Society of Critical Care Medicine 2024 Guidelines on Adult ICU Design

RATIONALE: Advances in technology, infection control challenges—as with the COVID-19 pandemic—and evolutions in patient- and family-centered care highlight ideal aspects of ICU design and opportunities for enhancement.

OBJECTIVES: To provide evidence-based recommendations for clinicians, administrators, and healthcare architects to optimize design strategies in new or renovation projects.

PANEL DESIGN: A guidelines panel of 27 members with experience in ICU design met virtually from the panel's inception in 2019 to 2024. The panel represented clinical professionals, architects, engineers, and clinician methodologists with expertise in developing evidence-based clinical practice guidelines. A formal conflict of interest policy was followed throughout the guidelines-development process.

METHODS: Embase, Medline, CINAHL, Central, and Proquest were searched from database inception to September 2023. The Grading of Recommendations Assessment, Development, and Evaluation approach was used to determine certainty in the evidence and to formulate recommendations, suggestions, and practice statements for each Population, Intervention, Control, and Outcomes (PICO) question based on quality of evidence and panel consensus. Recommendations were provided when evidence was actionable; suggestions, when evidence was equivocal; and practice statements when the benefits of the intervention appeared to outweigh the risks, but direct evidence to support the intervention did not exist.

RESULTS: The ICU Guidelines panel issued 17 recommendations based on 15 PICO questions relating to ICU architecture and design. The panel strongly recommends high-visibility ICU layouts, windows and natural lighting in all patient rooms to enhance sleep and recovery. The panel suggests integrated staff break/respite spaces, advanced infection prevention features, and flexible surge capacity. Because of insufficient evidence, the panel could not make a recommendation around in-room supplies, decentralized charting, and advanced heating, ventilation, and air conditioning systems.

CONCLUSIONS: This ICU design guidelines is intended to provide expert guidance for clinicians, administrators, and healthcare architects considering erecting a new ICU or revising an existing structure.

KEYWORDS: evidence-based design; guidelines; healthcare design; intensive care unit architecture; intensive care unit design

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Technologic advances, infection control challenges—such as those with the COVID-19 pandemic—and the importance of patient- and family-centered care have served to highlight ideal aspects of ICU design and suggest opportunities for enhancement (1, 2). For example, prior Society of Critical Care Medicine (SCCM) design guidelines (1995–2012) did not envision remote manipulation of ventilator settings or infusion pumps (3, 4). Design elements spanning square footage, air handling,

airborne isolation, linkage to electronic and digital local or remote systems, as well as ICU organization and layout may be addressed during new construction, revision of existing critical care space, or the conversion of previously non-ICU space to render critical care. ICU location within a facility may influence travel distances to other spaces such as procedural areas, satellite pharmacies, and other spaces such as elevators, diagnostic, or therapeutic areas such as radiology (i.e., CT scan, MRI scan), the operating rooms, cardiac catheterization laboratories, endoscopy procedure suite, or interventional radiology. Attention to staff respite areas, as well as safety and security for patients, families, visitors, and staff is expected (5). Due to substantial shifts in healthcare, SCCM sought to update the 2012 ICU Design Guidelines to provide expert guidance for clinicians, administrators, and healthcare architects considering new ICU design or renovation.

METHODOLOGY

Since many aspects of ICU design are difficult to evaluate using commonly applied evidence-based methods, a modified Delphi survey methodology was used to create a multiprofessional, expert consensus-based set of statements. These guidelines' construction is based on Grading of Recommendations Assessment, Development, and Evaluation (GRADE) guidelines methodology (6). Fifteen Population, Intervention, Comparator, and Outcomes (PICO) questions related to ICU design were explored. Methodology, panel membership, PICO question-related data (e.g., evidence summaries, evidence-to-decision framework, references, search strategy, and recommendation drafting) are detailed in the **Supplement Materials** (http://links.lww.com/CCM/H668). The findings are intended to provide explicit guidance for new ICU construction or renovation.

ICU DESIGN RATIONALES FOR RECOMMENDATIONS

Table 1 presents 17 Recommendations for ICU design, including five Good Practice Statements (GPSs), resulting from 15 PICO questions. The panel identified five themes within which to group questions, each of which are detailed below.

