ORIGINAL CLINICAL REPORT

OPEN

Characterizing Critical Care Pharmacy Services Across the United States

Robert MacLaren, PharmD, MPH, FCCM, FCCP[1]

Russel J. Roberts, PharmD, FCCM[2]

Amy L. Dzierba, PharmD, FCCM, FCCP, BCCCP[3]

Mitchell Buckley, PharmD, FASHP, FCCM, FCCP, BCCCP[4]

Ishaq Lat, PharmD, FCCM, FCCP[5]

Simon W. Lam, PharmD, MS, FCCM, BCCCP[6]

OBJECTIVES: Involvement of clinical pharmacists in the ICU attenuates costs, avoids adverse drug events, and reduces morbidity and mortality. This survey assessed services and activities of ICU pharmacists.

DESIGN: A 27-question, pretested survey.

SETTING: 1,220 U.S. institutions.

SUBJECTS: Critical care pharmacists.

INTERVENTIONS: Electronic questionnaire of pharmacy services and activities across clinical practice, education, scholarship, and administration.

MEASUREMENTS AND MAIN RESULTS: A total of 401 (response rate of 35.4%) surveys representing 493 ICUs were completed. Median daily ICU census was 12 (interquartile range, 6–20) beds with 1 (interquartile range, 1–1.5) pharmacist full-time equivalent per ICU. Direct clinical ICU pharmacy services were available in 70.8% of ICUs. Pharmacists attended rounds 5 days (interquartile range, 4–5 d) per week with a median patient-to-pharmacist ratio of 17 (interquartile range, 12–26). The typical workweek consisted of 50% (interquartile range, 40–60%) direct ICU patient care, 10% (interquartile range, 8–16%) teaching, 8% (interquartile range, 5–18%) order processing, 5% (interquartile range, 0–20%) direct non-ICU patient care, 5% (interquartile range, 2–10%) administration, 5% (interquartile range, 0–10%) scholarship, and 0% (interquartile range, 0–5%) drug distribution. Common clinical activities as a percentage of the workweek were reviewing drug histories (28.5%); assessing adverse events (27.6%); and evaluating (26.1%), monitoring (23.8%), and managing (21.4%) drug therapies. Services were less likely to occur overnight or on weekends. Telemedicine was rarely employed. Dependent prescriptive authority (per protocol or via practice agreements) was available to 51.1% of pharmacists and independent prescriptive authority was provided by 13.4% of pharmacists. Educational services most frequently provided were inservices (97.6%) and experiential training of students or residents (89%). Education of ICU healthcare members was provided at a median of 5 times/mo (interquartile range, 3–15 times/mo). Most respondents were involved with ICU or departmental policies/guidelines (84–86.8%) and 65.7% conducted some form of scholarship.

CONCLUSIONS: ICU pharmacists have diverse and versatile responsibilities and provide several key clinical and nonclinical services. Initiatives to increase the availability of services are warranted.

KEY WORDS: critical care; education; organization and administration; pharmacy; research; surveys and questionnaire

DOI: 10.1097/CCE.0000000000000323

Pharmacists are considered key personnel of the multidisciplinary team caring for ICU patients, because they possess unique expertise required to optimize drug therapies (1, 2). Critical care pharmacy is recognized as one of the most advanced disciplines within pharmacy practice and the field is expanding in terms of both the quantity and quality of services provided (3, 4). This is not surprising given the increasing complexity and specialization of critical care medicine, and a focus on multidisciplinary care to optimize patient outcomes (3–6). Direct patient care is the pharmacist's observation of the patient and their contributions to the selection, modification, and monitoring of patient-specific drug therapy through collaborative practice with an interprofessional team or another healthcare provider (5). Technological advances, practice changes, safety and cost-containment mandates, and competitive pressures are enabling pharmacists to be physically present in the ICU, often providing direct patient care as an integral member of the medical team (2, 5). Pharmacist delivery of direct, proactive, and patient-centered care in the ICU has been associated with both perceived and actual improvements in patient outcomes including attenuation of costs, fewer adverse drug events, shortened length of stay, and reduced morbidity and mortality (7–11).

The paradigm for critical care pharmacy services was first established in 2000 by the publication of a position article, which defined activities as fundamental, desirable, and optimal activities across clinical and nonclinical domains (12). A survey of 1,034 ICUs across 382 institutions conducted in 2004 found direct patient care was provided in 62.2% of ICUs (13). Clinical and administrative functions were common, whereas involvement in education and scholarship was variable. Recently, the position article was updated and expanded to 82 recommendations. Each recommendation was categorized as essential or desirable by the overall ICU classification (I, II, or III) (14). Level I ICUs deliver comprehensive critical care services for a wide range of disorders, level II ICUs may deliver comprehensive care but the resources to care for specific populations may be limited, and level III ICUs provide initial stabilization but offer limited critical care. Therefore, a recommendation might be deemed essential for ICUs classified as level I but desirable for level III ICUs. No recent information is available describing what and how pharmacy activities are provided to critically ill patients, yet these data are important for program development, benchmarking, and forecasting. This study was designed to characterize the activities provided by critical care pharmacists and delineate the levels of services as described in the revised opinion article.

