

Elevating Critical Care Pharmacy Services in a Resource-Limited Environment Through Establishment of a Pharmacist Team

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ABSTRACT

Background: Critical care pharmacy services are often provided by clinical specialists during limited hours and, otherwise, by general practice pharmacists, leading to varied level, expertise, and multidisciplinary expectations of these services.

Objective: Since no published descriptions of successful models sustaining routine, high-quality critical care pharmacy services in a community-based, resource-limited environment exist, a critical care pharmacist team (CCPT) was created to meet this goal. After successful launch, the initiative's primary goal was to assess whether team formation indeed standardized and increased the level of pharmacy services routinely provided. The secondary goal was to demonstrate cultural acceptance, and thus sustainability, of the model.

Methods: A CCPT was formed from existing pharmacist resources. A longitudinal educational plan, including classroom, bedside, and practice modeling, assured consistent skills, knowledge, and confidence. Interventions performed by pharmacists before and after implementation were assessed to determine whether the model standardized type and level of service. Surveys of the CCPT and multidisciplinary teams assessed perceptions of expertise, confidence, and value as surrogates for model success and sustainability.

Results: Interventions after CCPT formation reflected elevated and standardized critical care pharmacy services that advanced the multidisciplinary team's perception of the pharmacist as an integral, essential team member. CCPT members felt empowered, as reflected by self-directed enrollment in PharmD programs and/or obtaining board certification. This success subsequently served to improve the culture of cooperation and spark similar evolution of other disciplines.

Conclusion: The standardization and optimization of pharmacy services through a dedicated CCPT improved continuity of care and standardized multidisciplinary team expectations.

Keywords: critical care; clinical pharmacist; pharmaceutical care; standards of practice.

There has been significant evolution in the role, training, and overall understanding of the impact of critical care pharmacists over the past 2 decades. The specialized knowledge and role of pharmacists make them essential links in the provision of quality critical care services.¹ The Society of Critical Care Medicine (SCCM) and the American College of Clinical Pharmacy (ACCP) have defined the level of clinical practice and specialized skills that characterize the critical care pharmacist

and have made recommendations regarding both the personnel requirements for the provision of pharmaceutical care to critically ill patients and the fundamental, desirable, and optimal pharmacy services that should be provided to these patients (**Table 1**).² Despite this, only

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Table 1. **Categorical Levels of Critical Care Pharmacist Service**

	Categories		
	Fundamental	Desirable	Optimal
Examples of pharmacist activity	Dedicated to critical care Prospectively evaluate pharmacotherapy Prospectively evaluate all parenteral nutrition with dietician Identify adverse drug events and assist in management of events	Round regularly with multidisciplinary team Determine which maintenance medications continue during acute illness Advanced life support-competent pharmacist responds to codes routinely	Independently investigate or collaborate with other critical care providers Proactively design, prioritize, and promote new pharmacy services Conduct research and provide formal education/post-doctoral training programs

Adapted from Rudis MI, Brandl KM; Society of Critical Care Medicine and American College of Clinical Pharmacy Task Force on Critical Care Pharmacy Services. Position paper on critical care pharmacy services. *Crit Care Med*. 2000;28:3746-3750.

two-thirds of US intensive care units (ICUs) have clinical pharmacists/specialists (defined as spending at least 50% of their time providing clinical services), resulting in fundamental activities dominating routine pharmacist services.³ The clinical nature of most desirable and optimal activities, such as code response and pharmacist-driven protocol management, is limited, but these activities correlate with decreases in mortality across hospitalized populations.⁴

Despite their demonstrated benefit and recognized role, critical care pharmacists remain a limited resource with limited physical presence in ICUs.⁵ This presents hospital pharmacies with a real dilemma: given that clinical pharmacy specialists are often a limited resource, what services (fundamental, desirable, or optimal) should be provided by which pharmacists over what hours and on which days? For many hospitals, personnel resources allow for a clinical pharmacy specialist (either trained or with significant experience in critical care) to participate in multidisciplinary rounds, but do not allow a specialist to be present 7 days per week across all times of the day. As a result, routine services may be inconsistent and limited to activities that are fundamental-to-desirable, due to the varied educational and training backgrounds of pharmacists providing nonrounding services. Where gaps have been identified, remote (tele-health) provision of targeted ICU pharmacist services are beneficial.⁵

