

ICU Admission, Discharge, and Triage Guidelines: A Framework to Enhance Clinical Operations, Development of Institutional Policies, and Further Research

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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 (SCCM) that possesses recognized expertise in the practice of critical care. The College 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.

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Objectives: To update the Society of Critical Care Medicine's guidelines for ICU admission, discharge, and triage, providing a framework for clinical practice, the development of institutional policies, and further research.

Design: An appointed Task Force followed a standard, systematic, and evidence-based approach in reviewing the literature to develop these guidelines.

Measurements and Main Results: The assessment of the evidence and recommendations was based on the principles of the Grading

of Recommendations Assessment, Development and Evaluation system. The general subject was addressed in sections: admission criteria and benefits of different levels of care, triage, discharge timing and strategies, use of outreach programs to supplement ICU care, quality assurance/improvement and metrics, nonbeneficial treatment in the ICU, and rationing considerations. The literature searches yielded 2,404 articles published from January 1998 to October 2013 for review. Following the appraisal of the literature, discussion, and consensus, recommendations were written.

Conclusion: Although these are administrative guidelines, the subjects addressed encompass complex ethical and medico-legal aspects of patient care that affect daily clinical practice. A limited amount of high-quality evidence made it difficult to answer all the questions asked related to ICU admission, discharge, and triage. Despite these limitations, the members of the Task Force believe that these recommendations provide a comprehensive framework to guide practitioners in making informed decisions during the admission, discharge, and triage process as well as in resolving issues of nonbeneficial treatment and rationing. We need to further develop preventive strategies to reduce the burden of critical illness, educate our noncritical care colleagues about these interventions, and improve our outreach, developing early identification and intervention systems. (*Crit Care Med* 2016; 44:1553–1602)

Key Words: administration; admission; critical care; critically ill; discharge; fertility; guideline; healthcare rationing; intensive care; intensive care unit; metrics; nonbeneficial treatment; triage; utilization

Critical care resources are limited and expensive. The appropriate utilization of ICU beds is essential, but it is complex and a challenge to attain. In 2008, the cost of critical care in the United States was estimated to range between \$121 and \$263 billion (16.9–38.4% of hospital costs and 5.2–11.2% of national healthcare expenditures) (1). The increasing cost of delivering healthcare has become an unsustainable burden accompanied by waste, overuse, care delays, and other delivery inefficiencies.

In 1998, the Advisory Commission on Consumer Protection and Quality in the Health Care Industry, created by President William J. Clinton to evaluate and provide advice on the healthcare system, released a report asking for a national commitment to improve the quality of healthcare (2). Consequently, the Institute of Medicine released recommendations for improving the 21st century American healthcare system, emphasizing the delivery of safe, effective, patient-centered, timely, efficient, and equitable healthcare (3, 4). The institute proposed an urgent overhaul of the healthcare system; it was considered imperative that the management of our systems be improved. As time has passed, the increasingly older and growing population, limited workforce, increased complexity of care and severity of illness of hospitalized patients, and other factors are adding to the pressure to change clinical processes to improve patient care.

Preceding some of these reports, in 1999, the Society of Critical Care Medicine (SCCM) published guidelines for ICU admission, discharge, and triage (ADT) (5). Since that time,

practitioners and administrators have considered these guidelines in formulating policies and establishing criteria for ICU ADT in their institutions. In light of the significant health-care legislative changes and changes in ICU technologies and treatments that have occurred in the United States in the 15 years since the original ADT guidelines were published, the American College of Critical Care Medicine Board of Regents, through the Guidelines Management Committee, appointed a new Task Force to re-evaluate and update the guidelines.

The following recommendations are the result of the work of the ADT Task Force. The recommendations are divided into sections: admission criteria and benefits of different levels of care, triage, discharge timing and strategies, use of outreach programs to supplement ICU care, quality assurance/improvement and metrics, nonbeneficial treatment in the ICU, and rationing considerations and systems.

METHODOLOGY

SCCM

The Society is the largest multidisciplinary nonprofit medical organization dedicated to improve critical care practice, education, research, and advocacy. It embraces the delivery of timely interventions. SCCM's mission is "to secure the highest quality care for *all* critically ill and injured patients." At the same time, SCCM "envisions a world in which *all* critically ill and injured persons receive care from a present integrated team of dedicated trained intensivists and critical care specialists."

Task Force

A group of nationally and internationally recognized clinical experts, authors, and leaders in critical care medicine integrated the ADT Task Force. After a planning and group consolidation period, a teleconference was held to establish and agree on the organizational and functional structure of the Task Force, review the work of previous SCCM Task Forces, and make decisions regarding the agenda, scope, timeline, grading system, educational tools, and other potential support needs. Additional meetings were scheduled as necessary. The subsequent work of the group was conducted individually and through web meetings, teleconferences, telephone discussions, e-mails, and face-to-face meetings during the SCCM annual congress.

Objectives

The objectives of this Task Force were 1) to update the SCCM Guidelines for ICU ADT and 2) to provide a framework for the development of institutional policies, further research, and discussion for future refinement of these recommendations.

Topic Refinement

The population considered for these guidelines consisted of adult critically ill patients who are candidates for critical care services or admission to the ICU. Adults are considered to be persons 18 years old and older. Critical care and critical illness

are defined by the Centers for Medicare & Medicaid Services as follows: "Critical care is defined as the direct delivery by a physician(s) of medical care for a critically ill or critically injured patient. A critical illness or injury acutely impairs one or more vital organ systems such that there is a high probability of imminent or life-threatening deterioration in the patient's condition." (6)

Topic selection and organization were performed by the Task Force chair (J.L.N.) and agreed upon by all guideline authors. The broad sections for the guidelines addressed the following interventions: ICU ADT, outreach programs, non-beneficial care, rationing, and quality assurance and performance improvement. Individual section assignments were based on author expertise and interest. Relevant questions defined the coverage and recommendations for each section. For example, the authors of the ICU discharge section considered whether patients discharged during the day have different outcomes than patients discharged at night. All authors were responsible for identifying areas in which further research is needed.

Search and Review of the Literature

The Task Force chair, in consultation with the librarian (C.S.F.), clarified the topics and identified specific questions to be answered using the published literature. After group discussion and agreement, these questions served as a basis for constructing comprehensive literature searches in selected biomedical databases in order to identify relevant publications for each section of the guidelines. Using the 1999 ADT Guidelines as a starting point, searches in MEDLINE (Ovid), EMBASE (Ovid), and PubMed yielded 2,404 articles published from January 1998 to October 2013. Additional searches using Guidelines.gov, Scottish Intercollegiate Guidelines Network, Trip database, selected societies' websites, and handsearching yielded an additional 10 guideline documents and other articles that were considered by the authors. Detailed information about the search strategies is presented in **Appendix 1** (Supplemental Digital Content 1, <http://links.lww.com/CCM/B900>).

Each author received the set of citations and abstracts relevant to his or her section of the guidelines; references not directly related to the content area were excluded from the review. The full-text articles were retrieved, and the research presented in the articles was appraised prior to the formulation of the new recommendations.

Scoring of the Evidence

Authors were directed to use the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) system to appraise the literature and support their recommendations where applicable (7–9). In order to apply the GRADE criteria, the group underwent additional training on the use of GRADE through educational material provided by the librarian, a webinar led by a guideline co-author who had experience using GRADE (M.N.), and e-mail communication for consultation. SCCM resources were available to the team throughout the process.

The GRADE system explicitly separates the certainty of evidence from the strength of recommendation. It classifies evidence as high (grade A), moderate (B), low (C), or very low (D) certainty for individual study outcomes. Randomized controlled trials are initially classified as high-certainty evidence and observational studies as low-certainty evidence. Evidence can be downgraded on the basis of five factors: study limitations resulting in a likelihood of bias, inconsistency of results, indirectness of evidence, high likelihood of publication bias (publication of selective results), and imprecision of results. Evidence can be upgraded on the basis of three factors: a large effect size (10), presence of a dose-response gradient, and plausible confounding biases that would tend to blunt or negate findings.

Formulation of Recommendations

Recommendations are classified as strong (grade 1) or weak (grade 2) (11). Four considerations influenced assignment of the strength of a recommendation: certainty of evidence, assessment of the balance of risks and benefits, relevant values and preferences, and burdens and costs of interventions. The scores given for certainty of evidence and strength of recommendation reflect the group's degree of confidence in their assessment. As an example, a strong recommendation based on high-certainty evidence is indicated as a grade 1A recommendation (**Table 1**).

Making a recommendation entails interpreting data and clinical culture through the lens of expertise. The Task Force composed of the guidelines to respect the history of the document, clinical needs in the medical community, available evidence, and the demands imposed by these elements. Using GRADE to arrive at the recommendations made as clear as possible the link between certainty of evidence and data. Specifics regarding patients, interventions, comparisons, and outcomes were essential to the linkage between the literature and the recommendation. In many cases, recommendations were such that the alternative was not plausible. In this case, the recommendation was left ungraded as a best-practice statement.

Using five factors (bias, heterogeneity, imprecision, indirectness, and publication bias) to downgrade evidence and three factors (effect size, dose-response gradient, and plausible blunting effects of biases) to upgrade evidence, Task Force members assigned a score to the supporting data for confidence in the evidence. Strength of recommendation was based on the confidence in the evidence, the balancing of positive and negative effects, values and preferences, and burdens and costs of interventions.

Each section author wrote and scored recommendations for his or her assigned topic. If no recommendations were offered, authors provided a statement to that effect. An initial completed draft was reviewed by all of the members of the Task Force. Comments were addressed, and a revised draft was circulated among previous Task Forces' members for comment before the final draft submission and approval. Finally, the members completed two rounds of Delphi surveys, and their responses were scored using a Likert scale. The scaling ranged from strongly disagree (score = 1) to strongly agree (score = 5).

TABLE 1. Scoring for Certainty of Evidence and Strength of Recommendation

Certainty of Evidence	High (A)	Moderate (B)	Low (C)	Very Low (D)
Implications for future research	New data unlikely to change current confidence in findings	New data likely to have an important impact on confidence	New data very likely to have an important impact on confidence	Current lack of confidence in findings points to need for research
Strength of recommendation	Strong (1)		Weak (2)	
Confidence in recommendation	Benefits definitively outweigh associated costs and burdens	Benefits worth associated costs and burdens	Uncertain balance of benefits vs costs and burdens	Costs and burdens might outweigh benefits
Meaning	To clinicians: most patients should get the intervention		To clinicians: help patients make informed decisions about the intervention	
	To patients: most people would want the intervention		To patients: many people would not want the intervention	
	To policymakers: consider adopting the intervention as policy		To policymakers: the intervention's value is debatable	

Adapted from Andrews et al (11). Adaptations are themselves works protected by copyright. So in order to publish this adaptation, authorization must be obtained both from the owner of the copyright in the original work and from the owner of copyright in the translation or adaptation.

A score of 4 or greater was considered general agreement. Any differences after the second survey were decided by vote. General agreement was reached for all final recommendations and their grades.

Limitations and Strengths

Historically, administrative guidelines have not been developed using evidence-based methodology, but rather using a non-systematic expert-opinion approach; this approach was used for the previous ADT recommendations (5). Even the most recent SCCM guidelines continue to follow this approach, possibly because of the lack of traditional sources for evidence in administrative fields (12). Some recent clinical guidelines, such as the American Society of Anesthesiologists' latest difficult airway management and central venous access guidelines, were supported by a methodical mixture of evidence and expert opinion (13, 14). Despite the administrative nature of the ADT guidelines, the Task Force decided to use a systematic approach to review the literature and avoid an expert-opinion system to generate recommendations. Recommendations were left "ungraded" when there was no evidence to support a recommendation by the panel, the particular practice was considered "best practice," and/or the alternative statement did not make sense. The panel sought to base recommendations on evidence when it existed.

Target Audiences

The target audiences of these guidelines are the critical care professionals and administrators who make daily administrative and clinical decisions in the ICU, government agencies, non-government organizations, and any other healthcare legislative body evaluating the utilization of these resources. However, some of these recommendations may be inadequate in regions outside the United States. Major geographical, geopolitical,

and economic differences in other parts of the world could represent barriers for implementation or appropriateness.

Conflict of Interest

These administrative guidelines were formulated with no direct industry interference at any level. We did not discuss drugs, devices, software applications, or other industrial products during the development of this document. In the first meeting, the members of the ADT Task Force indicated that they have no significant financial or nonfinancial conflict of interest with participation in this project. In addition, all the members fulfilled the requirements of filling out and submitting the standard SCCM conflict of interest disclosure forms, which were evaluated and cleared by the SCCM Guidelines Management Committee for potential conflicts.

Guidelines Revision and Updates

Considering the complexity of a frequent review of this document and the potential lack of additional substantive evidence that would merit the revision of the current body of work, we do not foresee a full review of the guidelines in less than 3 years. However, the ADT Task Force has set a publication monitoring process that will allow the early identification of studies of enough significance to prompt an earlier update in any of the recommendations. This update would be linked to the electronic version of the article and would not require the revision of the entire document.

SUMMARY STATEMENT

Table 2 summarizes the Task Force's recommendations. The evidence and rationale for each recommendation, as well as suggestions for future research, are described in the remaining sections of this document.

TABLE 2. Summary of Evidence-Based Recommendations and Best Practices

Recommendations	Grade
ICU admission	
We suggest that individual institutions and their ICU leaders develop policies to meet their specific population needs (e.g., trauma, burns, and neurological), taking into consideration their institutional limitations such as ICU size and therapeutic capabilities	Ungraded
To optimize resource use while improving outcomes, we suggest guiding ICU admissions on the basis of a combination of	2D
<ul style="list-style-type: none"> • Specific patient needs that can be only addressed in the ICU environment, such as life-supportive therapies • Available clinical expertise • Prioritization according to the patient's condition • Diagnosis • Bed availability • Objective parameters at the time of referral, such as respiratory rate • Potential for the patient to benefit from interventions • Prognosis 	
We suggest using the following tools for bed allocation during the admission and triage processes	Ungraded
<ul style="list-style-type: none"> • Guide to resource allocation of intensive monitoring and care (Table 3) • ICU admission prioritization framework (Table 4) 	
We suggest patients needing life-sustaining interventions who have a higher probability of recovery and would accept cardiopulmonary resuscitation receive a higher priority for ICU admission than those with a significantly lower probability of recovery who choose not to receive cardiopulmonary resuscitation (Table 4)	2D
We suggest that patients with invasive mechanical ventilation or complex life-threatening conditions, including those with sepsis, be treated in an ICU. Patients should not be weaned from mechanical ventilation on the general ward unless the ward is a high-dependency/intermediate unit	2C
We suggest that critically ill patients in the emergency department or on the general ward be transferred to a higher level of care, such as the ICU, in an expeditious manner	2D
We suggest avoiding admitting to a specialized ICU patients with a primary diagnosis not associated with that specialty (i.e., boarding)	2C
We suggest the admission of neurocritically ill patients to a neuro-ICU, especially those with a diagnosis of intracerebral hemorrhage or head injury	2C
We recommend a high-intensity ICU model, characterized by the intensivist being responsible for day-to-day management of the patient, either in a "closed ICU" setting (in which the intensivist serves as the primary physician) or through a hospital protocol for mandatory intensivist consultation	1B
We do not recommend a 24-hr/7-d intensivist model if the ICU has a high-intensity staffing model (vide supra) during the day or night	1A
We suggest optimizing ICU nursing resources and nursing ratios, taking into consideration available nursing resources (e.g., levels of education, support personnel, specific workloads), patients' needs, and patients' medical complexity	2D
Because of current constraints on the availability and cost of 24-hr intensivist coverage, further studies are needed to address the efficacy of coverage with critical care–trained advance practice providers, including nurse practitioners and physician assistants, and critical care telemedicine	Ungraded
We suggest that patients receive ICU treatment if their prognosis for recovery and quality of life is acceptable regardless of their length of ICU stay. However, factors such as age, comorbidities, prognosis, underlying diagnosis, and treatment modalities that can influence survival should be taken into account	Ungraded

(Continued)

TABLE 2. (Continued). Summary of Evidence-Based Recommendations and Best Practices

Recommendations	Grade
ICU triage	
We suggest that every ICU institute methods for prioritizing and triaging patients, with policies and guidelines that are disclosed in advance	Ungraded
We suggest that triage decisions are made explicitly and without bias. Ethnic origin, race, sex, social status, sexual preference, or financial status should never be considered in triage decisions	Ungraded
We suggest that, under ideal conditions, patients be admitted or discharged strictly on their potential to benefit from ICU care	Ungraded
We suggest that some overtriage is more acceptable and preferable to undertriage	2D
We suggest minimizing the transfer time of critically ill patients from the emergency department to the ICU (< 6 hr in nontrauma patients)	2D
We suggest that, considering the frequent lack of rapid ICU bed availability, emergency medicine practitioners be prepared to deliver critical care in the emergency department	Ungraded
In addition to optimization of the triage process from the emergency department to the ICU, we suggest close monitoring and timely intervention for those who are triaged to the ward. These interventions might reduce delayed transfers to the ICU of undertriaged patients and prevent acute deterioration of those still requiring stabilization after hospital admission	2D
We suggest that patients with risk factors for postoperative instability or decompensation be closely monitored and managed in a higher level of care unit than the ward in the immediate postoperative period	Ungraded
There are insufficient data to make a recommendation for or against ICU-to-ICU interhospital transfer	No recommendation
We suggest that all ICUs have designated additional equivalent beds, equipment, and staff necessary to support the critically ill during a mass casualty incident emergency response	Ungraded
We suggest that a designated person or service, with control over resources and active involvement, be responsible for making ICU triage decisions during normal or emergency conditions	Ungraded
We suggest basing the decision to admit an elderly (> 80 yr) patient to an ICU on the patient's comorbidities, severity of illness, prehospital functional status, and patient preferences with regard to life-sustaining treatment, not on their chronological age	2C
We suggest that ICU access of cancer patients be decided on the basis established for all critical care patients, with careful consideration of their long-term prognosis	Ungraded
We suggest that ICU care of all critically ill patients, in particular, cancer patients with advanced disease, be reassessed and discussed with the patient, next of kin, legal representative, or power of attorney at regular intervals	Ungraded
We suggest not using scoring systems alone to determine level of care or removal from higher levels of care because these are not accurate in predicting individual mortality	2C
We suggest that all hospitals and regional areas develop a coordinated triage plan for epidemics. The hospital plans should include both triage and dissemination of patients throughout the hospital	Ungraded
We suggest that during epidemics, nontraditional settings be considered and utilized for the care of critically ill patients	Ungraded
We suggest not using routine laboratory studies alone in determining the nature of illness during an epidemic	Ungraded
We suggest that activation of the hospital disaster plan and a coordinated response of the entire healthcare team (e.g., physicians, nursing staff, environmental staff, administrators) follow the announcement of a mass casualty incident. The team should ensure that their institution and critical areas (emergency department, operating room, and ICU) are ready for the rapid and efficient transition from normal to emergency operations and increase their capacity to accommodate a larger volume of critically ill patients	Ungraded
We suggest that the disaster response teams identify all patients in need of ICU care and those already hospitalized who could be discharged, and then triage and transfer the incoming patients to the most appropriate setting as soon as possible	Ungraded
We suggest that in areas at risk, ICUs be prepared to deal with the victims of not only external disasters but also internal disasters, including collapse of surrounding services in large-scale disasters such as an earthquake, tsunami, or major tornado. Every ICU should have general disaster and evacuation plans such as those required by the Joint Commission Standards in the United States	Ungraded

(Continued)

TABLE 2. (Continued). Summary of Evidence-Based Recommendations and Best Practices

Recommendations	Grade
ICU discharge	
We suggest that every ICU stipulate specific discharge criteria in its ADT policy	Ungraded
We suggest that it is appropriate to discharge a patient from the ICU to a lower acuity area when a patient's physiologic status has stabilized and there no longer is a need for ICU monitoring and treatment	Ungraded
We suggest that the discharge parameters be based on ICU admission criteria, the admitting criteria for the next lower level of care, institutional availability of these resources, patient prognosis, physiologic stability, and ongoing active interventions	Ungraded
We suggest that, to improve resource utilization, discharge from the ICU is appropriate despite a deteriorated patient's physiological status if active interventions are no longer planned	Ungraded
We suggest refraining from transferring patients to lower acuity care areas based solely on severity-of-illness scores. General and specific severity-of-illness scoring systems can identify patient populations at higher risk of clinical deterioration after ICU discharge. However, their value for assessing the readiness for transfer of individual patients to lower acuity care has not been evaluated	Ungraded
We suggest avoiding discharge from ICU "after hours" ("night shift", after 7 PM in institutions with 12-hr shifts). In addition, best practice would seek to optimize evening and night coverage and services	Grade 2C Ungraded
We suggest discharging patients at high risk for mortality and readmission (high severity of illness, multiple comorbidities, physiologic instability, ongoing organ support) to a step-down unit or long-term acute care hospital as opposed to the regular ward	Grade 2C
We suggest that a standardized process for discharge from the ICU be followed; both oral and written formats for the report may reduce readmission rate	Ungraded
Outreach programs to supplement ICU care	
We suggest that rapid response systems be utilized for early review of acutely ill non-ICU patients to identify patients who need or would benefit from ICU admission and treatment and to prevent unnecessary ICU admissions	2C
We suggest that ICU consult teams be considered for use to facilitate transition from the ICU, assist ward staff in the management of deteriorating patients, facilitate transfer to ICU, and reduce rates of readmission to critical care	2C
Quality assurance/improvement and metrics of ADT practices	
We suggest following the SCCM's guidelines as described in "critical care delivery in the ICU: defining clinical roles and the best practice model" (currently undergoing revision)	Ungraded
We suggest that every ICU have a written ADT policy, as an administrative best practice, to guide appropriate patient placement	Ungraded
We suggest following the metrics identified as indicators of ADT performance in this framework (Table 5). This information should be collected electronically through the electronic health record, if available	Ungraded

(Continued)

TABLE 2. (Continued). Summary of Evidence-Based Recommendations and Best Practices

Recommendations	Grade
Nonbeneficial treatment in the ICU	
We suggest employing the term “nonbeneficial treatment” whenever clinicians consider further care “futile”	Ungraded
We suggest avoiding the current quantitative definitions of nonbeneficial treatment because of the lack of consensus on a single definition	Ungraded
We suggest against the routine use of the currently available severity-of-illness scores for identifying nonbeneficial treatments in specific patients	2C
We suggest that the information provided by healthcare professionals be quantitative to reduce disagreement between the prognostic information delivered to the patients' surrogates and their understanding and acceptance of the message	2C
We suggest developing clear ICU and institutional nonbeneficial treatment policies through consensus of all the parties involved (physicians, nurses, administrators, lawyers, ethicists, and family representatives)	Ungraded
We suggest that prudent clinical judgment, in conjunction with the latest American Heart Association guidelines and specific local and hospital policies, be followed in deciding when to withhold or terminate cardiopulmonary resuscitation	Ungraded
We suggest that life-supportive therapies be removed in cases of patients declared dead by neurological criteria in accordance with local law (including potential legal restrictions associated with the patient's religious beliefs), hospital policies, and standard medical practice and after appropriate organ donation considerations	Ungraded
We suggest the early involvement of ethicists (within 24 hr of identifying potential or actual conflict) to aid in conflicts associated with nonbeneficial treatment	2C
Although palliative medicine consultations have been previously associated with reduction in critical care resources, the most recent evidence does not support a recommendation, emphasizing the need for additional high-quality research on this subject	No recommendation
We suggest following the SCCM Ethics Committee's 1997 general recommendations for determining when treatments are nonbeneficial and for resolving end-of-life conflicts regarding withholding or withdrawing life support. We also support the fair-process approach recommended by the American Medical Association's Council on Ethical and Judicial Affairs committee	Ungraded
There is growing concern that nonbeneficial treatment affects not only the individuals receiving these treatments but also the rest of the population. Providing nonbeneficial treatments reduces the availability of the same resources in more appropriate situations, treatments, or patients and could cause unwanted and unrecognized harm. The effect of this practice has an unknown effect on the healthcare system as a whole, leading to an urgent need to better understand the impact of misallocation of critical care resources in the U.S. healthcare system	Ungraded
As a result of the major knowledge gaps identified, we suggest that more research be performed on all aspects of the determination and provision of nonbeneficial ICU treatment	Ungraded
Rationing	
We suggest adhering to the recommendations of the SCCM Ethics Committee, the Council on Ethical and Judicial Affairs of the American Medical Association, and the Bioethics Task Force of the American Thoracic Society for the ethical allocation of scarce medical resources until updated or appropriate evidence-based operational frameworks become available	Ungraded
Further research is needed on all aspects of rationing critical care resources to narrow the current gaps in allocating scarce resources	Ungraded

ADT = admission, discharge, and triage, SCCM = Society of Critical Care Medicine.

ICU ADMISSION

The ICU is an area within a medical facility equipped with advanced technologies such as ventilators and personnel trained to provide intensive, advanced life-supportive care to critically ill patients. These units can be general or specialized and can be organized by specific systems, pathologies, or

problems (e.g., neurological, burn, or trauma ICUs, and medical or surgical ICUs) or by age groups (e.g., adult or PICUs). Given the scarce human and economic resources available to support these units and the inappropriateness of delivering therapies that are not medically indicated, whether knowingly or not, the admission to these units is heavily guarded.

Criteria for Admission to the ICU

Recommendations:

- We suggest that individual institutions and their ICU leaders develop policies to meet their specific population needs (e.g., trauma, burns, and neurological), taking into consideration their institutional limitations such as ICU size and therapeutic capabilities (ungraded).
- To optimize resource use while improving outcomes, we suggest guiding ICU admissions on the basis of a combination of 1) specific patient needs that can be only addressed in the ICU environment, such as life-supportive therapies, 2) available clinical expertise, 3) prioritization according to the patient's condition, 4) diagnosis, 5) bed availability, 6) objective parameters at the time of referral, such as respiratory rate, 7) potential for the patient to benefit from interventions, and 8) prognosis (grade 2D).
- We suggest using the following tools for bed allocation during the admission and triage processes (ungraded):
 - Guide to resource allocation of intensive monitoring and care including levels of monitoring, care, and nursing ratios (**Table 3**).
 - Prioritization framework (**Table 4**).
- We suggest patients needing life-sustaining interventions who have a higher probability of recovery and would accept cardiopulmonary resuscitation receive a higher priority for ICU admission than those with a significantly lower probability of recovery who choose not to receive cardiopulmonary resuscitation (**Table 4**) (grade 2D).

Previous Guidelines and Current Status. In the previous guidelines (5), three models for guiding admission were discussed: the prioritization model, the diagnosis model, and the objective parameters model. In the prioritization model, patients are categorized by four priority levels based on how likely they are to benefit from admission to the ICU. In the diagnosis model, a list of specific conditions and diseases is offered for deciding which patients should be admitted to the ICU. In the objective parameters model, specific vital signs, laboratory values, imaging or electrocardiogram findings, and physical findings are offered for deciding which patients should be admitted. All these models have limitations, and none have been properly validated. Nevertheless, the need for objective criteria has been outlined as a part of the Joint Commission's requirements; currently, the Joint Commission requires that hospitals have a written process for accepting and admitting patients, including criteria to determine a patient's eligibility for care, treatment, and services rendered. The commission does not specifically address admission criteria in its latest publication (15).

Currently, there are no conclusive studies showing all-encompassing, definitive criteria for ICU admissions. The evidence gathered during the development of the current guidelines highlights the lack of high-quality evidence supporting specific ICU admission criteria and demonstrating improved outcomes. Furthermore, our literature review revealed the diversity and the range of methodological quality of the studies investigating this subject.

TABLE 3. Guide to Resource Allocation of Intensive Monitoring and Care

Level	Type of Patients	Nursing-to-Patient Ratios	Interventions
ICU (very high) or level 3	Critically ill patients who need hourly and/or invasive monitoring, such as continuous blood pressure monitoring via an arterial cannula	1:1 to \leq 1:2	Invasive interventions not provided anywhere else in the institution, such as cerebrospinal fluid drainage for elevated intracranial pressure management, invasive mechanical ventilation, vasopressors, extracorporeal membrane oxygenation, intraaortic balloon pump, left ventricular assist device, or continuous renal replacement therapy
Intermediate medical unit (high-medium) or level 2 ^a	Unstable patients who need nursing interventions, laboratory workup, and/or monitoring every 2–4 hr	\leq 1:3	Interventions such as noninvasive ventilation, IV infusions, or titration of vasodilators or antiarrhythmic substances
Telemetry (medium-low) or level 1 ^a	Stable patients who need close electrocardiographic monitoring for nonmalignant arrhythmias or laboratory work every 2–4 hr. This type of unit or ward service is mainly for monitoring purposes.	\leq 1:4	IV infusions and titration of medications such as vasodilators or antiarrhythmics
Ward (low) or level 0	Stable patients who need testing and monitoring not more frequently than every 4 hr	\leq 1:5	IV antibiotics, IV chemotherapy, laboratory and radiographic work, etc

^aIf an institution does not have this capability, the patient should be admitted to the next highest level.

