Chapter 1
Critical Care Services: Scope of Practice

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Introduction

Critical care services utilize specialized staff and teams to provide care, therapeutic interventions, and advanced monitoring to critically ill patients with life-threatening conditions or injuries and complex multi-organ dysfunction using protocols and principles to reverse pathophysiologic processes [1]. The standard goals of critical care services are improving quality of clinical care and decreasing morbidity and mortality of critically ill patients [2]. Critical care services should be patient-centered, directed by critical care physicians, collaborative, and multidisciplinary following protocols and guidelines to provide a high quality of care around the clock to critically ill patients [3, 4].

Critical care may be delivered within the intensive care unit (ICU) or in other areas of the hospital outside of the ICU. Although the ICU is a unique part of the hospital that is structured in a defined geographic area, its activities often involve other areas such as emergency departments, postanesthesia care units, general floors, and follow-up clinics [5]. The demand for an ICU bed often exceeds capacity, and plans should be developed to provide critical care expertise wherever it may be needed in the hospital.

In this chapter, we review types of ICU organizational models and critical care services outside the ICU. We also discuss clinical rounds in the ICU including the definition and composition, as well as structure and organization.

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ICU Organizational Models

A variety of models of ICU organization currently exist to manage critically ill patients: the open model, closed model, intensivist co-management model, high-intensity staffing model, low-intensity staffing model, and other mixed or transitional models [6–16]. These models vary by availability of an intensivist or ICU team and the level of involvement of the intensivist or ICU team in the care of the patients. The wide variation in organizational models in the ICU is mostly due to local practices, available resources, and economic factors of the hospital or institution [17].

Definitions

The Open Model An ICU in which patients are admitted under the care of a physician other than an intensivist. Any physician can admit patients to the ICU in this model. The admitting physician usually has competing responsibilities outside of the ICU such as outpatient clinics or operating rooms. Intensivists may play a primary role in the management of some patients, but only at the discretion of the admitting physician. Critical care consultation in this model is optional [7, 9, 15, 18].

The Intensivist Co-management Model (Transitional Model) This is an open ICU model in which all patients receive mandatory consultation from an intensivist. The physician of record remains the admitting physician with intensivists collaborating in the management of all ICU patients [15, 19–21].

The Closed Model An ICU in which patients are evaluated and approved for ICU admission by the intensivist or ICU team. Once the patient is admitted to the ICU, the intensivist becomes the physician of record and all other physicians are consultants. The intensivists have ICU admission and discharge privileges for all ICU patients and take the role and responsibilities of the primary admitting physician. In this model, the intensivist and ICU team are dedicated to providing care to ICU patients on a full-time basis with no other competing clinical responsibilities [8, 15].

The organization of ICUs has also been described on the basis of intensivist staffing and the amount of time spent by intensivists in providing care to ICU patients.

High-Intensity Staffing Model Includes both closed models and open models with mandatory consultation to critical care physicians for all patients admitted to the ICU [16]. In general, high-intensity staffing involves availability of intensivists throughout the day. The level of the intensivist involvement in open models with mandatory ICU consultation is still unclear with roles not comprehensively described.

Low-Intensity Staffing Model Any model other than closed or mandatory ICU consultation model (the intensivist co-management model) [16]. This may include no intensivist, elective intensivist consultation to care for specific ICU patients, or

Table 1.1 ICU organizational staffing models and the level of intensivist involvement

	Open	Closed	Mixed/ transitional
ICU admission/discharge decision	Any physician	Intensivist	Both
Primary attending physician	Nonintensivist	Intensivist	Either
Responsibility for management	Attending physician	Intensivist/ICU team	Variable
Intensivist involvement	Elective	Mandatory	Variable
Order writing	Any physician	Intensivist/ICU team	Either
Attending commitments	Multiple areas (OR, clinic, floor patients)	ICU only	Variable
Line of authority for management	Confusing	Clear	Not clear
Difficulty of implementing protocols	Higher	Lower	Variable

variable intensivist involvement such as rounding on certain patients. Intensivist availability is less than in high-intensity staffing models.

Mixed ICU Models Models that may share features of some or all of the aforementioned models. The above models may overlap to a considerable extent. Thus, some ICUs may have limited involvement of ICU physicians in patient care such as daily rounds by an intensivist or intensivist directorship with no specific organizational model [18, 21–23].