MATERIALS AND METHODS

This project is a work product of the Clinical Pharmacy and Pharmacology (CPP) Section's Practice Advancement Committee (PAC) of the Society of Critical Care Medicine. The study was approved by the Colorado Multiple Investigational Review Board.

Questions were formulated to address specifically the recommendations for pharmacy services and activities put forth in the revised opinion article (14) and designed to categorize responses by hospital/ICU characteristics and resources (14 questions); pharmacist activities across practice, education, scholarship, and administration (10 questions); and allocation of effort, funding, and employment benefits (three questions). A draft survey was developed by a subcommittee of ICU pharmacists from CPP's PAC using Qualtrics (Provo, UT) (http://qualtrics.com) and pretested by a panel of eight ICU pharmacists (five from CPP's PAC and three independent of the project) who were asked to comment on the relevance and clarity of each survey item. The questions were modified and redistributed to the panel for further feedback until the 27-question survey was finalized (see **supplemental information**, http://links.lww.com/CCX/A486).

The survey was distributed thrice approximately 4 weeks apart, starting in September 2018, via e-mail to the Pharmacy Director, Clinical Coordinator, or Residency Director/Coordinator at 1,220 institutions identified as having acute care services in the 2018 American Hospital Association (AHA) database. A link to the survey was embedded in the e-mail. The initial recipient was asked to complete questions pertaining to institutional and general ICU pharmacy services and provide e-mails for the pharmacists with the greatest involvement in each ICU of the institution. Qualtrics automatically generated another e-mail requesting each ICU pharmacist to complete questions pertaining to ICU characteristics; their activities across practice, education, scholarship, and administration; and their allocation of effort, funding, and employment benefits. The original recipient could complete the ICU-specific portion but only if they entered themselves as the pharmacist for the ICU. In

this case, a separate e-mail containing the ICU-specific survey link was still generated. Therefore, only one survey was completed per ICU, but an individual pharmacist providing services to multiple ICUs may have completed surveys for each ICU if the initial survey recipient entered the pharmacist's e-mail address for each ICU. Each survey specified confidentiality and implied consent with survey completion. ICU-specific respondents were asked about their service model with the following definitions. Direct care was defined as at least a partial pharmacist full-time equivalent (FTE) specifically devoted to the care of patients in the ICU as the primary responsibility of the pharmacist. Indirect care was defined as no portion of a pharmacist FTE being specifically devoted to the ICU although services could be provided in another manner (centralized staffing services, the pharmacist is primarily responsible for caring for non-ICU patients but "covers' the ICU, or pharmacy programs for specific indications that extend into the ICU such as antimicrobial stewardship, nutrition support, or anticoagulation services). A hybrid model was the combination of direct and indirect services.

The sample size was chosen to capture institutions in the United States with acute care services. Surveys for each section were excluded in the analyses if less than 25% of questions for the specific section were answered. Therefore, completed questionnaires may only represent institution-specific responses or ICU-specific responses although it was expected that an ICU-specific survey would be completed for each institution-specific survey. Based on the 2004 survey, a response rate of 15% was anticipated with approximately three ICU-specific surveys completed per institution (13). Therefore, assuming a response rate of 15% and a discard rate of 3%, 177 completed surveys would be available to describe general hospital characteristics. This provides a margin of error of 6.8% around a 95% confidence that the 1,220 institutions were adequately represented. Data analyses were performed using the JMP Statistical Analysis Software, Version 10.0.2 (SAS Institute, Cary, NC) for frequency, mean (SD), and median (interquartile range [IQR]). Normality of continuous data was assessed using the Shapiro-Wilk test. Missing data were not imputed. Where the parallelism of questions was similar, descriptive comparisons with the results of the 2004 survey were made in the "*Results* section" (13).

RESULTS

Of the 1,220 institutions with ICUs that were sent an e-mail invitation to complete the survey, 87 were "nondeliverable," resulting in a modified sample size of 1,133. A total of 416 surveys were attempted by the initial recipient describing institutional characteristics, but 15 were excluded, because they were less than 75% complete. Therefore, 401 completed surveys (35.4%) were included resulting in a margin of error of 3.9%. A total of 576 ICU-specific surveys were attempted, but 83 were excluded, because they were less than 75% complete. Therefore, 493 completed ICU-specific surveys were included. Almost all continuous data were not normally distributed, so only median (IQR) are reported for continuous data.

