynamics, and pharmacy services provided. **Results:** The baseline period consisted of 33 days, and the intervention period consisted of 20 days. The average complexity of interventions was 1.72 during the baseline period (mode = 2) versus 1.69 (mode = 2) during the intervention period. The number of desirable and optimal clinical activities performed daily increased during the intervention from 8.4 (n = 279) to 16.4 (n = 328) and 2.3 (n = 75) to 8.6 (n = 171) compared with the baseline, respectively. Focus group members qualitatively described additional pharmacist coverage as beneficial. **Conclusion:** The additional critical care pharmacist did not increase pharmacy intervention complexity; however, more interventions were performed per day. Additional pharmacist coverage increased the daily number of desirable and optimal clinical activities performed and positively impacted ICU team members' satisfaction.

Keywords
critical care, pharmacy services, intensive care unit, interdisciplinary team, critical care pharmacist

Introduction

Substantial literature exists to support the value of pharmaceutical care provided by critical care pharmacists.[1-6] Numerous studies show critical care pharmacists provide improved clinical outcomes for patients, including decreased intensive care unit (ICU) length of stay (LOS) and lower hospital mortality.[1,2,4,5] Many studies report the financial benefits from averted adverse drug events, direct cost savings from reduced laboratory orders, and reduced medication costs related to the interventions made by critical care pharmacists in the ICU setting.[1,2,4,5]

In 2000, a task force convened by the American College of Clinical Pharmacy (ACCP) and Society of Critical Care Medicine (SCCM) identified and described fundamental, desirable, and optimal services provided by a critical care pharmacist.[7] This task force's work resulted in a position paper describing critical care pharmacy services that could be used to assist in establishing or advancing critical care pharmacy practices.[7]

While the ACCP and SCCM position paper provides a framework for categorizing the activities of a critical care pharmacist, the literature is less clear on categorizing the complexity of interventions and recommendations made by the critical care pharmacist. Although not ICU specific,

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Sanchez et al developed a complexity-based approach to their inpatient medication therapy management (MTM) service.[8] This approach was used to assign the appropriate Current Procedural Terminology (CPT) code when billing for the MTM service provided.[8] Services were categorized into 5 levels, ranging from simple assessment to very complex.[8]

A 2004 survey designed to describe ICU pharmacy services currently being provided across the nation based on the 2000 ACCP and SCCM position paper reported that only 62.2% of 382 hospitals provided at least part of a full-time equivalent pharmacist's time devoted to the ICU.[9] This survey concluded that fundamental services are consistently provided, but desirable and optimal services are far less likely to be provided.[9]

Recently, SCCM started a nationwide effort to improve outcomes for ICU patients. The ICU Liberation ABCDEF Bundle Improvement Collaborative is a nationwide project comprised of 77 selected hospitals committed to improving outcomes for patients and families.[10] Based on the 2013 Clinical Practice Guidelines for the Management of Pain, Agitation, and Delirium in Adult Patients in the Intensive Care Unit, the ABCDEF care bundle elements individually and collectively can help reduce delirium, improve pain management, and reduce long-term consequences for ICU patients.[11] As essential members of the ICU team, pharmacists are integral to the success of this project. Intensivists at our facility expressed interest in increased pharmacist participation with this project.

The primary objectives of this study were to compare the complexity of interventions made on patients admitted to 30 adult ICU beds and to determine the types of clinical activities performed when there were 2 weekday dayshift critical care pharmacists versus the current standard of 1 weekday critical care pharmacist. Secondary objectives included comparing the number of interventions related to the ICU Liberation ABCDEF Bundle Improvement Collaborative, determining the impact on ICU LOS and time on mechanical ventilation, and qualitatively describing the impact of the additional pharmacist on ICU team members' satisfaction.