Closed ICU organizational models are more common in larger academic centers that have trainees present in the ICU [15]. Open ICU organizational models are more common in the United States [15, 24], and only 26% of ICUs have high-intensity staffing [25], while closed ICU models are more common in other countries [26–29]. Excluding closed ICU models, there are a number of knowledge gaps in accurately defining ICU organizational models relevant to staffing by ICU physicians. These include, but are not limited to, the exact roles of ICU physicians, the extent of intensivist involvement, and the duration of involvement throughout the day. Table 1.1 summarizes three ICU organizational models with the degree of ICU physician involvement.

Clinical Outcomes Associated with Different ICU Organizational Models

Many studies have tried to assess outcomes of ICU patients linked to various ICU organizational models. The ICU can be considered an organized complex adaptive system (CAS) which provides care to seriously ill patients [30, 31]. In such systems, many elements, including groups or teams, interact, change, and adapt with each

other for specific goals. It is difficult to evaluate and determine if better outcomes are solely related to intensivist involvement as it would require standardization and control of all variables that may influence clinical outcomes including ICU design, structure, size, type of cases, and the composition and functions of multidisciplinary teams [15].

Young et al. reviewed nine studies to evaluate the effect of a closed ICU model on patient mortality in the United States [32]. Relative reductions in mortality rates associated with the closed ICUs ranged from 15% to 60%, and the study concluded that even with modest reductions in mortality rates, lives can be saved given the large number of ICU patients. Pronovost et al. conducted a systematic review and meta-analysis which examined 27 observational and randomized controlled trials of different ICU organizational strategies from 1965 through 2001 [16]. ICUs were categorized into low-intensity staffing and high-intensity staffing models. In the high-intensity staffing model, the critical care physician consultation was mandatory. The high-intensity staffing model was associated with lower ICU and hospital mortality and shorter ICU and hospital length of stay. The improved outcomes linked to high-intensity staffing could be explained by the implementation of evidence-based care and standardized protocols provided by the ICU physicians and the multidisciplinary team [33]. Levy et al. conducted a cross-sectional study from the project IMPACT database, a US database originally developed by the Society of Critical Care Medicine [34]. The study included 101,832 patients in 123 ICUs throughout 100 hospitals from 2000 to 2004. Surprisingly, hospital mortality was higher when ICU physicians were involved in patient care. In this study, there was a concern of residual confounders for illness severity and selection biases that were not adequately assessed or recognized. Treggiari et al. examined the association of closed versus open organizational models with patient mortality from acute lung injury across 24 adult ICUs in the Seattle area [35]. The results showed that patients with acute lung injury cared for in a closed ICU had lower mortality (adjusted odds ratio, 0.68; 95% confidence interval, 0.53, 0.89; $P = 0.004$).

Outcomes Related to 24/7 and Night Coverage by ICU Physicians

The intensity of staffing of ICUs by critical care physicians may also have an impact on patient outcomes. As a high-intensity staffing model showed positive results related to patient outcomes, Gajic et al. evaluated the benefits of continuous presence of a critical care specialist in the ICU of a teaching hospital [36]. The 2-year prospective cohort study compared the quality of care and patient, family, and provider satisfaction before and after changing the staffing model from an on-demand to continuous 24-hour critical care specialist presence in the ICU. The results showed that a 24-hour on-site ICU specialist was associated with improved processes of care, staff satisfaction, decreased ICU complication rate, and hospital