In our organization, we recognized the significant variation created by this resource-defined model and sought to develop a process to move closer to published best practice standards for quality services² through the creation of

a formalized critical care pharmacist team (CCPT). This change was spurred by the transition of our organization's clinical pharmacist to a board-certified, faculty-based specialist, which in turn spurred new focus on standardizing both the type and quality of services provided by the entire pharmacy team, targeting a higher, more consistent level of pharmacist care which better aligned with SCCM/ACCP-defined activities associated with quality services. The specialist proposed the formation of a CCPT, a process that involved targeted, intensive education and clinical skills development of a narrow pharmacist audience; administration approved this plan, provided that the CCPT arose from existing resources. This realignment focused on ensuring continuity of services across pharmacist roles (ie, rounding vs satellite) as well as across times (both days of the week and shifts). This report describes the methods used to recruit, train, and sustain a CCPT; the resulting changes observed in levels of pharmacy services after CCPT implementation; and the impressions of the CCPT members and the multidisciplinary team (physicians, nurses, dietitians, respiratory therapists, chaplains, and social workers in addition to the pharmacist), as cultural integration and perceived value are essential for sustainability and growth of the model.

Methods

Setting

Robert Wood Johnson University Hospital Hamilton is a 248-bed suburban community hospital in New Jersey with

a 20-bed ICU that provides level II⁶ critical care services as part of an 11-hospital system. Critical care pharmacy services spanned from fundamental (eg, order review) to optimal (eg, independent pharmacotherapy evaluation) activities, with tremendous variability associated with who was engaged in care. In this original model, weekday ICU pharmacy services were provided by satellite-based general practice staff pharmacists (satellite pharmacy located in the ICU provides services for ICU, telemetry, and the emergency department) across 2 shifts (0700-2300; 9 pharmacists during the day shift and 2 on the evening shift). Satellite pharmacists largely focused on traditional/fundamental pharmacy practice, including order review, drug therapy evaluation, and adverse drug event identification. Additionally, a hospital-based, residency-trained clinical pharmacist rounded 3 days per week. General practice staff pharmacists provided weekend and overnight services. Very limited, prospective, independent clinical evaluation or individualized pharmacotherapy optimization occurred routinely. No established clinical assessment priorities or strategies existed, and thus expectations of pharmacy services were associated with the individual pharmacist present.

Team Structure and Recruitment

The staff pharmacists were well-established, with each having 25 to 41 years of practice experience. All 11 full-time staff pharmacists graduated with Bachelor of Science degrees in pharmacy, and 5 of them had returned to acquire Doctor of Pharmacy degrees prior to the initiative. None had completed post-doctoral training residencies, as residencies were not the standard when these pharmacists entered practice. The staffing model necessitated that pharmacists maintain Basic Life Support (BLS) and Advanced Cardiac Life Support (ACLS) competency as members of inpatient emergency response teams.

Three volunteers were recruited to the initial transformational process. These volunteer pharmacists were preferentially assigned to the ICU, with a clinically focused weekend rotation, to provide 7-day/week rounding continuity, but maintained general competencies and cross-functionality. Weekend responsibilities included critical care assessments and multidisciplinary rounding, inpatient emergency response, patient education/medication histories, and inpatient warfarin management consultations.

Team Training and Development

Longitudinal education of the CCPT included classroom, bedside, and practice-modeling training strategies to complement routine exposure and integration into the pharmacist's practice in providing direct patient care. Concentrated learning occurred over a 3-month period, with extended bedside and patient-case-based learning continuing for another 3 months. Expectations of the critical care pharmacist as an independent consultant to the interdisciplinary team targeting holistic pharmacotherapy optimization were established, instilling independence and accountability within the role. Next, lecture and bedside training targeted the development of crucial assessment skills, including an understanding of device and equipment implications on pharmacotherapy decisions, pharmacokinetic and pharmacodynamic variations in critically ill patients, and supportive care. A minimum of 5 hours of group lectures were included for all members of the CCPT, with additional instruction provided based on individual needs. Lectures explored the evidence and practice associated with common diagnoses, including review of related literature, core guidelines, and institutional order sets. Fundamental topics included pain, agitation, and delirium (PAD) during mechanical ventilation, infectious diseases, and hemodynamic management.