Practice Site Information

Respondent institutions were classified as not-for profit nongovernment (75.3%), nonfederal government (10.7%), for-profit nongovernment (9.5%), and federal government (4.7%). Types of institutions were community-teaching hospitals (39.9%), community nonteaching hospitals (34.4%), and university/academic hospitals (25.7%). Regional locations of the institutions were well represented across the United States: East Midwest (19.2%), South Atlantic (15%), Mid-Atlantic (15%), West Midwest (12.7%), Mountain West (10.5%), New England (7.5%), South Central (7%), Pacific (6.5%), and Southeast (6.5%). Daily inpatient census was 295 (173–500) occupied beds. Total number of beds devoted to critical care was 41 (21–80) across 3 (1–5.8) ICUs per institution. Inpatient pharmacist FTEs across the institutions and devoted to critical care were 30 (18–53.8) and 2.8 (1–6), respectively. These data are similar to the results of the 2004 survey with the exception that the daily inpatient census was 183 ± 172 beds in 2004.

ICU-Specific Information

The types of respondent ICUs were 126 medical (25.6%), 103 surgical (20.9%), 84 mixed (17%), 48 cardiovascular (9.7%), 34 neurosurgical (6.9%), 30 cardiothoracic (6.1%), 24 trauma (4.9%), 18 pediatric (3.7%), 11 burn (2.2%), six neonatal (1.2%), and nine other (1.8%). Daily census across all ICUs was 12 (6–20) occupied beds. The physician model was described

as closed (54.6%), open (26.2%), and mixed (19.3%). Pharmacy FTEs devoted to each ICU were 1 (1–1.5). These data are similar to the results of the 2004 survey with the exceptions that the types of ICUs have expanded, and in 2004, only 20.4% of ICUs were closed, whereas 51.7% were open. Respondent pharmacists had 6 years (2–10 yr) of ICU experience. Education and training of respondent pharmacists included completion of Doctor of Pharmacy (94.1%), postgraduate year-1 residency (72.2%), and postgraduate year-2 critical care residency (63.5%). Respondents were board-certificated in pharmacotherapy (70.8%) and/or critical care (54%). **Table 1** describes the characteristics of the medication use and information systems available to ICUs in comparison with the 2004 survey.

Clinical Activities

The most common mode of delivering pharmacy services to the ICU was direct (70.8%) and a combination of direct and indirect (29.2%). No respondent indicated that only indirect pharmacy services were available to the ICU. In the 2004 survey, 62.2% of respondents provided direct services and 37.8% provided indirect services (combination was not an option). The type and extent of clinical activities are described in **Table 2**. Pharmacists attended patient care rounds 5 days (4–5 d) per week and cared for 17 (12–26) total patients daily. In terms of pharmacist provider models, 41.4% of respondents indicated they had dependent prescriptive authority (e.g., they required approval from another entity or via collaborative practice agreement or protocol), but for only certain medications or classes of medications, 35.5% of respondents indicated no prescriptive authority was available, 11% of respondents indicated they had independent or autonomous prescriptive authority, but for only certain medications or classes of medications, 9.7% of respondents indicated they had dependent prescriptive authority (e.g., they required approval from another entity or via collaborative practice agreement or protocol) for almost all medications or classes of medications, and 2.4% of respondents indicated they had independent or autonomous prescriptive authority for almost all medications or classes of medications.

Educational and Scholarly Activities

The type and extent of educational and scholarly activities are described in **Tables 3** and **4**, respectively, in comparisons with the 2004 survey. Formal or informal drug-therapy educational sessions were provided to ICU healthcare team members at a rate of 5 times/mo (3–15 times/mo).

Administrative Activities

Table 5 outlines the administrative functions of ICU pharmacists in comparison with the 2004 survey. When pharmacists were asked about their involvement in systems or processes designed to improve the care or delivery of care to ICU patients (e.g., guidelines, protocols, policies, etc.), 95.7% identified areas of need for an intervention, 91.9% acted as a liaison between pharmacy and other healthcare professionals, 94.3% designed the intervention, 90.3% coordinated the intervention, 89% implemented the intervention, 74.9% assessed the clinical outcomes of the intervention, and 70.6% assessed the economic and/or workflow of the intervention. Services commonly reported to the ICU or pharmacy department were monitoring of drug therapies (70.8%), stewardship (69.6%), cost savings (66.9%), changing drug therapies (65.9%), medication reconciliation (61.1%), education (59.8%), drug information (59.8%), emergency response (56.4%), and research (52.4%).