length of stay. There was no effect on hospital or ICU mortality. The potential advantages of 24-hour in-house ICU physicians are enhancement in efficiency and quality of care and improvement in staff, trainee, patient, and family satisfaction. In contrast, potential but significant disadvantages may include physician burnout and higher costs [37, 38]. In a cross-sectional survey, Diaz-Guzman et al. surveyed 374 critical care training programs in United States academic medical centers [39]. A total of 138 responses from program directors and 380 responses from critical care fellows in training were received. The responses showed that 24/7 coverage was associated with better patient outcomes and trainee education, but concerns about trainees' autonomy were expressed using this model. A large retrospective cohort study was conducted by Wallace et al. in 49 ICUs of 25 hospitals to evaluate a 24-hour intensivist staffing strategy and associated quality of care [40]. Their results found that the presence of a critical care physician at night decreases mortality in low-intensity staffed ICUs but not in high-intensity daytime staffing models. Kerlin et al. conducted a 1-year randomized trial in an academic medical ICU to assess the effects of nighttime staffing with in-hospital intensivists (intervention) as compared with nighttime coverage by daytime intensivists who were available for consultation by telephone (control) [41]. A total of 1598 patients were included. Nighttime in-hospital intensivist staffing did not improve patient outcomes (ICU length of stay, in-hospital length of stay, ICU and in-hospital mortality, discharge disposition, and rates of readmission to the ICU). A meta-analysis and systematic review of 52 studies conducted by Wilcox et al. to evaluate staffing patterns in the ICU demonstrated that high-intensity staffing was associated with reduced ICU and hospital mortality [42]. Within high-intensity staffing models, 24-hour in-hospital intensivist coverage did not reduce hospital or ICU mortality. The benefit of high-intensity staffing was concentrated in surgical (risk ratio, 0.84; 95% CI, 0.44–1.6) and combined medical-surgical (risk ratio, 0.76; 95% CI, 0.66–0.83) ICUs, as compared to medical (risk ratio, 1.1; 95% CI, 0.83–1.5) ICUs. The effect on hospital mortality varied across different decades. In 2017, a systematic review and meta-analysis by the American Thoracic Society on the effect of nighttime intensivist staffing on mortality and length of stay among ICU patients suggested that nighttime intensivist staffing is not associated with reduced ICU patient mortality and recommended the evaluation of alternative staffing models [43].

The current evidence suggests that the high-intensity staffing model during the day improved patient outcomes in the ICU while benefits of 24-hour in-hospital intensivist coverage were mainly evident for low-intensity staffing models. The main obstacle to achieve these objectives is the existing and anticipated shortage of ICU physicians in some areas of the world [44] given the recommended ICU bed to intensivist ratio of less than 15:1 for optimal delivery of quality critical care services [45]. Strategies to meet these challenges may include regionalization of services, telemedicine (see Chap. 8), the use of nonphysician critical care-trained healthcare providers such as nurse practitioners and physician assistants, and a co-management model with noncritical care-trained physicians such as hospitalists (see Chap. 7).

General and Specialized ICUs

Two types of ICUs can be recognized: general ICU and specialty ICU. General ICUs provide care for a variety of patients and diagnoses. These ICUs, also called medical-surgical ICUs, are commonly found in smaller and community-based hospitals. Specialty ICUs provide diagnoses-specific care for an identified population of critically ill patients. These ICUs include cardiac and cardiothoracic ICUs, medical ICUs, surgical ICUs, and neurological ICUs. They are more commonly found in larger hospitals and teaching institutions [25]. The proposed advantages of specialty ICUs are convenient and efficient utilization of resources such as experienced providers including nurses and physicians to deliver care to patients with specific disease processes, conditions, and interventions, decrease treatment variability, provide focused education for trainees, and improve patient outcomes.

There is limited evidence to support the development of specialty ICUs. Lott et al. conducted a retrospective cohort study to examine patients admitted to 124 ICUs in the United States [46]. The authors analyzed data of 84,182 patients admitted to specialty and general ICUs with an admitting diagnosis or procedure of acute coronary syndrome, ischemic stroke, intracranial hemorrhage, pneumonia, abdominal surgery, or coronary-artery bypass graft surgery. No significant differences were found in risk-adjusted mortality between general and specialty ICUs for all conditions other than pneumonia. There was no consistent effect of specialization on length of stay for all patients or for ICU survivors. The study also revealed that admitting patients with a nonideal diagnosis (a diagnosis commonly not cared for by the specialty ICU) to a specialty ICU (boarding) was associated with increased risk-adjusted mortality.

The effect of a specialty ICU on patient outcomes related to a specific diagnosis has shown some positive outcomes. Mirski et al. conducted a retrospective review of patients with a primary diagnosis of intracerebral hemorrhage treated in medical or surgical ICUs and those treated in a neurosurgical ICU in the same institution [47]. Mortality and disposition at discharge in patients with intracerebral hemorrhage were significantly improved ($P < 0.05$) in patients treated in a neurosurgical ICU compared with those treated in a general ICU. The patients treated in the neurosurgical ICU had shorter hospital stays ($P < 0.01$) and lower total costs of care ($P < 0.01$). Diringer and colleagues conducted a prospective study analyzing data collected by project IMPACT over 3 years from 42 participating ICUs (including one neurological ICU) across the United States [48]. Patients with acute intracranial hemorrhage admitted to a neurological ICU had reduced mortality compared to a general ICU. Duane et al. conducted a retrospective review of registry data of 1146 trauma patients treated in a surgical trauma ICU compared to 1475 patients treated in a nonspecialized ICU [49]. Penetrating trauma and care in a nonspecialized ICU were predictors of mortality. A specialty ICU for cardiac patients has also been proposed based on specialized monitoring, interventions, and devices needed for the management of patients with advanced heart failure and cardiogenic shock.