To reinforce knowledge, build bedside assessment skills, and increase confidence, pharmacists routinely partnered with the specialist during independent morning bedside evaluations and rounds. Over time, the specialist role became increasingly supportive as the critical care pharmacist grew into the primary role. On weekends the specialist was not present but remained on call to discuss cases with the rounding critical care pharmacist. This served to reinforce clinical decision-making and expand knowledge; these patient-specific lessons were communicated with the team to support continued development and standardization.

In addition to these internal efforts, the specialist simultaneously recalibrated expectations among key ICU stakeholders, establishing uniform quality and scope of service from the CCPT. Historically, physicians and nurses sought input from specific pharmacists, and thus a cultural change regarding the perceived value of the team was required. To reinforce this, those demanding a specific

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Table 2. **Critical Care Pharmacist Team Standard Rounding and Assessment Tool**

Standard Clinical Assessments Reported by Critical Care Pharmacist During Rounds	
Antimicrobials	List current antibiotics, indication for antibiotic, day of therapy, and culture summary to date Recommend adjustments for renal function, de-escalation, or suggested changes in overall coverage (physician to enter orders)
Infusions	List infusion, current rate and 24-hour trend, site and line type of infusion (central or peripheral) and response For vasopressors in sepsis, evaluate fluid resuscitation status (eg, CVP or targeted exam) and potential role for hydrocortisone For sedation/analgesia infusions, summarize RASS/CPOT trends and cumulative intermittent agent use, assessing whether minimum effective dosing strategy applied For vasoactive infusions, note heart rate or blood pressure response as needed; if recommending conversion to enteral therapy, be prepared to comment about overlap times between infusion and first enteral dose
Pain and agitation	Unless addressed under infusions, summarize 24-hour opioid or sedative utilization patterns and trends, recommending adjustments if necessary Assess need or response to bowel regimen
Supportive care	Summarize venous thromboembolism risk assessment and therapy Summarize stress ulcer prophylaxis indications and therapy (or discontinuation) State blood sugar trends, 24-hour insulin utilization, steroid trends that would influence blood sugar, then a plan to address glycemic control for the day
New medications or medication levels	Briefly comment objectively on patient response to any medication changes/additions made in last 24 hours If medication levels were assessed this morning, provide interpretation and any adjustments recommended
Home medications	Considering patient's clinical course, note any omissions and whether continued hold or re-initiation of therapy is recommended

CPOT, Critical Care Pain Observation Tool; CVP, central venous pressure; RASS, Richmond Agitation Sedation Scale.

pharmacist were referred to the CCPT member present.

The initial training process involved a significant proportion of the specialist's time. Initially focused on classroom lecture and core skills development, time increasingly focused on individual learner's needs and learning styles. Mentoring and partnering were key during this period. In the first 6 months, weekend calls were routine, but these quickly tapered as the team gained experience and confidence in their knowledge and skills.

Tools and Team Support

Beyond standardizing knowledge and skills, team effectiveness depended on establishing routine assessment criteria (**Table 2**), communication tools, and references. Rounding and sign-out processes were standardized to support continuity of care. A patient census report gen-

erated by the clinical computer system was used as the daily worksheet and was stored on a sign-out clipboard to readily communicate clinically pertinent history, assessments, recommendations, and pending follow-up. The report included patient demographics, admitting diagnosis, and a list of consulting physicians. The pharmacist routinely recorded daily bedside observations, his/her independent assessments (topics outlined in Table 2), pertinent history, events, and goals established on rounds. Verbal sign-out occurred twice daily (during weekdays)—from the rounding to satellite pharmacist after rounds (unless 1 person fulfilled both roles) and between day and evening shifts. Additionally, a resource binder provided rapid accessibility to key information (eg, published evidence, tools, institutional protocols), with select references residing on the sign-out clipboard for immediate access during rounding.

Monthly meetings were established to promote full engagement of the team, demonstrate ownership, and provide opportunity for discussion and information sharing. Meetings covered operational updates, strategic development of the service, educational topics, and discussions of difficult cases.