TABLE 4. ICU Admission Prioritization Framework

Level of Care	Priority	Type of Patient
ICU	Priority 1	Critically ill patients who require life support for organ failure, intensive monitoring, and therapies only provided in the ICU environment. Life support includes invasive ventilation, continuous renal replacement therapies, invasive hemodynamic monitoring to direct aggressive hemodynamic interventions, extracorporeal membrane oxygenation, intraaortic balloon pumps, and other situations requiring critical care (e.g., patients with severe hypoxemia or in shock)
	Priority 2	Patients, as described above, with significantly lower probability of recovery and who would like to receive intensive care therapies but not cardiopulmonary resuscitation in case of cardiac arrest (e.g., patients with metastatic cancer and respiratory failure secondary to pneumonia or in septic shock requiring vasopressors)
IMU	Priority 3	Patients with organ dysfunction who require intensive monitoring and/or therapies (e.g., noninvasive ventilation), or who, in the clinical opinion of the triaging physician, could be managed at a lower level of care than the ICU (e.g., postoperative patients who require close monitoring for risk of deterioration or require intense postoperative care, patients with respiratory insufficiency tolerating intermittent noninvasive ventilation). These patients may need to be admitted to the ICU if early management fails to prevent deterioration or there is no IMU capability in the hospital
	Priority 4	Patients, as described above but with lower probability of recovery/survival (e.g., patients with underlying metastatic disease) who do not want to be intubated or resuscitated. As above, if the hospital does not have IMU capability, these patients could be considered for ICU in special circumstances
Palliative care	Priority 5	Terminal or moribund patients with no possibility of recovery; such patients are in general not appropriate for ICU admission (unless they are potential organ donors). In cases in which individuals have unequivocally declined intensive care therapies or have irreversible processes such as metastatic cancer with no additional chemotherapy or radiation therapy options, palliative care should be initially offered

IMU = intermediate medical unit.

Systems of Prioritization. With the lack of consensus in regard to the main approach to prioritizing/triaging admissions, several groups have proposed and tested new systems. Cohen et al (16) have suggested that admissions to the ICU should be based on functional impairment, rather than just severity of illness. In a study of medical admissions during 1 year, they showed that functional impairment at the time of intensivists evaluation was the determining factor influencing ICU acceptance. Patients were less likely to be admitted if their functional status was poor or they had a do-not-resuscitate order.

The most structured triage system using some vital signs available is Swedish Adaptive Process Triage, developed in 2006, which uses a combination of complaints and vital signs to create a total triage score (17). In the validation study, Barfod et al (18) found that among the vital signs, the best predictors of hospital mortality were respiratory rate, oxygen saturation, systolic blood pressure, and Glasgow Coma Scale score. Among the complaints, dyspnea and altered mental status had the highest association with mortality (12% and 11%, respectively).

Other studies have reviewed the use of abnormal vital signs for deciding ICU admissions. O’Connell et al (19) reviewed their data after starting a program in which abnormal vital signs were used as criteria to trigger patients to be admitted to an ICU until their condition improved or stabilized. In a comparison of data over 2 years for more than 5,700 patients,

211 patients met a trigger for ICU admission based on vital signs. Because tachypnea is a direct sign of critical illness, as outlined in the SCCM’s Fundamental Critical Care Support course (20), another study looked at just tachypnea (21) as a sign for ICU admission. Although this was a retrospective case-control study, Farley et al (21) determined that respiratory rate alone should be a major determinant for ICU admission. Unfortunately, there is not a reliable list of objective indicators or their respective specific thresholds for identifying candidates for ICU admission. As a matter of fact, there is evidence that some groups of critically ill patients do not present these signs. Lamantia et al (22) have shown that the sensitivity and the specificity of abnormal signs to predict death or ICU admission at triage were only 73% (95% CI, 66–81) and 50% (95% CI, 48–52), respectively, with a positive likelihood ratio of 1.47 (95% CI, 1.3–1.6) and negative likelihood ratio of 0.54 (95% CI, 0.3–0.6). Although these systems continue to improve and integrate response algorithms, their low predictive value and poor performance impede our sole reliance on them (23, 24).

Severe metabolic abnormalities may direct admissions to the ICU and overall outcomes. Jung et al (25) conducted a prospective observational, multiple-center study involving 155 patients to evaluate the use of bicarbonate therapy in the ICU and mortality. Severe metabolic acidemia (pH < 7.20) was associated with a greater than 57% chance of death. The authors suggested that earlier admission to the ICU and bicarbonate use were variables associated with better outcome.

Sprung et al (26) went further by investigating the feasibility of using a triage score to assist in deciding about ICU admissions. The score incorporated age; diagnosis; systolic blood pressure; pulse; respiratory rate; P_{aO_2} ; concentrations of creatinine, bilirubin, bicarbonate, and albumin; vasopressor use; Glasgow Coma Scale score; Karnofsky performance status score; operative status; and chronic disorders. The training and validation samples showed excellent discrimination (area under the receiving operating characteristic curve > 0.8). However, the tool is in its early stages, the assignment of the individual score is not simple (a computerized process), and its appropriateness for making decisions for individual patients is clearly limited pending further validation; therefore, it would be premature to introduce it in clinical practice (26). In another example, Bayraktar et al (27) evaluated a specific comorbidity index in hematopoietic stem cell transplantation patients in an effort to identify who would benefit from an ICU stay; however, the authors did not recommend denying ICU admission based on this score alone.

Several groups base admission to the ICU on severity of illness as determined by other national organization or local institutional scores (21, 28–38). Most of these tools represent the best guidance that is available, but most have only been validated locally and without high-quality data. Most have not been studied as preadmission tools, but rather in retrospective assessments. The Sequential Organ Failure Assessment (SOFA) score has been studied to evaluate outcomes in septic patients with evidence of hypoperfusion at the time of arrival to the emergency department (ED) and subsequent ICU evaluation 72 hours after admission (39). The authors showed that the SOFA score provided potentially valuable prognostic information for patients who needed ICU admission. Yet, Sinuff et al (40) have shown that 24 hours after admission, physicians predict more accurately than scoring systems whether ICU patients will survive.

Identifying the Required Level of Care. To reduced preventable cardiac arrests and late ICU admissions, several ways of providing critical care outside the ICU have been developed. In 1990, Schein et al (41) demonstrated that in-hospital cardiac arrests are preceded by detectable pathophysiologic changes associated with clinical deterioration within 8 hours of the arrest. This led to the establishment of the rapid response team, also called the “rapid response system” (RRS). These personnel, trained in critical care medicine, are dispatched when patients in general hospital wards have deteriorating conditions that might merit ICU admission. Several studies have evaluated the impact of RRS outreach care on ICU admissions (30, 42–45). Most have shown that RRSs have actually reduced ICU admission rates and mortality; however, the widespread use of RRS tools and validation of these teams are not based on robust data (45). This subject is discussed at length in *Use of Outreach Programs to Supplement ICU Care* section.

In 1999, a group of experts appointed by the Department of Health in the United Kingdom and led by Dr. Valerie Day suggested that patients in the hospital should be assigned a level of care based on an assessment of their clinical needs, regardless of

their location (46). In their review of critical care services published in 2000, they described these levels as follows:

- Level 0: regular hospitalized patients with no intensive monitoring or care requirements.
- Level I: patients requiring additional monitoring such as continuous electrocardiographic monitoring.
- Level II: patients requiring more frequent monitoring and interventions, such as those with single-organ dysfunction, that cannot be provided in the previous levels.
- Level III: patients requiring life-supportive therapies, such as those with single- or multiorgan failure, which can only be provided in the ICU.

This classification removes the division between ICU and other ward services and focuses on each patient’s specific monitoring and care needs. In fact, intensivists provide critical care services beyond the ICU borders; now even more with a variety of critical care outreach programs, including intermediate units, early warning systems, and medical emergency teams (47). Day and colleagues (46) clearly identified the major groups of patients regularly managed by intensivists; however, their system does not address terminal patients requiring life support and moribund patients.

Maintaining patients in flexible hospital beds can be easy if there are only monitoring needs such as electrocardiography but could create logistical problems for intensive care delivery. One possible solution is critical care outreach. In a recent ward (cluster)-randomized study of early interventions by a 24-hour outreach nurse-led team and critical care physician, Priestley et al (48) showed a significant hospital-mortality reduction for patients who received the outreach intervention, with an odds ratio (OR) of death of 0.52 (95% CI, 0.32–0.97).

Draft Tools to Aid in Patient Prioritization for ICU Admission. Acknowledging the limitations discussed above (e.g., lack of high-level evidence and validated functional admission/triage instruments), the ADT Task Force created the following tools for the use during the admission and triage processes (these tools are only offered as a framework for practical purposes, further study, and validation):

- A guide to levels of monitoring, care, and nursing ratios for bed allocation (Table 3): This tool matches the level of care the patient needs with the type of patient considered appropriate, the nursing ratios expected, and the type of interventions needed.
- An ICU admission prioritization framework based on these levels of monitoring and care requirements (Table 4): this tool provides guidance for prioritizing the patients referred to ICU for admission.

Benefits of Different Levels and Models of Critical Care

The survival benefit of critical care for different populations by age group, diagnosis, length of ICU stay, and place of treatment remains somewhat elusive (49, 50). Although ICU mortality rates are dependent on severity of illness, comorbidities,

and diagnosis, among other factors, patients hospitalized in an ICU are at increased risk of mortality after hospital discharge compared with patients who did not. In a recent survey characterizing the organizational structure and processes of care in 69 U.S. ICUs, 25 of which were medical (36%), 24 surgical (35%), and 20 of mixed type (29%), the average annual ICU mortality rate was 11% (49). In multivariable linear regression adjusted for severity of illness as measured by the Acute Physiology and Chronic Health Evaluation (APACHE) II score, as well as multiple ICU structure and process factors, the annual ICU mortality rate was lower in surgical ICUs than in medical ICUs (5.6% lower [95% CI, 2.4–8.8]) or mixed ICUs (4.5% lower [95% CI, 0.4–8.7]). A lower annual ICU mortality rate was found among ICUs that had a daily plan-of-care review (5.8% lower [95% CI, 1.6–10.0]) and a lower bed-to-nurse ratio (1.8% lower when the ratio decreased from 2:1 to 1.5:1 [95% CI, 0.25–3.4]). In contrast, 24-hour intensivist coverage ($p = 0.89$) and “closed ICU” status ($p = 0.16$) were not associated with a lower annual ICU mortality rate (51).

In a recent cohort study of ICU admissions from a Dutch national ICU registry linked to administrative records from an insurance claims database for 91,203 patients from 81 ICUs, the mortality rates at 1, 2, and 3 years after hospital discharge after an ICU stay were 13%, 19%, and 28%, respectively. Medical patients and patients admitted for cancer had statistically significantly worse mortality outcomes (adjusted hazard ratios, 1.41 and 1.94, respectively) compared with other ICU patients. Urgent surgery patients and patients with a subarachnoid hemorrhage, trauma, acute renal failure, or severe community-acquired pneumonia did not differ statistically from the other ICU patients after adjustment for case-mix differences. Although mortality after hospital discharge varied widely among subgroups, most ICU patients had an increased mortality risk in the subsequent 1–5 years after hospital discharge compared to the general population (52).

Overall, studies assessing the benefit of ICU care are limited to observational studies because of the ethical considerations of performing randomized controlled trials to answer these questions. We have categorized studies of ICU benefit into four types of comparisons in order to best evaluate the literature and to make recommendations.

Care in the ICU Versus Intensive Care in the Wards.

Recommendations:

- We suggest that patients with invasive mechanical ventilation or complex life-threatening conditions, including those with sepsis, be treated in an ICU. Patients should not be weaned from mechanical ventilation on the general ward unless the ward is a high-dependency/intermediate unit (grade 2C).
- We suggest that critically ill patients in the ED or on the general ward be transferred to a higher level of care, such as the ICU, in an expeditious manner (grade 2D).

Critical care does occur in hospital wards, usually during the activation of a RRS, deploying a rapid response team, or when a critical care bed is not immediately available to an acutely ill general ward patient. In some institutions, chronically ill patients are transferred from the ICU to the general ward for such processes as weaning from mechanical ventilation or starting rehabilitation. Although a randomized controlled trial would be difficult, several retrospective and observational studies have favored the benefits of critical care in an ICU. Worse than predicted survival is noted in the absence of ICU care for critically ill patients who receive mechanical ventilation and for those diagnosed with sepsis on general wards (53, 54). The ICU provides better monitoring, decreased endotracheal tube-related complications, and more active ventilator management (55). There is an increased risk of cardiac arrest for sicker ward patients when medical ICU beds are not available and increased risk of mortality and ICU length of stay (LOS) if there is a delay in admitting a critically ill patient from the hospital ward to the ICU (55–57). A delay of 4 hours or more in transferring patients from the hospital ward to the ICU was associated with a significant increase in mortality in a community hospital (58). Young et al (58) found that patients who were rapidly transferred to the ICU after identification of a problem (rapid transfers) had a hospital mortality rate of 11%, whereas those who arrived in the ICU after 4 hours (slow transfers) had a hospital mortality rate of 41% (relative risk [RR], 3.5; 95% CI, 1.4–9.5; $p = 0.004$). The “slow transfer” patients had a lower, but not significantly so, mean pre-ICU APACHE II score (16 ± 2 vs 19 ± 2 ; $p = 0.09$); in addition to a higher mortality rate, the “slow transfers” had a longer median hospital LOS (14 vs 9 d; $p = 0.03$) and higher median hospital cost (\$34,000 vs \$21,000; $p = 0.01$). A similar increase in ICU and hospital mortality and increase in LOS have been found for critically ill ED patients who have a 6-hour or longer delay in transfer to an ICU (59). Although complex postoperative patients benefit from admission to the ICU, the routine surgical patient may well be monitored in a non-ICU environment provided that the nursing staff has been adequately educated in the care of those patients (60–62).

General ICU Versus Specialized ICUs.

Recommendations:

Although investment in ICU specialization may not improve survival:

- We suggest avoiding admitting to a specialized ICU patients with a primary diagnosis not associated with that specialty (i.e., boarding) (grade 2C).
- We suggest the admission of neurocritically ill patients to a neuro-ICU, especially those with a diagnosis of intracerebral hemorrhage or head injury (grade 2C).

Multispecialty or general ICUs are typically located within smaller, community-based hospitals or may be utilized in tertiary institutions for critically ill patients who have diagnoses

that do not fit into one of the specialty ICUs. However, the complexities of critical care make it difficult to conclusively demonstrate efficacy for specialization (63). Studies have suggested that the organization and management of an ICU may have more of an effect on outcomes (64, 65). ICU specialization is likely motivated by physician convenience and the pooling of clinical resources around specialty departments to improve efficiency (66). Although some studies have shown the benefit of specialization of ICUs for certain fields, the literature does not support a survival benefit for specialized over general ICU care in the case of common admitting diagnoses such as acute coronary syndrome, ischemic stroke, intracranial hemorrhage, pneumonia, abdominal surgery, or coronary artery bypass graft surgery. Admission to a specialized ICU of a patient with a primary diagnosis not associated with that specialty (i.e., “boarding”) is associated with increased risk-adjusted mortality (66).

Although there are notable limitations in published studies, cumulative evidence suggests that neurocritical care unit patients show improved outcomes when compared with the treatment in a general ICU, especially for intracerebral hemorrhage and head injury (67–70). Neuro-ICU patients were reported to undergo more invasive intracranial and hemodynamic monitoring, continuous electroencephalogram monitoring, tracheostomy, and nutritional support as well as to receive less IV sedation compared with general ICU patients, possibly explaining the observed differences in outcome between neurocritical care and general ICUs (68, 69).

Modern trauma care has also become highly specialized for the critically ill patient with multiple-system injuries. Despite the development of surgical trauma ICUs, little information currently exists to compare outcomes with general ICUs. Most patients admitted to a trauma ICU appear to be sicker and more severely injured than general-ICU patients, making accurate comparisons and retrospective studies difficult (71).

Different Staffing Models.

Recommendations:

- We recommend a high-intensity ICU model, characterized by the intensivist being responsible for day-to-day management of the patient, either in a “closed ICU” setting (in which the intensivist serves as the primary physician) or through a hospital protocol for mandatory intensivist consultation (grade 1B).
- We do not recommend a 24-hour/7-day intensivist model if the ICU has a high-intensity staffing model (as described above) during the day or night (grade 1A).
- We suggest optimizing ICU nursing resources and nursing ratios, taking into consideration available nursing resources (e.g., levels of education, support personnel, specific workloads), patients’ needs, and patients’ medical complexity (grade 2D).
- Because of current constraints on the availability and cost of 24-hour intensivist coverage, further studies are needed

to address the efficacy of coverage with critical care–trained advanced practice providers, including nurse practitioners and physician assistants, and critical care telemedicine (ungraded).

This section will assess staffing models in regard to intensity of ICU physician participation in treatment of the critically ill patient, both in terms of low- and high-intensity ICU models and 24-hour intensivist care. The high-intensity model is characterized by the intensivist being responsible for day-to-day management of the patient, either in a closed ICU setting or through a hospital protocol for mandatory intensivist consultation. A low-intensity model involves elective intensivist consultation, either in an “open ICU” setting (in which patient management is mainly by another primary physician) or because there is no intensivist available. The superiority of closed ICU and high-intensity staffing in improving the outcomes of critically ill patients is supported by an abundant amount of evidence, as well as recommendations from the Leapfrog Group and the American College of Critical Care Medicine (72–79). Results of the latest systematic review and meta-analysis of ICU physician staffing models (80) further support the high-intensity staffing model. The authors showed that when compared with low-intensity staffing, the high-intensity model was associated with lower hospital mortality (pooled RR, 0.83; 95% CI, 0.70–0.99) and lower ICU mortality (pooled RR, 0.81; 95% CI, 0.68–0.96).

Our assessment of the literature reveals that the greater use of intensivists in the ICU led to significant reductions in ICU and hospital mortality and LOS. Although most of the studies were observational, these findings were consistent across a variety of populations and hospital settings. These improved outcomes were not only limited to medical ICUs but also included neurological and surgical ICUs and oncologic patient populations (81–85). Patients receiving care under the high-intensity intensivist staffing model were more likely to receive evidence-based care, including prophylaxis for deep vein thrombosis, stress ulcer prophylaxis, and spontaneous breathing trials (86). Interestingly, one study showed a higher mortality rate with the use of a high-intensity staffing model, but it was limited to patients with low severity of illness, suggesting that patients who are not critically ill may be exposed to unnecessary risk in the ICU (74, 87).

The literature supporting the need for 24-hour/7-day intensivist coverage of the ICU is not as abundant and presents several controversial issues. Although continuous 24-hour on-site critical care specialist coverage of an ICU has benefits in improved processes of care, increased staff and family satisfaction, decreased complication rate, and shorter hospital LOS, the evidence on improving patient mortality is weaker (88–90). In a retrospective study of 49 ICUs, the mortality rate improved with nighttime coverage of the ICU only when a low-intensity daytime staffing model was used (90). Although there was no difference in mortality in comparison with partial-day high-intensity coverage, 24-hour intensivist coverage was associated with improved compliance with evidence-based processes of

care. This study supports previous studies showing that intensivists improve outcomes regardless of the time of day (day or night) that they care for critically ill patients. However, adding intensivists at night after being present during the day did not confer an additional benefit. In a more recent study, van der Wilden et al (91) showed no improvement in mortality among 2,829 patients admitted during two 13-month periods, before and after a 24-hour/7-day intensivist program was introduced in their ICU. Although they found that fewer blood products and radiographs were ordered, they suggested that the health-care value may be decreased under the 24/7 model. A recent Canadian crossover study on the effects of 24-hour intensivist presence in the ICU showed no difference in adjusted hospital mortality (OR, 1.22; $p = 0.44$), ICU LOS ($p = 0.46$), or family satisfaction ($p = 0.79$). In addition, nurses reported significantly more role conflicts ($p < 0.001$) (92).

In the systematic review and meta-analysis mentioned above (80), 24-hour in-hospital intensivist coverage did not improve hospital mortality (pooled RR, 0.97; 95% CI, 0.89–1.1) or ICU mortality (RR, 0.88; 95% CI, 0.70–1.1). The authors also found that hospital mortality varied throughout different decades, ranging from a significant effect of this type of coverage in the 1980s (pooled RR, 0.74; 95% CI, 0.63–0.87) to a nonsignificant effect from 2010 to 2012 (pooled RR, 1.2; 95% CI, 0.84–1.8). The impact on ICU mortality followed this same pattern; pooled RR was 0.49 for 1980–1989 (95% CI, 0.33–0.71) and 1.0 for 2010–2012 (95% CI, 0.53–2.1). Kerlin et al (93) published the only randomized study to date, in which daytime in-hospital intensivist coverage was supplemented by either nighttime coverage by in-hospital intensivists or by nighttime availability of the daytime intensivists for telephone consultation; the results clearly demonstrated that there was no difference in ICU or hospital LOS, in-hospital mortality, or readmission.

A multidisciplinary model led by an intensivist and 24-hour care delivery by highly skilled physicians gained popularity during the past decade (74, 94). However, around-the-clock on-site intensivist coverage may not be feasible for all ICUs because of the shortage of available intensivists, the financial constraints in today's healthcare climate, and the lack of evidence supporting this approach. Coverage with critical care-trained advanced practice providers, including nurse practitioners and physician assistants, and telemedicine may be feasible alternatives (74, 95, 96).

Nursing staffing has been a matter of serious debate for more than a decade in the United States (97), but the lack of consensus in regard to the appropriate ratios, projected nursing deficits, and costs have prevented widespread acceptance. Cho and Yun (98) have shown that increased ICU and general ward nursing staffing are associated with lower in-hospital and 30-day mortality and better delivery of basic care. In a review of the literature investigating the effect of hospital staffing on infection rates, Stone et al (99) found that, among 38 studies where nursing staffing was considered, only seven did not find a statistical association. Another recent literature review spanning 2002–2011 failed to find a significant correlation

between ICU nursing staffing and adverse patient outcomes; most of the studies were observational and retrospective (100). Needleman et al (101) reported an association between better care and nursing hospital staffing. More recently, Needleman et al (102) correlated inadequate nursing staffing and increased hospital mortality. Regardless, government bodies have already established parameters for reimbursement that require specific nursing ratios of one nurse to two patients in areas in which critically ill patients are managed, such as the ICU and burn units (103). In the United States, California was the first state to introduce mandatory staffing ratios (1:2) (104).

Although 1:1 and 1:2 nurse-to-patient ratios are commonly used for critically ill patients, depending on severity of illness and patient care needs, there is insufficient evidence to establish a particular nursing ICU staffing ratio because the inadequacy of nursing resources and patients' needs and their complexity also need to be considered in the equation (105–108). However, there is growing evidence that inadequate staffing affects delivery of basic care and increases the risk of in-hospital death (106, 109). The impact of nursing rationing, and of the complexity of the evaluation of nursing resources, on outcomes is further discussed in *Impact of Rationing on ICU Outcomes* section.

The organizational structure and the system of healthcare delivery may actually influence the process of care and patient outcome more than intensivist staffing alone. Intensivists practicing medicine must organize their ICUs in ways that are ideal for implementing the standards of care based on the available evidence. Appropriately organized ICUs that utilize evidence-based bundles and protocols for delivering care to the critically ill have generated improved patient outcomes (64, 65).

Short Versus Long ICU Care.

Recommendation:

- We suggest that patients receive ICU treatment if their prognosis for recovery and quality of life is acceptable regardless of their length of ICU stay. However, factors such as age, comorbidities, prognosis, underlying diagnosis, and treatment modalities that can influence survival should be taken into account (ungraded).

Practicing critical care medicine involves treatment to sustain and prolong the life of the critically ill patient. The evolution of critical care has been to treat patients of all ages with a wide variety and severity of illness. For most of these patients, establishing a good quality of life is important because prolongation of life may result in an unacceptable health outcome (110, 111). The longer one remains in ICU, the worse one's prognosis is likely to be and the more resources that are likely to be expended (112). Older patients and those with prolonged requirement for life-supportive therapies (mechanical ventilation, dialysis, and vasopressor support), pre-existing comorbidities, and multisystem organ failure have higher mortality rates (112, 113). The dominant reason for prolonged ICU stays is often multiple organ failure, ventilatory support, or single-organ failure in nonventilated patients (112). Thus, the question that arises for patients that remain in the ICU

for a prolonged stay is: Will their outcome or quality of life be acceptable after discharge? Despite tremendous variation in what is considered a prolonged ICU stay (varying from over 5 d to over 21 d), studies have shown that even with high levels of ICU therapeutic intensity, there were reasonable hospital survival rates and quality of life after discharge (110, 114–119). This was seen in both medical and surgical ICUs, except for one study that showed a poor rate of survival and return to previous quality of life after cardiac surgery associated with a prolonged ICU stay (120). The benefit of prolonged ICU intervention can be seen even for elderly patients and those with a malignancy (118, 119). However, comparison among these studies was significantly limited because of lack of consistency in what was considered a prolonged ICU stay or quality of life. Further research with standardization of these variables is necessary to determine both predictors and sequelae of a prolonged ICU course (121). Until that time, limiting care on the basis of length of ICU stay, diagnosis, or treatment will be difficult. In future research, attention must be given as well to how transfer practices to long-term acute-care hospitals (LTACHs; *Long-Term Acute Care Hospitals* section) affect in-hospital mortality and LOS (122).

Future Directions and Research

Additional admission-related research should be focused on developing and validating specific criteria for determining appropriate admissions for ICU care, underlining the need for the development of simple and accurate ICU admission triage scoring. Unlike the severity-of-illness scoring systems developed to predict the outcome of patients already in the ICU, pre-ICU scoring focuses on determining the point at which patients would benefit from intensive care interventions. The development and proper validation of ICU criteria for admissions should be based on available resources (e.g., number of beds, staffing), acuity, diagnosis, specific measurable parameters, and other factors such as prognosis.

Research is needed in the areas of ICU staffing models and practitioners to patients' ratios, effects of teaching, burnout, factors that influence optimal ratios, impact of technology, and addition of other medical professionals (123). The current literature provides multiple beneficial effects associated with the integration of physician assistants and advance nurse practitioners in the ICU and other acute-care settings (124). Consequently, staffing models that include advance practitioners in acute and critical care environments could be a viable model to address intensivists shortages. The impact of introducing all these variables on patients' outcomes and healthcare costs needs to be further explored.

TRIAGE

General Considerations

Recommendations:

- We suggest that every ICU institute methods for prioritizing and triaging patients, with policies and guidelines that are disclosed in advance (ungraded).

- We suggest that triage decisions are made explicitly and without bias. Ethnic origin, race, sex, social status, sexual preference, or financial status should never be considered in triage decisions (ungraded).
- We suggest that, under ideal conditions, patients be admitted or discharged strictly on their potential to benefit from ICU care (ungraded).

Triage is the process of placing patients at their most appropriate level of care, based upon their need for medical treatment and the assessment that they will benefit from ICU care. Patients are admitted to the ICU from several sources (ED, operating room, intermediate care unit, general ward or floor bed, or by transfer from another hospital). Whatever the source of these patients, most ICU admissions are emergent and unplanned.

ICU care has been demonstrated to reduce mortality in severely ill patient populations (28-d mortality OR, 0.73; 95% CI, 0.62–0.87; and 90-d mortality OR, 0.79; 95% CI, 0.66–0.93) (125). However, in a prospective observational study, Simchen et al (126) showed that, after adjusting for age and severity of illness, 3-day survival was higher in the ICU patient population than in patients admitted to other areas of the hospital ($p = 0.018$), but thereafter, there was no difference in survival ($p = 0.9$). The authors concluded that there is a “window of critical opportunity” that is lost if access is not granted in time (126).

Triage decisions are based upon a combination of factors, including written criteria, available resources, and biases in the triage process that vary from person to person (127) and from institution to institution (128). A study of hospitals within the Veterans Administration system showed wide variability in ICU admission for patients with the same predicted mortality; the investigators concluded that access to critical care services may depend, in part, on the hospital at which a patient seeks his or her care.

In general, patients admitted to the ICU should meet one or more of the following criteria:

- Require care involving specialized competency of ICU staff that is not widely available elsewhere in the hospital (e.g., invasive mechanical ventilation, management of shock, extracorporeal membrane oxygenation, and intraaortic balloon pump).
- Have clinical instability (e.g., status epilepticus, hypoxemia, and hypotension).
- Be at high risk for imminent decline (e.g., impending intubation).

The process for triage described in the 1994 SCCM consensus statement on this topic (129) has the following common elements: patient assessment, urgency determination, priority of care based on urgency, resource analysis, documentation, and disposition. The statement recommends consideration of factors such as likelihood of successful outcome, patient's life expectancy in the context of the disease, wishes of the patient and/or surrogate, and missed opportunities to treat other patients. The authors recommend that decisions made during

the triage process be explicit, fair, and just without biases such as religion, ethnicity/race, sexual orientation, social background, or ability to pay.