Allocation of Effort, Funding, and Employment Benefits

ICU pharmacists allocated their time to key activities including 50% (40–60%) to direct care of ICU patients, 10% (8–16%) to teaching, 8% (5–18%) to order processing, 5% (0–20%) to direct care of non-ICU patients, 5% (2–10%) to administration/management, 5% (0–10%) to scholarship, and 0% (0–5%) to drug distribution. The primary funding entity was the hospital pharmacy department representing 100% (100–100%) with a small portion coming from the College or School of Pharmacy at 0% (0–5%). Employment benefits included financial support for basic life support/advanced cardiac life support training (89%), registration for national meetings (78.1%) or local meetings (62.3%), travel to and accommodation at national meetings (74.4%), board certification examination (69.6%) and recertification (29.2%), tuition (48.9%), other continuing education (37.7%) or workshops (25.6%), memberships to professional organizations (23.1%), projects/research through a

TABLE 1.

Characteristics of Medication Use and Information Systems Available to Pharmacists in ICUs in Comparison With the 2004 Survey (13, 14)

Medication Use System	% Provided	% Provided in 2004
Creates and maintains medication profiles (E)	100	99.1
Interfaces with laboratory data (E)	100	NA
Alerts users to drug-drug interactions (E)	100	97.5
Provides direct prescriber order entry (E)	100	9.9
Alerts users to drug allergies (E)	97.6	97.5
Interfaces with bedside barcode scanning (E)	96.3	80.3
Alerts users to maximum dosage limits (E)	91.5	62.1
Alerts users to drug-food/nutrient interactions (E)	80.5	63.7
Directly transfers bedside patient data into the health record (E)	80.5	NA
Interfaces with outpatient medication profiles (E)	76.8	21.6
Alerts users to approved substitutions (E)	76.8	NA
Alerts users to patient diagnoses (E)	73.2	NA
Manually transfers information from pumps into the health record (E)	69.5	NA
Alerts users to disease state-drug interactions (E)	68.3	25.1
Interfaces with mobile devices (E)	63.4	NA
Provides hospital goals for benchmarking or quality data (E)	58.5	NA
Alerts users to pertinent medication shortages (E)	50	NA
Interfaces with profiles from other health systems (E)	48.8	NA
Alerts user to the cost of medications (E)	40.2	NA
Directly transfers information from pumps into the health record (E)	32.9	21.2
Information system	**% provided**	**% provided in 2004**
Provides access to information about medications (E)	100	NA
Provides hospital policies and procedures related to medications (E)	97.6	NA
Provides hospital patient care algorithms (E)	91.5	NA
Provides IV admixture information (E)	91.5	71.1
Provides a platform to document recommendations or interventions (E)	91.5	NA
Provides a platform to communicate with others (E)	79.3	NA

E = essential across all ICU categorizations (levels I–III) of overall critical care services, NA = not assessed.

TABLE 2.
Clinical Activities Provided by Pharmacists to ICUs (14)

Responsibility	% of Pharmacist Time Devoted to Activity, Median (IQR)	24-hr Availability? (% Yes)	Weekend Availability? (% Yes)	Telemedicine Availability? (% Yes)
Review drug histories to assess maintenance of drugs (E, E, D)	20 (5–50)	26.8	43.8	6.1
Identify or prevent inappropriate drug therapy/ drug-related adverse effects (E, E, E)	17.5 (5–50)	48.9	63.5	8.5
Prospectively evaluate drug therapy (E, E, E)	15 (5-40)	56.2	59.8	6.1
Monitor the therapeutic regimen for efficacy or adverse events (E, E, E)	11 (5–38.8)	37.7	52.5	8.5
Provide therapeutic drug management to patient or physician (E, E, D)	10 (5–30)	45.2	58.6	7.3
Attend multidisciplinary rounds (E, E, D)	10 (2–25)	17	14.6	4.9
Provide pharmacokinetic monitoring (E, E, E)	10 (2–20)	72	80.5	7.3
Educate care team members regarding medication therapies (E, E, D)	10 (3–20)	36.5	40.2	4.9
Assist providers in discussion with patients and/or family members (E, E, D)	5 (2–50)	23.2	24.3	1.2
Perform-independent patient assessments (e.g., nutrition, delirium, and cardiac) (E, D, D)	9.5 (2–20)	19.5	28	3.7
Provide formal clinical pharmacotherapy consults with documentation (E, E, E)	5 (2–20)	41.4	53.8	3.7
Provide medication reconciliation at the time of ICU admission (E, E, E)	5 (2–20)	19.5	29.2	3.7
Educate patients or family members regarding medication therapies (E, E, D)	5 (2–15)	20.7	29.2	2.4
Reviews nutrition therapy plans (E, D, D)	5 (2–15)	14.6	25.6	2.4
Document clinical activities or recommendations in the medical record (E, E, E)	5 (2–10)	55	63.5	8.5
Provide stewardship activities (e.g., antimicrobials, factor products, and sedation) (E, E, E)	2 (1–10)	41.4	59.8	7.3
Respond to time-dependent emergencies (e.g., codes, trauma, and stroke) (E, E, D)	2 (1–5)	51.3	56.2	4.9
Collaborate with other pharmacists to address specific therapeutic issues (E, E, E)	2 (1–3)	30.4	45.2	4.9
Provide comprehensive drug information (E, E, E)	2 (1–2)	44	47.7	4.9
Involvement in ICU research (D, D, D)	2 (1–2)	20.7	16.6	1.2