Assessment

While not directly studied, existing evidence suggests that appropriately trained critical care pharmacists should be able to perform a broad range of services, from fundamental to optimal.⁷ To evaluate if CCPT training elevated and standardized the type of interventions routinely made, services provided prior to the team's formation were compared to those provided after formation through interrogation of the institution's surveillance system. As a baseline, a comparison of the types of ICU interventions documented by the specialist during a 2-month period prior to the team's formation were compared to the interventions documented by the staff pharmacists who became part of the CCPT. Since standardization of skills and practice were goals of the CCPT formation, the same comparison was conducted after team formation to assess whether the intervention types normalized across roles, reflecting a consistent level of service.

As assignment to the CCPT is voluntary, with no additional compensation or tangible benefits, the success of the CCPT relies on active pharmacist engagement and ongoing commitment. Thus, a personal belief that their commitment was valuable and increased professional satisfaction was key to sustain change. An online, voluntary, anonymous survey was conducted to assess the CCPT member's perceptions of their preparedness, development of skills and comfort level, and acceptance by the multidisciplinary team, as these elements would influence members' beliefs regarding the impact and value of the team and their justification for commitment to continuous, uncompensated learning and training. Their thoughts on professional satisfaction and development were collected as a surrogate for the model's sustainability.

Success and sustainability also depend on the multidisciplinary team's acceptance and perceived value of the CCPT, especially given its evolution from a model in

which clinical feedback was sought and accepted exclusively from the specialist. To evaluate these components, an online, voluntary, anonymous survey of the multidisciplinary members was conducted.

Results

CCPT Interventions and Level of Service

Prior to CCPT formation, intervention categories documented by the specialist differed from those of the staff (**Figure 1**). The staff's baseline interventions represented those arising from the established, routine assessments performed by all pharmacists for all inpatients, such as renal dose assessments. The specialist's interventions largely focused on independent pharmacotherapy assessments and optimization strategies. After team formation, intervention type became increasingly consistent across the CCPT, with all members aligning with the specialist's interventions. Intervention categories reflected the clinically focused, independent assessments targeted during training (eg, supportive care and pain/sedation assessment), expanding beyond the routine assessments performed across the general hospitalized population.

When compared to SCCM/ACCP ideals, these interventions corresponded with an expansion from routinely fundamental to routinely broad (ie, fundamental, desirable, and optimal) critical care pharmacist activities, thus elevating the overall quality of services provided by the team while assuring continuity. Desirable activities adopted by the CCPT included multidisciplinary rounding on all ICU patients; drug history review for appropriate management during acute illness; and training of students and providing educational in-services. Optimal activities routinely integrated included independent and/or collaborative investigation of ICU guidelines/protocol impact and scholarship in peer-reviewed publications. Prior to CCPT formation, staff involvement of desirable activities was limited to resuscitation event response and clarification of effective dosage regimens, with no involvement in optimal activities.

CCPT Impressions

The online, voluntary, anonymous survey was completed by 5 of the 6 staff members (the 3 original members plus 3 staff members who were added several months into