In 2007, a Task Force for Mass Critical Care Working Group made several suggestions for expanding critical care services emergently and conducting the triage process in disaster situations (130). Among the suggestions was that healthcare facilities need to develop the infrastructure, acquire the necessary resources, or ensure the transfer of patients to facilities that have these capabilities before any decision to ration critical care is made during disaster situations where critical care capacity is exceeded and augmentation has to be implemented. The European Society of Intensive Care Medicine's Task Force for Intensive Care Unit Triage during an Influenza Epidemic or Mass Disaster has recommended that units develop, among other things, an Incident Management System, objective criteria for triage that can be applied ethically and transparently, and fair policies with admission and discharge criteria (131). (In addition to the information on triage in epidemics, mass casualty incidents (MCIs), and natural disasters later in this section, further discussion about triage in times of bed shortage is found in *Rationing* section.)

Overtriage Versus Undertriage

Recommendation:

- We suggest that some overtriage is more acceptable and preferable to undertriage (grade 2D).

A patient may not need intensive care if effective therapeutic treatment can be delivered in another hospital setting without significantly compromising the patient's care. An ideal triage model would identify all patients in need of ICU care with an acceptable level of overtriage, or the understanding that some patients admitted will, in retrospect, not have been sick enough to have required the ICU. Because triage involves the use of judgment, not all decisions will be accurate all of the time. Some overtriage may be preferable to undertriage in order to reduce life-threatening undertriage.

Over- and undertriage rates are affected by who performs the patient selection (132) and what definitions are used (133). It has been reported that for trauma patients anesthesiologists have lower overtriage (35% vs 66%, respectively) and undertriage rates (2% vs 35%, respectively) than paramedics making decisions in the field (132). In that study, undertriage was associated with a significantly higher mortality risk (OR [adjusted for injury severity score], 2.34; 95% CI, 1.59–3.43; $p < 0.001$). However, in mass casualty events, overtriage can be as deleterious as undertriage because a large volume of noncritical casualties could affect the management of the critically ill (134). A linear correlation has been noted between a higher mortality rate and a higher percentage of overtriaged patients in mass casualties due to terrorist bombings (135). Secondary overtriage, or transfer of patients between facilities to higher levels of care, has been found to range from as low as 6.8–38% in a rural trauma setting (136). In a prospective observational study of 17 unannounced mass casualty-training exercises in Berlin

hospitals between 2010 and 2011, the accuracy of in-hospital triage was only 61%. They found a 24% rate of overtriage and a 16% rate of undertriage (137).

Transfer to the ICU From the ED

Recommendations:

- We suggest minimizing the transfer time of critically ill patients from the ED to the ICU (< 6 hr in nontrauma patients) (grade 2D).
- We suggest that, considering the frequent lack of rapid ICU bed availability, emergency medicine practitioners be prepared to deliver critical care in the ED (ungraded).

In many hospitals, the majority of ICU admissions are through the ED. Patients are seen and stabilized by emergency medicine personnel. Because of a shortage of readily available empty beds in many ICUs, patients may spend hours being cared for in the ED by its staff. In one survey of 3,562 ED caregivers, half answered that ED patients requiring admission to the ICU were rarely transferred from the ED to the ICU within 1 hour (138). In a cross-sectional analytical study, ED patients with a 6-hour or higher delay in ICU transfer had higher ICU mortality (10.7% vs 8.4% for patients transferred within 6 hr; $p < 0.01$) and hospital mortality (17.4% vs 12.9%; $p < 0.001$) (59). In a study of trauma and emergency general surgery patients, the authors concluded that experienced clinicians could effectively triage more critically injured patients to earlier ICU admission and thereby prevent any increased mortality associated with a longer ED stay. The authors initially categorized patients as “nondelayed” when the transfer occurred within the first 3 hours, but they changed the time threshold to compare their results to the findings of Chalfin et al (59). They found that patients admitted with less than a 6-hour delay were more seriously injured and had worse outcomes than those admitted with a longer delay (139). Horwitz et al (140) showed that the transfer of a patient from the ED to an internal medicine ward is associated with adverse events that can be due to issues with poor communication, environment, workload, information technology, patient flow, and assignment of responsibility. The authors suggested that system-based interventions aimed at these issues could improve patient safety. These findings also suggest the existence of a care gap between the ED and the ward that should not necessarily be solved in the ICU. With a projected increase in numbers of critically ill patients presenting to EDs, the shortage of intensivists, and the shortage of readily available ICU beds, there will be an increased emphasis on the provision of critical care by the ED physician (141). A potential alternative could be the admission of some of these patients to intermediate care units.

ICU Transfer After Admissions From ED to a Less Intense Level of Care

Recommendation:

- In addition to optimization of the triage process from the ED to the ICU, we suggest close monitoring and timely intervention for those who are triaged to the ward. These

interventions might reduce delayed transfers to the ICU of undertriaged patients and prevent acute deterioration of those still requiring stabilization after hospital admission (grade 2D).

Delgado et al (142) found that ED patients admitted to a less intense level of care with pneumonia, chronic obstructive pulmonary disease, myocardial infarction, or sepsis were at increased risk for unplanned transfer to the ICU. The authors concluded that “better triage from the ED, earlier intervention, or closer monitoring to prevent acute decompensation” might benefit this population. In another study of patients with community-acquired pneumonia, Brown et al (143) showed that initial ward triage of patients who were later transferred to the ICU was associated with a twofold higher 30-day mortality rate. Likewise, a retrospective Australian study showed that patients transferred to the ICU within 24 hours of admission to the ward from the ED had a significantly higher 30-day mortality rate than patients admitted to the ICU directly from the ED (144). Other studies also show that patients transferred to a more intense level of care following admission to the hospital have higher mortality and LOS (145–147). RRSs were created to minimize delays in ICU admission through early recognition and response to patients who are deteriorating in general wards. Use of these teams is discussed further in *Use of Outreach Programs to Supplement ICU Care* section.

Unplanned ICU Admissions From the Operating Room

Recommendation:

- We suggest that patients with risk factors for postoperative instability or decompensation be closely monitored and managed in a higher level of care unit than the ward in the immediate postoperative period (ungraded).

Unplanned admissions to the ICU from the operating room may be anesthetic related (19.4%) or due to the surgical and medical conditions of the patient (148). In a study by Sobol et al (149), a low surgical Apgar score, which gives a numeric value to intraoperative estimated blood loss, lowest mean arterial pressure, and lowest heart rate, correlated with clinical decision making regarding ICU admission after high-risk intraabdominal surgery. However, the authors did not provide information about the outcomes of these patients (e.g., LOS, mortality) or about patients with similar scores who were triaged to the wards but later admitted to the ICU. In another study of unplanned admissions to the ICU after elective total hip arthroplasty, factors predictive of unplanned ICU admission were age greater than 75 years, revision surgery, creatinine clearance less than 60 mL/min, prior myocardial infarction, and body mass index greater than 35 kg/m². With one risk factor, the risk of ICU admission was 40%, and with two, three, four, and five factors, the risks of admission were 75%, 93.5%, 98.5%, and greater than 99%, respectively (150). Another study identified RRS activations that occurred within 48 hours after surgery and found that preoperative opioid use, history of central neurologic disease,

and intraoperative hemodynamic instability were associated with postoperative decompensation (151).

Transfer of Patients From Outside Facilities

Recommendation:

- There are insufficient data to make a recommendation for or against ICU-to-ICU interhospital transfer (no recommendation).

Transfer of patients to a tertiary-care ICU from the ED of a referring hospital is associated with lower mortality and LOS than transfers from referring hospitals' ICUs (152). Gerber et al (152) showed a significant difference in the outcomes of patients transferred to their ICU from outside facilities' EDs and ICUs. For patients transferred from an ED, they found a lower mortality rate (21% vs 33%; $p = 0.0031$), ICU LOS (4.7 ± 9.3 vs 17.3 ± 9.1 d; $p = 0.018$), and hospital LOS (14.4 ± 21.8 vs 21.8 ± 30.8 d; $p = 0.017$), despite the fact that the two groups of patients had similar survival probability (Simplified Acute Physiology Score [SAPS] II 0.77 for ED-transferred patients vs 0.71 for ICU-transferred patients; $p = 0.13$). In another study by Duke and Green, acute interhospital transfers due to lack of available ICU beds in the referring hospital were associated with a delay in ICU admission and a longer stay in the ICU and hospital, but the study was underpowered to show whether there was a statistically significant difference in mortality (153).

Newgard et al (154) investigated the impact of transferring patients out of non-tertiary centers within the Oregon State Trauma System. Among the 10,176 trauma patients first evaluated in 42 non-tertiary centers, 37% were transferred to level I and II centers. A propensity-adjusted analysis suggested that early transfer to a higher level of care was associated with lower in-hospital mortality (OR, 0.67; 95% CI, 0.48–0.94; $p = 0.009$). The benefit was noted in patients transferred to a level I center (OR, 0.62; 95% CI, 0.40–0.95; $p = 0.001$), but not in patients transferred to a level II center (OR, 0.82; 95% CI, 0.47–1.43; $p = 0.42$) (154).

In 2009, there were over 128 million estimated ED visits in the United States, and approximately 1.5% of these patients were transferred to a higher level of care facility to receive treatments not available in the referring centers. Kindermann et al (155) reported that certain populations are more prone to transfer; among them, patients aged 65 years or older and infants. They also found that the 10 most frequent causes for transfer were, in order, shock, intrauterine hypoxia/birth asphyxia, live birth, respiratory distress syndrome (newborn), aneurysm, intentional self-injury, paralysis, acute myocardial infarction, short gestation, and acute cerebrovascular disease. The Emergency Medical Treatment and Labor Act from 1986 regulates transfer activities.

Factors That Affect Triage Decisions

Recommendation:

- We suggest that all ICUs have designated additional equivalent beds, equipment, and staff necessary to support the

critically ill during a MCI emergency response (ungraded).

The goal of triage is to match resources to the needs of critically ill and injured patients. In times of ICU bed shortages, age, illness severity, code status (156), baseline functional status, and admission diagnosis have been used to triage patients (127, 157, 158). Some of the variables used for triage include age, diagnosis, creatinine clearance, WBC count, platelet count, albumin level, use of vasopressors, Glasgow Coma Scale score, Karnofsky performance status score, operative status, and chronic disorders (26). Abnormal vital signs, including the type and number, are also strongly associated with ICU admission and adverse outcome (19, 159); however, in the multivariate analysis, only heart rate greater than 111 beats/min, peripheral capillary oxygen saturation (SpO_2) less than 89%, and Glasgow Coma Scale score less than 8 were significantly associated with outcome (159). Sprung et al (160) showed that physicians use age, admitting diagnosis, severity of illness, the number of ICU beds available, and operative status to make triage decisions. Reasons for ICU refusal include patient too well, patient too sick, lack of beds, and need for more information (161, 162). In a prospective evaluation of ICU refusals, Joynt et al (163) demonstrated that denying ICU admission is common and that age, severity of illness, and diagnosis were important factors in making the decision. In a multicenter, multinational cohort study, Iapichino et al (125) found that the following factors were all associated with supporting ICU admission: bed availability (OR, 3.22; 95% CI, 2.76–3.75), Karnofsky score of greater than 70 (OR, 1.82; 95% CI, 1.42–2.33), Karnofsky score of 40–70 (OR, 2.84; 95% CI, 2.23–3.62), no SAPS comorbidities (OR, 1.5; 95% CI, 1.05–2.15), hematological malignancy (OR, 4.08; 95% CI, 2.26–7.36), emergency surgery (OR, 4.44; 95% CI, 3.49–5.64), elective surgery (OR, 4.10; 95% CI, 3.30–5.09), trauma (OR, 1.94; 95% CI, 1.24–3.01), vascular involvement (OR, 1.68; 95% CI, 1.26–2.24), and treatment versus observation (OR, 2.99; 95% CI, 2.54–3.52). Performing more than one triage was associated with refusal (OR, 0.69; 95% CI, 0.58–0.82).

Triage over the phone has been associated with significantly poorer compliance with triage recommendations and with refusal (127). Garrouste-Orgeas et al (164) have also shown that refusals were associated with the ability of the physician to examine the patients.

Mery and Kahn (165) showed that for patients with sudden clinical deterioration, lack of ICU beds decreases the probability of ICU admission and increases the probability of initiating comfort measures on the ward, but did not affect hospital mortality. Their study corroborated the findings of Sprung et al (160), indicating that number of beds available is an important factor associated with triaging, as are ICU physician seniority and autonomy. A policy that directs critically ill medical patients to an alternative coronary care unit within the institution has been suggested as a safe practice with careful planning during times of lack of bed availability (166). Delayed ICU admission due to a lack of bed availability when first referred is associated with increased mortality, as is refusal of ICU admission (106, 160, 167). More recently, Gabler

et al (168) have reported an increase in ICU mortality associated with high census secondary to surges in capacity strain. The relationship was stronger if the patients' acuity was higher or the ICU had a closed physician-staffing model (OR, 1.07; 95% CI, 1.02–1.12). In contrast to the lack of calls for increasing ICU capacity during normal operations, several groups of experts advocate for increasing surge capacity when the available critical care services are overwhelmed by disasters (169, 170). Recommendations to expand critical care surge capacity include 1) stockpiling equipment, medications, and other essential supplies to provide critical care services (e.g., endotracheal tubes, sedatives, ventilators), 2) using first all additional monitored beds in the facility (e.g., telemetry beds, post anesthesia care unit beds), 3) using non-ICU areas with emergency enhancements (e.g., using reserve monitors, beds), 4) organizing mobile units, and 5) transferring patients to other facilities not affected (170–172).

Triage Decision Makers

Recommendation:

- We suggest that a designated person or service, with control over resources and active involvement, be responsible for making ICU triage decisions during normal or emergency conditions (ungraded).

Intensivists make the majority of the triage decisions to admit to an ICU, but in some hospitals, the decisions are made by the hospitalists, residents, ICU charge nurse, hospital nursing supervisor, ED physician, or other attending physicians. In one study, an ICU triage service led by critical care physicians from 7:30 AM to 10 PM was shown to have an impact on patient flow by reducing the number of pending admissions, the number of patients waiting for ICU discharge, and the surgical ICU LOS (173). All of these reductions would make an ICU bed more readily available for new admissions. In another study, hospitalists made triage decisions for patients to be admitted, facilitated their transfer from the ED, made twice-daily ICU bed management rounds, and regularly visited the ED to assess flow. These interventions decreased the transfer time from the ED to the ICU (174). These observations seem to indicate that having clinicians monitoring and coordinating admissions improves patient flow.

In a recent study, Rath et al (175) showed the lack of agreement among clinicians prioritizing patients for triage using the prioritization model from the previous SCCM ADT guidelines (5) (described in *Previous Guidelines and Current Status* section). This finding suggests that even with apparently clear guidelines, significant disagreement among practitioners is possible and that a more robust algorithm is necessary. It also indicates that there are subjective elements during the prioritization process that need to be better understood. A study by Azoulay et al (127) investigating the compliance with recommendations for triage to intensive care in 26F ICUs showed that triage recommendations were rarely observed. They also showed that patients with certain diagnoses were more frequently admitted (e.g., patients in shock or respiratory failure with no cancer) than others (e.g., patients > 65 yr, with metastatic cancer or heart failure).

Triage for Admission of Elderly Patients

Recommendation:

- We suggest basing the decision to admit an elderly (> 80 yr) patient to an ICU on the patient's comorbidities, severity of illness, prehospital functional status, and patient preferences with regard to life-sustaining treatment, not on their chronological age (grade 2C).

With the aging of America, using age as a potential criterion for triage will have implications for resource utilization and potential admissions to an ICU. In a retrospective study of 1,970 patients evaluated by the trauma team, Peschman et al (176) indicated that independent of specific physiologic parameters, age alone was a risk factor to be admitted to the hospital after a trauma. Other studies reviewed age as it relates to sepsis and trauma and concluded that elderly patients may need to be admitted to the ICU based on associated risk factors and comorbid conditions (177–181). However, many studies have shown that elderly patients have more ICU rejections than younger patients (160, 163, 164, 182). In the observational Eldicus study, Sprung et al (182) showed a greater benefit in the elderly population admitted to European ICUs than in those who were not admitted. Most authors now agree that ICU triage decisions should not be based on the age of the patient alone (183–185). The admission diagnosis and severity of illness, but not age, determine ICU survival (180).

In 2013, Sprung et al (186) published the results of the most recent Eldicus consensus process to develop recommendations on triage. The authors agreed that the percentage of elderly patients seeking a higher level of care will increase in the near future and that age per se should not be the reason for critical care services denial, rather the decision should be based on physiological status (100% consensus among the participants). In regard to triage, the participants in the consensus agreed that the most important factors to take into consideration when triaging are 1) likelihood of successful outcome (100% consensus), 2) patient's life expectancy due to disease(s) (97% agreement), 3) health and other needs of the community (97% agreement), 4) missed opportunities to treat other patients (94% agreement), 5) anticipated quality of life of the patient (93% agreement), 6) wishes of the patient and/or surrogate (93% agreement), 7) burden of those affected, including financial or psychological costs (71% agreement), and 8) institution's moral and religious values (32% agreement).

In addition, assessing treatment preferences for life-sustaining therapies is important, especially in elderly patients. This information is essential considering that many triage decisions are made without adequate informed consent. The recent two-part Elderly's Thoughts about Intensive Care unit Admission for life-sustaining treatments study (187, 188) showed that individuals aged 80 years and older were more likely to refuse ICU treatments (27% refusal for noninvasive mechanical ventilation, 43% for invasive mechanical ventilation, and 63% for renal replacement therapy) after viewing films of scenarios involving the use of ICU treatments. In the second part of the observational simulation study, examining physician decisions

for the same patients, decisions that noninvasive mechanical ventilation, invasive mechanical ventilation, and renal replacement therapy were warranted were made 86%, 78%, and 62% of the time (187). The findings identified that physicians making these decisions for elderly patients had low agreement. Previous ICU stay or cancer affected medical decisions regarding invasive mechanical ventilation; a living spouse or respiratory disease affected renal replacement therapy decisions. The physicians' decisions also changed based on ICU bed availability and on knowledge of patient preferences, which in many instances is unknown to the practitioner when making emergency decisions.

Triage for Admission of Patients With Malignancies

Recommendations:

- We suggest that ICU access of cancer patients be decided on the basis established for all critical care patients, with careful consideration of their long-term prognosis (ungraded).
- We suggest that ICU care of all critically ill patients, in particular cancer patients with advanced disease, be reassessed and discussed with the patient, next of kin, legal representative, or power of attorney at regular intervals (ungraded).

Cancer patients, in particular patients with hematologic malignancies, are often considered poor candidates for ICU admission because of their historic high mortality rates, and their access to critical care services may be limited. In a study of 320 consecutive patients with hematological malignancies admitted to an ICU, Magid et al (189) reported ICU and 1-year mortality rates of 44% and 77%, respectively. The mortality rate of these patients (77%) was more than twice that of the other patients admitted to the ICU (33%). However, the authors concluded that they did not have tools to differentiate between those for whom transfer to an ICU would and would not be beneficial, and they recommended a strategy of admitting hematological patients to an ICU using the same criteria that are used with any other patient (189). In another study, hospital survival rates were 40% in mechanically ventilated cancer patients who survived to day 5 and 22% in all cancer patients. In this study, Lecuyer et al (190) recommended that an ICU admission trial be given to all cancer patients for whom life-extending therapy is available and who are not bedridden, with full-code status followed by reassessment on day 6.

In a study to validate the SOFA score in 6,645 critically ill cancer patients, Cárdenas-Turanças et al (191) reported overall ICU and in-hospital mortality rates of 11% and 17%, respectively. Medical patients (2,609 patients, including hematological patients) had higher ICU and in-hospital mortality rates (25% and 37%, respectively) than surgical patients (4,036 patients) (2% and 4%). These results were confirmed by Azoulay et al (192) in another prospective, multicenter study of 1,011 critically ill patients with hematologic malignancies in France and Belgium. The hospital, 90-day, and 1-year mortality rates were 39%, 48%, and 57%, respectively (192). Similar short-term survival was noted in these two studies (hospital

survival rates, 63% and 61%, respectively) (191, 192). Horster et al (193) reported overall ICU mortality of 46% among patients with hematological malignancies. Bos et al (194) have recently reported low elective cancer surgery mortality rates, with ICU and hospital mortalities of 1% and 5%, respectively, and in-hospital mortality of 17% among cancer patients with unplanned ICU admissions (195). Despite that many other recent studies corroborate the above survival trends, the comparison of overall mortality or survival rates between studies can be misleading because of factors such as differences in mortality among subgroups (medical vs surgical), volumes of specific cancer groups (i.e., hematological patients), age distribution, differences in severity of illness, and variations in admission criteria.

In a nationwide study of 12,180 patients admitted to Finnish ICUs, Niskanen et al (196) showed that short-term survival was similar between cancer and noncancer patients and depended on the severity of illness; the survival of cancer and trauma patients with APACHE II scores greater than 24 was also similar. Patients admitted after cardiac arrest had the highest mortality (79%). Likewise, the mortality rates of burn patients with more than a 70% burn area are extremely high if they have associated thrombocytopenia (67% mortality at 60 d) or sepsis (76% mortality at 60 d). Based on newer mortality prediction models, burn patients with 50% full-thickness surface area burns and APACHE III-j scores of 120 have a predicted mortality rate between 40% and 60% (197). In contrast, patients with breast cancer metastatic to the liver have a 5-year survival rate of 50% (198). The above-cited studies suggest that ICU access of cancer patients should be decided on the basis of their severity of illness and long-term prognosis, which is rapidly and continuously changing (as in the case of metastatic breast cancer outcomes), rather than on the basis of the presence of a malignancy or metastasis.

Triage in Epidemics

Recommendations:

- We suggest not using scoring systems alone to determine level of care or removal from higher levels of care because these are not accurate in predicting individual mortality (Grade 2C).
- We suggest that all hospitals and regional areas develop a coordinated triage plan for epidemics. The hospital plans should include both triage and dissemination of patients throughout the hospital (ungraded).
- We suggest that during epidemics, nontraditional settings be considered and utilized for the care of critically ill patients (ungraded).
- We suggest not using routine laboratory studies alone in determining the nature of illness during an epidemic (ungraded).

As with many sections of these guidelines, there is a paucity of literature that relates to triage for epidemics. The current literature is divided into two main categories.

The first category describes the importance of each hospital or region developing and maintaining a generic plan for dealing with epidemics. Each hospital system must have in place a coordinated disaster plan for mass casualty/epidemic events. Key individuals must have defined roles and responsibilities. Pre-event training must include uniform instruction in communication, coordination, and cooperation, both within the hospital and community/region wide (199).

Hick et al (200) recommended that a surge plan for epidemics be in place at all hospitals. Developing such a plan would include a working draft that incorporated a feedback cycle with all involved parties. It was also recommended that following the development of the initial plan and orientation of staff, a "tabletop" exercise, in which the response to an epidemic is talked through, would be conducted in an attempt to determine the adequacy of the plan. The goal of this exercise would be to determine the potential to care for critically ill patients in nontraditional settings in the face of an epidemic threat at that facility.

The second category of literature encompasses studies of epidemic triage practices, which are typically retrospective and observational in nature. The majority of the literature on triage during specific epidemics that was published during the reviewed time frame (1998–2013) focused on respiratory illness such as influenza—specifically H1N1 and severe acute respiratory syndrome (SARS). Interestingly, even though the majority of the period reviewed was after September 2001, no literature was found on other types of infectious epidemics, such as potential terrorist release of smallpox.

Barr et al (201) developed a survey to determine health-care workers' attitudes about their duties and resource utilization during a hypothetical influenza pandemic in the United Kingdom. On review of the case scenarios, the researchers noted wide variability in resource allocation, with only 54% of the respondents choosing the same patient for the last ICU bed. The majority of hospital staff (79%) felt that professional healthcare workers would continue to work, and 83% felt that it would be unprofessional for doctors to leave work (201).

An Italian prospective observational study during the H1N1 influenza epidemic demonstrated that patients with moderate intermediate disease could be appropriately managed in an intermediate care unit, not in an ICU. Moderate intermediate disease was defined as the presence of any of the following: pH less than 7.35 or greater than 7.45, respiratory rate of greater than 25 breaths/min, oxygen saturation of less than 94%, heart rate greater than 110 beats/min, WBC count less than 4,000 μ L or greater than 12,000 μ L, or evidence of organ dysfunction that required hospitalization. Only 10% of the studied patients required noninvasive ventilation, 96% were treated with antibacterial agents, and 83% were treated with antivirals. Only 2% required admission to an ICU. In this population, there were no deaths (202).

The Pandemic Medical Early Warning Score (PMEWS) was developed in the United Kingdom to facilitate admission and discharge decisions. Challen et al (203) validated this scoring system using community-acquired pneumonia as a surrogate

illness. This clinical scoring system is intended to identify patients who need admission to a hospital and to reassure the “worried well.” This scoring system evaluates acute physiologic derangements and also incorporates age, comorbidities, and other social factors, such as being a displaced person. The authors found that PMEWS was a better predictor for need for admission (area under the curve 0.944 vs 0.881) and higher level of care (area under the curve 0.881 vs 0.640) than the CURB-65, but not as good at predicting mortality (area under the curve 0.663 vs 0.788).

Guest et al (204) applied the U.K. government-recommended triage process for an influenza pandemic to their ICU patient population. The investigators discovered that 46% of their current ICU population would have been denied ICU care based on the government recommendations. Of the “denied” population, 39% survived to hospital discharge. The conclusion was that the scoring system used by the United Kingdom was inadequate to determine admission criteria for a critical care setting. Talmor et al (205) created and validated a triage scoring system for use during epidemics. The score was based on five independent variables identified in a cohort of patients with suspected infection in the ED: age more than 65 years, altered mental status, respiratory rate greater than 30 breaths/min, low oxygen saturation, and a shock index greater than 1 (heart rate > blood pressure). The validation of this simple triage decision scoring system in two different cohorts had an area under the curve greater than 0.7. An Australian retrospective study evaluated the utility of procalcitonin to differentiate between viral and bacterial causes of respiratory tract infections; the authors wanted to determine the utility of laboratory data to help with the placement of ICU patients during an epidemic. They concluded that procalcitonin was neither sensitive nor specific in determining the presence or absence of influenza and should be used with caution for this purpose (206).

An interesting phenomenon was noted in Taiwan during the height of the SARS epidemic: the total volume of patients seeking emergency care significantly decreased after the news report of nosocomial transmission of SARS. This decrease was seen across most principal ED diagnosis types, from cardiovascular disease to trauma. It did not affect the number requiring critical care. Simultaneously, there was an increase in the volume of patients suffering from respiratory illness and from suicide attempts via drug overdose, but this increase was not statistically significant (207).

A retrospective chart review was conducted in Singapore, an active site during the 2009 H1N1 influenza outbreak. The review showed that patients who had complaints of breathlessness, were tachycardiac, were hypoxemic by pulse oximetry, had leukocytosis, or had an elevated protein C or low albumin level on presentation were statistically more likely to have moderate (needing treatment in a hospital ward) to severe disease (needing treatment in a high-dependency unit or ICU) than mild disease. Of the patients who required ICU admission, 94% did so within the first 24 hours of presentation to the hospital (208).

Khan et al (209) performed a retrospective review using the SOFA score to evaluate patients admitted to their ICU with H1N1 influenza. They discovered that SOFA is not a valid scoring system to predict outcome in these patients. For five patients, the SOFA scores predicted that they would have had support withdrawn at 48 hours, yet all patients in the cohort survived. It appears that respiratory failure requiring ventilatory support in patients with H1N1 influenza requires a longer duration of support but still can result in good outcomes. A task force reviewing the allocation of resources in an influenza epidemic or mass critical care events suggests the use of the SOFA score in appropriate patients (130). Inclusion criteria include the need for mechanical ventilation and vasopressors; exclusion criteria consider little likelihood of survival, such as a SOFA score-predicted mortality equal or greater than 80%. A SOFA score of greater than 11 has also been proposed to exclude patients from critical care resources during influenza epidemics (131). Christian et al (131) created a prioritization tool based on the SOFA score and divided patients into four groups designated by colors; they also established inclusion and more detailed exclusion criteria. Any of the exclusion criteria or a SOFA score greater than 11 (Blue Category) on the initial assessment or at the subsequent evaluation stages at 48 hours and 120 hours triages patients to medical management with or without palliative care and terminates critical care; a SOFA score of less than or equal to 7 or single-organ failure (Red Category) places patients in the highest priority; a SOFA score of 8–11 (Yellow Category) places patients in the intermediate priority; and no significant organ failure (Green Category) places patients on reassessment or defer priority. However, in a retrospective cohort study, Shahpori et al (210) found that their hospital mortality rate exceeded 90% only for patients with SOFA scores of greater than 20; H1N1 patients who had SOFA scores of greater than 11 had a mortality rate of only 31%. Although the SOFA score seems to be the most widely accepted tool assisting triage prioritization of patients to the ICU, there is insufficient evidence to support its use in clinical decision-making for individuals.