1. ICU LAYOUT

1.1. Should High-Visibility vs. Low-Visibility Layouts Be Used in ICUs?

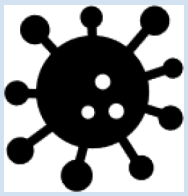
One primary determinant of patient visibility is ICU layout, and layouts facilitating ready visualization of patients may be more difficult to design and construct. The visibility of patients at risk of deterioration is a high priority and complements existing monitoring devices, as the sickest patients benefit from early detection of clinical deterioration (7, 8). Caring for patients in more visible areas may allow staff to more rapidly intervene and to recognize when colleagues require assistance. The panel noted that "visibility" specifically refers to the patient, including their face, monitors, and bedside alarms, as opposed to the room entryway or nonpatient care design elements.

A Strong Recommendation was made in favor of high-visibility layouts, despite a low certainty of evidence that evaluated patient safety during critical illness. Patients requiring critical care benefit from effective monitoring and rapid team response to emerging threats as well as adverse events. Although the certainty of evidence is low, this is a fundamental aspect of ICU care. The undesirable effects of high-visibility rooms (e.g., reduced privacy) (9) are believed to be minimal by comparison to the anticipated benefits and may be easily mitigated. ICU design for optimum patient visibility from staff workstations is a priority regardless of layout.

1.2. Should Centralized vs. Decentralized Charting Areas Be Used in ICUs?

Historically, clinical care areas were commonly designed with a large, central area with seated work areas for staff to complete charting, documentation, and other nonclinical tasks. It is uncertain whether ICU designs featuring decentralized staff areas, with multiple locations for charting, are more effective than traditional centralized layouts. Decentralization may allow staff to remain closer to individual patients resulting in shorter response times, as well as improved patient visibility and safety (10). The panel judged the overall evidence certainty to be low but assessed desirable and undesirable effects of centralized vs. decentralized charting as likely to be closely matched and thus made no recommendation and that either could

TABLE 1.
Summary Recommendations

Theme	Recommendations	Evidence Strength
ICU layout 	1.1. We recommend designing ICUs to have high patient visibility.	Strong recommendation, low certainty evidence
	1.2. Either decentralized or centralized ICUs staff charting areas may be used.	No recommendation, low certainty evidence
	1.3. We suggest ICUs use single-patient rooms rather than open-bay layouts.	Conditional recommendation, very low certainty of evidence
	1.4. New facilities should locate critical care units as close as possible to frequently used non-ICU care sites (e.g., surgery, recovery, emergency, imaging, procedural areas) to reduce transport and adverse patient events.	Good practice statement
Room design 	2.1a. We recommend having windows and natural lighting in all ICU patient rooms.	Strong recommendation, low certainty of evidence
	2.1b. We suggest using noise-reduction strategies (e.g., sound-absorbing tiles) to reduce ambient noise.	Conditional recommendation, very low certainty of evidence
	2.2. Either in-room or centralized supply room location(s) may be used.	No recommendation, very low certainty of evidence
Infection control 	3.1. Either advanced HVAC systems or standard HVAC systems can be used, depending on the resources available and feasibility of implementation at a given site.	No recommendation, very low certainty of evidence
	3.2. ICUs should incorporate advanced infection prevention features to prevent airborne, waterborne, and surface-borne transmission.	Good practice statement
Infrastructure 	4.1. We suggest designing ICUs with capacity for monitoring and controlling devices outside of patient rooms.	Conditional recommendation, very low certainty of evidence
	4.2. We suggest building ICUs using tele-ICU capacity.	Conditional recommendation, very low certainty of evidence
	4.3. ICU designs should plan for surges in patient volumes, and this should consider the ICU space, as well as novel hospital spaces.	Good practice statement
	4.4. We suggest nonwall-based life support utility access (e.g., power columns, pendant-mounted booms).	Conditional recommendation, very low certainty of evidence
Staff space 	5.1. We suggest using ergonomic designs in the ICU both for staff workspaces and patient care areas.	Conditional recommendation, very low certainty of evidence
	5.2a. ICUs should include dedicated staff break rooms.	Good practice statement
	5.2b. We suggest separate quiet rooms and respite spaces to promote staff wellbeing.	Conditional recommendation, low certainty of evidence
	5.3. ICU designs should permit use of mobile workstations or devices.	Good practice statement

HVAC = heating, ventilation, and air conditioning.

be used. Both approaches carry significant patient and staff safety risks if not carefully implemented.