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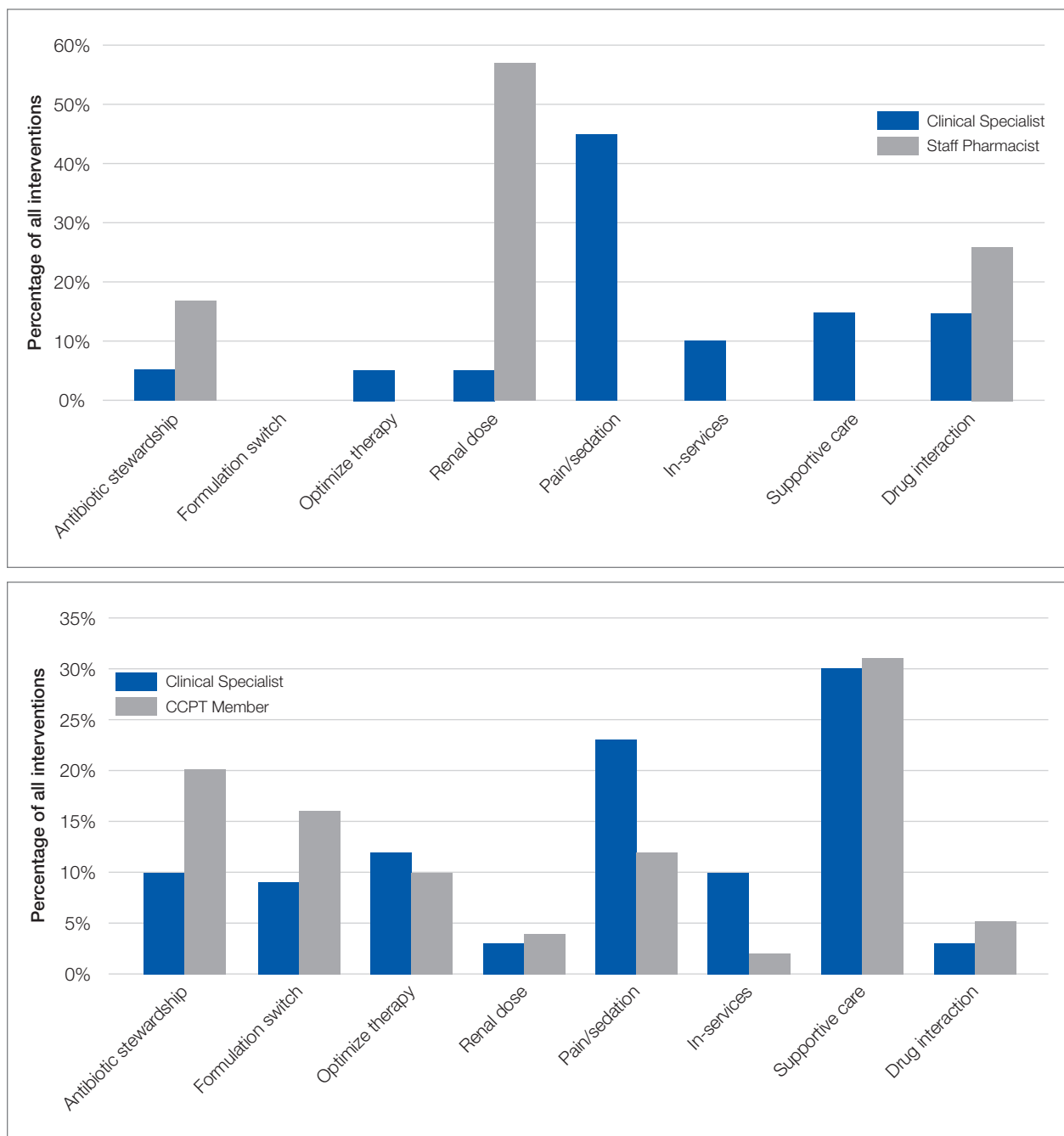


Figure 1. Pharmacist interventions before and after implementation of critical care pharmacist team (CCPT).

the program to enhance continuity and cross-shift coverage) comprising the team. Using a 5-point Likert scale, members ranked their comfort level with their critical care knowledge, bedside skills, ability to actively participate in rounds, and ability to address controversial clinical issues

in their staffing role prior to team formation (ie, baseline) compared to their current CCPT practice. Overall, self-assessments reflected perceived increases across all categories. Prior to CCPT training and implementation, all team members were “not at all,” “slightly comfortable,”