Methods

This mixed-method prospective descriptive study was performed at a community medical center with approximately 600 beds. At the time of this study, there were 30 adult ICU beds separated into three 10-bed units, with 1 intensivist covering each 10-bed unit. Prior to this study, there was 1 pharmacist who provided weekday ICU coverage. This was a decentralized pharmacist who provided order entry and computerized provider order entry (CPOE) validation, provided clinical dosing services (pharmacy to dose and renal adjustment services), answered drug information questions, and completed other daily activities for the 30 adult ICU beds and an additional 40 adult non-ICU patient beds. The pharmacist began attending daily rounds with the intensivists in the fall of 2014 and was able to round in 1 unit (10 ICU beds) on weekdays.

Table 1. ICU Liberation Campaign ABCDEF Care Bundles.

ABCDEF care bundles
A: Assess, prevent and manage pain
B: Both spontaneous awakening trials (SAT) and spontaneous breathing trials (SBT)
C: Choice of analgesia and sedation
D: Delirium: assess, prevent, and manage
E: Early mobility and exercise
F: Family engagement and empowerment

This study involved collecting interventions, recommendations, and clinical activities performed by the current critical care pharmacist and 2 postgraduate year 1 (PGY1) pharmacy residents, serving as critical care pharmacists on their ICU rotations. Baseline data were collected during two 4-week periods of November 23, 2015, to December 18, 2015, and February 1, 2016, to February 26, 2016. During these time periods, only the current critical care pharmacist performed daily ICU pharmacy services. For the intervention period, data were collected during two 4-week periods of December 28, 2015, to January 22, 2016, and March 14, 2016, to April 8, 2016. During these time periods, the current critical care pharmacist and a PGY1 pharmacy resident worked on weekdays, coordinating the daily ICU pharmacy services and daily workload.

The critical care pharmacist and PGY1 pharmacy resident independently documented interventions and recommendations made throughout the day. Information collected included the date of the intervention, a brief description of the intervention, whether the intervention was related to the ICU Liberation Campaign ABCDEF care bundles (Table 1), and a complexity score. The complexity was scored by the pharmacist making the intervention based on a complexity table (Table 2) created by the research team and modified from the Sanchez et al study.[8] Interventions were rated with a weighted point value (low complexity = 1 point, moderate complexity = 2 points, and high complexity = 3 points). Prior to the data collection, the 3 pharmacists participating in the study reviewed the intervention complexity table, and this information was available to the pharmacists throughout the study. An interrater reliability test developed from modified real-life historical interventions and hypothetically developed interventions was used to assess the variability of the raters' intervention complexity scoring.

The critical care pharmacist and pharmacy resident independently documented the types of clinical activities performed throughout the day. Efforts were made to ensure no duplications in interventions or clinical activities were recorded. If duplicate data were recorded, it would have been counted as one occurrence in data analysis.

Table 2. Intervention complexity scoring.

	Low complexity (1 point)	Moderate complexity (2 points)	High complexity (3 points)
Description of complexity	Requires little patient information to make decisions, decisions are mostly protocol driven or standard practice, alert/warning is computer generated	Requires patient information that is easily accessed and quickly interpreted, calculations are commonly used, dosing information is readily accessible in drug information databases, medication is commonly used but higher risk/narrow therapeutic window	Requires careful review of patient's condition, multiple labs may be needed to make clinical decision, may require lengthy calculations, dosing is not standardized or referenced
Examples of interventions	MAR cleanup, order clarification, duplicate order, renal adjustment, electrolyte replacement, avoid drug interaction (computer generated), avoid drug allergy (computer generated)	De-escalation of therapy, drug information question, dosing adjustment (nonrenal), initiate monitoring/order lab monitoring, avoid drug interaction (non–computer generated), IV compatibility, route selection, IV to PO conversion	Medication selection, medication therapy recommendation, optimization of drug therapy recommendation, initiation of therapy, nutrition consultation, experimental treatment

Note. MAR = medication administration record; IV = intravenous; PO = oral.

Table 3. Pharmacists' Intervention Complexity.