Triage in Other Types of MCIs

Recommendations:

- We suggest that the activation of the hospital disaster plan and a coordinated response of the entire healthcare team (e.g., physicians, nursing staff, environmental staff, and administrators) follow the announcement of a MCI. The team should ensure that their institution and critical areas (ED, operating room, and ICU) are ready for the rapid and efficient transition from normal to emergency operations and increase their capacity to accommodate a larger volume of critically ill patients (ungraded).
- We suggest that the disaster response teams identify all patients in need of ICU care and those already hospitalized who could be discharged, and then triage and transfer the incoming patients to the most appropriate setting as soon as possible (ungraded).

Because we cannot address this subject in its entirety due to its complexity and scope, we suggest that the readers needing guidance beyond this work refer to more comprehensive guides. For example, the comprehensive program developed by a multidisciplinary team of experts sponsored by SCCM, Fundamental Disaster Management, provides a practical approach for the management of disasters and the basis for medical response in multiple scenarios ranging from MCIs to natural disasters (211). In addition, the Task Force for Mass Critical Care Working Group, under the umbrella of the Critical Care Collaborative Initiative, has made recommendations to guide the allocation of critical care resources in situations such as those described above (130); recently, on behalf of the American College of Chest Physicians, the group published a Consensus Statement about the care of critically ill and injured patients during pandemics and disasters (212).

Given the nature of such events, there have been no randomized controlled trial studies of MCIs. Most of the relevant literature is observational or descriptive in nature. One such publication describes the experience in the Netherlands of the Major Incident Hospital that it opened in 1991. This facility is designed to provide immediate emergency care in a large-scale capacity for disasters and mass casualty events. It is also designed for quarantine situations. The facility has designated areas for triage, emergency care, OR, radiology, and varying levels of care from low level to ICU. With set protocols, the facility can be opened and functional in 15 minutes. In a 19-year period, the Major Incident Hospital was deployed 34 times (213).

MCIs affect not only the disaster victims but also routine patients who are not directly affected by the event. A retrospective review of a hospital system after a mass casualty event that filled the hospital to greater than 105% capacity showed spill-over effect to the noncasualty patients as well (214). All patients experienced an increased LOS and increased charges compared with patients cared for during nonmass casualty times. The authors suggested that the longer hospitalization was caused by limited resources of personnel, space, and material. A Canadian regional trauma center conducted a retrospective review examining MCIs occurring over a 12-month period. An MCI was defined as treating and admitting at least three trauma patients in a maximum time of 3 hours. Ten percent of the center's patients received care during an MCI. Compared with the rest of the center's patients, the MCI patients did have a statistically longer hospital LOS, time to first surgical procedure, time to emergent laparotomy, and ED LOS. However, there was no overall increase in hospital mortality after admission (215).

Certain injury patterns may help identify injury severity and need for ICU care. A prospective database was collected for patients suffering injury after attacks from suicide bombers. Independent predictors of admission to the ICU were the presence of facial fractures, peripheral vascular injury, skull fractures, and injury to greater than four body parts (216). The authors suggested that these types of injuries be used as surrogate markers for severe injury and advocated prompt

admission of such patients to the ICU. Clinicians at Rhode Island Hospital shared their experience caring for multiple casualties from a fire caused by a presumed malfunction of pyrotechnics during a concert. This type of MCI is different from others in that many victims not only had significant burns that needed immediate and prolonged care but also suffered from inhalational injuries that required extensive ICU and pulmonary care (217).

Many factors can affect the outcome and care of patients during an MCI. An MCI from a bombing in 1998 in Northern Ireland demonstrated challenges in communication. Landlines were damaged, and mobile towers were overloaded; local EMS members were able to communicate only by radio. There were challenges in tracking patients. An information board was utilized, but patients still were transferred to beds scattered around the hospital and temporarily forgotten (218). The unpredictable nature of MCIs makes them challenging to prepare for. In urban bombings, most patients arrive at hospital facilities within 30 minutes of the initial event (219). The Israeli medical system has perfected, and documented, the ability to be prepared and function at a high level of care literally at a moment's notice (220). It has been shown that after terrorist-related MCIs in Israel, injuries that result in an Injury Severity Score greater than 16 are seen more frequently (in about 30% of patients) than after nonterror events (20% of patients) (221). About 26% of terror victims are admitted to the ICU for at least 24 hours. A difference has also been shown between mechanism of injury, with a greater amount and severity of injuries for explosions than for gunshot wounds. Those injured by explosion and by gunshot had about the same rates of admission to an ICU, 26%, but victims of explosions had a significantly longer LOS in the ICU. The authors stratified patients by the number of body regions injured; those with only one injured region had about a 9% admission rate to the ICU, whereas those with greater than two injured regions had a 71% ICU admission rate (222).

Data from an Israeli trauma registry study showed that terrorism victims who suffer burns are much more likely to have other associated injuries (87% vs 10%) and be admitted to an ICU (50% vs 12%) than burned nonterrorism victims (223). The burned terrorism victims had a similar mortality rate to the nonburned terrorism victims (6% vs 7%), which was higher than that of burned nonterrorism patients (3%). In another study in Israel, there was no difference in rates of ICU admission for victims of gunshot wounds occurring during an MCI vs not. The likelihood of death from gunshot wounds was 2.7 times higher (95% CI 1.09–7.02) if they occurred during an MCI than if they did not (224). Another study comparing blast-wounded terrorism victims to gunshot wound victims showed that blast-wounded victims were more likely to have an Injury Severity Score greater than 16 and be admitted to the ICU; the mortality rate and LOS were also significantly higher in the blast-wounded victims (225).

Avidan et al (226) performed a two-decade retrospective review of their trauma patients who were victims of terrorist bombing attacks. The focus of the review was patients who

suffered from blast lung injury. Terrorist bombing attacks that occurred in closed spaces, such as a bus or café, were more likely to cause blast lung injury. Blast lung injury was a significant cause of on-the-scene death of victims. This center admitted all patients with blast lung injury to the ICU. Patients who developed blast lung injury did so within the first few hours after injury. Those who required mechanical ventilation did so within the first 2 hours after injury. Mechanical ventilation with the lowest levels of positive end-expiratory pressure to maintain oxygenation and limited IV fluid to reduce lung edema were the mainstays of therapy. This cohort of patients had a 96% survival rate.

ICU availability is one of the major concerns during initial deployment of an MCI plan as ICU bed demand is the second only to ED demand in the typical MCI. About one-third of patients are admitted to the ICU, many directly from the ED. High staffing levels for the ED, OR, and ICU are required during an MCI. Einav et al (227) recommend that the post-anesthesia care unit also be used as an overflow ICU. The initial 48 hours of care is just the initial step on a potentially long road to recovery for the significantly injured victim. One report showed that terrorism victims who were hospitalized and survived their initial injuries had almost a 50% readmission rate (228), typically for complications from the initial injury or reconstructive surgery. Terrorism victims who were initially cared for in the ICU had a greater than 40% readmission rate in the first 3 months after discharge.

Shamir et al (229) have published an informative review for ICU personnel. Their work covers the typical progression of events of an MCI, the potential number of expected patients, and the types of injuries to anticipate in the ICU. These authors have also described the importance of the chain of command and perioperative care provided through what they call "forward deployment" of anesthesiologists. Instead of leaving anesthesiologists in the operating room, their hospital MCI response system mobilizes anesthesiologists outside the operating room to facilitate the care of victims throughout the institution, from the moment of arrival at the ED to the transportation to CT scanners, angiography suite, operating room, post-anesthesia care unit, and ICU (219). This system not only facilitates patient flow but also provides expert and continuous intensive care from hospital arrival to the operating room (in their study, an average of 2 hr after arrival) and ICU admission (several hours later) (219).

Pulmonary blast injury is associated with suicide bombings, as are penetrating head injury, skull fractures, and burns. Patients suffering from blast lung injury can experience rapid progression that may be fatal. It is recommended that patients at risk be quickly transported to the ICU. Another key point is that access to the ICU should not be a limiting factor during these events. Administration and staff need to work expeditiously to clear ICU beds so that they can readily accept victims who need ongoing resuscitation. However, this process should be preplanned and part of the critical care surge operational arrangements contained in every hospital disaster response plan, a requirement of the Joint Commission in the United States (230).

Triage in Natural Disasters

Recommendation:

- We suggest that in areas at risk, ICUs be prepared to deal with the victims of not only external disasters but also internal disasters, including collapse of surrounding services in large-scale disasters such as an earthquake, tsunami, or major tornado. Every ICU should have general disaster and evacuation plans such as those required by the Joint Commission Standards in the United States (ungraded).

Events such as earthquakes, volcanic eruptions, tsunamis, floods, hurricanes, and tornados can devastate entire health-care systems. In the past decade, we have seen a record number of severe disasters in the continental United States and around the world. As a matter of fact, since 1960, the numbers of disasters and people affected have increased exponentially, suggesting that we will be exposed to these events more frequently (231). Because we cannot stop disasters, it is important to recognize our role and capabilities for preventing, containing, and/or mitigating the impact of these catastrophic events on the population at risk.

Hospitals, and in particular ICUs, are vulnerable during natural disasters. Relatively minor events such as a tropical storm could lead to the closing of a complete healthcare system (171). During tropical storm Allison in 2001, at a major teaching and trauma center in the heart of Houston, a power outage and generator failure rendered useless all the services and devices that depended on electricity (e.g., elevators, water and infusion pumps, ventilators, dialysis machines, medication stations, electronic records, labs, telephones, and drugs). All aspects of medical care and basic needs were affected. In the case of a major hurricane such as Katrina in 2005, the devastation extended not only to the medical center, as happened in Houston, but also to the entire city of New Orleans (232).

Some of the key lessons learned from recent floods and hurricanes include the importance of

- Adequate leadership before, during, and after a disaster (e.g., a clear leader, no confusion about who is in charge, clearly defined roles of national agencies [in large-scale disasters]).
- Appropriate coordination of the human response (at small and large scales, such as regional hospital coordinating groups).
- Preservation of essential critical services (e.g., electricity, water supplies).
- Appropriate planning and equipment for vertical evacuation from tall hospital buildings when elevators are not working (e.g., during loss of electrical power).
- Continuity of care with an adequate patient-logging system and solutions for enhancing the portability of health records (e.g., in sharp contrast to systems at neighboring hospitals, the Veterans Administration electronic health records performed well during the New Orleans evacuation).
- Adequate communication (internal and external), considering the potential and reported failure of telephone networks.

- Availability of adequate ventilation resources (e.g., ventilators, oxygen).
- Appropriate use of available military resources (e.g., helping with helicopter evacuations and medical personnel).
- Attention to potential dangers to the security of medical personnel (171, 232, 233).

In small-scale emergencies such as tropical storm Allison, the surrounding still-standing healthcare systems can provide the necessary support to maintain services to the patients and residents affected. In larger scale events such as Hurricane Katrina, the nearby facilities were affected, leading to total collapse of the system. Healthcare organizational leaders should ensure that their emergency plans have backup systems at the local, regional, and national levels.

Large-scale disasters like earthquakes can lead to additional catastrophic events. In 2011, the Great East Japan Earthquake and subsequent tsunami devastated the information infrastructure of the region affected and damaged the Fukushima Daiichi nuclear power plant, triggering the isolation of a 30-km zone (234). In contrast to U.S. storms, evacuation of patients was hindered by fear of radioactive material contamination in the vicinity of the reactor or outside the 30-km radius because the official priority was the evacuation zone (234). The medical teams that came to assist did not have any information on the conditions and actual needs of the area. A Nippon Medical School team reported that during their medical rounds in the Kesennuma City evacuation shelters, many basic needs were lacking (e.g., no water or food) (235); however, some services such as blood banks were not overwhelmed and able to respond effectively (236). Evacuations in these conditions are more complex and require long-distance trips with triage on arrival at the destination ICU; in the Richter magnitude scale 9 earthquake that affected Southeast Asia in 2004, some European tourists were transferred to German ICUs via medevac aircraft (237).

The common picture that emerges from the review of the literature on natural disasters caused by storms or associated floods is one of ICU/hospital evacuation after extensive destruction of the healthcare infrastructure. Triage is mainly performed for evacuation from the area of disaster. In the case of disasters caused by Enhanced Fujita (EF) scale 3 tornados, severely injured patients in the rural community were transferred from local hospitals by helicopters to level I trauma centers with a broad spectrum of bodily injuries, from fractures to thoracic crush, abdominal, or head injuries (238). In an EF4 mass casualty event that affected Georgia and Tennessee in 2011, 104 patients were evacuated with injuries, 28 admitted to the hospital, and 11 to the ICU. The ICU LOS was 10.9 ± 11.8 days, but all survived, with three patients (11%) transferred to skilled nursing facilities (239). In cases of larger-EF-scale tornados, entire communities and their healthcare facilities are totally destroyed, and there is a need for long-distance transportation. Ablah et al (240) reported a "critical mortality" (mortality rate of the critically ill survivors) of about 18% in the EF5 tornado that affected Greensburg, Kansas, in 2007. Frykberg reported a

slightly lower critical mortality (13%) in a review of 10 terrorist bombing incidents (135).

As described above, most healthcare centers are devastated during these types of events, and evacuation is the most likely outcome of the incident. Very few examples of successful medical responses to major incidents, such as the citywide devastation following Hurricane Katrina, have been documented. The complexity of the massive response by the entire Houston healthcare system and the recommendations of some of the teams involved are worth using to guide future planning and responses to MCIs (171, 241, 242).

Future Directions and Research

There is a need for more objective and validated tools for accurate triage and reduction of variability among ICU admission practitioners. Further work using a prospective approach is needed to establish which parameters have the highest predictive validity for benefit from ICU care. Given the heavy financial burden and potential dangers associated with inter-hospital transfers, more research is needed to determine the actual impact of transfers to a higher level of care from one institution to another. There is a need for triage models that would work during normal operations and catastrophic situations. Efforts must continue to increase critical care resources at lower costs and to develop more efficient systems to respond to the needs of the population adequately in order to minimize rationing.

ICU DISCHARGE

Recommendations:

- We suggest that every ICU stipulate specific discharge criteria in its ADT policy (ungraded).
- We suggest that it is appropriate to discharge a patient from the ICU to a lower acuity area when a patient's physiologic status has stabilized and there no longer is a need for ICU monitoring and treatment (ungraded).
- We suggest that the discharge parameters be based on ICU admission criteria, the admitting criteria for the next lower level of care, institutional availability of these resources, patient prognosis, physiologic stability, and ongoing active interventions (ungraded).
- We suggest that, to improve resource utilization, discharge from the ICU is appropriate despite a deteriorated patient's physiological status if active interventions are no longer planned (ungraded).
- We suggest refraining from transferring patients to lower acuity care areas based solely on severity-of-illness scores (ungraded). General and specific severity-of-illness scoring systems can identify patient populations at higher risk of clinical deterioration after ICU discharge. However, their value for assessing the readiness for transfer of individual patients to lower acuity care has not been evaluated.

Patients admitted to the ICU must be reevaluated continuously to identify those who no longer require ICU care. Ideally,

transfer from the ICU occurs when the patient no longer meets ICU admission criteria and meets admitting criteria for a lower level of care. The decision is made difficult by the absence of clear and objective metrics to indicate which patients will continue to benefit from critical care. Marked heterogeneity exists in critical care discharge practices, often influenced by institutional factors (243). This observation is confirmed in the daily practices among the members of the Task Force.

Investigations of ICU discharge processes were divided into four major categories: 1) timing of discharge, both day versus night and weekday versus weekend; 2) the effectiveness of discharge to specialty facilities such as step-down units and LTACHs; 3) the causes and risk factors for readmission to the ICU; and 4) ICU outflow limitations.

Timing of Discharge From ICU

Day Versus Night Discharge.

Recommendation:

- We suggest avoiding discharge from ICU “after hours” (“night shift”, after 7 PM in institutions with 12-hr shifts) (grade 2C). In addition, best practice would seek to optimize evening and night coverage and services (ungraded).

The effect of time of discharge from the ICU has been investigated both in terms of mortality and readmission rates. Discharge in the evening or night hours is an independent risk factor for increased mortality (244–250) and readmission (245, 247, 248, 251). Reports from conference proceedings confirm this relationship (252–255). The findings have been consistent in diverse large samples (1,870–76,690 patients) in multiple countries, supporting generalizability. However, a few studies have found no relationship between the discharge time of day and risk of readmission (252, 256) or between the discharge time of day and mortality (245, 254).

The reason for the increased mortality noted in the late-discharge population is not clear. The increased risk may be related to decreased coverage and services available after hours. In fact, the time defined as evening or night varies across studies based on the institutional definition of “after hours” (e.g., after hours would start after 7 PM in the case of 12-hr nursing shift changes). Another possible explanation for the higher mortality rate is ICU bed capacity and the requirement for triage to accommodate incoming emergencies. The patients discharged from ICU in the evening or night, therefore, may be of higher acuity than those discharged during the day. Studies to date do not differentiate between patients who are discharged after hours due to delayed availability of the non-ICU beds (ICU outflow limitation), patients triaged earlier in the day as “ready for discharge” if needed, and patients discharged from the ICU only because patients with a higher acuity emergency need to be admitted.

Weekday Versus Weekend Discharge. Weekend discharge from the ICU has not been found to be associated with increased mortality (247, 256, 257). Reports on the relationship between day of discharge and risk for readmission have varied, with some evidence for increased risk following

weekend discharge (257) and some for increased risk following weekday discharge (256). These differential results may be due to institutional factors; the causes have not been validated. If higher acuity patients are discharged from the ICU during the week due to bed capacity issues but kept in the ICU on the weekends when bed demand is not as high, increased risk of readmission for weekday discharges could be expected because of the severity of illness. On the other hand, if higher acuity patients are discharged from the ICU on the weekends or less coverage is available during the weekends, increased risk of readmission for weekend discharges could be expected. Premature discharge may be affected by increased strain on the ICU capacity, including new admissions, high acuity, and high unit census (258).

Discharge Strategies to Reduce ICU LOS

Recommendation:

- We suggest discharging patients at high risk for mortality and readmission (high severity of illness, multiple comorbidities, physiologic instability, and ongoing organ support) to a step-down unit or LTACH as opposed to the regular ward (grade 2C).

The organization of patient care areas within the institution influences patient readiness for discharge from the ICU. Quality and quantity of care on the general ward (floor) may be inadequate to meet the needs of some patients otherwise meeting criteria for ICU discharge. Utilization of specialized care facilities such as step-down units within the hospital or discharge to an LTACH can decrease LOS in the ICU while still providing safe care for the patient.

Step-Down Units. Step-down units are variously referred to as “high-dependency units,” “intermediate care units,” or “transitional care units.” The existence and capabilities of such units vary greatly among institutions. Perhaps because of this, little formal investigation has been undertaken to evaluate outcomes. Descriptions of the types of patients discharged to step-down units include those with ongoing neurologic, circulatory, or respiratory conditions, particularly those with high severity-of-illness scores (259, 260).

Evaluation of outcomes comparing care in these units to care in the ICU is incomplete. There is some evidence for success with weaning from mechanical ventilation (261) and for decreasing ICU bed utilization without increasing mortality or readmissions (262). The paucity of data here may not reflect ineffectiveness of the step-down unit but rather a large gap in research to validate effectiveness.

Long-Term Acute-Care Hospitals. LTACHs are hospitals that provide continuing care expected to be needed for at least 25 days after discharge from an acute-care hospital. LTACHs may provide many ICU-level services, including vasoactive medications and mechanical ventilation, although these vary at individual facilities. Attempts have been made to develop a scoring system to determine early in the ICU stay whether an individual patient will qualify for discharge to an LTACH (263). Such a discharge can significantly decrease both ICU

and hospital LOS while positioning the patient to receive continuing effective care.

There are wide variations in LTACH use, more than can be accounted for by the location and availability of facilities. Utilization occurs more often with discharge from larger hospitals, for-profit hospitals, and academic teaching institutions, and when the LTACH is located within the acute-care hospital (264). Discharge to an LTACH is more frequent when the patient has commercial insurance, rather than Medicaid (265) because Medicaid does not recognize LTACHs for payment. Outcomes evaluation has primarily focused on the success in weaning from mechanical ventilation (266, 267). However, the prevalence of chronic critical illness is expected to increase with the aging of the population; inability to the transfer of chronic ICU patients still requiring ventilatory support to LTACHs or ventilated hospice beds could become a serious discharge outflow limitation (268).

Readmission to ICU

Recommendation:

- We suggest that a standardized process for discharge from the ICU be followed; both oral and written formats for the report may reduce readmission rate (ungraded).

Readmission to the ICU after initial discharge is most often due to respiratory failure; cardiovascular failure, sepsis, and neurologic issues (251, 256, 269–274). Prevention of the need for readmission is vital, as readmission adds to patient risk. Readmission to the ICU significantly increases mortality beyond that predicted by patient acuity alone (256, 273–275). However, adjusting for the effect of case mix on the mortality rate may moderate or negate the correlation between readmission and poorer outcomes, as demonstrated by Kramer et al (276).

Readmission rates are a frequently measured quality criterion. However, the time frame considered varies among studies, limiting comparison of results. One large study, analyzing data for 214,692 critically ill patients from the 2001 to the 2008 Project IMPACT database, found the optimal interval to evaluate to be two full calendar days (rather than 48 hr) although uncertainty remained about the validity of the data as a measure of quality (277).

Knowledge of which patients are at risk for readmission to the ICU would enable the ICU team to either postpone discharge or identify the patients as high risk during transfer to the accepting providers. General severity-of-illness scoring systems such as APACHE (II and III), SAPS II, SOFA, and the Therapeutic Intervention Scoring System have been shown to correlate with mortality after discharge from the ICU (251, 269, 270, 272–275, 278, 279). In addition, multiple factors have been independently associated with unplanned readmission to the ICU, including age, comorbidities, admission source other than planned surgery, and ongoing requirements for organ support (251, 256, 271, 272, 274, 275, 280–285).

There is some evidence that the risk of readmission is greater when patients are discharged from the ICU to admit

new patients to the ICU during periods of high demand. Although there are not a great number of studies to support this, one study documented a highly significant increase in risk of ICU readmissions on days when there were more than nine patients admitted to a neurosciences unit than days with less than eight admissions (OR, 2.43; 95% CI, 1.39–4.26) (286). Another study of 200,730 patients demonstrated that although readmission rate increased relative to ICU capacity strain, there was no association with increased odds of death, reduced odds of being discharged to home, or increased hospital LOS (258). Several predictive models have been developed, with initial significant results but variable results upon attempted validation in other ICU populations (251, 280, 287–293).

Lower nursing staffing levels in the post-ICU unit are associated with an increased rate of ICU readmission. Interestingly, in non-ICU patients with the highest levels of severity of illness, this association is not apparent (294). Similarly, higher nursing workload on the day of ICU discharge is associated with decreased levels of readmission (295). Although limited by the number of studies, the findings suggest that the most severely ill patients have their needs met. However, this may be at the expense of less severely ill patients. In a qualitative study, nurses identified the following factors as associated with readmission to the ICU: premature discharge from ICU, delayed medical care at the ward level, heavy nursing workloads, lack of adequately qualified staff, and clinically challenging patients (296). Thematically, these factors are in agreement with the quantitative findings discussed earlier.

Interventions to decrease the prevalence of readmissions to the ICU may occur within institutions as performance improvement projects, but published research is rare. At an urban teaching hospital, institution of a discharge process that included a transfer phone call, charted care summary, and discharge physical re-examination by the discharging provider resulted in a decrease in readmission rate from 41% to 10%. Of those readmitted cases, 30% were found to be noncompliant with the new processes (297). In another study, the institution of ICU discharge phone reports by the ICU physician or nurse practitioner, nurse, and respiratory therapist also resulted in a significant decrease in readmissions (298). Although they represent only two studies, these findings reinforce that we can improve patient outcomes after discharge from ICU.

ICU Outflow Limitations

Although outflow limitations and bottlenecks produced in the ICU discharge process are common in daily practice, this problem has not received enough attention in the past. Levin et al (299) have reported that among 856 attempts to discharge 703 patients over a period of 16 months, 18% (153 attempts) of the discharges could not be completed within 24 hours. Forty-six percent of the failures to discharge were associated with lack of beds on the floors or lack of agreement with the accepting teams outside the ICU. In addition, a simulation model identified the ICU as the first potential bottleneck in surge

capacity during disasters (300). No additional relevant studies were identified.

Future Directions and Research

We believe that there is need for

- Further development and validation of predictive models (e.g., mortality and ICU readmission).
- Evaluation of outcomes in both step-down units and LTACHs in comparison with continued ICU care.
- Research in the area of outflow limitations and the impact of high hospital bed occupancy rates on ICU utilization and outcomes.
- Further intervention studies on reducing rates of readmission to the ICU, evaluating transfer location, staffing levels, and handoff report components.

USE OF OUTREACH PROGRAMS TO SUPPLEMENT ICU CARE

Unplanned (unexpected) transfers to the ICU are often preceded by physiologic instability (301). Yet often, recognition of critical illness states that require ICU admission is delayed or inadequate (302). RRSs have been used by some institutions to identify patients who need or would benefit from early ICU admission and treatment, as well as to prevent unnecessary ICU admissions (45, 303–307).

RRS Intervention Prior to ICU Admission

Recommendation:

- We suggest that RRSs be utilized for early review of acutely ill non-ICU patients to identify patients who need or would benefit from ICU admission and treatment and to prevent unnecessary ICU admissions (grade 2C).

A number of single-center studies demonstrate significant differences in mortality rates with the use of RRSs for both adult and PICU patients (308–310), including decreases in hospital-wide mortality, out-of-ICU mortality, and out-of-ICU cardiac arrest codes (311). In a synthesis review of the outcomes for RRSs of 26 before-and-after studies and a meta-analysis of 18 studies, RRSs were associated with reduced rates of cardiorespiratory arrest outside the ICU and reduced mortality (312). Several additional systematic reviews and meta-analyses on the effects of RRSs on clinical outcomes have associated implementation of an RRS with a reduction in the rate of cardiopulmonary arrest outside the ICU (up to 34%; RR, 0.66; 95% CI, 0.54–0.80), but not with lower hospital mortality rates (RR, 0.96; 95% CI, 0.85–1.09) (313). In children, implementation of an RRS correlated with reduced rates of cardiopulmonary arrest outside the ICU (up to 38%) and a reduction in hospital mortality rates (up to 21%) (RR, 0.79; 95% CI, 0.63–0.98) (313). A meta-analysis of 13 studies—one cluster randomized controlled trial, one interrupted time series, and 11 before-and-after studies—identified no effect on clinical outcomes in the randomized controlled trial but a

reduction in inpatient mortality (RR, 0.82; 95% CI, 0.74–0.91) and cardiac arrest (RR, 0.73; 95% CI, 0.65–0.83) in the other studies (314). However, some of the studies were considered to be of poor methodological quality and control hospitals in the randomized controlled trial reported reductions in mortality and cardiac arrest rates comparable with those in the before-and-after studies (314). Similarly, a systematic review of eight studies on RRSs found “weak” evidence that RRSs are associated with a reduction in hospital mortality (pooled RR, 0.76 [95% CI, 0.39–1.48] between two randomized studies and 0.87 [95% CI, 0.73–1.04] among five observational studies). RRSs were associated with a decreased cardiac arrest rate (the pooled RR was 0.94 [95% CI, 0.79–1.13] in a single randomized study and 0.70 [95% CI, 0.56–0.92] in four observational studies), but limitations in the quality of the studies, the wide CIs, and the presence of heterogeneity limited the ability to conclude that RRSs are effective interventions (315).

The Medical Emergency Response, Intervention and Therapy (MERIT) trial, a large cluster-randomized controlled trial involving 23 hospitals in Australia, attempted to study the effects of an RRS during a study period of 6 months after RRS activation. The study found no differences in the composite outcome of cardiac arrest, unexpected death, or unplanned admission to the ICU between the control hospitals and the RRS hospitals (5.86 vs 5.31 per 1,000 admissions, respectively; $p = 0.640$), nor in the individual secondary outcomes: cardiac arrests (1.64 [control hospitals] vs 1.31 [RRS hospitals]; $p = 0.736$), unplanned ICU admissions (4.68 vs 4.19; $p = 0.599$), and unexpected deaths (1.18 vs 1.06; $p = 0.752$) (316).

Chen et al (317), in a study analyzing 11,242 serious adverse events and 3,700 emergency team calls, showed that for every 10% increase in the proportion of early emergency team calls, the number of unexpected cardiac arrests decreased by 2 per 10,000 hospital admissions (95% CI, –2.6 to –1.4). The investigators also found a reduction in overall cardiac arrests of 2.21 per 10,000 hospital admissions (95% CI, –2.9 to –1.6) and a reduction in unexpected deaths of 0.94 per 10,000 admissions (95% CI, –1.4 to –0.5). No significant relationships were found for unplanned ICU admissions or for the aggregate of unexpected cardiac arrests, unplanned ICU admissions, and unexpected deaths. The results demonstrated that as the proportion of early emergency team calls increases, the rate of cardiac arrests and unexpected deaths decreases. This inverse relationship provides support for early review of acutely ill non-ICU patients by an RRS.