For either choice, efforts should be made to maximize desirable and minimize undesirable effects. The selected approach is likely to be impacted by ICU layout, patient visibility (high priority), staff risk perceptions, and available technologies. Many ICUs have both centralized and decentralized monitoring. Technological considerations may be particularly essential to support decentralized staff in maintaining effective situational awareness and support team-based care (e.g., remote monitoring; portable communication devices/alarms; staff areas). Tele-critical care is discussed in section 4.2.

1.3. Should Single-Bed Rooms vs. Open Bay Layouts Be Used in ICUs?

Major differences between single-bed vs. multibed rooms—besides square footage and occupancy—may be evaluated based on staff and patient impact. While single-bed rooms may enhance infection control, they may also complicate care as staff must exit and reenter multiple rooms during a typical shift. They furthermore limit visibility of patients compared with an open layout. Reduced staff and/or family contact with patients during the COVID-19 pandemic due to room entry limitations appeared to increase delirium and coma risk; however, the evidence is of very low certainty (11). Based on existing data, there is a low certainty of impact on family members and staff. Nonetheless, single patient rooms likely enhance patient and family satisfaction and may support staff comfort compared with multipatient rooms, especially if multipatient rooms are a temporary adaptation to surge volume. Single patient rooms offer higher levels of privacy and enhance the confidentiality of patient and family conversations with clinicians.

Adverse event risk perception or occurrence can drive clinician anxiety, especially in complex care environments. A study of adverse events in an ICU that transited from multibed to single occupancy single ICU rooms documented significant decreases in unforeseen cardiac arrest but significant increases in unplanned extubation; nine other potential adverse events (e.g., falls, pressure ulcers) were not impacted by room occupancy (12). Evidence for the effect of single-bed rooms on adverse events is of very low certainty. Clinician survey data suggest that staff experience more difficulty observing patients in single-bed room settings (7, 10, 13–15). Decision-making regarding single-bed vs. multiple bed approaches highlight realities such as variables of space, cost, equipment, and volume. Costs for each approach will vary significantly across construction, renovation, and operations. Based on low certainty data, and variable impacts between the two approaches, a conditional recommendation for single-bed rooms was due to likely reduction of infection, delirium and coma, as well as patient and family satisfaction. In addition to the above, there may be local infection control requirements for isolation rooms, based upon the jurisdiction, size, and ICU type to consider alongside other aspects of design (16, 17).

1.4. Should Designs With Close Proximity vs. Without Close Proximity to Key Destinations Be Used for ICUs?

Reducing travel distance and transport time for critically ill patients may reduce adverse event frequency and staff injury risk; however, structural limitations within a facility may serve to limit feasible options for the ICU physical location. Transport out of the ICU is a high-risk event for patients, and risk appears related to both time and distance (18). Patient transport requires substantial resources including monitoring and care devices, therapeutic agents, and clinicians to support safety. Specific transport locations associated with increased risk of death included radiology, the operating room, and to procedures such as angiography and endoscopy (19). These influences persist regardless of the complexity or resources available at the intended destination. Ensuring proximity to key destinations helps enable safe, quality care for all ICU patients (20). It is desirable that ICU location within a facility reflects deliberate support of patient care priorities vs. other factors (e.g., cost, aesthetics). Based on this indirect evidence, a GPS was made to prioritize locating ICUs near key resources to reduce patient transport time.

2. ROOM DESIGN

2.1. Should Rooms With Environmental Features to Enhance Sleep and Recovery (Light and Noise Mitigation, Natural Lighting) vs. Standard Rooms Be Used in ICUs?

Light and noise mitigation are priorities as ICU environments commonly disrupt natural sleep cycles, promote

delirium, and impede recovery. Incorporating natural lighting, circadian lighting, and noise mitigation could reduce sleep disruption (21–24). While early studies of windows suggested a beneficial impact upon mortality and delirium, effects remain unclear. Given the observational nature of the research, confounding risks and imprecise effect estimates, the panel assigned a low certainty of evidence for access to window views and/or natural lighting on mortality, delirium, and ventilator or ICU length of stay (25–28). Windows views are inherently desirable as they reduce the clinical character of the setting, reflect current patient, family, and staff expectations and are encoded in existing ICU standards. Therefore, a Strong Recommendation was made supporting windows in patient rooms.