A factor that may limit the role and effectiveness of specialty ICUs in treating critically ill patients is the need for multi-organ support in conditions such as sepsis, acute respiratory failure, acute heart failure, and acute renal failure. Another factor could be related to the concept of organized care provided by experienced ICU providers (intensivists, nursing staff, respiratory therapists, dietitians, and others) who adopt a multidisciplinary approach of care and use strict protocols and guidelines. Nevertheless, ICU specialization may offer efficient use of resources, treatment of specific conditions by an experienced provider, enhancement of trainee education pertinent to a particular group of diseases and clinical conditions, higher family satisfaction, and reduction of the cost of care.

Critical Care Services Outside the ICU

The goal of critical care services is to deliver specialized care to critically ill patients. A comprehensive approach to critical care services should consider the provision of these services to all critically ill patients in the hospital irrespective of their physical location. This may include emergency departments, hospital units, intermediate care units, and postoperative units. Thus, the term "intensive care system without walls" has evolved to describe delivery of critical care and ICU expertise outside the walls of the ICU to any critically ill patient in the hospital [50].

Rapid response systems represent the main approach to deliver necessary critical care services in every part of the hospital outside the walls of traditional ICUs. Different terms may be used to identify these teams such as rapid response teams, medical emergency teams, and critical care outreach teams. They usually share the concepts of an afferent limb that represents the activating team and an efferent limb that represents the response team. The afferent limb can be activated by anyone in the hospital and at any time. The response team is a specialized team that consists of critical care-trained providers led by an intensivist, advanced critical care provider, or nurse that respond to patients with deteriorating clinical conditions in the hospital. The main functions are identification of at-risk patients and resuscitation, stabilization, and safe transfer to an ICU if indicated for critically ill patients [51]. The advantage of rapid response teams is the availability of experienced critical care providers that can respond immediately to seriously ill patients. Both experience and time to response at bedside may result in safe and effective management of critically ill patients and improve outcomes [52]. Other advantage of rapid response teams may also include minimizing the inappropriate utilization of ICUs by providing adequate care to prevent admission to the ICU and following up with patients after ICU discharge to prevent readmission [21]. Rapid response systems use a set of criteria to identify patients who are at risk [51, 53]. The utilization of appropriate criteria can be effective in decreasing admissions to the ICU for patients who are at low risk [54, 55] or for patients who have minimal or no chance of survival or recovery [56].

The effectiveness of rapid response systems in reducing hospital mortality, non-ICU cardiopulmonary arrest, and ICU admissions has been evaluated in a number of studies. Priestley et al. conducted a pragmatic randomized trial that found critical care outreach teams reduced mortality in general hospital wards compared to wards with usual care [57]. Hillman et al. conducted a trial randomizing 23 Australian hospitals to usual care compared with the presence of medical emergency teams [58]. No difference in the incidence of cardiac arrest, unplanned ICU admissions, or unexpected death occurred between the two groups. A systematic review and meta-analysis by Chan et al. included 18 studies to evaluate the effect of rapid response teams [59]. The results showed that implementation of a rapid response team in adult populations was associated with a 33.8% reduction in rates of cardiopulmonary arrest outside the ICU (relative risk [RR], 0.66; 95% confidence interval [CI], 0.54–0.80) but was not associated with lower hospital mortality rates (RR, 0.96; 95% CI, 0.84–1.09). The implementation of a rapid response team in children was associated with a 37.7% reduction in rates of cardiopulmonary arrest outside the ICU (RR, 0.62; 95% CI, 0.46–0.84) and a 21.4% reduction in hospital mortality rates (RR, 0.79; 95% CI, 0.63–0.98). A systematic review by Winters et al. showed that rapid response systems were associated with reduced rates of cardiorespiratory arrest outside the ICU and reduced mortality [60]. In a recent systematic review and meta-analysis of 29 studies, Maharaj et al. found that the implementation of a rapid response team was associated with a decrease in hospital mortality in both the adult (RR 0.87, 95% CI 0.81–0.95, $p < 0.001$) and pediatric (RR 0.82, 95% CI 0.76–0.89) in-patient populations [61]. The rapid response system team was also associated with a reduction in cardiopulmonary arrests in adults (RR 0.65, 95% CI 0.61–0.70, $p < 0.001$) and pediatric (RR 0.64, 95% CI 0.55–0.74) patients. Similarly, a systematic review by Solomon et al. found that the implementation of a rapid response or medical emergency team was associated with a reduction in hospital mortality (relative risk [RR], 0.88; 95% confidence interval [CI], 0.83–0.93) and a reduction in the number of non-ICU cardiac arrests (RR, 0.62; 95% CI, 0.55–0.69) [62].