Further review of the MERIT study identified that across the 12 intervention hospitals, a median of 86% of RRS activations were not related to a cardiac arrest or death. In addition, RRS utilization varied significantly across the 12 hospitals ($p = 0.002$) and was significantly associated with knowledge of the activation criteria ($p = 0.048$), understanding of the purpose of the RRS ($p = 0.01$), and an overall positive attitude toward the RRS ($p = 0.003$). Overall, measures related to the process of implementation of the RRS were significantly associated with the level of its use (318). It has been cited that the evidence in support of an RRS or equivalent system is not

straightforward, as issues such as education, resources, and communication are vital to implementation success (319).

Physiological track-and-trigger warning systems, which seek to identify patients outside critical care areas who are at risk of deterioration, were studied in a systematic review and evaluation of 15 studies, including a cohort study of data from 31 acute-care hospitals in England and Wales. A number of study limitations, including little evidence of reliability, validity, and utility and insufficient data to identify the best type of warning system, precluded comparisons between systems or the ability to establish the best track-and-trigger system (320). The authors highlight that because of the lack of rigorous testing and poor sensitivity in the evaluation of the available data, attributed in part to rapidly deteriorating patients and infrequent and nonstandardized measurement of physiological function, there is not sufficient evidence to support discontinuing the use of track-and-trigger systems. Rather, the authors suggest that additional work is needed to validate the impact of such systems.

During RRS activations, the following factors have been associated with the need for ICU admission: need for non-invasive ventilation (321), hypoxia as the reason for the RRS call, and ward “staff worried about the patient” (322). Several studies have demonstrated a decrease in unplanned ICU admissions with the use of an RRS, which has implications for ICU patients. A single-center study of RRS calls during a 3-year interval identified that the RRS was associated with a 36% reduction in the rate of unplanned transfers to the ICU following an RRS event (30). Similarly, a single-center pre-/post-implementation study of an RRS that also utilized routine 48-hour follow-up for patients discharged from the ICU found that the RRS was associated with a reduction of in-hospital cardiac arrests and ICU readmissions. The number of ICU readmissions was reduced from 112 of 712 (16%) to 56 of 586 (10%) by the third year ($p = 0.05$) (323). In addition, a single-center study of an RRS over a 1-year period, during which there were 344 RRS calls, demonstrated a decrease of cardiac arrests from 7.6 to 3.0 per 1,000 discharges per month. Overall hospital mortality decreased from 3% to 2%, and unplanned ICU admissions decreased from 45% to 29% ($p < 0.05$) (324). Other studies, however, have not demonstrated a change in unplanned admissions to the ICU (325).

Failure of clinical bedside staff to activate the RRS has also been identified as a factor in the overall effectiveness of the RRS (326, 327). A point prevalence survey focused on identifying the incidence of staff failure to activate the RRS revealed that while the prevalence of physiological instability in acute-care patients was 4%, nearly half of these patients (42%) did not receive an appropriate clinical response from staff, despite the fact that most (69%) met physiologic criteria for activating the RRS (327). Lack of an associated RRS call despite the presence of documented RRS calling criteria has been termed “RRS afferent limb failure.” Of clinical significance, RRS afferent limb failure has been demonstrated to be associated with unanticipated ICU admissions and higher hospital mortality rates (328, 329).

Delay in activating the RRS has been attributed to delays in the time for nursing staff to call for assistance and where needed, in the time for physicians to call for higher-level care (330). Structured interviews with 91 staff members identified predominantly sociocultural reasons for failure to activate the RRS. Other studies examining RRS activation delays have found that the implementation, utilization, and impact of the RRS are shaped by problems with team cohesion, including poor communication and team efficiency, lack of resources, inexperience of staff, lack of availability of ICU beds, and contextual features such as leadership, organizational culture, and training (331, 332).

ICU Consult Teams in the Wards

Recommendation:

- We suggest that ICU consult teams be considered for use to facilitate transition from the ICU, assist ward staff in the management of deteriorating patients, facilitate transfer to ICU, and reduce rates of readmission to critical care (grade 2C).

ICU consult teams have been used to promote follow-up of patients recently discharged from the ICU and to recognize deteriorating patients on the ward requiring ICU admission. The aim of an ICU outreach or consult team is to facilitate discharges from the ICU, educate ward staff in the management of deteriorating patients, reduce ICU readmission rates, and facilitate transfer to ICU when merited (333). An extension of the ICU consult team that has demonstrated a significant impact in preventing ICU readmissions is the use of an ICU liaison or outreach nurse. This model is used in Australia and in the United Kingdom, where the ICU liaison nurse emerged as a member of the multidisciplinary team to assist in the transition of patients from the ICU to the ward and sometimes to also act as a member of the RRS (334). The areas of focus of the liaison nurse are providing support for patients recently discharged from the ICU, support for acutely ill patients on general wards, formal and informal education and skills training for ward staff, and support for families (335). Although this role is a recognized clinical service role in Australia, a lack of data on its effect on patient outcomes after ICU discharge has been cited (336). Overall, research on the impact of ICU outreach teams has demonstrated a positive effect of such teams on a number of outcomes, including a decrease in discharge delays (337, 338), prevention of adverse events (339), a decrease in unplanned ICU admissions/readmissions (333, 340, 341), reduced mortality rates in general hospital wards (342), and staff evaluations suggesting that care was more timely, referrals to the ICU were fewer, and ICUs felt more able to discharge patients to the hospital wards (343).

Several single-center observational studies have found a positive impact of an ICU liaison nurse service on patient outcomes. The impact of the service in a 36-month before-and-after study on ICU and hospital LOS, mortality rate, and ICU step-down days found a 13% increase in patient throughput after the introduction of the ICU liaison nurse service (344).

Despite trends toward improvement, there was no significant change in median ICU LOS (2.2 d before compared with 2.1 d after) or median hospital LOS (12.0 d before compared with 11.5 d after) or in ICU or hospital mortality (ICU, 15% before compared with 14% after; hospital, 23% before compared with 22% after). However, ICU step-down days were significantly decreased by 48% (71 ± 14.2 d before compared with 37 ± 15.5 d after; $p > 0.001$). For the patient group readmitted to the ICU (49 patients before compared with 55 patients after), there was a 25% decrease in median ICU LOS (4.0 vs 3.0 d) and a trend toward decreased mortality in both the ICU (18% before compared with 16% after) and hospital (35% before compared with 26% after), demonstrating trends toward more efficient ICU discharge (increased throughput, decreased ICU step-down days, and ICU readmission LOS) (344).

An integrative review and meta-synthesis of 20 studies assessing the scope and impact of intensive care liaison and outreach services concluded that the outreach services had a beneficial impact on ICU mortality, hospital mortality, discharge delay, and rates of adverse events (340). A variety of research methods were used, however, and it was not possible to conclude unequivocally that the ICU liaison/outreach service had resulted in improved outcomes. Potential sources of bias that were identified included selection bias (use of a single site), performance bias (nonstandardized intervention), and no or limited control of confounders (340). Outcomes for nurses in the form of improved confidence, knowledge, and critical care skills were identified in qualitative studies but not formally measured. A noteworthy major benefit across the studies, although not measured quantitatively, was improved communication pathways between critical care and ward staff (340).

A systematic review of the effectiveness of critical care outreach services conducted in the United Kingdom identified two randomized controlled trials, 16 uncontrolled before-and-after studies, three quasi-experimental studies, one controlled before-and-after study, and one post-implementation-only controlled study (345). The most frequent outcomes measured were mortality rate, cardiac arrest, unplanned critical care admission from wards, LOS, and critical care readmission rates. Review of the studies identified improvements in patient outcomes yet insufficient evidence to demonstrate such outcomes conclusively.

A Cochrane database systematic review of outreach and early warning systems for the prevention of ICU admission and of death of critically ill adult patients on general hospital wards identified two cluster randomized controlled trials, one randomized at the hospital level (23 hospitals in Australia) and one at the ward level (16 wards in the United Kingdom) (45). The primary outcome in the Australian trial (a composite score including incidence of unexpected cardiac arrests, unexpected deaths, and unplanned ICU admissions) demonstrated no significant difference between control and outreach team hospitals (adjusted $p = 0.640$; adjusted OR, 0.98; 95% CI, 0.83–1.16). The U.K.-based trial found that outreach reduced in-hospital mortality (adjusted OR, 0.52; 95% CI, 0.32–0.85) compared with the control group. Meta-analysis was not possible due

to heterogeneity of the interventions, settings, outcomes and study design and their review of similar works found that most studies investigating outreach were diverse and had poor methodological quality (45).

Proactive rounding by the RRS team, which, similar to an ICU consult team, is aimed at promoting early detection of patients with clinical deterioration, has not been found to decrease the ICU readmission rate, ICU LOS, or hospital mortality of patients discharged from the ICU (346). In contrast, a recent systematic review and meta-analysis on the use of critical care transition programs identified a reduced risk of ICU readmission (risk ratio, 0.87 [95% CI, 0.76–0.99]; $p = 0.03$). The risk of readmission was not affected by the presence or absence of an intensivist or by type of program (e.g., within an outreach team or a nurse liaison program). Although there was no significant reduction in hospital mortality, the authors concluded that critical care transition programs appear to reduce the risk of ICU readmission in patients discharged from ICU to a general unit (347).

Future Directions and Research

Clearly, the lack of evidence on ICU outreach requires further multisite randomized controlled trials to determine its potential effectiveness. As different models of outreach exist, additional research that identifies the specific roles of various types of outreach liaisons and their impact on ICU and ward patients is needed.

Despite the demonstrated benefit of RRSs, a number of factors have been identified that can affect the effectiveness of the RRS, including staff skill set and activation criteria (326, 327). In countries such as Australia and the United Kingdom, RRS teams commonly include a physician team member, while in the United States, teams may be composed of critical care nurses and respiratory therapists who conduct a first-line assessment and identify the need for physician support. The effect of these differences in RRS models on outcomes has not been explored. Regardless of the organizational commitment to the RRS, clinical staff may act on the basis of local cultural rules that need to be better understood in order to ensure appropriate activation of the RRS.

With respect to ICU ADT criteria, research on RRSs has demonstrated an impact on decreased unplanned ICU readmissions. Additional research on the impact of RRSs is indicated as the studies to date have demonstrated conflicting results with respect to impact on hospital mortality, cardiac arrest, and unexpected death.

QUALITY ASSURANCE/IMPROVEMENT AND METRICS OF ICU ADT PRACTICES

Quest for Appropriate ICU Metrics

Recommendations:

- We suggest following the SCCM's guidelines as described in "Critical Care Delivery in the Intensive Care Unit: Defining Clinical Roles and the Best Practice Model" (currently undergoing revision) (ungraded).

- We suggest that every ICU have a written ADT policy, as an administrative best practice, to guide appropriate patient placement (ungraded).
- We suggest following the metrics identified as indicators of ADT performance in this framework (**Table 5**). This information should be collected electronically through the electronic health record, if available (ungraded).

ICUs should be administered following the SCCM's "Critical Care Delivery in the Intensive Care Unit: Defining Clinical Roles and the Best Practice Model" (a revision of these guidelines is under way) (348). The ADT process should be monitored, as with any administrative and clinical activity within the healthcare system. Administrative and clinical best practices include having policies to guide patients' flow throughout their hospital stay. An ICU's ADT policies should encompass a broad scope of practice, including management and leadership, multidisciplinary team members, patient types, processes, and procedures. These policies should also provide clear directives to prevent conflicts and patient care delays, a process to deal with conflict and provisions for escalation to higher levels should be delineated.

In 2002, the Joint Commission developed a set of six performance measures (ventilator-associated pneumonia prevention, stress ulcer prophylaxis, deep vein thrombosis prophylaxis, central line-associated bloodstream infection prevention, ICU LOS, and hospital mortality rate) for the ICU, which were later aligned with its ORYX performance measurement system (349). These measures are specific processes that, if undertaken/addressed, are expected to improve patient outcomes. The Joint Commission chose the APACHE version IV scoring system for risk adjustment of the two outcome measures (ICU LOS and hospital mortality); the implementation of these two measures was put on hold in 2005 to allow alignment with the new requirements established. In 2010, the Commission divided its performance measures into accountability and nonaccountability measures. The first, measures that have the greatest impact on patient outcomes, are identified by four criteria: strong research evidence that the process will improve patient outcomes, proximity of the measured process to the outcomes, ability to accurately measure the process, and minimization of unintended adverse effects caused by the process (350). On the updated list (2012), only one of the almost 50 accountability measures was specific to ICU care, ICU venous thromboembolism prophylaxis (351).

We identified three works on ICU quality indicators that are considered important for the scope of these guidelines—a systematic review of the literature by Berenholtz et al (352); the guidelines of the Spanish SCCM and Coronary Units (SEMICYUC) Multidisciplinary Steering Committees and Working Teams, titled "Quality Indicators in Critically Ill Patients" (353); and a report from the Task Force on Safety and Quality of the European Society of Intensive Care Medicine (ESICM) (354). These documents all used an evidence-based approach to summarize the quality indicators identified.

The first study identified six outcome, six process, four access, and three complications measures. The access quality indicator measures were 1) rate of delayed admissions, 2) rate of delayed discharges, 3) rate of cancelled surgical cases, and 4) number of ED bypass hours (352).

The 188 pages of the SEMICYUC document, published in 2011 after 2 years of revising the original 2005 publication, proposed 120 quality indicators; among the planning/organization and management quality indicators, they identified: 1) rate of delayed admissions, 2) rate of delayed discharges, 3) rate of premature discharges, 4) rate of suspensions of scheduled surgeries, 5) regulated exchange of information, and 6) daily rounds by multidisciplinary teams. Among the indicators for perceived quality at discharge from the ICU, they identified standardized mortality rate and use of an ICU discharge report. Unscheduled readmission was also identified as an adverse-event quality indicator (353).

For the third publication, the members of the ESICM task force evaluated 111 potential indicators and came to more than 90% agreement on nine: 1) the need for ICUs to meet the national standard requirements for resource allocation and reporting, 2) 24-hour availability of a consultant-level intensivist, and for times that the intensivist was not immediately available, having a provider capable of initiating immediate resuscitation, 3) an adverse-event reporting system, 4) multidisciplinary rounds, 5) a standardized handover system for discharge, 6) reporting and analysis of standardized mortality ratios, 7) rate of ICU readmission at 48 hours, 8) rate of central venous catheter-related infections, and 9) rate of unplanned extubations (354).

After considering the literature reviewed and discussed throughout these guidelines, our Task Force has developed a number of ICU ADT-focused quality indicator metrics, delineated in Table 5. The purpose of these metrics is to assist in evaluating the ICU ADT process and making necessary changes to improve the specific unit/multidisciplinary team performance. In addition, a few tools developed by the ADT Task Force have been included to guide practitioners in the process of:

Developing an ICU admission, discharge and triage policy (**Appendix 2**, Supplemental Digital Content 2, <http://links.lww.com/CCM/B901>).

Allocating critical care resources (**Appendix 3**, Supplemental Digital Content 3, <http://links.lww.com/CCM/B902>).

Prioritizing ICU admission or discharge based on specific patient needs (**Appendix 4**, Supplemental Digital Content 4, <http://links.lww.com/CCM/B903>).

Instructions to create a two-sided pocket card with the tools in Appendix 3 (Supplemental Digital Content 3, <http://links.lww.com/CCM/B902>) and Appendix 4 (Supplemental Digital Content 4, <http://links.lww.com/CCM/B903>) are provided in **Appendix 5** (Supplemental Digital Content 5, <http://links.lww.com/CCM/B904>).

Future Directions and Research

Developing a perfect policy and/or tool to measure acuity is extremely challenging. ADT policy development is a

TABLE 5. Quality Assurance/Improvement and Metrics of ICU Admission, Discharge, and Triage Practices

Monitor and Evaluate	
Admission	<p>ICU admissions and the basic administrative information of the patients (e.g., source of referral [such as the emergency department, ward patients, RRS, or the ICU consult team], number per day, number per month, time of day or night, outcomes [including standardized mortality rate])</p> <p>Daily census (e.g., ICU census every 8–12 hr). This allows determining staffing needs (e.g., number of nurses needed during the day, evening, and night shifts or during the week vs the weekend)</p> <p>Surgery cancellations (e.g., lack of ICU beds versus hospital beds; track together with hospital/ED bypass)</p> <p>Admission delays (e.g., source, time between referral and admission, outcomes for these patients)</p> <p>Physician and nursing staffing and its impact on admission delays and refusals (e.g., correlation of high or low staff availability/workloads leading to admission delay or denial and the associated referral sources)</p> <p>Admissions via RRS referral (e.g., number of patients treated by the RRS, admission rate, outcomes)</p> <p>ICU consults in the wards, if this service is provided (e.g., number of patients, type of patients, admission rate, outcomes)</p>
Triage	<p>Denied admissions (e.g., source of referral, reason, number per day, number per month, time of day, weekday versus weekend, outcomes)</p> <p>Interhospital transfers (e.g., from other EDs, other ICUs)</p> <p>Cancelled transfers as a result of hospital/ED bypass (e.g., number of cancellations, hours on bypass)</p> <p>Conflicts (e.g., rate and type of conflicts during referral and admission)</p>
ICU stay	<p>ICU utilization (e.g., LOS, ventilator days)</p> <p>Ethics and palliative care consults (e.g., rates, outcomes [LOS, ventilator days, end-of-life interventions such as do-not-resuscitate orders or comfort care])</p> <p>Unexpected cardiac arrests (e.g., source of admission, rate, outcomes for correlation with admission delays, use of prior RRS intervention or ICU consultation in the ward)</p> <p>Conflicts (e.g., rate and type of conflicts during ICU stay, including admission-discharge-triage and futility disagreements)</p> <p>Unexpected deaths (e.g., source of admission, number)</p>
Discharge	<p>Delay in discharges (overutilization) (e.g., avoidable ICU days and reason, such as no beds in the wards)</p> <p>Time and day of discharge (e.g., discharge at night, weekends)</p> <p>Patient discharge status (alive or dead) and site of discharge (e.g., ward, intermediate care unit, long-term acute care hospital, operating room, morgue)</p> <p>Outcomes of all patients adjusted by severity of illness and expected mortality on the basis of standardized mortality rates</p> <p>Unplanned readmissions (e.g., rate, source, reason for readmission, outcomes)</p> <p>Conflicts (e.g., rate and type of conflicts or disagreements during discharge, including those between medical teams and families)</p> <p>Family/patient satisfaction. If patients or families are not satisfied with service, identify the problems and address them</p>
ICU ADT policy	<p>Compliance with the ICU ADT policy (e.g., number of policy violations, number of inappropriate admissions, number of delayed discharges)</p> <p>Overall ICU performance. A multidisciplinary committee should review and discuss the metrics on an ongoing basis, and the outcomes should be analyzed and considered for implementation of improvement measures</p> <p>Needed changes to the ICU ADT policy upon periodic reviews according to needs and changes at each institution</p>

RRS = rapid response system, ED = emergency department, LOS = length of stay, ADT = admission, discharge, and triage.

task complicated by the numerous variables to consider, the complexity of critically ill patients, and the diversity of healthcare systems. Tools can be developed that can assist with guiding decisions; however, no policy or tool can replace the clinical judgment of the critical care multiprofessional team. Future directions for developing the most predictable process for determining patient placement should focus on

- Improving accuracy of severity scoring tools (APACHE, SAPS, and Mortality Prediction Model) and nursing productivity models.
- Utilizing electronic medical record documentation to automatically capture patient characteristics and developing a self-populating tool for ADT.
- Utilizing telemedicine to monitor discharged patients and “capture” red flags to increase timeliness of intervention and prevent readmission to critical care.
- Utilizing telemedicine to assist with monitoring critical care patients who were triaged to a nontraditional critical care unit because of lack of critical care bed availability.
- Determining how standardization of all critical care processes (policies, team hand-off reports, rounds reports, nurse-driven protocols, and standing orders) influences ADT decisions.
- Determining how the use of nonintensivist physicians admitting to a critical care unit affects decisions about patient placement.
- Determining how hardwiring of safety and quality measures can be captured as a characteristic of nurse workload to determine the impact on discharge and triage/transfer criteria.
- Exploring including a palliative care/end-of-life specialist as a member of the critical care team to build relationships with families and assist in decision making.

NONBENEFICIAL TREATMENT (FUTILE CARE) IN THE ICU

Nonbeneficial treatment, or futile care, was not addressed in the previous version of these guidelines (5). Medical futility received a lot of attention in the early nineties during the intense national debates regarding healthcare reform (355). With the exception of the 1999 report by the Council on Ethical and Judicial Affairs committee of the American Medical Association (AMA) (356), the subject received progressively less attention during the next decade, and it has not been directly addressed in guidelines for critically ill patients since 1997 (357, 358), when futility was extensively discussed by the Ethics Committee of the SCCM in a consensus statement regarding futile and otherwise inadvisable treatments (357) and by the American Thoracic Society in an official statement on the fair allocation of intensive care resources (358). Because of the difficulties associated with the type of evidence for determining futility, the extreme complexity of the subject, and the infeasibility of covering the subject in its entirety in these guidelines, here we only briefly comment on a few aspects of the topic related to ADT.

Terminology

Recommendation:

- We suggest using the term “nonbeneficial treatment” whenever clinicians consider further care “futile” (Ungraded).

The definition of “futile care” remains controversial; there is no current consensus or definitive, objective definition (359, 360). Futile care has been described as an intervention that only prolongs the final stages of the dying process (356), but many other definitions have also been published (356, 357, 359, 360). The AMA’s Council on Ethical and Judicial Affairs has stated that a fully objective and concrete definition of futility is unattainable (356). Qualitative definitions of futile care are value laden and have not helped to resolve disagreements among patients, families, healthcare providers, and courts (355). Regrettably, quantitative definitions have not helped solve this problem either.

The Ethics Committee of the SCCM has discouraged using the concept of futility to establish policies that limit care (357) and has recommended not using the term futile care. We concur with this recommendation. Until critical care practitioners can accurately predict specific outcomes in clinical practice and reach consensus regarding which clinical situations are futile, we suggest avoiding the term futile at the bedside.

Instead of futile care, the SCCM Ethics Committee recommended the term “inadvisable treatment”; others have recommended the term “nonbeneficial treatment” (361). The terms, regardless of how they are defined, are subjective, as are many of the factors that we use to determine benefit (e.g., likelihood of success of an intervention, the life expectancy or quality of life of the patient, burdens to all affected by the event, wishes of the patient and their closest relatives). Nevertheless, among these terms, nonbeneficial appears to confer a less threatening connotation (compared to futile) and a more professional estimation (compared with inappropriate or inadvisable) that providing or continuing to provide treatments is not, in our opinion, in the best interest of the patient. An example would be continuing to provide ventilatory support to a leukemia patient in respiratory failure and multiorgan failure with poor prognosis. However, in certain circumstances, such as requests for interventions that in our medical opinion are unethical, the term “inappropriate treatment” should be used. An example would be performing cardiopulmonary resuscitation (CPR) in a patient with metastatic cancer, in multiorgan failure, with a devastating intracranial hemorrhage.

Attempts to Design Objective Models for Determining Nonbeneficial Treatment Status

Recommendations:

- We suggest avoiding the current quantitative definitions of nonbeneficial treatment because of the lack of consensus on a single definition (ungraded).
- We suggest against the routine use of the currently available severity-of-illness scores for identifying nonbeneficial treatments in specific patients (grade 2C).

- We suggest that the information provided by healthcare professionals be quantitative to reduce disagreement between the prognostic information delivered to the patients' surrogates and their understanding and acceptance of the message (grade 2C).

Several quantitative approaches to determining futility were developed in the early 1990s, but they have failed to be adopted in clinical practice. Schneiderman et al (360, 362) suggested the following threshold for deciding when a treatment is non-beneficial or "futile": when a medical treatment has fewer than one success in 100 uses or when it only helps to preserve permanent coma. However, the risk of error in these calculations and lack of data for all the disorders and populations admitted to the ICU have led to the use of clinicians' actual experience and individual biases instead. In addition, individualized predictions based on any of the numerous scores available are not appropriate and should not be used alone to make such decisions (357, 358). In a comprehensive response to the numerous criticisms of their approach, Schneiderman et al (363) addressed the lack of professional or societal consensus about the definition of futility, the concern that empirical data could not be applied with certainty to any given patient, the concern that empirical data may suggest decisions that conflict with patients' religious beliefs, and the fact that rationing and resource allocation will ultimately determine medical futility, among other criticisms.

Other quantitative approaches proposed included a mathematical model by Murphy and Matchar (364) to identify thresholds for deciding the medical and economical appropriateness of a given treatment, as well as a cost-effectiveness ratio. Teno et al (365) suggested implementation of a strict prognosis-based futility guideline. They analyzed 4,301 patients enrolled in the Study to Understand Prognoses and Preferences for Outcomes and Risks of Treatment (SUPPORT) and identified 115 individuals (2.7%) with less than a 1% chance of surviving 2 months. In a simulation of the model, they found that stopping treatment of those 115 patients earlier would have saved \$1.2 million (14%) of the \$8.8 million in total charges. Also, nearly 75% of the reduction in the total number of hospital days was due to the simulated discontinuation of treatment of only 12 patients. The researchers concluded that patients at high risk of dying could be identified, but the implementation of a strict, prognosis-based futility guideline on the third day would have resulted in only modest savings.

Regardless of the model used and its limitations, the discrepancies among healthcare providers' opinions remain an important obstacle to standardizing decisions about nonbeneficial treatments (366). In a study about the prevalence of withholding and withdrawal of life support from the critically ill, Prendergast and Luce (367) showed that only 4% of physicians considered medical futility on the basis of low probability of survival alone. Others considered comorbid diseases leading to recurrent hospitalizations or death, poor quality of life, patient's suffering, and even resource allocation in their decisions. In the recent Eldicus Triage Consensus, physicians were

not able to agree to a cutoff probability for triage even when the chance of survival was estimated at 0.1% (186).

Although the use of predictive models or scores has been suggested to aid in the identification of nonbeneficial treatment, these models, in addition to having large margins of error, have been developed for group predictions and are not appropriate for establishing futility in individual cases. The early adoption of any of futility prediction models or recommendations could slow medical progress in terms of the development of adequate therapies to improve the survival of patients with conditions that have initially high mortality rates. Neither doctors nor nurses have been able to demonstrate accurate predictive abilities (366). However, this problem is more complex than providers being able to make accurate predictions. A recent randomized study (368) comparing the reliability of quantitative versus qualitative statements in discussions conveying prognostic estimates in two video versions of a simulated family conference showed that there was a big gap between what was conveyed by the doctors and what patients' surrogates understood from the doctor's predictions. The patients' understanding of the physician's estimates did not differ based on whether the information was provided quantitatively (17% likelihood of patient survival \pm 22% SD) versus qualitatively ($16 \pm 17\%$; $p = 0.62$). Almost half of the surrogates (47%) believed that their relatives had much better prognosis than the prognosis provided by the physicians, and the surrogates' own estimates of likelihood of patient survival did not differ based on whether the information was provided qualitatively (mean likelihood $26 \pm 24\%$ SD) versus quantitatively ($22 \pm 23\%$; $p = 0.26$). Among the group as a whole, the surrogates' mean estimate of patients' survival likelihood ($23 \pm 22\%$) was more than twice the rate provided by the physician (10%; $p < 0.0001$). In the multivariate analysis, the authors found that the two variables associated with less discordance were trust in the patient's physician (coefficient, -0.85 ; 95% CI, -1.7 to -0.04 ; $p = 0.04$) and receiving the prognostic information quantitatively (coefficient, -9.2 ; 95% CI, -14.5 to -3.8 ; $p = 0.001$). Another publication noted that nonbeneficial interventions can be perceived differently if they are cheap, easy, and without morbidity versus aggressive, technologically intensive, and entailing great pain and suffering (369).

Delivery of Nonbeneficial Treatment in the ICU

Recommendation:

- We suggest developing clear ICU and institutional nonbeneficial treatment policies through consensus of all the parties involved (physicians, nurses, administrators, lawyers, ethicists, and family representatives) (ungraded).

Care that is considered to be nonbeneficial continues to be delivered around the world. For example, Hariharan et al (370) reported in Barbados the continued provision of aggressive treatment to patients whose prognoses were considered "futile" by some of the healthcare providers. A third of the patients who died in the investigators' ICU, 5% of the 662 admissions, met their futility criteria, including patients diagnosed as dead

by neurological criteria, or brain dead. The authors found that age, legal considerations, family wishes, and disagreement among treating physicians were the main reasons for the futile treatment (370).

In a Canadian survey, Palda et al (371) reported that 95% of the nurses and 87% of the physicians responding to the survey had provided “futile” care during the past year. They identified eight main reasons for the provision of nonbeneficial treatment by these practitioners. The most common reason was the perception of death as a treatment failure by the physicians, and the second was poor communication between the providers and families. Among the other reasons recognized were prognostic uncertainty, legal pressures, and fragmented care owing to the involvement of multiple subspecialists.