Studies of specific-design related features to address ICU noise mitigation were not identified. Noise canceling ceiling tiles may enhance patient rest and staff communication (21). Common ICU noise sources include staff activity and conversation, furniture movement, other patients, visitors, and monitor and device alarms. Because alarms often exceed the World Health Organization decibel standards they are associated with impaired sleep hygiene (22). The panel agreed that the effect of ICU design noise mitigation strategies warranted a very low certainty of evidence assessment due to quite limited study data.

2.2. Should In-Room Supplies vs. Centralized Supply Rooms Be Used in ICUs?

The panel found multiple facility specific approaches to address this question. Given that very low empirical evidence was found to suggest the superiority of one approach over the other, no recommendation was made and that either in-room or centralized routine supplies may be successfully used to support bedside patient care.

3. INFECTION CONTROL

3.1. Should Advanced Heating, Ventilation, and Air Conditioning Designs vs. Standard Heating, Ventilation, and Air Conditioning Designs Be Used in ICUs?

The COVID-19 pandemic brought efforts to mitigate respiratory transmission of pathogens into sharper focus. Advanced heating, ventilation, and air conditioning (HVAC) designs may include increased airflow or ventilation rates, incorporation of ultraviolet light, additional filtration beyond that required by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (29) for natural ventilation, and/or use of 100% outside air. While evidence suggests there may be some benefit to advanced HVAC systems to reduce pathogens, the impact of those systems on infections, morbidity, mortality, or other important patient-relevant outcomes remains uncertain (30–32). Advanced HVAC system costs may be substantial, and there may be difficulties with adoption and use in some institutions as well as resource-limited settings. There was insufficient evidence to make a recommendation for or against using advanced HVAC systems.

3.2. Should Advanced Infection Prevention Features vs. No Advanced Infection Prevention Features Be Used in ICUs?

Advanced infection prevention features may include antimicrobial surfaces, specific handwashing sink designs, location of personal protective equipment (PPE), dedicated donning and doffing spaces, and cleaning protocols. The evidence reviewed highlighted nosocomial infection as a challenging source of morbidity and mortality in the ICU (33). There is no strong evidence supporting the efficacy of any single infection control and prevention measure to address nosocomial infection. While it is unclear which single advanced infection prevention and control feature is most effective, the cumulative effect of multiple simultaneous interventions to mitigate nosocomial colonization, infection, and localized outbreaks is anticipated to be large. Nonetheless, the interventions are designed to reduce the likelihood of nosocomial pathogen acquisition and subsequent infection, especially in those with immune compromise. Guidance regarding interventions included: 1) reducing or clearing pathogen bioburden (30, 34, 35); 2) improving hand hygiene compliance (36–38); 3) attention to sink location, splash guard use, and water filter emplacement (39–42); 4) appropriate space for PPE (43); 5) pathogen-reducing or surface-cleaning enabling surface materials (44–48); and 6) the impact of push-plate door handles (49). Most interventions demonstrate face validity and appear to reduce microbe counts on surfaces as well

as patient colonization by antimicrobial resistant or multidrug-resistant organism pathogens.

Given the large potential harms associated with nosocomial infection, the panel established a GPS for planners to incorporate advanced infection prevention features to prevent airborne, waterborne, and surface borne transmission. Such interventions should ideally occur in conjunction with local infection control and prevention clinicians experienced in assessing outbreak patterns and sources.

4. INFRASTRUCTURE

4.1. Should Outside-Room Monitoring and Control of Devices vs. Inside-Room Only Monitoring and Control of Devices Be Used in ICUs?

Technological advances have made it possible for ICU equipment to be monitored, documented, and controlled from outside the patient room. During the COVID-19 pandemic, this became an important consideration for frontline staff safety and efficiency, while supporting infection control practices and reducing PPE use. The ability to monitor and control devices outside ICU rooms demonstrates face validity as a beneficial intervention but is devoid of robust evidence supporting efficacy (50). Overall flexibility, safety, and convenience favor having monitor and device control capacity duplicated outside the room. Such an approach should consider the impact of locating staff further away from the patient during care episodes. When using remote interventions, patient visibility and staff access to the care space are essential.

4.2. Should Advanced Remote Monitoring (e.g., Tele-Critical Care) vs. Usual Care Be Used in ICUs

Tele-ICU programs may reduce mortality and ICU length of stay (51). Staffing costs may be high, but infrastructure costs need not be financially prohibitive based upon specific equipment and platform selections. It may be more difficult to install tele-ICU infrastructure after occupancy, especially if new wiring (including power) needs to be installed. The panel made a Conditional Recommendation for incorporating tele-critical care capability, particularly in community and rural hospitals where rapid access to critical care specialists may be problematic (52, 53).