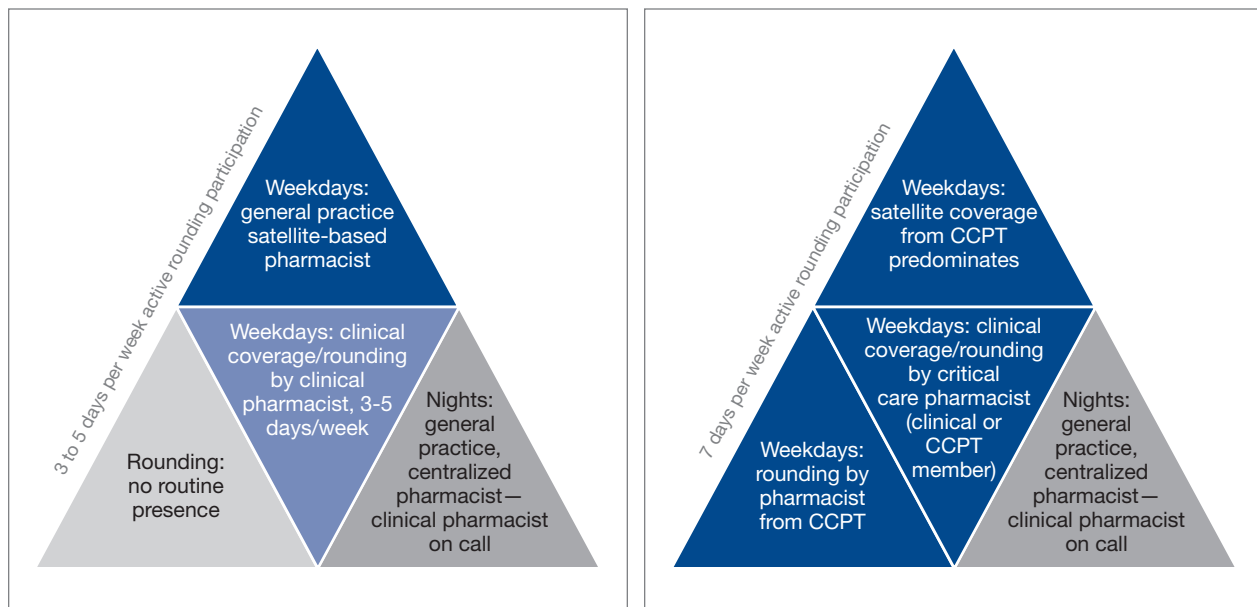


Figure 2. Intensive care unit (ICU) practice model before and after implementation of critical care pharmacist team (CCPT).

or “somewhat comfortable” with these points, while after training and implementation all reported being “comfortable” or “very comfortable” with the same points. All members reported feeling better prepared and confident in caring for critically ill patients and felt that the team and its standardized approach enhanced medication safety. When asked about their impressions of the perceived value of the CCPT by interdisciplinary peers, pharmacists felt it was perceived as bringing “a lot” or “a great deal” of value. Additionally, all members uniformly felt that the team supported their professional growth and enhanced their professional satisfaction.

Multidisciplinary Impressions of Service and Value

A total of 29 (90%) multidisciplinary team members completed the online, voluntary, anonymous survey of their impressions of the CCPT’s service and impact. Surveys represented the impressions of critical care physicians, the unit’s nursing leadership (administrative and clinical), nursing education, staff nurses, social work, and pastoral care. Using a 5-point Likert scale, all respondents reported that they “agreed” or “entirely agreed” that the CCPT enhanced care. Specifically, they reported that pharmacists were more visible and engaged, and provided more

consistent and reliable care regardless of which member was present. Services were seen as more robust and seamless, meeting interdisciplinary needs. The CCPT was viewed as a cohesive, efficient group. Respondents felt that the CCPT’s presence and engagement on weekends enhanced continuity of pharmaceutical care. As a result, the CCPT was seen as enhancing interdisciplinary understanding of the pharmacist’s value in critical care.

Discussion

Realignment and development of existing personnel resources allowed our organization to assure greater continuity, consistency, and quality of pharmacy care in the critical care setting (**Figure 2**). By standardizing expectations and broadening multidisciplinary understanding of the CCPT’s unique value, the pharmacist’s role was solidified and became an integral, active part of routine patient bedside care.

Prior to forming the CCPT, the physical presence of the pharmacist, as well as the services provided, were inconsistent. While a general practice pharmacist was in the satellite pharmacy within the ICU for up to 2 shifts on weekdays, pharmacists largely focused on traditional functions associated with order review and drug dispensing or established hospital-wide programs such as renal

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dosing or intravenous-to-oral formulation switches. The pharmacist remained in the satellite, not visible on rounds or at the bedside. In fact, there was a clear lack of comfort, frequently articulated by the pharmacists, with clinical questions that required bedside assessment, leading to routine escalation to the clinical specialist, who was not always readily available. This dynamic set an expectation for the multidisciplinary team that there were segregated pharmacy services—the satellite provided order review and product and the clinical specialist, in the limited hours present, provided clinical consultation and education. The formation of the CCPT abolished this tiered level of expectations, establishing a physical and clinical presence of a critical care pharmacist with equal capability and comfort. Both the pharmacist and multidisciplinary members perceived enhancements and value associated with the standardization and consistency provided by implementing the CCPT. Intervention data from before and after team formation support that routine interventions in critical care normalized the care provided and increased the robustness of critical care pharmacy services, with a strong shift to both clinical and academic activities considered desirable to optimal by SCCM/ACCP standards.