The study of Palda et al (371) showed a significant difference between the opinions of nurses and physicians regarding “futile” care (368). Frick et al (366) have also described such disagreements between nurses and doctors. The higher the severity score and the longer the ICU stay, the higher the discrepancy between nurses’ and doctors’ opinions regarding nonbeneficial treatment. Nurses were more pessimistic in general; of the 284 days in which daily judgments were recorded, nurses considered withdrawal on 123 days and physicians on 26 days ($p < 0.001$). Nurses also more frequently than doctors considered care to be “futile” for survival (92 vs 61 d; $p < 0.001$) and quality of life (119 vs 70 d; $p < 0.001$).

In a more recent study, Huynh et al (372) studied the frequency of provision of perceived “futile treatments” defined through a focus group consensus process and identified via a multivariate model. The investigators found that 134 patients among 1,136 patients in five Californian ICUs received 464 days of nonbeneficial treatments for a total cost of \$2.6 million. The authors considered the costs to be substantial, in contrast to others who have downplayed the economical impact of these interventions, such as the SUPPORT study investigators (365) and Luce and Rubenfeld (373).

Nonbeneficial Cardiopulmonary Resuscitation

Recommendation:

- We suggest that prudent clinical judgment, in conjunction with the latest American Heart Association guidelines and specific local and hospital policies, be followed in deciding when to withhold or terminate cardiopulmonary resuscitation (ungraded).

Modern CPR was developed from efforts to resuscitate patients from sudden cardiac death in the 1700s, and this technique has been a main focus during medical training since (374). CPR is performed on any patient in cardiac arrest even if the arrest is the result of a chronic and debilitating terminal disease or the patient is dying, as long as there is not an advance directive to the contrary or an objective sign of irreversible death (e.g., rigor mortis or decapitation).

Deciding not only when to start CPR but also when to stop is difficult. The evolution of termination-of-resuscitation rules is an excellent example of the complexity and challenges we face

when considering using the term “nonbeneficial treatment” as a justification for setting limits on medical interventions. Decision rules for termination of nonbeneficial resuscitations for in-hospital cardiac arrests were proposed in 1999 (375). Guidelines by the National Association of Emergency Medical Services Physicians Standards and Clinical Practice Committee for termination of resuscitation in the prehospital setting (376) were published in 2000. These were followed in 2003 by guidelines for withholding or terminating resuscitation in cases of prehospital traumatic cardiopulmonary arrest, authored by the same group in association with the American College of Surgeons Committee on Trauma (377, 378). However, since those guidelines were published, the practices have come into question in light of changes made to the American Heart Association (AHA) resuscitation recommendations in 2005 (379, 380).

The AHA dedicates a chapter of its guidelines to the ethical aspects of CPR and the issue of futility. In the past, the chapter included ethical guidelines, a simple decision algorithm in cases of cardiopulmonary arrest, as well as recommendations on when to stop CPR. The recommendations clearly stated that the burden of the decision to terminate resuscitation rested with the responsible clinician and that clinical judgment always trumps clinical criteria: “In the final analysis, the decision that a resuscitation attempt would be futile is a matter of medical judgment that only a responsible physician can make” (381). This leaves room for variability in the delivery and termination of any resuscitative effort, as two physicians could easily disagree in any given case. Additional interventions, such as therapeutic cooling (382) and the introduction of extracorporeal membrane oxygenation as a part of the management of circulatory arrest (383), have further complicated adherence to these recommendations, despite studies validating the guidelines’ rules (380, 384). The AHA continues narrowing the rules for termination of resuscitation and in the most recent recommendations published at the end of 2010 questioned the reliability of the evidence calling for prospective validation (385). Regardless, CPR continues to be provided in conditions that have been considered nonbeneficial even by the practitioners who provide the treatment (386, 387). Family, peer pressure, and legal pressures are among the important reasons for this practice.

Death by Neurological Criteria

Recommendation:

- We suggest that life-supportive therapies be removed in cases of patients declared dead by neurological criteria in accordance with local law (including potential legal restrictions associated with the patient’s religious beliefs), hospital policies, and standard medical practice and after appropriate organ donation considerations (ungraded).

Guidelines for the determination of death by neurological criteria were updated and published by the American Academy of Neurology in 2010 (388). Most of the recommendations are classified by the academy as grade U, or “studies not meeting

level of evidence from class I to III; data inadequate or conflicting; given current knowledge, treatment is unproven.” Brain death could be seen as a diagnosis that leads to simple medical decisions. However, a family’s reluctance or religious beliefs can complicate or lead to challenging decisions about life-supportive therapy withdrawal.

In some circumstances, legal considerations can affect clinical practice. For example, for the declaration of brain death, the State of New Jersey includes in its law exemptions to accommodate personal religious beliefs as well as specific examination guidelines and physician standards (389). Similarly, in Israel, the Brain Death Law prohibits the discontinuation of ventilation in brain-dead patients if the family disagrees with the life-support withdrawal (390); in addition, another law addressing terminally ill patients prohibits the withdrawal of ventilators (391). Physicians and other healthcare providers (e.g., nurses, respiratory therapists) who find themselves in analogous circumstances need the assistance of the legal services of their institutions for multiple reasons, including the risk of harm to healthcare providers, the legal implications of continuing life support to a patient declared dead or even not yet declared brain dead, additional costs for the institution, and the inappropriate utilization of critical care resources (392).

When a patient’s relatives object to withdrawal despite expert attempts to explain that the patient is brain dead, unsatisfactory agreements or legal conflicts may result. In a recent report, Smith and Flamm (393) described the case of a brain-dead patient dispute between a very religious Jewish family and the medical team. The authors described in detail all the social, ethical, medical, and legal ramifications of the opposition to accepting the diagnosis, complicated by the vagueness of the state law’s statements that require “reasonable short-term accommodation”; the patient was finally transferred to another institution’s ICU, leaving the case essentially unresolved. Laws of the states of New York and New Jersey require a “reasonable accommodation period” in cases in which the family objects on religious or moral grounds. The lack of clear recommendations by the authors exemplifies the challenges of providing clear advice for future similar cases.

Such legal battles are not infrequent, do not happen only in New York and New Jersey, and can involve other religious groups that disagree with the diagnosis of brain death. Buddhist beliefs also represent a challenge for many practitioners that find themselves in these situations; recently, a Buddhist family obtained a restraining order against Beth Israel Deaconess Medical Center in Massachusetts to prevent the withdrawal of life support of their relative who had been declared brain dead. Because of deterioration of the patient’s extremities, the hospital pursued stopping life support by seeking an order from the court (394). In addition to legal and religious challenges, the potential for organ donation also has to be considered when confronted with the decision to admit a patient to the ICU as well as the decision to withdraw life-supportive therapies. The ramifications of these decisions reach beyond local practices

and policies affecting the lives of numerous patients waiting for organ transplantation.

Reducing the Delivery of Nonbeneficial Treatment

Ethics Teams.

Recommendation:

- We suggest the early involvement of ethicists (within 24 hr of identifying potential or actual conflict) to aid in conflicts associated with nonbeneficial treatment (grade 2C).

Ethics consultations have been suggested as a means of resolving conflicts associated with nonbeneficial treatment. Since the publication of the SCCM (357), American Thoracic Society (358), and AMA (395) consensus guidelines, only three randomized studies have investigated the role of these consultations (396–398). The first study, from a single center, explored the impact of ethics consultations in the ICU on reducing the number of nonbeneficial treatments for patients who could not survive until hospital discharge (396). The investigators randomized 74 patients who had value-based conflicts during their management and found that although there was no difference in mortality rates between patients who were offered ethics consultations and those who were not, the intervention group had fewer ICU hospital days and life-sustaining treatments. The second study, a multicenter study, was a larger-scale replication of the first study; 551 patients from seven U.S. hospitals were randomized into the two groups (397). The researchers demonstrated a significant reduction in the number of hospital days (-2.95 d; $p = 0.01$), ICU days (-1.44 d; $p = 0.03$), and ventilator days (-1.7 d; $p = 0.03$) in the intervention group, and most participants (87%) involved in the process, including healthcare providers and patients’ surrogates, thought ethics consultations were helpful in resolving their conflicts. The third randomized study investigated the impact of a proactive intervention by a bioethicist in reducing utilization of ICU resources in a large tertiary center medical/surgical ICU (398). This study failed to demonstrate any significant difference in hospital LOS, number of nonbeneficial treatments, surrogate satisfaction, or hospital costs, conflicting with the previous two studies.

In a multicenter study, Gilmer et al (399) investigated the costs associated with nonbeneficial ICU treatment and found a mean cost difference of \$5,246 per patient. They estimated that in a 40-bed ICU with the same rate of consultation, a mortality rate of 60%, and savings of \$5,246 per patient, treatment costs would be reduced by \$157,380 per year if the nonbeneficial therapy were withheld. These modest savings further strengthen the findings of the SUPPORT study (365) and suggest that conflicts arising from futility discussions leading to costly legal confrontations may negate the potential healthcare savings intended by enforcing a strict policy of nonbeneficial treatment. Other authors have estimated more substantial savings; Huynh et al (372) estimated \$2.6 million in costs of nonbeneficial treatment during a 3-month study in five ICUs, equivalent to \$10.4 million/yr.

Palliative Care Teams. Recommendation:

- Although palliative medicine consultations have been previously associated with reduction in critical care resources, the most recent evidence does not support a recommendation, emphasizing the need for additional high-quality research on this subject (no recommendation).

A recent study of two retrospective cohorts investigated the role of palliative medicine consultations on do-not-resuscitate (DNR) designations and LOS of patients with terminal disease in a medical ICU. There was a significant increase in the utilization of life-supportive limitations with a higher rate of DNR designations in the intervention group (86% vs 68%) (400). The authors also found a reduction in hospital LOS ($p < 0.01$) and ICU LOS ($p < 0.01$). In contrast, the Educate, Nurture, Advise, Before Life Ends II randomized controlled trial did not show improvements in outcomes (some of the symptoms, LOS, and ICU or ED utilization) after palliative care consultations (intervention group); at the same time, the costs of management of these patients increased (400). In a systematic review, Zimmermann et al (401) showed that after a palliative care intervention, a cost reduction was seen in only one of seven studies, improved quality of life in only four of 13 studies, and improvement in symptoms in one of 14 studies. The authors concluded that because of methodological shortcomings, more carefully planned trials are needed and that standardized palliative care interventions and specific measures for this population are needed.

In a before-and-after study of a palliative care quality-improvement intervention conducted in a single-center ICU, Curtis et al (402) found no significant changes in quality of dying (from the family's perspective) or family satisfaction. Furthermore, Curtis et al (403), in a cluster randomized study of a multifaceted intervention in 12 hospitals with 2,318 eligible patients, showed no improvement after the intervention in perceived quality of dying, ICU LOS before death, or time from ICU admission to withdrawal of life-supportive therapies. A subanalysis of 2003–2008 data collected for that study did not show significant changes over time although they identified significant interhospital variation in palliative care delivery and ratings (404). Finally, it may be that these services were underutilized, as suggested by the editorial of Truog (405); only 8% and 1% of the patients had palliative care and ethics consults, respectively.

Research on the use of early palliative care for patients with complex conditions such as metastatic lung cancer has demonstrated beneficial effects, including improvements in quality of life and mood and less aggressive care at the end of life. In a randomized study of early palliative care intervention, patients in the intervention group reported better quality-of-life scores and less depression and had more documentation of resuscitation preferences and less aggressive care at the end of life, compared with the control group (406). Yet ICU use in the last days of life continues to increase, as demonstrated in multiple reports in the United States and Canada (407–409).

Despite the conflicting results between retrospective/observational and systematic review/randomized studies, the use of early implementation and integration of palliative care in the patient's plan of care is promulgated by experts (410). Unfortunately, the unclear value of these interventions in the ICU setting, reports of increased costs associated with implementation of these programs, the lack of widespread public awareness of the goals of palliative care, and poor implementation of palliative medicine at early or even late stages of disease demand further focused research to answer these questions (400, 405, 410).

Potential for Nonbeneficial Treatment to be Harmful

Although the discussion of potential harm caused by nonbeneficial treatment is beyond the scope of this article, it is important to highlight some of the current concerns about the misallocation of critical care resources and bring them to public attention for further discussion. Recent voices have questioned the indiscriminate delivery of nonbeneficial treatment even in systems with unlimited resources (411). Some examples of unethical treatment include the delivery of less effective treatments to demanding patient populations (e.g., aggressive life-supportive treatments at the end of life) and providing antibiotics even when they are considered nonbeneficial treatment, which could lead to antibiotic resistance, making it more difficult or impossible to treat other patient populations in need. In addition, the individuals receiving nonbeneficial treatments could be also negatively affected; while expending all their economic resources on expensive treatments that do not improve the outcome of their disease, they could be left with no coverage for later treatable ailments or have their lives shortened by opting for aggressive therapies prone to more complications. In a randomized study of patients with metastatic lung cancer, Temel et al (412) recently compared standard oncologic care integrated with early palliative care versus standard oncologic care alone. They showed that patients receiving early palliative care used less aggressive care at the end of life and yet lived longer. Niederman and Berger (411) and others consider the delivery of nonbeneficial treatment to be not only an individual decision but also a societal problem, requiring a solution to reduce the unequal allocation of progressively scarcer healthcare resources.

Conflicts in Determining Nonbeneficial Treatment

Recommendation:

- We suggest following the SCCM Ethics Committee's 1997 general recommendations for determining when treatments are nonbeneficial and for resolving end-of-life conflicts regarding withholding or withdrawing life support. We also support the fair-process approach recommended by the AMA's Council on Ethical and Judicial Affairs committee (ungraded).

Occasionally, patients or their relatives have opposing views about the provision or termination of life-supportive therapies. There seems to be a developing emphasis on family-centered

care and a shared decision-making process for addressing the withholding and withdrawal of life-supportive therapies. This consensus-based approach could reduce potentially nonbeneficial treatment (355, 413, 414). In cases in which conflict between patients or their families and the healthcare team arises, the adoption of the fair process recommended by the Council on Ethical and Judicial Affairs of the AMA has gained strength. This process has been adopted by many institutions and has even been incorporated into law in the states of Texas and California (217, 414, 415). However, concerns about the constitutionality of some of these processes have been raised and remain unresolved (416).

Future Directions and Research

Recommendations:

- There is growing concern that nonbeneficial treatment affects not only the individuals receiving these treatments but also the rest of the population. Providing nonbeneficial treatments reduces the availability of the same resources in more appropriate situations, treatments, or patients and could cause unwanted and unrecognized harm. The effect of this practice has an unknown effect on the healthcare system as a whole, leading to an urgent need to better understand the impact of misallocation of critical care resources in the U.S. healthcare system (ungraded).
- As a result of the major knowledge gaps identified, we suggest that more research be performed on all aspects of the determination and provision of nonbeneficial ICU treatment (ungraded).

The need for guidance in making decisions to administer or withdraw life support has led to the development of a multitude of tools and guidelines. Recently, Giacomini et al (417) identified life-support decision tools as an important area of critical care practice and research. In their review of 49 publications addressing this problem, the researchers critically appraised what they considered to be an abundant body of literature reporting a wide variety of tools to aid in different aspects of this process. However, they pointed out some of the discrepancies of the different documents in their positions on key life support, as well as in their scope and practicality. The investigators recommended that future research focus on how to interpret and apply these tools, as well as on their impact on the quality of patient care and outcomes. The cost reduction associated with the reduction of nonbeneficial therapy has been reported to be modest (365, 399). However, the cost-effectiveness of such efforts to reduce nonbeneficial therapy, including enlarging palliative/supportive care teams, is still under debate.

RATIONING

As with the issue of nonbeneficial treatment, the rationing of medical care has been extensively discussed in the past. Rationing has been interpreted in several ways (362). More recently, the Task Force on Values, Ethics, and Rationing in Critical Care

defined it as “the allocation of potentially beneficial healthcare services to some individuals in the face of limited availability that necessarily involves the withholding of those services from other individuals” (158). The definition can be customized according to the specific service rationed. For example, rationing of nursing care has been defined as “the withholding or failure to carry out necessary nursing tasks due to inadequate time, staffing level, and/or skill mix” (107).

As the U.S. healthcare system changes and critical care costs increase (418), attention to this old problem has reintensified. A recent study by Ward et al (419) examined perceptions of nurse and physician directors regarding resource use and constraints in 447 U.S. hospitals with ICUs. Their results indicated that nurses have a larger role than physicians do in managing ICU costs; 91% of nurse directors versus 38% of physician directors were given feedback on expenditures, and nurse directors played a larger role in ICU budgetary decisions. Interestingly, many of the responders agreed that “too much” care (excessive care for some patients) was being provided in their units; for this question, 46% of the physician directors and 39% of the nurse directors chose the responses “sometimes” (25–75% of the time) or “frequently” (> 75% of the time). In contrast, only 7% of both nurse and physician directors thought that patients received “too few” resources sometimes or frequently. The additional pressure of the diminishing physician workforce has led to new coverage models, including telemedicine, the use of nurse practitioners and physician assistants, and hospitalists, that have the potential to improve resource utilization (418).

Impact of Rationing on ICU Outcomes

Although earlier studies failed to demonstrate a difference in outcomes between those admitted to the ICU versus those denied ICU admission (395), many subsequent studies indicate otherwise. Sinuff et al (158) found that the mortality rate was higher for patients refused ICU admission than for patients admitted to the ICU (OR, 3.04; 95% CI, 1.49–6.17). In their systematic review, they found that age, illness severity, and medical diagnosis were used to triage patients and refuse patients at times of ICU bed shortages. During bed shortages, those admitted to the ICU were sicker, were less often admitted for monitoring, and had shorter ICU stays than during times of greater bed availability. In practice, intensivists made the majority of the triage and rationing decisions. The authors stated that the relative importance of the factors used to triage (e.g., age, illness severity, and medical diagnosis) was uncertain. The data were not sufficient to provide clear recommendations or guidance for rationing based on this systematic review.

Simchen et al (126) also showed in a prevalence study an improvement in survival among those admitted to the ICU, but only in the first 3 days after deterioration and after adjusting for age and severity of illness. They concluded that there was a window of critical opportunity that could be used to increase the turnover of patients in ICUs under economic constraints or with bed shortages. Vanhecke et al (420) showed that of 1,302 patients referred to the ICU, 353 (27%) were not admitted, mostly because they were “too well” to benefit. Among

the patients who were not admitted, those who died within 6 months were characterized by older age, more severe illnesses, greater likelihood of being enrolled in hospice at the time of the evaluation, and more likely to decline care than those still living at 6 months. Among the 324 patients analyzed, 9% of the patients considered “too well” to benefit from the critical care services deteriorated and required admission within 48 hours, and they had a 36% mortality rate at 6 months. Another study by Simchen et al (421) showed that only a small percentage of patients eligible for ICU care actually were admitted to the unit; of 44,000 patients screened, 749 patients (1.7%) met predetermined ICU admission criteria, but only 13% of these patients were admitted. The majority of the patients (55%) were admitted to general wards, and 32% were admitted to special units.

Edbrooke et al (422) have suggested that intensive care therapies are as effective as therapies considered “essential”; however, they lamented that because ICU care was considered expensive, this led to an unreasonable restriction in the availability of these resources. In their multicenter, multinational study that encompassed 11 hospitals in seven European countries, they found an overall relative mortality risk among the patients triaged to ICU of 0.70 (95% CI, 0.52–0.94) at 28 days. As the predicted mortality of the patients increased, the RR of ICU admission decreased, with a RR of 0.55 (95% CI, 0.37–0.83) in patients with a predicted mortality of greater than 40%. The estimated mean difference in total cost per hospital stay between patients accepted and not accepted into the ICU was \$6,156 (95% CI, \$5,028–7,283), with a cost per life-year saved of \$7,065 (95% CI, \$3,009–\$11,073).

Data from the Rationing of Nursing Care in Switzerland study have shown worsening in all the variables studied during rationing (107). Schubert et al (107) explored the association between implicit rationing of nursing care and six selected patient outcomes in a cross-sectional study of patients and nurses in eight acute-care hospitals. They used a validated instrument that includes 20 items, the Basel Extent of Rationing of Nursing Care (BERNCA). During implicit rationing (combination of low nursing resources, high nurse workloads, and increased patient complexity and care needs), significantly worse outcomes were found for patient satisfaction, nurse-reported medication errors (adjusted OR, 1.68; 95% CI, 1.17–2.41), patient falls (adjusted OR, 2.81; 95% CI, 1.65–4.78), nosocomial infections (adjusted OR, 1.61; 95% CI, 1.03–2.51), pressure ulcers (adjusted OR, 1.15; 95% CI, 1.06–1.25), and critical incidents (adjusted OR, 1.1; 95% CI, 1.04–1.17) (105).

In 2012, the same investigators reported the impact of rationing of nursing care on inpatient mortality (106). In this cross-sectional correlational study, they found that patients were 51% more likely to die in hospitals with the highest rationing level (in terms of the patient-to-nurse ratio as measured with the BERNCA tool) when compared with the other centers studied (adjusted OR, 1.51; 95% CI, 1.34–1.70). Patients treated in hospitals with a higher-quality nurse work environment (measured with the nurse work environment index-revised,

a validated tool with 51 items) had a significantly lower risk of death (adjusted OR, 0.8; 95% CI, 0.67–0.97); in contrast, patients treated in hospitals with high patient-to-nurse ratios of 10:1 had a 37% higher risk of death (adjusted OR, 1.37; 95% CI, 1.24–1.52).

Other studies have examined bed occupancy and mortality risk. Staffing concerns have also been raised from the significant increased mortality observed during higher bed occupancy rates in Danish hospitals between 1995 and 2012 (109). Madsen et al (109) found an overall 1.2% mortality risk increase for each additional 10% bed occupancy rate, with significant increases in both in-hospital and 30-day mortality rates. Gabler et al (168) have also reported this association in strained ICUs.

Systems for Rationing Critical Care

Recommendation:

- We suggest adhering to the recommendations of the SCCM Ethics Committee, the Council on Ethical and Judicial Affairs of the American Medical Association, and the Bioethics Task Force of the American Thoracic Society for the ethical allocation of scarce medical resources until updated or appropriate evidence-based operational frameworks become available (ungraded).

As described in *General Considerations* section, General Considerations (Triage), in a consensus statement published in 1994, the SCCM Ethics Committee addressed the distribution of scarce resources during the process of triage of critically ill patients (129). In addition to the important elements to consider during triage, the committee highlighted the need for a benefit to be derived from the ICU admission. In other words, the committee considered that the provision of these resources should be linked with likelihood of benefit. The main principles proposed by the committee included 1) “providers should advocate for patients”; 2) “members of the provider team should collaborate”; 3) “care must be restricted in an equitable system”; 4) “decisions to give care should be based on expected benefit”; 5) “mechanisms for alternative care should be planned”; 6) “explicit policies should be written”; 7) “prior public notification is necessary.” The Ethics Committee clearly recommended against admitting patients with a likely poor outcome and stated that “patients who are not expected to benefit from intensive care, such as those with imminently fatal illnesses or permanent unconsciousness, should not be placed in the ICU.”

The Council on Ethical and Judicial Affairs committee of the AMA has also addressed some of the ethical considerations required for the allocation of scarce medical resources (395). In the 1995 statement, the Council proposed several important elements to take into consideration during allocation of scarce resources; among them: “1) the likelihood of benefit to the patient, 2) the impact of treatment in improving the quality of the patient’s life, 3) the duration of benefit, 4) the urgency of the patient’s condition (i.e., how close the patient is to death), and in some cases, 5) the amount of resources required for successful treatment.”

In 1997, a multidisciplinary Bioethics Task Force of the American Thoracic Society (ATS) published an extensive and detailed advisory statement on the fair allocation of intensive care resources (358). The ATS Task Force proposed five principles and 12 position statements in regard to fair allocation of resources. Among the principles, the group sustained that: 1) "ICU care, when medically appropriate, is an essential component of a basic package of health care services that should be available for all"; and 2) "The duty of health care providers to benefit an individual patient has limits when doing so unfairly compromises the availability of resources needed by others." Among the position statements, the group affirmed that: "access to ICU care requires that patients have sufficient medical need"; "whenever feasible, patients should give their informed consent for initiation and continuation of ICU care"; "when demand for ICU beds exceeds supply, medically appropriate patients should be admitted on a first-come, first-served basis"; "access for marginally beneficial ICU care ... may be restricted on the basis of its limited benefit relative to cost"; "prior to health care institutions limiting access to ICU care on the basis of limited benefit relative to cost, prerequisites for efficient use of health care resources, fair redistribution of savings, and public disclosure must be fulfilled"; "health care institutions and their providers should ensure availability of ICU beds by matching supply to medical need"; and "health care institutions and their providers should limit access to ICU resources by means of explicit policies that are made known to patients and the public."

The ATS Task Force recommendations mention a first-come, first-served basis for ICU admission, whereas the SCCM Ethics Committee recommendations indicate that patient benefit be considered. However, in the most recent recommendation by the participants in the Eldicus study consensus process (186), 100% of respondents stated that decisions should not be made on a first-come, first-served basis. In addition, despite the fact that most of the participants represented practiced in ICUs where patients frequently had to be refused ICU admission, they agreed that patients should be refused ICU admission only when the chance of survival was exceedingly low: the agreement levels for refusing admission were 48% if the chance of survival was less than or equal to 1% (one in 100); 65% if the chance of survival was less than or equal to 0.2% (one in 500); and 77% if the chance of survival was less than or equal to 0.1% (one in 1,000). There seems to be a shift away from obligations to patients already hospitalized, perhaps because of the recent pandemics/disasters and resultant planning, and more of an emphasis on age. There was 100% consensus that "Age should never be the sole determining factor in triage decisions" and "Physiological status is more important than chronological age in triage decisions." These principles notwithstanding, during epidemics or mass disaster conditions when benefit is even more difficult to determine, a first-come, first-served approach may have to be used.

Truog et al (423) provided a taxonomical framework of rationing in critical care for further development through empirical evidence and ethical analysis. They divided rationing

decisions into three main categories: decisions made on the basis of external constraints, those made on the basis of clinical guidelines, and those made on the basis of clinical judgment. Hurst and Danis (424) further advanced this framework by dividing clinical judgment into three categories: decisions made on the basis of triage (e.g., limited time, limited beds, and limited staff), those made on the basis of fixed resources (e.g., insufficient blood supplies), and those made on the basis of physician opinion (e.g., assessment of individual benefit or cost). The authors also outlined a proposal to apply the proposed rationing framework. In an innovative approach to gain a better understanding of this complex problem, Strosberg (425) has recently experimented with simulations, including role-playing and incorporating organizational theory perspective. However, despite our growing concerns about rationing for over two decades (426, 427), to date, no practical or consistent guidelines exist to systematically allocate scarce intensive care resources (423).

Future Directions and Research

Recommendation:

- Further research is needed on all aspects of rationing critical care resources to narrow the current gaps in allocating scarce resources (ungraded).

Cook and Giacomini (428) have suggested that investigating rationing is central to understanding the practice of medicine as we approached the new millennium. As our understanding continues to improve with the increasing body of knowledge in this area, the limited role that bedside clinicians and ICU directors play in the management of ICU resources must be taken into account (419). Some bedside clinical interventions, such as identification of those at the end of life with the intent of reducing LOS and costs, do not seem to be matched with significant cost savings (373). Some have suggested that a better approach may be to improve efficiency in ICU settings by increasing our reliance on information technology and increasing the role of telemedicine in the delivery of critical care, but studies to support these assertions are needed (429–432). Recent experiences of various healthcare systems utilizing "tele-ICU" have been reported to be positive (433); however, in a study including more than 4,000 patients, Thomas et al (434) were not able to demonstrate a significant impact of electronic ICU systems on LOS or on ICU or hospital mortality rates. It is still too early to fully understand the multidimensional aspects and impact of the use of this technology in the delivery of critical care services, and the topic demands further study (430).

The misutilization of scarce or expensive resources remains a present and future important problem that needs to be addressed. We must educate primary care physicians, cardiologists, pulmonologists, hematologists, oncologists, and other clinicians to talk to their patients with serious illnesses and determine the patients' real wishes. Patients should be provided with proper advance care planning (a process through which patients, in consultation with their relatives and physicians, make individual decisions regarding their current and

future medical treatments) (435), including discussions about realistic probabilities of cure, benefits of interventions, probabilities of dying despite interventions, hospice, and other options (436, 437).

We must find appropriate and acceptable alternatives to the ICU to care for dying patients. We must re-examine practices such as 1) admitting patients to the ICU because ward attending physicians or hospitalists are “uncomfortable caring for the patient on the ward,” 2) placing dying or moribund patients on life support simply to prolong life in the ICU under the argument of “doing everything,” but in the process adding to the suffering of the patients and their families without any clear benefits, and 3) obtaining blanket consent upon ICU admission to receive a series of life-supportive interventions, which some patients probably would not accept if they were fully informed about each intervention and other alternatives such as end-of-life or palliative care (438).