The weight of the available evidence suggests that rapid response systems are associated with a decrease in hospital morality and non-ICU cardiopulmonary arrest [59–62]. Rapid response teams were also associated with a decrease in unnecessary ICU admissions, length of hospital stay, and adverse outcomes such as respiratory failure, sepsis, stroke, and acute renal failure requiring renal replacement therapy [55, 63, 64]. The scope of critical care services has been expanding beyond the walls of the ICU. Critical care services and expertise may include the management of non-ICU patients who are at risk or whose clinical condition is deteriorating to prevent serious adverse events such as cardiopulmonary arrest or even death. Other roles of the critical care experienced teams may also include consultation about the appropriate level of care for individual patients within the hospital or for patients transferred from an outside hospital; ongoing treatment for patients while waiting for ICU bed availability; conducting or assisting in resuscitation of patients with cardiopulmonary arrest; performance of procedures such as central venous access, arterial line insertion, or endotracheal intubation; and discussing goals of care and end-of-life decision-making. The composition and responsibilities of a rapid

response or medical emergency team should be carefully planned and continuously evaluated to ensure goals for patient care and anticipated outcomes are achieved.

Summary

ICU organizational models are variable throughout the world. High-intensity staffing and closed ICU organizational models result in favorable outcomes including lower hospital mortality related to the use of evidence-based care and protocols and a multidisciplinary approach. The benefit of nighttime coverage by intensivists is mainly evident in low-intensity staffing models. The main obstacle to the high-intensity staffing model is availability of intensivists.

ICU Rounds

Clinical rounds in the ICU represent a planned activity where healthcare providers in the critical care setting review and discuss clinical information and develop and establish treatment plans for ICU patients using a multidisciplinary approach. Thus, they are called multidisciplinary or interdisciplinary rounds. Multidisciplinary rounds are usually defined as scheduled assemblies that are regularly conducted by healthcare providers from different specialties, clinical fields, or disciplines who are involved in the care of the same patients or the same clinical management unit in the hospital or institution [65]. Clinical rounds vary in type, structure, composition, time, and functions. Despite these variable elements, the main focus should remain patient-centered to provide high quality of care. In this section, we refer to clinical rounds in the ICU as multidisciplinary rounds, clinical rounds, or ICU rounds.

The Composition of the Multidisciplinary Team

The characteristics of the multidisciplinary team (such as size, the training and experience of the physicians and other healthcare providers, or the exact members comprising the team) may differ depending on the ICU organizational model for the hospital (academic vs community hospital), type of ICU (general vs specialty), or level of care (level 1 vs tertiary ICU). The multidisciplinary team includes an ICU physician or a primary physician (depending on the ICU organizational model), the bedside nurse, and at least one other healthcare provider such as a pharmacist or respiratory therapist. It is unclear what the optimal size of the multidisciplinary team is or specific characteristics of the multidisciplinary members that are associated with improved outcomes.

The 2015 guidelines from the Society of Critical Care Medicine recommend a devoted multidisciplinary ICU team led by an ICU physician (intensivist) to deliver effective care to critically ill patients [66]. The multidisciplinary clinical rounds in the ICU focus on collaborative team-based care. The multidisciplinary team may include, but is not limited to, physicians, advanced practice providers (nurse practitioners or physicians assistants), nursing staff, pharmacists, physical therapists, occupational therapists, respiratory therapists, case managers or social workers, palliative care clinicians, other healthcare providers, and patient and family members. In academic centers, multidisciplinary rounds include trainees rotating in the ICU. While some members of the rounding team may be present every day, other members may join rounds several times a week. During clinical rounds, the ICU multidisciplinary team addresses clinical information, various aspects of the clinical condition, and the overall plan of care for patients on daily basis [15, 33, 67]. This allows adequate exchange of information through direct and organized communication. Interaction among the multidisciplinary team members is shown to foster communication, coordination of care, and leadership qualities in the ICU that are significantly associated with deceased length of stay, improved family and staff satisfaction, and lower rates of preventable adverse events [68–71].