D = desirable according to categorization of overall critical care services (level I, level II, and level III ICUs), E = essential according to ICU categorization of overall critical care services (level I, level II, and level III ICUs).
For example, E, E, D means the statement was essential for levels I and II and desirable for level III.

TABLE 3.
Educational Activities of ICU Pharmacists in Comparison With the 2004 Survey (13, 14)

Responsibility	% Provided	% Provided in 2004
Provide informal drug therapy education to the ICU team (e.g., inservices) (E, E, D)	97.6	92.8
Provide educational services to pharmacists or other ICU professionals (E, E, D)	97.6	NA
Provide experiential ICU training to pharmacy students, residents, and fellows (E, E, D)	89	72.4
Serve as a project advisor to trainees in critical care-related topics (D, D, D)	79.1	NA
Apply predefined outcomes to assess competencies of trainees (E, E, E)	78.1	NA
Provide didactic education in critical care pharmacotherapy (E, E, D)	75.7	50.7
Provide accredited continuing educational sessions (D, D, D)	62.1	32.2
Implement training programs for personnel working in the ICU (E, D, D)	42.6	37.8
Educate medical and community groups about the role of ICU pharmacists (D, D, D)	23.1	17
Participate in interdisciplinary simulation activities (D, D, D)	20.9	NA
Provide certification classes for advanced cardiac life support (or similar) (D, D, D)	16	17.7

D = desirable according to categorization of overall critical care services (level I, level II, and level III ICUs), E = essential according to ICU categorization of overall critical care services (level I, level II, and level III ICUs), NA = not assessed.
For example, E, E, D means the statement was essential for levels I and II and desirable for level III.

noncompetitive process (12.2%) or competitive process (9.7%), and licensure (6.1%).

DISCUSSION

This is the first survey to describe the scope of critical care pharmacy services since 2004, and it is significant, because it is based on the recommendations of the revised opinion article (13, 14). Perhaps the most noteworthy finding is that all ICU-specific respondents indicated that pharmacy services are at least, in part, provided directly (i.e., a portion of a pharmacist FTE was dedicated to the care of ICU patients). Past surveys conducted in 2004 and 1988 showed only 62.2% of respondents provided direct patient care services and the role of the ICU pharmacist with direct patient care responsibilities was uncertain, respectively (13, 15). The results of this survey suggest that conventional care in the ICU includes direct pharmacy services provided in a proactive manner and performance benchmarks for ICUs should ensure a pharmacist is part of the multidisciplinary ICU team.

ICU pharmacists cared for more patients than the ICU census, suggesting these pharmacists are involved in the care of patients located outside the ICU. This is supported by the allocation of pharmacist effort to the care of non-ICU patients. Not surprisingly, the educational background of ICU pharmacists has advanced substantially since the 2004 survey when only 54.6% possessed the Doctor of Pharmacy degree and 11.1% and 5.9% had completed postgraduate year-1 and year-2 residencies, respectively (13). The advanced training of ICU pharmacists contributes to the expansion of direct pharmacy services in the ICU, as these pharmacists possess the skills and knowledge needed to act as the drug therapy expert. Another factor enabling pharmacists to provide direct patient care is the incorporation and advancement of technology in the ICU. In the 2004 survey, only 9.9% of respondents indicated direct prescriber order entry was available at their institution compared with 100% of respondents in the current survey (13). Today, order processing accounts for only ~8% of an ICU pharmacist's allocation of time. This suggests that some activities are delegated to other pharmacy personnel that enable the critical care pharmacist to provide direct patient care.