Intervention complexity score	Baseline (average/day)	Intervention period (average/day)	Percent change
Number of days data collected	33	20	—
Total number of interventions	349	364	—
Average number of interventions/day	10.6	18.2	71.7%
Low—1 point	129 (3.9/d)	130 (6.5/d)	66.7%
Moderate—2 points	185 (5.6/d)	217 (10.9/d)	94.6%
High—3 points	35 (1.1/d)	17 (0.8/d)	−27.2%
Average complexity	1.72	1.69	−1.7%

Three randomly selected ICU team members (1 intensivist, 1 ICU nurse, and 1 respiratory therapist) attended a focus group at the end of the study period. The goal of the focus group was to qualitatively describe the additional pharmacist's impact on patient care, team dynamics, and the quality of pharmacy services provided. The moderator asked questions regarding these areas with follow-on questions to discern more specific information based on the initial responses of the attendees.

Results

The baseline data collection period consisted of 33 days, and the intervention data collection period consisted of 20 days. Daily averages were calculated for better comparison of the data to adjust for the differences in days of data collected. The total number of interventions made during the baseline period was 349, an average of 10 interventions per day. The total number of interventions made during the intervention period was 364, an average of 18 interventions per day.

Results regarding the complexity of the pharmacists' interventions during this study are shown in Table 3. The weighted average of intervention complexity during baseline versus intervention period was 1.72 and 1.69, respectively. Interventions of moderate complexity were the most common type of interventions made during both baseline and intervention periods (5.6 and 10.9 per day, respectively).

The types of clinical activities and number of times performed during the study are shown in Table 4. On average, the number of clinical activities performed per day of every type (fundamental, desirable, and optimal) increased during the intervention period. The average number of desirable activities performed per day nearly doubled from 8.5 during the baseline period compared with 16.3 during the intervention period. The number of optimal activities performed per day more than tripled from 2.3 during the baseline period to 8.6 during the intervention period.

A full breakdown of the fundamental, desirable, and optimal activities performed and average number performed per day is shown in Table 5. All fundamental activities showed an increase in the number performed per day during the intervention period. All desirable activities, except responding to codes and reviewing nutrition orders, showed increased daily averages compared with baseline (Table 5). The average number of patients that were rounded on with the ICU team per day increased from 7.2 to 13.8. During the intervention period, 4 didactic lectures were provided and 22 days were counted as training a resident/student. Even though the

Table 4. Pharmacists' Clinical Activities Performed.

	Baseline period, 33 d	Intervention period, 20 d	Percent change
	Average/day	Average/day	
Fundamental activities	684 (20.7)	522 (26.1)	26.1%
Desirable activities	279 (8.5)	325 (16.3)	91.8%
Optimal activities	75 (2.3)	171 (8.6)	273.9%

PGY1 pharmacy residents were performing many daily activities independently, these days were counted as providing training by the current critical care pharmacist. In addition, there were 2 days that a fourth-year pharmacy student was on rotation during the intervention period.

Although there were only modest increases in the average number of most optimal clinical activities, the largest increase in optimal activities performed related to prospective patient profile reviews. This activity was performed on 73 profiles during the baseline period, an average of 2.2 profiles per day. Prospective profile reviews were performed on 168 profiles during the intervention period, an average of 8.4 profiles per day. One continuing education activity was provided for the ICU nurses during the intervention period.

Interventions related to the ICU Liberation Campaign ABCDEF care bundles increased from 4 (0.1 per day) during the baseline period to 12 (0.6 per day) during the intervention period. The average ICU LOS did not improve during the intervention period, 81.6 hours during baseline versus 90 hours during the intervention period. Time on mechanical ventilation did not improve.