CONCLUSION

Although these are administrative guidelines, the subjects addressed encompass complex ethical and medico-legal aspects of patient care that affect daily clinical practice. A limited amount of high-quality evidence made it difficult to answer all the questions raised related to ICU ADT, and other processes. After an arduous process of appraising the literature and generating recommendations, it is certain that extensive research is needed to address many specific dilemmas at all levels. Despite these limitations, the members of the Task Force believe that these recommendations provide a comprehensive framework for guiding practitioners in making informed decisions during the ADT process, as well as in resolving issues of nonbeneficial treatment and rationing.

The decision to admit to the ICU can be very easy when resources are abundant or very difficult when limited. Scarce resources may threaten or impede the allocation of critical care services to patients; misusing these resources can aggravate the problem. The ICU should be reserved for critically ill patients who require life-supportive therapies from a trained team of healthcare providers; however, we cannot ignore our responsibility outside the boundaries of these units. We need to further develop preventive strategies to reduce the burden of critical illness, educate our noncritical care colleagues about these interventions, and improve our outreach, developing early identification and intervention systems.

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The members of the Task Force acknowledge the limitations of these guidelines. As a result of the vast amount of medical and healthcare management information to consider,

constraints to evaluate the published and rapidly available new evidence, human fallibility and fast progress among others, the reader has to use his own judgment on how best apply our suggestions and recommendations. Therefore, neither the Society of Critical Care Medicine nor the authors of this document assume responsibility for any injury to individuals as a result of the use of this guide.

REFERENCES

- Coopersmith CM, Wunsch H, Fink MP, et al: A comparison of critical care research funding and the financial burden of critical illness in the United States. *Crit Care Med* 2012; 40:1072–1079
- Agency for Healthcare Research and Quality: President's Advisory Commission on Consumer Protection and Quality in the Healthcare Industry: Consumer Bill of Rights and Responsibilities. Rockville, MD, AHRQ, 1997
- Kohn LT, Corrigan JM, Donaldson MS (Eds): To Err Is Human: Building a Safer Health System. Washington, DC, The National Academies Press, 2000
- Institute of Medicine: Crossing the Quality Chasm: A New Health System for the 21st Century. Washington, DC, The National Academies Press, 2001
- Guidelines for intensive care unit admission, discharge, and triage. Task Force of the American College of Critical Care Medicine, Society of Critical Care Medicine. *Critical Care Medicine* 1999; 27:633–638
- Centers for Medicare & Medicaid Services: Medicare Claims Processing Manual. Chapter 12 - Physicians/Nonphysicians Practitioners. Baltimore, MD, Centers for Medicare & Medicaid Services, 2013
- Guyatt GH, Oxman AD, Kunz R, et al; GRADE Working Group: Going from evidence to recommendations. *BMJ* 2008; 336:1049–1051
- Guyatt GH, Oxman AD, Kunz R, et al; GRADE Working Group: What is “quality of evidence” and why is it important to clinicians? *BMJ* 2008; 336:995–998
- Guyatt GH, Oxman AD, Vist GE, et al; GRADE Working Group: GRADE: An emerging consensus on rating quality of evidence and strength of recommendations. *BMJ* 2008; 336:924–926
- Guyatt G, Oxman AD, Akl EA, et al: GRADE guidelines: 1. Introduction-GRADE evidence profiles and summary of findings tables. *J Clin Epidemiol* 2011; 64:383–394
- Andrews J, Guyatt G, Oxman AD, et al: GRADE guidelines: 15. Going from evidence to recommendations: The significance and presentation of recommendations. *J Clin Epidemiol* 2013; 66:726–735
- Thompson DR, Hamilton DK, Cadenhead CD, et al: Guidelines for intensive care unit design. *Crit Care Med* 2012; 40:1586–1600
- Apfelbaum JL, Hagberg CA, Caplan RA, et al; American Society of Anesthesiologists Task Force on Management of the Difficult Airway: Practice guidelines for management of the difficult airway: An updated report by the American Society of Anesthesiologists Task Force on Management of the Difficult Airway. *Anesthesiology* 2013; 118:251–270
- Rupp SM, Apfelbaum JL, Blitt C, et al: Practice guidelines for central venous access: A report by the American Society of Anesthesiologists Task Force on Central Venous Access. *Anesthesiology* 2012; 116:539–573
- Joint Commission: Hospital Accreditation Standards 2012. In: Standards, Elements of Performance, Scoring, Accreditation Policies 2012. Joint Commission Resources; 1st edition (December 5, 2011)
- Cohen RI, Eichorn A, Silver A: Admission decisions to a medical intensive care unit are based on functional status rather than severity of illness. A single center experience. *Minerva Anestesiol* 2012; 78:1226–1233
- Nordberg M, Lethvall S, Castrén M: The validity of the triage system ADAPT. *Scand J Trauma Resusc Emerg Med* 2010; 18:P36
- Barfod C, Lauritzen MM, Danker JK, et al: Abnormal vital signs are strong predictors for intensive care unit admission and in-hospital

- mortality in adults triaged in the emergency department - a prospective cohort study. *Scand J Trauma Resusc Emerg Med* 2012; 20:28
19. O'Connell FJ, McGillicuddy DC, Canham LS, et al: Abnormal triage vital signs are associated with intensive care unit admission. *In: 2011 Annual Meeting of the Society for Academic Emergency Medicine*. Vol. 18. Society for Academic Emergency Medicine (Ed). Boston, MA, Society for Academic Emergency Medicine; 2011, p S195
 20. Society of Critical Care Medicine: Fundamental critical care Support. *In: Fundamental Critical Care Support*. Second Edition. Zimmerman JL (Ed). Des Plaines, IL, Society of Critical Care Medicine, 2001, pp 1-5
 21. Farley H, Zubrow MT, Gies J, et al: Emergency department tachypnea predicts transfer to a higher level of care in the first 24 hours after ED admission. *Acad Emerg Med* 2010; 17:718-722
 22. Lamantia MA, Stewart PW, Platts-Mills TF, et al: Predictive value of initial triage vital signs for critically ill older adults. *West J Emerg Med* 2013; 14:453-460
 23. Jansen JO, Cuthbertson BH: Detecting critical illness outside the ICU: The role of track and trigger systems. *Curr Opin Crit Care* 2010; 16:184-190
 24. Smith GB, Prytherch DR, Schmidt PE, et al: Review and performance evaluation of aggregate weighted 'track and trigger' systems. *Resuscitation* 2008; 77:170-179
 25. Jung B, Rimmele T, Le Goff C, et al; AzuRea Group: Severe metabolic or mixed acidemia on intensive care unit admission: Incidence, prognosis and administration of buffer therapy. A prospective, multiple-center study. *Crit Care* 2011; 15:R238
 26. Sprung CL, Baras M, Iapichino G, et al: The Eldicus prospective, observational study of triage decision making in European intensive care units: Part I-European Intensive Care Admission Triage Scores. *Crit Care Med* 2012; 40:125-131
 27. Bayraktar UD, Shpall EJ, Liu P, et al: Hematopoietic cell transplantation-specific comorbidity index predicts inpatient mortality and survival in patients who received allogeneic transplantation admitted to the intensive care unit. *J Clin Oncol* 2013; 31:4207-4214
 28. Chalmers JD, Taylor JK, Mandal P, et al: Validation of the Infectious Diseases Society of America/American Thoracic Society minor criteria for intensive care unit admission in community-acquired pneumonia patients without major criteria or contraindications to intensive care unit care. *Clin Infect Dis* 2011; 53:503-511
 29. Nseir S, Grailles G, Soury-Lavergne A, et al: Accuracy of American Thoracic Society/Infectious Diseases Society of America criteria in predicting infection or colonization with multidrug-resistant bacteria at intensive-care unit admission. *Clin Microbiol Infect* 2010; 16:902-908
 30. Hatlem T, Jones C, Woodard EK: Reducing mortality and avoiding preventable ICU utilization: Analysis of a successful rapid response program using APR DRGs. *J Healthc Qual*. 2010; 33:7-16
 31. Caldeira VM, Silva Júnior JM, Oliveira AM, et al: Criteria for patient admission to an intensive care unit and related mortality rates. *Rev Assoc Med Bras* 2010; 56:528-534
 32. Meisel ZF, Mathew R, Wydro GC, et al: Multicenter validation of the Philadelphia EMS admission rule (PEAR) to predict hospital admission in adult patients using out-of-hospital data. *Acad Emerg Med* 2009; 16:519-525
 33. Kontou P, Kuti JL, Nicolau DP: Validation of the Infectious Diseases Society of America/American Thoracic Society criteria to predict severe community-acquired pneumonia caused by *Streptococcus pneumoniae*. *Am J Emerg Med* 2009; 27:968-974
 34. Duke GJ, Piercy M, DiGiantomasso D, et al: Comparison of intensive care outcome prediction models based on admission scores with those based on 24-hour data. *Anaesth Intensive Care* 2008; 36:845-849
 35. Wunsch H, Brady AR, Rowan K: Impact of exclusion criteria on case mix, outcome, and length of stay for the severity of disease scoring methods in common use in critical care. *J Crit Care* 2004; 19:67-74
 36. Procaccio F, Stocchetti N, Citerio G, et al: Guidelines for the treatment of adults with severe head trauma (part I). Initial assessment; evaluation and pre-hospital treatment; current criteria for hospital admission; systemic and cerebral monitoring. *J Neurosurg Sci* 2000; 44:1-10
 37. Meek K, Toosie K, Stabile BE, et al: Simplified admission criterion for predicting severe complications of gallstone pancreatitis. *Arch Surg* 2000; 135:1048-1052
 38. Dahm P, Tuttle-Newhall JE, Yowell CW, et al: Indications for surgical intensive care unit admission of postoperative urologic patients. *Urology* 2000; 55:334-338
 39. Jones AE, Trzeciak S, Kline JA: The Sequential Organ Failure Assessment score for predicting outcome in patients with severe sepsis and evidence of hypoperfusion at the time of emergency department presentation. *Crit Care Med* 2009; 37:1649-1654
 40. Sinuff T, Adhikari NK, Cook DJ, et al: Mortality predictions in the intensive care unit: Comparing physicians with scoring systems. *Crit Care Med* 2006; 34:878-885
 41. Schein RM, Hazday N, Pena M, et al: Clinical antecedents to in-hospital cardiopulmonary arrest. *Chest* 1990; 98:1388-1392
 42. Laurens N, Dwyer T: The impact of medical emergency teams on ICU admission rates, cardiopulmonary arrests and mortality in a regional hospital. *Resuscitation* 2011; 82:707-712
 43. Siddiqui S, Razzak J: Early versus late pre-intensive care unit admission broad spectrum antibiotics for severe sepsis in adults. *Cochrane Database Syst Rev* 2010:CD007081
 44. Ersoy N, Akpınar A: Turkish nurses' decision making in the distribution of intensive care beds. *Nurs Ethics* 2010; 17:87-98
 45. McGaughey J, Alderdice F, Fowler R et al: Outreach and Early Warning Systems (EWS) for the prevention of intensive care admission and death of critically ill adult patients on general hospital wards. *Cochrane Database Syst Rev* 2007:CD005529
 46. Comprehensive Critical Care: A review of adult critical care services. Available at: http://webarchive.nationalarchives.gov.uk/+www.dh.gov.uk/en/publicationsandstatistics/publications/publicationspolicyandguidance/dh_4006585. Accessed May 2, 2016
 47. Naeem N, Montenegro H: Beyond the intensive care unit: A review of interventions aimed at anticipating and preventing in-hospital cardiopulmonary arrest. *Resuscitation* 2005; 67:13-23
 48. Priestley G, Watson W, Rashidian A, et al: Introducing Critical Care Outreach: A ward-randomised trial of phased introduction in a general hospital. *Intensive Care Med* 2004; 30:1398-1404
 49. Nguyen YL, Angus DC, Boumendil A, et al: The challenge of admitting the very elderly to intensive care. *Ann Intensive Care* 2011; 1:29
 50. Shmueli A, Sprung CL: Assessing the in-hospital survival benefits of intensive care. *Int J Technol Assess Health Care* 2005; 21:66-72
 51. Checkley W, Martin GS, Brown SM, et al; United States Critical Illness and Injury Trials Group Critical Illness Outcomes Study Investigators: Structure, process, and annual ICU mortality across 69 centers: United States Critical Illness and Injury Trials Group Critical Illness Outcomes Study. *Crit Care Med* 2014; 42:344-356
 52. Brinkman S, Bakhshi-Raiez F, Abu-Hanna A, et al: Determinants of mortality after hospital discharge in ICU patients: Literature review and Dutch cohort study. *Crit Care Med* 2013; 41:1237-1251
 53. Hampshire PA, Welch CA, McCrossan LA, et al: Admission factors associated with hospital mortality in patients with haematological malignancy admitted to UK adult, general critical care units: A secondary analysis of the ICNARC Case Mix Programme Database. *Crit Care* 2009; 13:R137
 54. Tang WM, Tong CK, Yu WC, et al: Outcome of adult critically ill patients mechanically ventilated on general medical wards. *Hong Kong Med J* 2012; 18:284-290
 55. Hersch M, Sonnenblick M, Karlic A, et al: Mechanical ventilation of patients hospitalized in medical wards vs the intensive care unit—an observational, comparative study. *J Crit Care* 2007; 22:13-17
 56. Huber M, Town J, Yuen T, et al: The relationship between ICU bed availability and cardiac arrest on the general wards. *In: 2012 Annual Meeting of the Society of Hospital Medicine, SHM 2012*. Vol. 7. Society of Hospital Medicine (Ed). San Diego, CA, Society of Hospital Medicine, 2012, pp S3-S4
 57. Jayaraman D, University M, Mardini L, et al: Delay in ICU admission from hospital wards increases mortality. *In: 39th Critical Care Congress of the Society of Critical Care Medicine*. Vol. 37. Society of Critical Care Medicine (Ed). Miami Beach, FL, Society of Critical Care Medicine, 2009, A316

58. Young MP, Gooder VJ, McBride K, et al: Inpatient transfers to the intensive care unit: Delays are associated with increased mortality and morbidity. *J Gen Intern Med* 2003; 18:77–83
59. Chalfin DB, Trzeciak S, Likourezos A, et al; DELAY-ED Study Group: Impact of delayed transfer of critically ill patients from the emergency department to the intensive care unit. *Crit Care Med* 2007; 35: 1477–1483
60. Angel D, Sieunarine K, Finn J, et al: Comparison of short-term clinical postoperative outcomes in patients who underwent carotid endarterectomy: Intensive care unit versus the ward high-dependency unit. *J Vasc Nurs* 2004; 22:85–90; quiz 91
61. McVeigh KP, Moore R, James G, et al: Advantages of not using the intensive care unit after operations for oropharyngeal cancer: An audit at Worcester Royal Hospital. *Br J Oral Maxillofac Surg* 2007; 45:648–651
62. Prather SH, Forsyth LW, Russell KD, et al: Caring for the patient undergoing transsphenoidal surgery in the acute care setting: An alternative to critical care. *J Neurosci Nurs* 2003; 35:270–275
63. Kramer AH, Zygun DA: Do neurocritical care units save lives? Measuring the impact of specialized ICUs. *Neurocrit Care* 2011; 14:329–333
64. Angus DC, Black N: Improving care of the critically ill: Institutional and health-care system approaches. *Lancet* 2004; 363:1314–1320
65. Shortell SM, Zimmerman JE, Rousseau DM, et al: The performance of intensive care units: Does good management make a difference? *Med Care* 1994; 32:508–525
66. Lott JP, Iwashyna TJ, Christie JD, et al: Critical illness outcomes in specialty versus general intensive care units. *Am J Respir Crit Care Med* 2009; 179:676–683
67. Diring MN, Edwards DF: Admission to a neurologic/neurosurgical intensive care unit is associated with reduced mortality rate after intracerebral hemorrhage. *Crit Care Med* 2001; 29:635–640
68. Kurtz P, Fitts V, Sumer Z, et al: How does care differ for neurological patients admitted to a neurocritical care unit versus a general ICU? *Neurocrit Care* 2011; 15:477–480
69. Mirski MA, Chang CW, Cowan R: Impact of a neuroscience intensive care unit on neurosurgical patient outcomes and cost of care: Evidence-based support for an intensivist-directed specialty ICU model of care. *J Neurosurg Anesthesiol* 2001; 13:83–92
70. Patel HC, Menon DK, Tebbs S, et al: Specialist neurocritical care and outcome from head injury. *Intensive Care Med* 2002; 28: 547–553
71. Duane TM, Rao IR, Aboutanos MB, et al: Are trauma patients better off in a trauma ICU? *J Emerg Trauma Shock* 2008; 1:74–77
72. Afessa B, Gajic O, Keegan MT, et al: Impact of introducing multiple evidence-based clinical practice protocols in a medical intensive care unit: A retrospective cohort study. *BMC Emerg Med* 2007; 7:10
73. Crunden E, Boyce C, Woodman H, et al: An evaluation of the impact of the ventilator care bundle. *Nurs Crit Care* 2005; 10:242–246
74. Gajic O, Afessa B: Physician staffing models and patient safety in the ICU. *Chest* 2009; 135:1038–1044
75. Hampton DC, Griffith D, Howard A: Evidence-based clinical improvement for mechanically ventilated patients. *Rehabil Nurs* 2005; 30:160–165
76. Haupt MT, Bekes CE, Brilli RJ, et al; Task Force of the American College of Critical Care Medicine, Society of Critical Care Medicine: Guidelines on critical care services and personnel: Recommendations based on a system of categorization of three levels of care. *Crit Care Med* 2003; 31:2677–2683
77. Pronovost PJ, Angus DC, Dorman T, et al: Physician staffing patterns and clinical outcomes in critically ill patients: A systematic review. *JAMA* 2002; 288:2151–2162
78. The Leapfrog Group: Factsheet: ICU Physician Staffing (IPS). Washington, DC, AcademyHealth, 2000
79. Pronovost P, Needham D, Berenholtz S, et al: An intervention to decrease catheter-related bloodstream infections in the ICU. *N Engl J Med* 2006; 355:2725–2732
80. Wilcox ME, Chong CA, Niven DJ, et al: Do intensivist staffing patterns influence hospital mortality following ICU admission? A systematic review and meta-analyses. *Crit Care Med* 2013; 41:2253–2274
81. Dimick JB, Pronovost PJ, Heitmiller RF, et al: Intensive care unit physician staffing is associated with decreased length of stay, hospital cost, and complications after esophageal resection. *Crit Care Med* 2001; 29:753–758
82. Dimick JB, Pronovost PJ, Lipsett PA: The effect of ICU physician staffing and hospital volume on outcomes after hepatic resection. *J Intens Care Med* 2002; 17:41–47
83. Hawari FI, Al Najjar TI, Zaru L, et al: The effect of implementing high-intensity intensive care unit staffing model on outcome of critically ill oncology patients. *Crit Care Med* 2009; 37:1967–1971
84. Logani S, Green A, Gasperino J: Benefits of high-intensity intensive care unit physician staffing under the Affordable Care Act. *Crit Care Res Pract* 2011; 2011:170814
85. Suarez JJ, Zaidat OO, Suri MF, et al: Length of stay and mortality in neurocritically ill patients: Impact of a specialized neurocritical care team. *Crit Care Med* 2004; 32:2311–2317
86. Kahn JM, Brake H, Steinberg KP: Intensivist physician staffing and the process of care in academic medical centres. *Qual Saf Health Care* 2007; 16:329–333
87. Levy MM, Rapoport J, Lemeshow S, et al: Association between critical care physician management and patient mortality in the intensive care unit. *Ann Intern Med* 2008; 148:801–809
88. Blunt MC, Burchett KR: Out-of-hours consultant cover and case-mix-adjusted mortality in intensive care. *Lancet* 2000; 356:735–736
89. Gajic O, Afessa B, Hanson AC, et al: Effect of 24-hour mandatory versus on-demand critical care specialist presence on quality of care and family and provider satisfaction in the intensive care unit of a teaching hospital. *Crit Care Med* 2008; 36:36–44
90. Wallace DJ, Angus DC, Barnato AE, et al: Nighttime intensivist staffing and mortality among critically ill patients. *N Engl J Med* 2012; 366:2093–2101
91. van der Wilden GM, Schmidt U, Chang Y, et al: Implementation of 24/7 intensivist presence in the SICU: Effect on processes of care. *J Trauma Acute Care Surg* 2013; 74:563–567
92. Garland A, Roberts D, Graff L: Twenty-four-hour intensivist presence: A pilot study of effects on intensive care unit patients, families, doctors, and nurses. *Am J Respir Crit Care Med* 2012; 185:738–743
93. Kerlin MP, Small DS, Cooney E, et al: A randomized trial of nighttime physician staffing in an intensive care unit. *N Engl J Med* 2013; 368:2201–2209
94. Afessa B: Intensive care unit physician staffing: Seven days a week, 24 hours a day. *Crit Care Med* 2006; 34:894–895
95. Gershengorn HB, Wunsch H, Wahab R, et al: Impact of non-physician staffing on outcomes in a medical ICU. *Chest* 2011; 139:1347–1353
96. Boyle III WA, Buckman TG, Kleinpell RM: Integrating Nurse Practitioners and Physician Assistants Into the ICU: Strategies for Optimizing Contributions to Care: Society of Critical Care Medicine; 2012
97. Doolan D: Keeping watch: California's staffing ratios. *Nurs Manage* 2005; 36:36–40
98. Cho SH, Yun SC: Bed-to-nurse ratios, provision of basic nursing care, and in-hospital and 30-day mortality among acute stroke patients admitted to an intensive care unit: Cross-sectional analysis of survey and administrative data. *Int J Nurs Stud* 2009; 46:1092–1101
99. Stone PW, Pogorzelska M, Kunches L, et al: Hospital staffing and health care-associated infections: A systematic review of the literature. *Clin Infect Dis* 2008; 47:937–944
100. McGahan M, Kucharski G, Coyer F; Winner ACCCN Best Nursing Review Paper 2011 sponsored by Elsevier: Nurse staffing levels and the incidence of mortality and morbidity in the adult intensive care unit: A literature review. *Aust Crit Care* 2012; 25:64–77
101. Needleman J, Buerhaus P, Mattke S, et al: Nurse-staffing levels and the quality of care in hospitals. *N Engl J Med* 2002; 346:1715–1722
102. Needleman J, Buerhaus P, Pankratz VS, et al: Nurse staffing and inpatient hospital mortality. *N Engl J Med* 2011; 364:1037–1045
103. Centers for Medicare & Medicaid Services: The Provider Reimbursement Manual - Part 1. Baltimore, MD, Centers for Medicare & Medicaid Services, 2013

104. Assembly Committee on Health: AB 394. Health facilities: Nursing staff, 1999. Available at: http://www.leginfo.ca.gov/pub/99-00/bill/asm/ab_0351-0400/ab_394_cfa_19990628_171358_sen_comm.html. Accessed May 2, 2016
105. Schubert M, Glass TR, Clarke SP, et al: Validation of the Basel Extent of Rationing of Nursing Care instrument. *Nurs Res* 2007; 56:416–424
106. Schubert M, Clarke SP, Aiken LH, et al: Associations between rationing of nursing care and inpatient mortality in Swiss hospitals. *Int J Qual Health Care* 2012; 24:230–238
107. Schubert M, Glass TR, Clarke SP, et al: Rationing of nursing care and its relationship to patient outcomes: The Swiss extension of the International Hospital Outcomes Study. *Int J Qual Health Care* 2008; 20:227–237
108. Stone PW, Kunches L, Hirschhorn L: Cost of hospital-associated infections in Massachusetts. *Am J Infect Control* 2009; 37:210–214
109. Madsen F, Ladelund S, Linneberg A: High levels of bed occupancy associated with increased inpatient and thirty-day hospital mortality in Denmark. *Health Aff (Millwood)* 2014; 33:1236–1244
110. Lipsett PA, Swoboda SM, Dickerson J, et al: Survival and functional outcome after prolonged intensive care unit stay. *Ann Surg* 2000; 231:262–268
111. Patrick DL, Starks HE, Cain KC, et al: Measuring preferences for health states worse than death. *Med Decis Making* 1994; 14:9–18
112. Martin CM, Hill AD, Burns K, et al: Characteristics and outcomes for critically ill patients with prolonged intensive care unit stays. *Crit Care Med* 2005; 33:1922–1927; quiz 1936
113. Douglas SL, Daly BJ, O'Toole EE, et al: Age differences in survival outcomes and resource use for chronically critically ill patients. *J Crit Care* 2009; 24:302–310
114. Bickenbach J, Fries M, Rex S, et al: Outcome and mortality risk factors in long-term treated ICU patients: A retrospective analysis. *Minerva Anestesiol* 2011; 77:427–438
115. Flaatten H, Kvåle R: Survival and quality of life 12 years after ICU. A comparison with the general Norwegian population. *Intensive Care Med* 2001; 27:1005–1011
116. Friedrich JO, Wilson G, Chant C: Long-term outcomes and clinical predictors of hospital mortality in very long stay intensive care unit patients: A cohort study. *Crit Care* 2006; 10:R59
117. Heyland DK, Konopad E, Noseworthy TW, et al: Is it 'worthwhile' to continue treating patients with a prolonged stay (>14 days) in the ICU? An economic evaluation. *Chest* 1998; 114:192–198
118. Montuclard L, Garrouste-Orgeas M, Timsit JF, et al: Outcome, functional autonomy, and quality of life of elderly patients with a long-term intensive care unit stay. *Crit Care Med* 2000; 28:3389–3395
119. Weiler N, Waldmann J, Bartsch DK, et al: Outcome in patients with long-term treatment in a surgical intensive care unit. *Langenbecks Arch Surg* 2012; 397:995–999
120. Gaudino M, Girola F, Piscitelli M, et al: Long-term survival and quality of life of patients with prolonged postoperative intensive care unit stay: Unmasking an apparent success. *J Thorac Cardiovasc Surg* 2007; 134:465–469
121. Chalfin DB: Length of intensive care unit stay and patient outcome: The long and short of it all. *Crit Care Med* 2005; 33:2119–2120
122. Hall WB, Willis LE, Medvedev S, et al: The implications of long-term acute care hospital transfer practices for measures of in-hospital mortality and length of stay. *Am J Respir Crit Care Med* 2012; 185:53–57
123. Ward NS, Afessa B, Kleinpell R, et al; Members of Society of Critical Care Medicine Taskforce on ICU Staffing: Intensivist/patient ratios in closed ICUs: A statement from the Society of Critical Care Medicine Taskforce on ICU Staffing. *Crit Care Med* 2013; 41:638–645
124. Kleinpell RM, Ely EW, Grabenkort R: Nurse practitioners and physician assistants in the intensive care unit: An evidence-based review. *Crit Care Med* 2008; 36:2888–2897
125. Iapichino G, Corbella D, Minelli C, et al: Reasons for refusal of admission to intensive care and impact on mortality. *Intensive Care Med* 2010; 36:1772–1779
126. Simchen E, Sprung CL, Galai N, et al: Survival of critically ill patients hospitalized in and out of intensive care units under paucity of intensive care unit beds. *Crit Care Med* 2004; 32:1654–1661
127. Azoulay E, Pochard F, Chevret S, et al; PROTOCETIC Group: Compliance with triage to intensive care recommendations. *Crit Care Med* 2001; 29:2132–2136
128. Chen LM, Render M, Sales AE, et al: Variation in triage practices among veterans administration hospitals. In: 34th Annual Meeting of the Society of General Internal Medicine. Vol. 26. Society of General Internal Medicine (Ed). Phoenix, AZ, Society of General Internal Medicine, 2011, p S51
129. Consensus statement on the triage of critically ill patients. Society of Critical Care Medicine Ethics Committee. *JAMA* 1994; 271:1200–1203
130. Devereaux AV, Dichter JR, Christian MD, et al: Definitive care for the critically ill during a disaster: A framework for allocation of scarce resources in mass critical care: From a Task Force for Mass Critical Care summit meeting, January 26–27, 2007, Chicago, IL. *Chest* 2008; 133:51S–66S
131. Christian MD, Joynt GM, Hick JL, et al; European Society of Intensive Care Medicine's Task Force for intensive care unit triage during an influenza epidemic or mass disaster: Chapter 7. Critical care triage. Recommendations and standard operating procedures for intensive care unit and hospital preparations for an influenza epidemic or mass disaster. *Intensive Care Med* 2010; 36(Suppl 1):S55–S64
132. Rehn M, Eken T, Krüger AJ, et al: Precision of field triage in patients brought to a trauma centre after introducing trauma team activation guidelines. *Scand J Trauma Resusc Emerg Med* 2009; 17:1
133. Lossius HM, Rehn M, Tjosevik KE, et al: Calculating trauma triage precision: Effects of different definitions of major trauma. *J Trauma Manag Outcomes* 2012; 6:9
134. de Ceballos JP, Turégano-Fuentes F, Perez-Díaz D, et al: 11 March 2004: The terrorist bomb explosions in Madrid, Spain—an analysis of the logistics, injuries sustained and clinical management of casualties treated at the closest hospital. *Crit Care* 2005; 9:104–111
135. Frykberg ER: Medical management of disasters and mass casualties from terrorist bombings: How can we cope? *J Trauma* 2002; 53:201–212
136. Sorensen MJ, von Recklinghausen FM, Fulton G, et al: Secondary overtriage: The burden of unnecessary interfacility transfers in a rural trauma system. *JAMA Surg* 2013; 148:763–768
137. Kleber C, Cwojdzinski D, Strehl M, et al: Results of in-hospital triage in 17 mass casualty trainings: Underestimation of life-threatening injuries and need for re-triage. *Am J Disaster Med* 2013; 8:5–11
138. Magid DJ, Sullivan AF, Cleary PD, et al: The safety of emergency care systems: Results of a survey of clinicians in 65 US emergency departments. *Ann Emerg Med* 2009; 53:715–23.e1
139. Richardson JD, Franklin G, Santos A, et al: Effective triage can ameliorate the deleterious effects of delayed transfer of trauma patients from the emergency department to the ICU. *J Am Coll Surg* 2009; 208:671–678
140. Horwitz LI, Meredith T, Schuur JD, et al: Dropping the baton: A qualitative analysis of failures during the transition from emergency department to inpatient care. *Ann Emerg Med* 2009; 53:701–10.e4
141. Goldstein RS: Management of the critically ill patient in the emergency department: Focus on safety issues. *Crit Care Clin* 2005; 21:81–9, viii
142. Delgado MK, Liu V, Pines JM, et al: Risk factors for unplanned transfer to intensive care within 24 hours of admission from the emergency department in an integrated healthcare system. *J Hosp Med* 2013; 8:13–19
143. Brown SM, Jones JP, Aronsky D, et al: Relationships among initial hospital triage, disease progression and mortality in community-acquired pneumonia. *Respirology* 2012; 17:1207–1213
144. Parkhe M, Myles PS, Leach DS, et al: Outcome of emergency department patients with delayed admission to an intensive care unit. *Emerg Med (Fremantle)* 2002; 14:50–57
145. Escobar GJ, Greene JD, Gardner MN, et al: Intra-hospital transfers to a higher level of care: Contribution to total hospital and intensive care unit (ICU) mortality and length of stay (LOS). *J Hosp Med* 2011; 6:74–80
146. Flabouris A, Jeyadoss J, Field J, et al: Direct and delayed admission to an intensive care or high dependency unit following discharge