ICU pharmacists frequently attend patient care rounds and regularly provide a diverse array of

TABLE 4.
Scholarly Activities of ICU Pharmacists in Comparison With the 2004 Survey (13, 14)

Responsibility: Research in Past 5 yr	% Provided	% Provided in 2004
Article preparation (D, D, D)	75.3	15.7
Data analysis (D, D, D)	71.4	18.6
Protocol design (D, D, D)	69.4	23.6
Principal investigator (D, D, D)	65.3	NA
Data collection (D, D, D)	54	34.6
Patient screening (D, D, D)	49.5	23.8
Study coordinator (D, D, D)	37.3	15.7
Site investigator for multicenter projects (D, D, D)	35.3	NA
Funding procurement (D, D, D)	13.6	5.8
Laboratory analysis (D, D, D)	18.7	5.5
External grant reviewer (D, D, D)	4.9	NA
Responsibility: literature contribution in past 5 yr	**% Provided**	**% Provided in 2004**
Retrospective clinical research (D, D, D)	65.7	18.1
External peer reviewer of articles (D, D, D)	57.2	NA
Abstracts (D, D, D)	51.7	23
Review articles/book chapters (D, D, D)	47.1	15.7
Case reports (D, D, D)	37.7	16.2
Prospective clinical research (D, D, D)	22.3	18.1
Letters to the editor of journals (D, D, D)	20.3	NA
Educational research (D, D, D)	17.4	NA
Pharmacoepidemiology/survey/outcomes research (D, D, D)	16.6	3.7
Practice insights (D, D, D)	15	7.6
Administrative research (D, D, D)	11.8	NA
Laboratory/translational research (D, D, D)	3	2.9

D = desirable across all ICU categorizations (level I, level II, and level III ICUs) of overall critical care services, NA = not applicable.

essential clinical activities. Unfortunately, comparisons cannot be made to the 2004 survey, because responses were based on different units of measurement (time devoted to each activity vs the percentage of ICU days that patients receive the activity). What is comparable with the 2004 survey, however, is that clinical services remain less likely to be provided overnight or on weekends (13). Patient care in the ICU is continuous, so future efforts must assure these clinical activities are available every day at any hour. Very few respondents indicated that telemedicine is available, which may be one strategy to ensure these services are always provided.

Pharmacists are heavily involved in educational and scholarly activities and many of these activities have increased since the 2004 survey (13). The expansion

TABLE 5.
Administrative Activities of ICU Pharmacists in Comparison With the 2004 Survey (13, 14)

Responsibility	% Provided	% Provided in 2004
Develop and implement ICU-focused protocols, order sets, and clinical guidelines (E, E, D)	86.8	95.1
Implement and maintain ICU policies and procedures (E, E, E)	85.2	85.3
Implement and maintain departmental policies and procedures (E, E, E)	84	83.8
Perform quality assurance/improvement programs (E, E, D)	71.4	68.4
Develop and implement stewardship policies and procedures (E, E, D)	69.8	NA
Implement and maintain safety policies and procedures (E, E, E)	69	NA
Pharmacy and Therapeutics Committee (or subcommittee) involvement (D, D, D)	65.5	72
Ascertain core measures/performance quality metrics (E, D, D)	62.7	NA
Residency program involvement (e.g., coordination, scheduling, etc.) (E, E, D)	62.5	NA
Contribute to Joint Commission (or equivalent) preparatory and response team (E, E, D)	54.8	70
Student program involvement (e.g., coordination, scheduling, etc.) (E, E, D)	49.5	NA
Prepare and present drug monographs (D, D, D)	48.5	46.7
ICU or pharmacy research committee involvement (D, D, D)	47.7	NA
Participate in design of technology/electronic delivery of information (E, E, D)	43.6	NA
Contribute to hospital newsletters (E, E, D)	23.9	46.7
Contribute to other accreditation preparatory and response teams (e.g., residency and critical care programs) (E, E, D)	20.9	NA
Participate in disaster response preparedness policies and procedures (E, E, D)	20.7	NA
Investigational review board involvement (E, D, D)	19.9	20.6
Participate in design of ICU or pharmacy space (D, D, D)	19.5	NA

D = desirable according to ICU categorization of overall critical care services (level I, level II, and level III ICUs), E = essential according to ICU categorization of overall critical care services (level I, level II, and level III ICUs), NA = not assessed.
For example, E, E, D means the statement was essential for level I and level II and desirable for level III.

of these services may stem from the advanced training of these pharmacists that incorporate expectations for these activities so they feel compelled to provide educational and scholarly services once employed. Advancements in technology may also contribute, as the delivery of education and data collection are more efficient. Like 2004, however, desirable educational activities are far less likely to be provided, which may be explained by the lack of opportunities to engage in these activities across respondents (13). More than half of all respondents serve as principal investigators, conduct retrospective research, design research protocols, collect and analyze data, and prepare abstracts and articles. In 2004, the overwhelming majority of respondents did not perform these scholarly activities (13). The delivery and scope of administrative activities is similar to the 2004 survey (13). This lack of change is expected, since many of the activities were provided at high rates in the 2004 survey. However, considerable room for growth remains as many of the essential activities were delivered by less than half of all respondents.