The additional pharmacist was found to have a favorable impact on the ICU team members' satisfaction and experiences. Members of the focus group reported they were more satisfied with the pharmacists' availability, therapy changes and problems were addressed faster and in-person, and medication delivery was expedited. Focus group members stated that the presence of an additional pharmacist positively impacted the interdisciplinary nature of rounds and ensured that rounds were more thorough and were more structured. Pharmacists were praised by focus group members for making sure appropriate antimicrobial and prophylactic medications were being used. The focus group members expressed that there was an increase in the pharmacists providing information regarding drug interactions during the ICU team rounds. Team members did note that pharmacy residents were less experienced than the current ICU pharmacist.

Discussion

The value of pharmacy services provided in the critical care environment has been known for quite some time. At our institution, the current ICU pharmacist began rounding daily during the week, usually with 1 intensivist covering a 10-bed unit, about a year and a half prior to this study. Based on the initial impact of this pharmacist being engaged in rounds, our intensivists expressed a strong desire to have additional pharmacy resources available to bolster ICU services. Our study showed that, although the complexity of interventions did not increase, an additional pharmacist in the ICU at our institution identifies additional clinical interventions.

Complexity of interventions was chosen as one aspect to evaluate the impact of an additional pharmacist covering the ICU. The most common level of intervention complexity provided was moderate in nature. The most common type of moderate complexity intervention involved making dosing changes for patients on intravenous antibiotics and on a pharmacokinetic dosing service. Moderate complexity interventions also involved de-escalating antibiotic therapy or recommending an intravenous to oral conversion.

Although intervention complexity did not increase, the fact that it stayed the same with the addition of a PGY1 pharmacy resident is encouraging. This may be due to the influence of workload division on perceived complexity when there were 2 pharmacists sharing the daily responsibilities. During the intervention periods, pharmacists' recommendations were noted by team members to be more insightful and their availability was perceived to be increased. Perhaps by dividing the ICU daily workload, even though the pharmacists were making more complex recommendations, they subjectively perceived their recommendations to be less complex because they had more time available to contemplate their interventions.

Daily fundamental activities performed by the pharmacists increased in every category collected when comparing the intervention period with baseline. Except for pharmacokinetic monitoring, each of the fundamental activities performed nearly doubled. The pharmacokinetic monitoring would not have been expected to double, as this number is limited by the number of patients in ICU beds.

Of the desirable and optimal clinical activities performed, increases were most notable in the number of patients' charts that were prospectively reviewed, the number of patients the pharmacists rounded on with the ICU team, and the number of educational activities provided. At our institution, the 3 intensivists covering the 30 ICU beds often round at overlapping times which restricts the pharmacist from attending all the rounds daily. Prospective chart review was very limited during the baseline period due to order entry, CPOE validation, and other responsibilities of the pharmacist. With the additional pharmacist, the 2 pharmacists shared workload responsibilities and completed prospective profile reviews before rounding. This led to the pharmacists being more familiar with patients' medications during rounds, as was reported by the noticeable increase in pharmacists' input regarding medication interactions during interdisciplinary rounds.

The provision of educational activities was found to be highly variable in a 2004 survey of ICU pharmacy services.[9] Training students or residents and continuing education sessions were provided by 72.4% and 32.2% of respondents,

Table 5. Fundamental, Desirable, and Optimal Clinical Activities Performed.

	Baseline period, 33 d	Intervention period, 20 d	
	Average/day	Average/day	Percent change
Fundamental clinical activities			
Provided informal instruction to ICU professionals	15 (0.5)	15 (0.8)	60%
Prevented adverse event/medication error	38 (1.2)	35 (1.6)	33.3%
Pharmacokinetic monitoring	571 (17.3)	664 (20.2)	16.7%
Provided drug information	60 (1.8)	68 (3.4)	88.9%
Desirable clinical activities			
Number of patients rounded on with ICU team	236 (7.2)	276 (13.8)	91.7%
Provided didactic lecture	0 (0)	4 (0.2)	—
Reviewed nutrition order	1 (0.1)	0 (0)	−100%
Trained student/resident	0 (0)	22 (1.1)	—
Responded to code	4 (0.1)	0 (0)	−100%
Reconciled home medication	37 (1.1)	25 (1.3)	18.2%
Optimal clinical activities			
Number of patient profiles prospectively reviewed	73 (2.2)	168 (8.4)	282%
Consulted with clinical nutritionist	0 (0)	0 (0)	—
Provided accredited continuing education	0 (0)	1 (0.1)	—
Facilitated patient/family discussion	2 (0.1)	2 (0.1)	0%