In addition to critical care physicians, other healthcare providers from different disciplines with complementary clinical skills and expertise are also essential for successful ICU rounds. The nursing staff role is extremely important as the bedside nurse spends the majority of working time caring for the patient; thus, she/he can provide valuable knowledge about the patient's medical condition and family dynamics and play a pivotal role in the management of critically ill patients [15, 72]. The role of the ICU pharmacists in assisting with pharmacotherapy, dosing, related potential adverse events, and overall management plan is crucial. Pharmacist participation in ICU rounds is associated with a significant reduction in the total number of preventable adverse drug events [69]. Studies have also shown improvements in infection control management, anticoagulation therapy, and sedation and analgesia utilization in ICUs with critical care pharmacists [73]. Advanced practice providers (APPs) may also assist in the treatment of ICU patients. The outcomes related to involvement of APPs in ICUs were at least equivalent to that provided by resident physicians [74]. The role of respiratory therapists in the ICU is paramount given the high percentage of patients requiring invasive or noninvasive mechanical ventilation [75, 76]. Nutrition assessment and recommendations from specialized dietitians have important value in caring for seriously ill patients [77]. Palliation and end-of-life care for ICU patients with different cultural backgrounds and beliefs is critical. Palliative care service participation in ICU rounds and throughout the ICU stay provides comprehensive care to patients and their families [78]. Involvement of a bioethics team can function as an additional key resource in cases with ethical dilemmas and end-of-life care [79]. The role of social workers and case managers is evident in ICU rounds to determine the appropriate disposition for patients ready for discharge from the ICU, facilitate communication between healthcare providers and patients and their families, and provide resources to patients and families [80, 81]. Family participation in ICU rounds to discuss the plan and goals of care, improve

collaboration, inform decision-making, and communicate wishes and concerns is important. The American College of Critical Care Medicine's guidelines describing evidence-based best practices for patient and family-centered care in the ICU recommend family participation in ICU rounds to improve bidirectional communication [82]. Other members of the ICU multidisciplinary team such as physical therapy and occupational therapy have effective roles for ICU patients to achieve mobility and engage in regular daily activities [83, 84].

Overall, it is apparent that all members of the multidisciplinary team can provide a critical and collaborative role during ICU rounds. This includes, but is not limited to, discussion, planning, and executions of the treatment strategy for ICU patients. Multidisciplinary rounds represent a key mechanism for communication and coordination of care among various specialties in the ICU [65].

The Structure and Organization of ICU Rounds

Clinical rounds in the ICU may vary from an informal and unstructured format led by a physician to a more structured and formal multidisciplinary rounds among the critical care team. Structured multidisciplinary rounds have been shown to have a positive impact on collaboration and teamwork for physicians and nurses [71, 85, 86]. One of the major components of high-quality critical care includes multidisciplinary rounds. Multidisciplinary rounds reduce the ICU length of stay [87] and mortality of critically ill patients [88].

In a large population-based retrospective cohort study, Kim et al. examined the effect of multidisciplinary daily rounds on 30-day mortality in 112 hospitals that included 107,324 patients [88]. The lowest odds of death were in ICUs with a high-intensity physician staffing model and multidisciplinary care teams (OR, 0.78; 95% CI, 0.68–0.89 [$P < 0.001$]), followed by ICUs with a low-intensity physician staffing model and multidisciplinary care teams (OR, 0.88; 95% CI, 0.79–0.97 [$P = 0.01$]), as compared with hospitals with a low-intensity physician staffing model but without multidisciplinary care teams. The results also emphasized the role of evidence-based treatment adopted by the multidisciplinary team in which protocols and guidelines were used to standardize care and the value of effective communication and collaboration among the multidisciplinary team members. In ICUs with a low-intensity staffing model, multidisciplinary rounds may still improve patient outcomes with significant mortality reductions achieved with a team-based approach. These findings provide an alternative solution to hospitals when there is a shortage of ICU specialists. The study also confirmed previous results that demonstrated the role of high-intensity staffing models in decreasing mortality.