Not surprisingly, hospital pharmacy departments provided the overwhelming majority of funding for respondents. In addition, employers provided a multitude of benefits ranging from support for attending meetings or conferences to career development opportunities such as tuition or board certification. Pharmacists continue to justify their value by documenting their services. Given the beneficial patient outcomes associated with direct critical care pharmacy services and the incorporation of the pharmacist into the educational and scholarly missions of the ICU, the return on investment of the ICU pharmacist's salary is almost certainly favorable (16–18). Some have suggested that the time has come to discard the need for ICU pharmacists to justify their value and instead for ICUs and patients to expect the presence of direct pharmacy services either through accreditation standards or reimbursement (19). The multidisciplinary community of critical care must seek other modes and sources of financial support and explore payment for critical care pharmacy services (20).

Several limitations of this study exist. Similar to the 2004 survey, institutions were identified by the AHA database as having an ICU, but the 2004 survey collected 1,034 completed ICU-specific questionnaires from 382 institutions, whereas this survey garnered 493 completed ICU-specific questionnaires from 401 institutions (13). The fewer ICU responses likely are attributable to the different approaches of survey distribution as the 2004 version was article-based and delivered by postal mail and did not rely on the initial recipient to circulate further the survey to ICU-specific pharmacists. However, the overall response rate for institutions completing this survey was 35.4%, which far exceeds the response rate of 11.8% in 2004. Although the survey items were pretested, some definitions and questions may have generated inconsistent responses, especially considering that the survey was lengthy. Response bias is plausible as respondents were likely more comfortable completing the survey when direct pharmacy services were available in their ICUs. Although the types of institutions were diverse and represented every region of the United States, responding institutions were larger with more ICU beds than what is reported by AHA, so our results may not represent the typical hospital in the United States (21). In addition, only one pharmacist per ICU completed the survey, which likely skewed respondents toward those primarily employed within the hospital's pharmacy department rather than other hospital units or external entities like academia. In addition, we did not differentiate who provided services, so it is plausible that some activities were conducted by other pharmacy personnel. All responses were self-reported, and no attempts were made to verify them. The survey was distributed before the publication of the revised opinion article so whether practice changes might result from the release of the revised opinion article is yet to be determined. Finally, direct comparisons of responses are made to the 2004 survey based on similar questions, but the construct of questions was not identical, so comparative interpretation of responses requires prudence.

CONCLUSIONS

This survey found that direct pharmacy services were delivered to all ICUs with nearly two-thirds of pharmacists having some form of prescriptive authority. The scope of clinical services provided is broad although these activities are far less likely to be delivered after "business hours." Compared with the results of the survey published in 2004, educational and scholarly activities have expanded greatly, while administrative responsibilities of ICU pharmacists have remained consistently broad.

ACKNOWLEDGMENTS

This project is a work product of the Clinical Pharmacy and Pharmacology Section's Practice Advancement Committee of the Society of Critical Care Medicine. The following individuals either helped identify pharmacists at each institution to receive the original survey request or reviewed the survey for validity: Yarelis Alvarado, Mahmoud Ammar, Seth Bauer, Mitch Buckley, Heather Bullard, Melissa Chudow, Michaelia Cucci, Amy Dzierba, Deepali Dixit, Sonia Everhart, Jeffrey Gonzales, Elizabeth Goswami, Kendall Gross, Payal Gurnani, Susan Hamblin, Drayton Hammond, RaeAnn Hirschy, Rachel Kruer, Simon Lam, Ishaq Lat, Rob MacLaren, Katie Morneau, Scott Mueller, Gourang Patel, Jeannette Ploetz, Megan Rech, Russ Roberts, Pam Smithburger, Joanna Stollings, Linda Uchal, and Sharon Wilson.

1 *Department of Clinical Pharmacy, University of Colorado Skaggs School of Pharmacy and Pharmaceutical Sciences, Aurora, CO.*

2 *Department of Pharmacy, Massachusetts General Hospital, Boston, MA.*

3 *Department of Pharmacy, NewYork-Presbyterian Hospital, New York, NY.*

4 *Department of Pharmacy, Banner University Medical Center Phoenix, Phoenix, AZ.*

5 *Department of Pharmacy Services, Shirley Ryan AbilityLab, Chicago, IL.*

6 *Department of Pharmacy, Cleveland Clinic, Cleveland, OH.*

Supplemental digital content is available for this article. Direct URL citations appear in the printed text and are provided in the HTML and PDF versions of this article on the journal's website (http://journals.lww.com/ccejournal).