Note. ICU = intensive care unit.

respectively. During the intervention period, pharmacists provided an increased number of educational activities. Most of the educational activities were in the form of the current pharmacist precepting and training the PGY1 pharmacy residents. There was 1 continuing education activity provided during the intervention period by one of the pharmacy residents for the critical care nurses.

Desirable and optimal clinical activities that did not increase included attending codes, reviewing nutrition orders, and consulting with nutrition. Less frequent response to codes was due to the lack of codes called on the ICU during the intervention periods and the limited number of intervention period days collected. Currently, code response is also not a requirement for the pharmacist on the ICU. Few activities related to clinical nutrition occurred during the baseline or intervention periods. Currently, our facility has a clinical nutritionist devoted to the ICU, but there is not an interdisciplinary nutrition team.

Limitations

A number of limitations were present with this study. The limited number of intervention period days compared with baseline period days makes the results difficult to generalize. Due to illness that struck the critical care pharmacist and one of the PGY1 residents during the intervention period, a significant number of days were excluded from the intervention periods. The intervention periods also alternated with baseline periods. These factors could have confounded ICU team members' perception of whether there were 1 or 2 pharmacists on duty.

Secondary objectives related to the clinical outcomes of ICU LOS and time on mechanical ventilation were not positively impacted by the additional pharmacist coverage in our study. However, we did not control for patient acuity or for patients who were admitted exclusively during baseline and intervention time periods.

Complexity of interventions was a highly subjective measurement, and our complexity scale was not a validated scoring tool. The variability of complexity scoring had been previously documented during the interrater variability test. A Fleiss Kappa score of 0.36 was determined between the 3 raters. This variability was not necessarily due to pharmacy residents ranking interventions with higher complexity scores than the current critical care pharmacist. There were interventions that residents scored lower, while the current critical care pharmacist scored higher.

Our team modified the ACCP and SCCM critical care pharmacist activities based on current activities being performed at our facility. This could have biased the results toward showing a more favorable impact of the additional pharmacist. The financial impact of the additional pharmacists' interventions and clinical activities was not addressed. This may make justifying an additional pharmacist position difficult from a financial standpoint.

The ACCP and SCCM position paper on critical care pharmacists is also more than 15 years old. A new position paper is currently being drafted by ACCP, SCCM, and the American Society of Health-System Pharmacists (ASHP). This may provide newly defined fundamental, desirable, and optimal activities of the critical care pharmacist.

This study included a single focus group meeting with 3 ICU team members participating. It may not have been a large enough sample to gather substantial positive or negative impacts on the ICU team members' satisfaction with the additional pharmacist. A focus group to gather ICU team members' baseline experiences was not performed and could have been useful for comparing with the poststudy experiences.

Conclusion

During this study, the complexity of the pharmacists' interventions was maintained, with the majority of interventions being moderate complexity. Desirable and optimal clinical activities performed per day nearly doubled and more than tripled, respectively. Most of the desirable and optimal clinical activities performed related to prospective chart review, patient rounding, and educational activities. ICU team members reported mostly favorable experiences with the additional pharmacist coverage. This study showed that additional critical care pharmacist coverage positively impacted the level of clinical activities performed by the pharmacists and the ICU team members' satisfaction.

Authors' note

Joshua McDaniel was a PGY1 pharmacy resident at the time of the research and submission of the article.

Declaration of Conflicting Interests

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