Lane et al. conducted a systematic review to examine the evidence for facilitators and barriers to clinical rounds in the ICU [89]. The authors reviewed 43 articles that were mainly performed in academic adult medical ICUs in the United States. There was considerable variation in the structure and process of the clinical rounds with a duration of 5–15 minutes per patient. The review showed that 75% of ICU rounds

Table 1.2 Facilitators and barriers practices for ICU rounds

Facilitators	Barriers
Open collaborative discussion environment	Interruptions
Reduce nonessential time-wasting activities	Increased rounding time
Access to patient data	Nonstandardized structure
Discussion and documentation of goals	Allied healthcare provider perceptions of not being valued by medical doctors
Standardized rounds structure and process	Electronic health record use
Checklist use	Poor information retrieval and documentation
Pharmacist participating on rounds	Hierarchical healthcare provider structure
Multidisciplinary rounds	
Greater healthcare provider autonomy	
Explicit healthcare provider roles	
Visibility of healthcare provider	

Adapted from Lane et al. [89]

were performed daily, 84% by a multidisciplinary team, and 56% at bedside. The process mainly included reviewing a patient's medical history, course in the ICU, acute clinical status, and making a plan of care. The authors recognized 13 facilitators and 9 barriers for practices during ICU rounds as shown in Table 1.2.

The study concluded that rounds conducted using a standardized structure and best practices checklist by multidisciplinary team members with explicitly defined roles and a goal-oriented approach had the strongest impact. The main barriers during ICU rounds included long rounding time and interruptions during rounds [89]. In another study, interruptions and resource utilization were identified as the main barriers to task completion during ICU rounds [90]. Key recommendations to improve ICU rounds include structure and process modifications. The structure modifications include standardization of location, time, and composition of the ICU multidisciplinary team. A multidisciplinary ICU team, comprised of (at a minimum) an ICU physician, nurse, and pharmacist, promotes both effectiveness and safety of clinical rounds. An explicit definition of each healthcare provider's role in discussions aids in increasing patient-centeredness and facilitates more effective discussions [89]. Conflicting evidence exists about the location of ICU rounds with most studies in the review conducting ICU rounds at the bedside to increase the multidisciplinary team collaboration and patient-centeredness of the discussions. One study described longer rounding times and lesser communication at the bedside compared with discussions held in a conference room [91]. Conference room rounds yielded a reduction in interruptions and timeliness efficiency of ICU rounds and improved the quality of communication among the multidisciplinary team members.

The process modifications to ICU rounds may include building a goal-oriented discussion centered on patient care goals. Discussing and documenting goals in patient records improves effectiveness of communication among providers [67]. An open and collaborative environment facilitates increased healthcare provider participation, improved patient outcomes, and reduced costs to the healthcare system

[92]. There is an association between provider understanding of the daily treatment plan and goals of care with provider satisfaction, perception of quality communication, and adherence to practice guidelines. Justice et al. implemented a standardized rounding process, including documentation of patient daily goals at bedside or utilization of daily goals checklists, which showed improved understanding of daily goals by all ICU team members and improved family satisfaction in addition to improvement in goal-directed care [93].

There is evidence for implementing structured (including the use of a checklist) multidisciplinary ICU rounds, in a standard location, at a standard time, with explicit roles defined for each participating healthcare provider. Weaker evidence is available for identifying the ideal location for discussions or the value of open discussion environments [89]. Table 1.3 depicts evidence-based recommendations to improve ICU rounds as recommended by Lane et al.

In a cross-sectional survey of 111 Canadian adult medical and surgical ICUs, Holodinsky et al. examined ICU rounding practices and potential solutions for improvement [94]. The results showed that a variety of rounding practices existed with the majority reporting a multidisciplinary approach (81% of ICUs) in which 98% of ICU physicians, 94% of bedside nurses, 89% of respiratory therapists, and 85% of pharmacists regularly attended the ICU rounds. The study confirmed the positive role of collaboration and communication among the multidisciplinary team members and standardization of structure and process of ICU rounds including

Table 1.3 Practices to improve ICU rounds

Best practice	Strength of recommendation
Implement multidisciplinary rounds (including at least a physician, nurse, and pharmacist)	Strong – definitely do it
Standardize location, time, and team composition	Strong – definitely do it
Define explicit roles for each healthcare provider participating on rounds	Strong – definitely do it
Develop and implement a structured tool (best practices checklist)	Strong – definitely do it
Reduce nonessential time-wasting activities	Strong – definitely do it
Minimize unnecessary interruptions	Strong – definitely do it
Focus discussions on development of daily goals and document all discussed goals in the health record	Strong – definitely do it
Conduct discussions at bedside to promote patient-centeredness	Weak – probably do it
Conduct discussions in a conference room to promote efficiency and communication	Weak – probably do it
Establish an open collaborative discussion environment	Weak – probably do it
Ensure clear visibility between all healthcare providers	Weak – probably do it
Empower healthcare providers to promote a team-based approach to discussions	Weak – probably do it
Produce a visual presentation of patient information	No specific recommendation