The benefit of pharmacist presence in the ICU is well described, with studies showing that the presence of a pharmacist is associated with medication error prevention and adverse drug event identification.⁸⁻¹⁰ However, this body of evidence applies no standardized definition regarding critical care pharmacist qualifications, with many studies pre-dating the wider availability of post-doctoral training programs and national board certification for critical care pharmacists.¹¹ Training and certification structures have evolved with increased recognition of the specialization required to optimize the pharmacist's role in providing quality care, albeit at a slower pace than published standards.¹² In 2018, 136 organizations offered America Society of Health-System Pharmacists–accredited critical care pharmacy residencies.¹² National recognition of expertise as a critical care pharmacist was established by the Board of Pharmacy Specialists in 2015, with more than 1600 pharmacists currently recognized.¹² Our project is the only known description of a pharmacist practice model that increases critical care pharmacist availability through the application of standardized criteria

incorporating these updated qualifications, thus ensuring expertise and experience that correlates with practice quality and consistency.

Despite the advancements achieved through this project, several limitations exist. First, while this model largely normalized services over the day and evening shifts, our night shift continues to be covered by 1 general practice pharmacist. More recently, resource reallocation mandated reduction in satellite hours, although that CCPT member remains available from the main pharmacy. The specialist remains on call to support the general practice pharmacists, but in-house expertise cannot be made available in the absence of additional resources. To optimize existing staffing, the specialist begins clinical evaluations during the early morning, overlapping with the night-shift prior to the satellite pharmacist's arrival. This both provides some pharmacist presence at the bedside for night shift nurses and extends the hours during which a critical care pharmacist is physically available. Second, while all efforts are made to stagger time off, unavoidable gaps in critical care pharmacist coverage occur; expansion of the original team from 3 to 6 members has greatly reduced the likelihood of such gaps. Last, the program was designed to achieve routine integration of activities shown in the literature as being associated with quality, and those activities were assessed as a surrogate for quality.

Informal input, confirmed through survey data, from various disciplines on our team has consistently supported that the establishment of the CCPT has met a need by both standardizing critical care pharmacy practice and optimizing the pharmacist role within the team. While we recognize the limitations associated with the size of these surveys, they represent large proportions of our team and reflect key elements known to be important in sustaining long-term cultural change—a belief that what one is doing is both justified and valuable. This success has been a catalyst for several ongoing projects, fostering the development and adoption of critical care pharmacist protocols to allow more autonomous practice within our scope. Team development and movement toward robust protocol management has sparked a cultural evolution across disciplines as we strive to achieve the SCCM description of a highly effective team^{2,13} that emphasizes

each discipline practicing fully within its scope in a horizontal team structure. Thus, the ICU medical director has used the success of the CCPT structure as an example to support optimization and development of the practice by other disciplines within the team. This has led to a significant revision in our rounding structure and interdisciplinary care model.¹⁴

The survey of CCPT members revealed that the model both engaged and stimulated the pharmacists involved, reflective of the autonomy and accountability required for sustainable, transformational cultural change. Within a year of entering the CCPT, 2 of the 3 pharmacists initially engaged had earned their board certification in pharmacotherapy (ie, BCPS) and the other, who had not acquired her Doctor of Pharmacy degree prior to the CCPT initiative, enrolled in a program to do so. The pharmacists expressed that they obtained BCPS over the newly available critical care certification because of the expectation that they maintain expertise across patient populations. This level of self-driven motivation in the absence of compensation reflects the value and professional satisfaction gained from being voluntary members of the CCPT.

Conclusion

Critical care pharmacy practice has continued to evolve to include increasingly specialized training for newer graduates and, more recently, the availability of critical care pharmacist board certification. While it is optimal to apply these standards when filling open critical care pharmacist positions, many hospitals require existing staff to fulfill multiple roles across various patient populations, leading to a variation in educational, training, and practice backgrounds for pharmacists currently practicing in the ICU. To minimize the variation associated with this resource-limited structure in a manner that standardized and elevated the type and level of service provided, we created a CCPT with existing pharmacists who were willing to accept intensive training and demonstrate an ongoing commitment to maintain defined competencies and skills. Our goal was to solidify the essential role of the critical care pharmacist in providing quality critical care services as described in the literature. The CCPT was well-received by the multidisciplinary team and served as an example for other disciplines that had similar struggles. The team's

success expanded into several other ongoing initiatives, including critical care pharmacist-driven protocols.

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