4.3. Should Flexible Surge Capacity vs. No Specific Design for Surge Capacity Be Used in ICUs?

We recommend ICU designs plan for surges in patient volumes, whether this is done within the ICU or using other unconventional spaces. The COVID-19 pandemic highlighted the unpredictability of critical care needs and the importance of being able to rapidly augment bed capacity to address patient volume surges. Surge capacity includes equipment, staff, and the ICU physical infrastructure (i.e., beds or care locations). While comparison studies of surge capacity were not identified, strategies to rapidly increase capacity included: 1) cohorting multiple patients within a single room (54, 55); 2) using novel spaces for patient care (56, 57); 3) leveraging resources across health systems such as load balancing across sites (58); 4) deploying monitors to increase observation capability (56); and 5) emplacing portable high-efficiency particulate air filters to improve airborne isolation room complement (59). Additionally, staff augmentation may occur using a tiered-staffing structure where ICU clinicians guide teams of non-ICU clinicians to provide critical care during surges (60).

Surge planning requires acquisition, storage, and intermittent deployment of resources beyond those required for usual care. Resources, along with space constraints, are likely to widely vary between sites. COVID-19 pandemic surge challenges included insufficient supply of medical gasses, suction, monitors, electrical outlets, and space for respite or dining while preserving interpersonal distances, equipment storage space in novel care zones, PPE storage, as well as donning and doffing zones. Electrical outlets may be more readily increased in comparison to outlets for medical grade gasses (56, 59). Surge-driven space constraints, especially in novel spaces, may limit care when multiple devices must be present at the same time (e.g., ventilator, continuous renal replacement therapy device, multiple medication infusion pumps). Novel space conversion should be specifically anticipated to address anticipated challenges in unfamiliar locations, impaired sightlines, and nonstandard storage solutions.

4.4. Should Nonwall-Based Access vs. Wall-Based Life Support Utilities Access Be Used in ICUs?

Wall-based support utilities, including power and medical gas configurations, often require the bed to be moved away from the wall to access the head of the patient (61). The clinical impact of nonwall-based life support systems is uncertain but may be substantial in terms of flexibility. The potential advantage should be balanced against greater cost compared with traditional headwall systems. Flexibility is anticipated to be valued by all users during usual and high-intensity ICU care (62). A boom configuration is likely the most flexible, but engenders more cost compared with a fixed column approach (63). The panel made a Conditional Recommendation for nonwall-based access, recognizing that there is no consensus regarding the specific design. Life support utility design and selection should occur in conjunction with end-users and related stakeholders to be congruent with usual practice while addressing potential unanticipated needs.

5. STAFF SPACE

5.1. Should Ergonomic Features vs. Usual Designs Be Used for ICUs?

Staff workplace injuries are an issue in ICUs. There is limited and very low certainty of evidence for ergonomically designed structures and devices in the ICU, such as common ergonomic devices like adjustable desks, monitors, footrests, chairs, and other height-adjustable components. While there is insufficient evidence for a recommendation and ergonomically designed devices are more costly than standard ones, they may help reduce injury, increase efficiency, enhance staff satisfaction, and reduce fatigue. In combination, each of these benefits may also improve staff retention (64).

5.2. Should Integrated Break/Respite Space vs. Nonintegrated Break/Respite Spaces Be Used in ICUs?

Staff satisfaction, burnout, and clinical performance may be influenced by the design, usability, and impact provided by nonworkspaces, such as break rooms, breast pumping space, and respite areas. Break rooms are often multifunctional, providing space for nourishment, team education, as well as team bonding. Accordingly, such spaces may promote staff well-being.

The panel made two recommendations. First, including dedicated staff break rooms that provided storage lockers, washrooms with showers, and nutrition areas arose as a GPS. An additional consideration is to locate the break room within or near the ICU in a space with windows for natural light. Second, the panel crafted a Conditional Recommendation for less essential "wellness rooms" or 'respite spaces' as promising complements to break rooms, noting that there is limited evidence to support this as a routine practice (65, 66).