The authors have disclosed that they do not have any potential conflicts of interest.

For information regarding this article, E-mail: rob.maclaren@ucdenver.edu

Work was performed at the University of Colorado Skaggs School of Pharmacy and Pharmaceutical Sciences.

REFERENCES

1. Kane-Gill SL, Dasta JF, Buckley MS, et al: Clinical practice guideline: Safe medication use in the ICU. *Crit Care Med* 2017; 45:e877–e915
2. Haupt MT, Bekes CE, Brilli RJ, et al; Task Force of the American College of Critical Care Medicine, Society of Critical Care Medicine: Guidelines on critical care services and personnel: Recommendations based on a system of categorization of three levels of care. *Crit Care Med* 2003; 31:2677–2683
3. Preslaski CR, Lat I, MacLaren R, et al: Pharmacist contributions as members of the multidisciplinary ICU team. *Chest* 2013; 144:1687–1695
4. Horn E, Jacobi J: The critical care clinical pharmacist: Evolution of an essential team member. *Crit Care Med* 2006; 34:S46–S51
5. Dager W, Bolesta S, Brophy G, et al. An opinion paper outlining recommendations for training, credentialing, and documenting and justifying critical care pharmacy services. *Pharmacotherapy* 2011; 31:135e–175e
6. Halpern NA, Tan KS, DeWitt M, et al: Intensivists in U.S. Acute care hospitals. *Crit Care Med* 2019; 47:517–525
7. Lee H, Ryu K, Sohn Y, et al: Impact on patient outcomes of pharmacist participation in multidisciplinary critical care teams: A systematic review and meta-analysis. *Crit Care Med* 2019; 47:1243–1250
8. MacLaren R, Bond CA, Martin SJ, et al: Clinical and economic outcomes of involving pharmacists in the direct care of critically ill patients with infections. *Crit Care Med* 2008; 36:3184–3189
9. MacLaren R, Bond CA: Effects of pharmacist participation in intensive care units on clinical and economic outcomes of critically ill patients with thromboembolic or infarction-related events. *Pharmacotherapy* 2009; 29:761–768
10. Leape LL, Cullen DJ, Clapp MD, et al: Pharmacist participation on physician rounds and adverse drug events in the intensive care unit. *JAMA* 1999; 282:267–270
11. Bauer SR, Kane-Gill SL: Outcome assessment of critical care pharmacist services. *Hosp Pharm* 2016; 51:507–513
12. Rudis MI, Brandl KM: Position paper on critical care pharmacy services. Society of Critical Care Medicine and American College of Clinical Pharmacy task force on critical care pharmacy services. *Crit Care Med* 2000; 28:3746–3750
13. Maclaren R, Devlin JW, Martin SJ, et al: Critical care pharmacy services in United States hospitals. *Ann Pharmacother* 2006; 40:612–618
14. Lat I, Paciullo C, Daley MJ, et al: Position paper on critical care pharmacy services (executive summary): 2020 update. *Crit Care Med* 2020; 48:1375–1382
15. Dasta JF, Segal R, Cunningham A: National survey of critical-care pharmaceutical services. *Am J Hosp Pharm* 1989; 46:2308–2312
16. MacLaren R, Brett McQueen R, Campbell J: Clinical and financial impact of pharmacy services in the intensive care unit: Pharmacist and prescriber perceptions. *Pharmacotherapy* 2013; 33:401–410
17. Schumock GT, Butler MG, Meek PD, et al; 2002 Task Force on Economic Evaluation of Clinical Pharmacy Services of the American College of Clinical Pharmacy: Evidence of the economic benefit of clinical pharmacy services: 1996-2000. *Pharmacotherapy* 2003; 23:113–132
18. Hammond DA, Flowers HJC, Meena N, et al. Cost avoidance associated with clinical pharmacist presence in a medical intensive care unit. *Pharmacotherapy* 2019; 2:610–615
19. MacLaren R, Devlin JW: The bedside critical care pharmacist: A mandatory ICU team member essential for patient care. *Crit Care Med* 2019; 47:1276–1278
20. Erstad BL, Mann HJ, Weber RJ: Developing a business plan for critical care pharmacy services. *Hosp Pharm* 2016; 51:856–862
21. Fast Facts on U.S: Hospitals, 2020. Available at: https://www.aha.org/statistics/fast-facts-us-hospitals. Accessed November 19, 2020