Adapted from Lane et al. [89]

optimal location and identifying team members' roles and the negative role of interruptions during ICU rounds. The survey also found that 80% of rounding time was spent on patient care activities and 20% on teaching. Opportunities for teaching and learning for team members were reported as positive during ICU rounds. Teaching can be included in ICU rounds when it does not adversely affect patient care but rather enhances it. The ideal balance between patient care and teaching activities during ICU rounds is unknown and may depend on certain situations related to the urgency of the patient's clinical conditions.

In academic hospitals, the multidisciplinary ICU team often consists of trainees from multiple specialties with different levels of training and experience. Challenges for education are attributed to a combination of factors such as patients with life-threatening and unpredictable clinical conditions, variability in trainees' experience and their primary specialties, limitations in trainees' duty hours, competing responsibilities of ICU physicians, and factors related to achieving patient safety and optimal quality of care [95, 96]. In a survey study by Giri et al. exploring the objectives of multidisciplinary rounds in the ICU, 72% of the multidisciplinary team members identified developing a plan of care as the main purpose of rounds, while only 11% of the multidisciplinary team reported education as an important element of rounds (the least reported goal) [90]. ICU multidisciplinary rounds, if used effectively, can simultaneously improve the quality of care and enhance trainees' education [97].

Centofanti et al. conducted a mixed-method study using a qualitative and quantitative approach to evaluate the role of daily checklists during ICU rounds [98]. The results showed that the daily goals checklist improved communication among multidisciplinary providers and enhanced patient care by creating a structured, systematic, and comprehensive approach and fostered education of residents as it offered multipurpose teaching opportunities for ICU trainees.

Cao et al. performed a prospective unblinded, nonrandomized parallel study to evaluate the effects of patient-centered structured multidisciplinary bedside ICU rounds on rounding efficiency, provider satisfaction, and patient and family satisfaction [99]. Data were compared between 367 patient-centered structured multidisciplinary bedside ICU rounds and 298 nonstructured rounds. The results showed that family presence was significantly more likely in the structured multidisciplinary bedside ICU rounds. Total rounding and interruption times were significantly shorter in patient-centered structured ICU rounds with improved communication of the plan of care among team members. A significant increase in teaching occurred during patient-centered structured multidisciplinary bedside ICU rounds. The authors concluded that patient-centered structured multidisciplinary bedside ICU rounds increased ICU rounds efficiency, providers' satisfaction, and teaching.

Other components of high-quality critical care are effective team dynamics. Effective team dynamics rely on strong team leadership, effective communication among providers, and team structure [15, 100]. Attributes which defined positive team dynamics include safe work environments in which questions and concerns are addressed, errors are reported, and team members' skills and attributes are recognized to promote a team-oriented approach to patient care [101].

Summary

Multidisciplinary rounds in the ICU represent a key activity to achieve effective communication among critical care providers and collaboratively exchange clinical information, develop care plans, and make clinical decisions for critically ill patients. This process is optimally performed during a scheduled discussion among the multidisciplinary team members on a daily basis. Multidisciplinary clinical rounds in the ICU are associated with positive outcomes related to patients and healthcare providers.

A standardized and systematic approach to conduct multidisciplinary rounds in the ICU with explicit goals and defined roles is highly recommended. The rounds should be efficient, professional, interactive, and educational to provide value for patients, their families, and the multidisciplinary ICU team members. Since ICU rounds are a key tool for communication among providers, failures during this process may have a profound impact on the quality and safety of patient care.

Conclusion

The ICU functions as a complex adaptive system. In such an organizational system, improvement in performance and outcomes depends on improving the structures and processes of the system. The ICU organizational model is one component of this system. Factors that affect the organizational system of the ICU have been associated with improved outcomes including the model of ICU staffing (high-intensity staffing model being associated with positive outcomes), the process and quality of care delivered to critically ill patients such as a dedicated ICU physician-led multidisciplinary critical care team that provides collaborative high quality of care, and multidisciplinary patient and family-centered ICU rounds. Effective communication is especially important in complex healthcare settings such as the ICU. ICU multidisciplinary rounds are a key mechanism by which healthcare providers communicate and make patient care decisions collaboratively.

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