5.3. Should Mobile Workstations or Combination Workstations vs. Fixed Workstations Be Used in ICUs?

Computers are integral to healthcare documentation and clinical practice. Contemporaneous bedside access to laboratory results, diagnostic imaging, and other elements of the electronic health record are routine aspects of bedside care. Mobile devices that move in and out of isolation spaces present an infection control issue and drive the need for in-room charting capability. Workstations-on-wheels (WOWs) require certain accommodations based on their size, charging needs, and wireless network connectivity (66–68). Wider hallways and common areas for rounds and teamwork may need to accommodate staff utilizing WOWs. A GPS recommendation favors the use of mobile devices.

UNADDRESSED ASPECTS OF ICU DESIGN

The 15 PICO question limit left a wide variety of relevant ICU design domains unexplored.

Key domains include but are not limited to: 1) room size, 2) family accommodations (visiting vs. sleeping), 3) service animal accommodations, 4) dedicated procedure rooms (with or without lead shielding), 5) location of administrative leadership space (inside or outside but adjacent), 6) ICU layout (straight, pods, rectangular, other), 7) total room number, 8) location of call rooms, 9) work spaces for allied health professionals, 10) flooring materials, 11) location of sinks and toilets, 12) integrated shower in each room vs. no

shower or limited showers, 13) type of privacy accommodations (drapery vs. on-demand window frosting, 14) location of care teams (on unit vs. within a closed core), 15) education supporting conference room(s), 16) family consultation room(s), 17) methods of unit access control, 18) signage (fixed, mobile, electronic), and 19) ICU carbon footprint and waste management. Other design elements may be pursued that reflect unique site needs or constraints such as those in resource-limited or austere settings as well as general vs. specialty ICUs. Finally, it remains unclear how each of the guidelines recommendations or practice statements will influence care and outcomes for patients, families, and staff. Each aspect merits specific focused inquiry.

LIMITATIONS

GRADE-based methodology has been used for these guidelines, which is a different approach from earlier ICU Design Guidelines (3, 4). The systematic review identified, at best, literature of low certainty, and most commonly literature of very low certainty, and occasionally areas deemed important by the panel but with no relevant literature to evaluate. A paucity of high-quality research systematically evaluating the impact of ICU design elements on clinical or patient-important outcomes also impacted the panel's strength of evidence assessment in many domains, resulting in only two Strong Recommendations. Although systematic evaluation of the literature is an important element of ideal guidelines development, future ICU design guidelines efforts will likely continue to require incorporating expert opinion to craft guidance that is useful to individuals, teams, and organizations engaged in ICU design work.

Unlike other guidelines, public nonclinical input was not sought as the major focus was ICU design and not ICU use. SCCM's 2017 Family-Centered Care guidelines (69) is currently under revision and is anticipated to inform how such care interfaces with ICU design and use elements. Forthcoming SCCM work products will separately address environmental responsibility and sustainability in the ICU, which may impact later green ICU design recommendations. These guidelines may not reflect design priorities in some specialty ICUs. Additionally, specific adaptations for resource-limited or austere environments are not addressed. Nonetheless, general principles for considering ICU design are likely translatable to fixed structures. Mobile critical care spaces are not covered herein and likely reflect military priorities instead of ones relevant for civilian clinicians. Since only English language manuscripts were included, relevant studies published in other languages would not inform guidelines development.

CONCLUSIONS

These guidelines addresses aspects of current ICU design to inform planning of new or renovated ICUs. It serves as a complement to recommendations addressed in SCCM's 2012 ICU design guidelines (4). The expert guidance reflects the impact of key drivers of bedside critical care delivery including technological advances, infection control imperatives, patient care exigencies, staff well-being, and challenges brought by the COVID-19 pandemic. Additional areas of ICU design-relevant research are noted and may drive future inquiry.

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The American College of Critical Care Medicine (ACCM), which honors individuals for their achievements and contributions to multidisciplinary critical care medicine, is the consultative body of the Society of Critical Care Medicine, which possesses recognized expertise in the practice of critical care. The ACCM has developed administrative guidelines and clinical practice parameters for the critical care practitioner. New guidelines and practice parameters are continually developed, and current ones are systematically reviewed and revised. Librarian services, systematic review, and analysis for these guidelines were provided contractually through the Guidelines in Intensive Care Medicine, Development and Evaluation Group, McMaster University, Canada. Methodologists served as expert panel members specializing in this area.

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