- from the emergency department: Associated patient characteristics and hospital outcomes. *Crit Care Resusc* 2012; 14:191–197
147. Liu V, Kipnis P, Rizk NW, et al: Adverse outcomes associated with delayed intensive care unit transfers in an integrated healthcare system. *J Hosp Med* 2012; 7:224–230
 148. Piercy M, Lau S, Loh E, et al: Unplanned admission to the intensive care unit in postoperative patients—an indicator of quality of anaesthetic care? *Anaesth Intensive Care* 2006; 34:592–598
 149. Sobol JB, Gershengorn HB, Wunsch H, et al: The surgical Apgar score is strongly associated with intensive care unit admission after high-risk intraabdominal surgery. *Anesth Analg* 2013; 117:438–446
 150. Kamath AF, McAuliffe CL, Baldwin KD, et al: Unplanned admission to the intensive care unit after total hip arthroplasty. *J Arthroplasty* 2012; 27:1027–32.e1
 151. Weingarten TN, Venus SJ, Whalen FX, et al: Postoperative emergency response team activation at a large tertiary medical center. *Mayo Clin Proc* 2012; 87:41–49
 152. Gerber DR, Schorr C, Ahmed I, et al: Location of patients before transfer to a tertiary care intensive care unit: Impact on outcome. *J Crit Care* 2009; 24:108–113
 153. Duke GJ, Green JV: Outcome of critically ill patients undergoing interhospital transfer. *Med J Aust* 2001; 174:122–125
 154. Newgard CD, McConnell KJ, Hedges JR, et al: The benefit of higher level of care transfer of injured patients from nontertiary hospital emergency departments. *J Trauma* 2007; 63:965–971
 155. Kindermann D, Mutter R, Pines JM: Emergency Department Transfers to Acute Care Facilities, 2009: Statistical Brief #155. Healthcare Cost and Utilization Project (HCUP) Statistical Briefs. Rockville, MD, 2013
 156. Cohen RI, Lisker GN, Eichorn A, et al: The impact of do-not-resuscitate order on triage decisions to a medical intensive care unit. *J Crit Care* 2009; 24:311–315
 157. Cohen RI, Eichorn A, Lisker G, et al: Triage practices in a US-based medical intensive care unit. In: American Thoracic Society International Conference. Vol. 181. ATS (Ed). New Orleans, LA, American Journal of Respiratory and Critical Care Medicine, 2010
 158. Sinuff T, Kahn moui K, Cook DJ, et al: Values Ethics and Rationing in Critical Care Task Force: Rationing critical care beds: A systematic review. *Crit Care Med* 2004; 32:1588–1597
 159. Barfod C, Lauritzen MM, Danker JK, et al: Abnormal vital signs are strong predictors for intensive care unit admission and in-hospital mortality in adults triaged in the emergency department - a prospective cohort study. *Scand J Trauma Resusc Emerg Med* 2012; 20:28
 160. Sprung CL, Geber D, Eidelman LA, et al: Evaluation of triage decisions for intensive care admission. *Crit Care Med* 1999; 27:1073–1079
 161. Howe DC: Observational study of admission and triage decisions for patients referred to a regional intensive care unit. *Anaesth Intensive Care* 2011; 39:650–658
 162. Louriz M, Abidi K, Akkaoui M, et al: Determinants and outcomes associated with decisions to deny or to delay intensive care unit admission in Morocco. *Intensive Care Med* 2012; 38:830–837
 163. Joynt GM, Gomersall CD, Tan P, et al: Prospective evaluation of patients refused admission to an intensive care unit: Triage, futility and outcome. *Intensive Care Med* 2001; 27:1459–1465
 164. Garrouste-Orgeas M, Montuclard L, Timsit JF, et al: Triaging patients to the ICU: A pilot study of factors influencing admission decisions and patient outcomes. *Intensive Care Med* 2003; 29:774–781
 165. Mery E, Kahn JM: Does space make waste? The influence of ICU bed capacity on admission decisions. *Crit Care* 2013; 17:315
 166. Sidlow R, Aggarwal V: "The MICU is full": One hospital's experience with an overflow triage policy. *Jt Comm J Qual Patient Saf* 2011; 37:456–460
 167. Robert R, Reigner J, Tournoux-Facon C, et al: Association des Réanimateurs du Centre Ouest Group: Refusal of intensive care unit admission due to a full unit: Impact on mortality. *Am J Respir Crit Care Med* 2012; 185:1081–1087
 168. Gabler NB, Ratcliffe SJ, Wagner J, et al: Mortality among patients admitted to strained intensive care units. *Am J Respir Crit Care Med* 2013; 188:800–806
 169. Hick JL, Christian MD, Sprung CL; European Society of Intensive Care Medicine's Task Force for Intensive Care Unit Triage During an Influenza Epidemic or Mass Disaster: Chapter 2. Surge capacity and infrastructure considerations for mass critical care. Recommendations and standard operating procedures for intensive care unit and hospital preparations for an influenza epidemic or mass disaster. *Intensive Care Med* 2010; 36(Suppl 1):S11–S20
 170. Bayram JD, Sauer LM, Catlett C, et al: Critical resources for hospital surge capacity: An expert consensus panel. *PLoS Curr* 2013; 5
 171. Nates JL: Combined external and internal hospital disaster: Impact and response in a Houston trauma center intensive care unit. *Crit Care Med* 2004; 32:686–690
 172. Sprung CL, Zimmerman JL, Christian MD, et al; European Society of Intensive Care Medicine Task Force for Intensive Care Unit Triage during an Influenza Epidemic or Mass Disaster: Recommendations for intensive care unit and hospital preparations for an influenza epidemic or mass disaster: Summary report of the European Society of Intensive Care Medicine's Task Force for intensive care unit triage during an influenza epidemic or mass disaster. *Intensive Care Med* 2010; 36:428–443
 173. Nates J, Rath N, Haque S, et al: ICU Triage Improves Patient Flow and Resource Utilization. *Chest* 2011; 140:357A
 174. Howell E, Bessman E, Marshall R, et al: Hospitalist bed management effecting throughput from the emergency department to the intensive care unit. *J Crit Care* 2010; 25:184–189
 175. Rath N, Haque S, Feng L, et al: Variability of ICU triage practices in a cancer hospital. *Crit Care Med* 2011; 39:166
 176. Peschman J, Neideen T, Brasel K: The impact of discharging minimally injured trauma patient: Does age play a role in trauma admission? *J Trauma* 2011; 70:1331–1336
 177. Nasa P, Juneja D, Singh O, et al: Severe sepsis and its impact on outcome in elderly and very elderly patients admitted in intensive care unit. *J Intensive Care Med* 2012; 27:179–183
 178. Mok JM, Durrani SK, Yamamoto A, et al: Admitting service and morbidity and mortality in elderly patients after hip fracture: Finding a threshold for medical versus orthopedic admission. *Am J Orthop (Belle Mead NJ)* 2010; 39:80–87
 179. Garrouste-Orgeas M, Boumendil A, Pateron D, et al; ICE-CUB Group: Selection of intensive care unit admission criteria for patients aged 80 years and over and compliance of emergency and intensive care unit physicians with the selected criteria: An observational, multicenter, prospective study. *Crit Care Med* 2009; 37:2919–2928
 180. Ryan D, Conlon N, Phelan D, et al: The very elderly in intensive care: Admission characteristics and mortality. *Crit Care Resusc* 2008; 10:106–110
 181. Demetriades D, Sava J, Alo K, et al: Old age as a criterion for trauma team activation. *J Trauma* 2001; 51:754–756
 182. Sprung CL, Artigas A, Kesecioglu J, et al: The Eldicus prospective, observational study of triage decision making in European intensive care units. Part II: Intensive care benefit for the elderly. *Crit Care Med* 2012; 40:132–138
 183. Demoule A, Cracco C, Lefort Y, et al: Patients aged 90 years or older in the intensive care unit. *J Gerontol A Biol Sci Med Sci* 2005; 60:129–132
 184. Flaatten H: ICU triage: An overview. In: 30th Congress of the Scandinavian Society of Anaesthesiologists. Vol. 53. Scandinavian Society of Anaesthesiologists (Ed). Odense, Denmark, Acta Anaesthesiologica Scandinavica, 2009, pp 17–18
 185. Marik PE: Management of the critically ill geriatric patient. *Crit Care Med* 2006; 34:S176–S182
 186. Sprung CL, Danis M, Iapichino G, et al: Triage of intensive care patients: Identifying agreement and controversy. *Intensive Care Med* 2013; 39:1916–1924
 187. Garrouste-Orgeas M, Tabah A, Vesin A, et al: The ETHICA study (part II): Simulation study of determinants and variability of ICU physician decisions in patients aged 80 or over. *Intensive Care Med* 2013; 39:1574–1583
 188. Philippart F, Vesin A, Bruel C, et al: The ETHICA study (part I): Elderly's thoughts about intensive care unit admission for life-sustaining treatments. *Intensive Care Med* 2013; 39:1565–1573

189. Magid T, Haase N, Andersen JS, et al: Intensive care of haematological patients. *Dan Med J* 2012; 59:A4395
190. Lecuyer L, Chevret S, Thierry G, et al: The ICU trial: A new admission policy for cancer patients requiring mechanical ventilation. *Crit Care Med* 2007; 35:808–814
191. Cárdenas-Turan M, Ensor J, Wakefield C, et al: Cross-validation of a Sequential Organ Failure Assessment score-based model to predict mortality in patients with cancer admitted to the intensive care unit. *J Crit Care* 2012; 27:673–680
192. Azoulay E, Mokart D, Pène F, et al: Outcomes of critically ill patients with hematologic malignancies: Prospective multicenter data from France and Belgium—a groupe de recherche respiratoire en réanimation onco-hématologique study. *J Clin Oncol* 2013; 31:2810–2818
193. Horster S, Stemmler HJ, Mandel PC, et al: Mortality of patients with hematological malignancy after admission to the intensive care unit. *Onkologie* 2012; 35:556–561
194. Bos MM, Bakhshi-Raiez F, Dekker JW, et al: Outcomes of intensive care unit admissions after elective cancer surgery. *Eur J Surg Oncol* 2013; 39:584–592
195. Bos MM, de Keizer NF, Meynaar IA, et al: Outcomes of cancer patients after unplanned admission to general intensive care units. *Acta Oncol* 2012; 51:897–905
196. Niskanen M, Kari A, Halonen P: Five-year survival after intensive care—comparison of 12,180 patients with the general population. Finnish ICU Study Group. *Crit Care Med* 1996; 24:1962–1967
197. Moore EC, Pilcher DV, Bailey MJ, et al: A simple tool for mortality prediction in burns patients: APACHE III score and FTSA. *Burns* 2010; 36:1086–1091
198. Mariani P, Servois V, De Rycke Y, et al: Liver metastases from breast cancer: Surgical resection or not? A case-matched control study in highly selected patients. *Eur J Surg Oncol* 2013; 39:1377–1383
199. Joynt GM, Loo S, Taylor BL, et al; European Society of Intensive Care Medicine's Task Force for Intensive Care Unit Triage During an Influenza Epidemic or Mass Disaster: Chapter 3. Coordination and collaboration with interface units. Recommendations and standard operating procedures for intensive care unit and hospital preparations for an influenza epidemic or mass disaster. *Intensive Care Med* 2010; 36(Suppl 1):S21–S31
200. Hick JL, Christian MD, Sprung CL; European Society of Intensive Care Medicine's Task Force for Intensive Care Unit Triage During an Influenza Epidemic or Mass Disaster: Chapter 2. Surge capacity and infrastructure considerations for mass critical care. Recommendations and standard operating procedures for intensive care unit and hospital preparations for an influenza epidemic or mass disaster. *Intensive Care Med* 2010; 36(Suppl 1):S11–S20
201. Barr HL, Macfarlane JT, Macgregor O, et al: Ethical planning for an influenza pandemic. *Clin Med (Lond)* 2008; 8:49–52
202. Carbonara S, Bruno G, Ciaula GD, et al: Limiting severe outcomes and impact on intensive care units of moderate-intermediate 2009 pandemic influenza: Role of infectious diseases units. *PLoS One* 2012; 7:e42940
203. Challen K, Bright J, Bentley A, et al: Physiological-social score (PMEWS) vs. CURB-65 to triage pandemic influenza: A comparative validation study using community-acquired pneumonia as a proxy. *BMC Health Serv Res* 2007; 7:33
204. Guest T, Tantam G, Donlin N, et al: An observational cohort study of triage for critical care provision during pandemic influenza: 'clipboard physicians' or 'evidenced based medicine'? *Anaesthesia* 2009; 64:1199–1206
205. Talmor D, Jones AE, Robinson L, et al: Simple triage scoring system predicting death and the need for critical care resources for use during epidemics. *Crit Care Med* 2007; 35:1251–1256
206. Hammond NE, Corley A, Fraser JF: The utility of procalcitonin in diagnosis of H1N1 influenza in intensive care patients. *Anaesth Intensive Care* 2011; 39:238–241
207. Huang CC, Yen DH, Huang HH, et al: Impact of severe acute respiratory syndrome (SARS) outbreaks on the use of emergency department medical resources. *J Chin Med Assoc* 2005; 68:254–259
208. Siau C, Tee A, Au V, et al: Influenza A H1N1 (2009): Clinical spectrum of disease among adult patients admitted to a regional hospital in Singapore. *Singapore Med J* 2011; 52:475–480
209. Khan Z, Hulme J, Sherwood N: An assessment of the validity of SOFA score based triage in H1N1 critically ill patients during an influenza pandemic. *Anaesthesia* 2009; 64:1283–1288
210. Shahpori R, Stelfox HT, Doig CJ, et al: Sequential Organ Failure Assessment in H1N1 pandemic planning. *Crit Care Med* 2011; 39:827–832
211. Farmer JC, Jimenez EJ, Taylor DS et al: Fundamentals of Disaster Management. Des Plaines, IL, Society of Critical Care Medicine, 2003
212. Christian MD, Sprung CL, King MA, et al; Task Force for Mass Critical Care; Task Force for Mass Critical Care: Triage: Care of the critically ill and injured during pandemics and disasters: CHEST consensus statement. *Chest* 2014; 146:e61S–e74S
213. Marres GM, van der Eijk J, Bemelman M, et al: Evaluation of admissions to the Major Incident Hospital based on a standardized protocol. *Eur J Trauma Emerg Surg* 2011; 37:19–29
214. Abir M, Choi H, Cooke CR, et al: Effect of a mass casualty incident: Clinical outcomes and hospital charges for casualty patients versus concurrent inpatients. *Acad Emerg Med* 2012; 19:280–286
215. Ball CG, Kirkpatrick AW, Mulloy RH, et al: The impact of multiple casualty incidents on clinical outcomes. *J Trauma* 2006; 61:1036–1039
216. Bala M, Willner D, Keidar A, et al: Indicators of the need for ICU admission following suicide bombing attacks. *Scand J Trauma Resusc Emerg Med* 2012; 20:19
217. Mahoney EJ, Harrington DT, Biffi WL, et al: Lessons learned from a nightclub fire: Institutional disaster preparedness. *J Trauma* 2005; 58:487–491
218. Lavery GG, Horan E: Clinical review: Communication and logistics in the response to the 1998 terrorist bombing in Omagh, Northern Ireland. *Crit Care* 2005; 9:401–408
219. Shamir MY, Weiss YG, Willner D, et al: Multiple casualty terror events: The anesthesiologist's perspective. *Anesth Analg* 2004; 98:1746–1752, table of contents
220. Stein M: Urban bombing: A trauma surgeon's perspective. *Scand J Surg* 2005; 94:286–292
221. Peleg K, Aharonson-Daniel L, Michael M, et al; Israel Trauma Group: Patterns of injury in hospitalized terrorist victims. *Am J Emerg Med* 2003; 21:258–262
222. Peleg K, Aharonson-Daniel L, Stein M, et al; Israeli Trauma Group (ITG): Gunshot and explosion injuries: Characteristics, outcomes, and implications for care of terror-related injuries in Israel. *Ann Surg* 2004; 239:311–318
223. Peleg K, Liran A, Tessone A, et al: Do burns increase the severity of terror injuries? *J Burn Care Res* 2008; 29:887–892
224. Peleg K, Jaffe DH; Israel Trauma Group: Are injuries from terror and war similar? A comparison study of civilians and soldiers. *Ann Surg* 2010; 252:363–369
225. Weil YA, Peleg K, Givon A, et al; Israeli Trauma Group: Penetrating and orthopaedic trauma from blast versus gunshots caused by terrorism: Israel's National Experience. *J Orthop Trauma* 2011; 25:145–149
226. Avidan V, Hersch M, Armon Y, et al: Blast lung injury: Clinical manifestations, treatment, and outcome. *Am J Surg* 2005; 190:927–931
227. Einav S, Aharonson-Daniel L, Weissman C, et al; Israel Trauma Group: In-hospital resource utilization during multiple casualty incidents. *Ann Surg* 2006; 243:533–540
228. Avitzour M, Mintz Y, Liebergall M, et al: The burden of terrorism: High rate of recurrent hospital referrals. *Injury* 2008; 39:77–82
229. Shamir MY, Rivkind A, Weissman C, et al: Conventional terrorist bomb incidents and the intensive care unit. *Curr Opin Crit Care* 2005; 11:580–584
230. Joint Commission TJ: 2014 Hospital Accreditation Standards. 2013; 1:520
231. Nates JL, Moyer VA: Lessons from Hurricane Katrina, tsunamis, and other disasters. *Lancet* 2005; 366:1144–1146
232. Franco C, Toner E, Waldhorn R, et al: Systemic collapse: Medical care in the aftermath of Hurricane Katrina. *Biosecur Bioterror* 2006; 4:135–146

233. Berggren R: Hurricane Katrina. Unexpected necessities—inside Charity Hospital. *N Engl J Med* 2005; 353:1550–1553
234. Koyama A, Fuse A, Hagiwara J, et al: Medical relief activities, medical resourcing, and inpatient evacuation conducted by Nippon Medical School due to the Fukushima Daiichi Nuclear Power Plant accident following the Great East Japan Earthquake 2011. *J Nippon Med Sch* 2011; 78:393–396
235. Fuse A, Igarashi Y, Tanaka T, et al: Onsite medical rounds and fact-finding activities conducted by Nippon Medical School in Miyagi prefecture after the Great East Japan Earthquake 2011. *J Nippon Med Sch* 2011; 78:401–404
236. Nollet KE, Ohto H, Yasuda H, et al: The great East Japan earthquake of March 11, 2011, from the vantage point of blood banking and transfusion medicine. *Transfus Med Rev* 2013; 27:29–35
237. Maegele M, Gregor S, Yucel N, et al: One year ago not business as usual: Wound management, infection and psychoemotional control during tertiary medical care following the 2004 Tsunami disaster in southeast Asia. *Critical Care* 2006; 10:R50
238. Millie M, Senkowski C, Stuart L, et al: Tornado disaster in rural Georgia: Triage response, injury patterns, lessons learned. *Am Surg* 2000; 66:223–228
239. Hartmann EH, Creel N, Lepard J, et al: Mass casualty following unprecedented tornadic events in the Southeast: Natural disaster outcomes at a Level I trauma center. *Am Surg* 2012; 78:770–773
240. Ablah E, Tinius AM, Konda K, et al: Regional Health System Response to the 2007 Greensburg, Kansas, EF5 Tornado. *Disaster Med Public Health Prep* 2007; 1:90–95
241. Hamilton DR, Gavagan TF, Smart KT, et al: Houston's medical disaster response to Hurricane Katrina: Part 1: The initial medical response from Trauma Service Area Q. *Ann Emerg Med* 2009; 53:505–514
242. Hamilton DR, Gavagan T, Smart K, et al: Houston's medical disaster response to Hurricane Katrina: Part 2: Transitioning from emergency evacuee care to community health care. *Ann Emerg Med* 2009; 53:515–527
243. Heidegger CP, Treggiari MM, Romand JA; Swiss ICU Network: A nationwide survey of intensive care unit discharge practices. *Intensive Care Med* 2005; 31:1676–1682
244. Duke GJ, Green JV, Briedis JH: Night-shift discharge from intensive care unit increases the mortality-risk of ICU survivors. *Anaesth Intensive Care* 2004; 32:697–701
245. Hanane T, Keegan MT, Seferian EG, et al: The association between nighttime transfer from the intensive care unit and patient outcome. *Crit Care Med* 2008; 36:2232–2237
246. Laupland KB, Misset B, Souweine B, et al: Mortality associated with timing of admission to and discharge from ICU: A retrospective cohort study. *BMC Health Serv Res* 2011; 11:321
247. Laupland KB, Shahpori R, Kirkpatrick AW, et al: Hospital mortality among adults admitted to and discharged from intensive care on weekends and evenings. *J Crit Care* 2008; 23:317–324
248. Pilcher DV, Duke GJ, George C, et al: After-hours discharge from intensive care increases the risk of readmission and death. *Anaesth Intensive Care* 2007; 35:477–485
249. Singh MY, Nayyar V, Clark PT, et al: Does after-hours discharge of ICU patients influence outcome? *Crit Care Resusc* 2010; 12:156–161
250. Tobin AE, Santamaria JD: After-hours discharges from intensive care are associated with increased mortality. *Med J Aust* 2006; 184:334–337
251. Ouanes I, Schwebel C, Français A, et al; Outcomerea Study Group: A model to predict short-term death or readmission after intensive care unit discharge. *J Crit Care* 2012; 27:422.e1–422.e9
252. Barker RC, Flint NJ: Consequences of time of discharge from intensive care on mortality and readmission rates in a uk university teaching hospital. In: 23rd Annual Congress of the European Society of Intensive Care Medicine. Vol. 36. ESICM (Ed). Barcelona, Spain, Intensive Care Medicine, 2010, p S164
253. Brama YL, Allan R, Sundaram R: Out-of-hours discharge from the ICU: Defining the out-of-hours period and its effect on mortality. In: 32nd International Symposium on Intensive Care and Emergency Medicine. Vol. 16. Department of Intensive Care Emergency Medicine of Erasme University Hospital (Ed). Brussels, Belgium, Critical Care, 2012, p S182
254. Clarke L, McAllister C: Intensive care unit discharge timing audit. In: 24th Annual Congress of the European Society of Intensive Care Medicine. Vol. 16. ESICM LIVES (Ed). Berlin, Germany, Intensive Care Medicine, 2011, p S218
255. Santamaria JD, Duke G, Pilcher D, et al: After-hours discharge from ICU is a risk factor for in-hospital mortality in a large multi-center prospective study. In: American Thoracic Society International Conference. Vol. 183. ATS (Ed). New Orleans, LA, American Journal of Respiratory and Critical Care Medicine, 2011
256. Makris N, Dulhunty JM, Paratz JD, et al: Unplanned early readmission to the intensive care unit: A case-control study of patient, intensive care and ward-related factors. *Anaesth Intensive Care* 2010; 38:723–731
257. Obel N, Schierbeck J, Pedersen L, et al: Mortality after discharge from the intensive care unit during the early weekend period: A population-based cohort study in Denmark. *Acta Anaesthesiol Scand* 2007; 51:1225–1230
258. Wagner J, Gabler NB, Ratcliffe SJ, et al: Outcomes among patients discharged from busy intensive care units. *Ann Intern Med* 2013; 159:447–455
259. da Silva MC, de Sousa RM, Padilha KG: Patient destination after discharge from intensive care units: Wards or intermediate care units? *Rev Lat Am Enfermagem* 2010; 18:224–232
260. Adkins EJ, Huet JD, Rahmanian S, et al: Clinical factors associated with step-down unit request at ICU discharge. In: American Thoracic Society International Conference. Vol. 181. ATS (Ed). New Orleans, LA, American Journal of Respiratory and Critical Care Medicine, 2010
261. Su J, Lin CY, Chen PJ, et al: Experience with a step-down respiratory care center at a tertiary referral medical center in Taiwan. *J Crit Care* 2006; 21:156–161
262. Jung RS, Sila C, Furlan AJ, et al: Impact of a new neuroscience intermediate care unit on acute stroke care: Quality, cost, and nursing productivity. In: 2011 International Stroke Conference. Vol. 42. Los Angeles, CA, Stroke, 2011, e342
263. Chen HY, Vanness DJ, Golestanian E: A simplified score for transfer of patients requiring mechanical ventilation to a long-term care hospital. *Am J Crit Care* 2011; 20:e122–e130
264. Kahn JM, Werner RM, Carson SS, et al: Variation in long-term acute care hospital use after intensive care. *Med Care Res Rev* 2012; 69:339–350
265. Lane-Fall MB, Iwashyna TJ, Cooke CR, et al: Insurance and racial differences in long-term acute care utilization after critical illness. *Crit Care Med* 2012; 40:1143–1149
266. Hassenpflug M, Steckart J, Nelson DR: Post-ICU mechanical ventilation: Extended care facility residents transferred from intensive care to long-term acute care. In: American Thoracic Society International Conference. Vol. 183. ATS (Ed). Denver, CO, American Journal of Respiratory and Critical Care Medicine, 2011
267. Scheinhorn DJ, Hassenpflug MS, Votto JJ, et al; Ventilation Outcomes Study Group: Post-ICU mechanical ventilation at 23 long-term care hospitals: A multicenter outcomes study. *Chest* 2007; 131:85–93
268. Kahn JM, Benson NM, Appleby D, et al: Long-term acute care hospital utilization after critical illness. *JAMA* 2010; 303:2253–2259
269. Brown SE, Ratcliffe SJ, Kahn JM, et al: The epidemiology of intensive care unit readmissions in the United States. *Am J Respir Crit Care Med* 2012; 185:955–964
270. Chrusch CA, Olafson KP, McMillan PM, et al: High occupancy increases the risk of early death or readmission after transfer from intensive care. *Crit Care Med* 2009; 37:2753–2758
271. Lai JI, Lin HY, Lai YC, et al: Readmission to the intensive care unit: A population-based approach. *J Formos Med Assoc* 2012; 111:504–509
272. Litmathe J, Kurt M, Feindt P, et al: Predictors and outcome of ICU readmission after cardiac surgery. *Thorac Cardiovasc Surg* 2009; 57:391–394

273. Renton J, Pilcher DV, Santamaria JD, et al: Factors associated with increased risk of readmission to intensive care in Australia. *Intensive Care Med* 2011; 37:1800–1808
274. Timmers TK, Verhofstad MH, Moons KG, et al: Patients' characteristics associated with readmission to a surgical intensive care unit. *Am J Crit Care* 2012; 21:e120–e128
275. Kramer AA, Higgins TL, Zimmerman JE: Intensive care unit readmissions in U.S. hospitals: Patient characteristics, risk factors, and outcomes. *Crit Care Med* 2012; 40:3–10
276. Kramer AA, Higgins TL, Zimmerman JE: The association between ICU readmission rate and patient outcomes. *Crit Care Med* 2013; 41:24–33
277. Brown SE, Ratcliffe SJ, Halpern SD: An empirical derivation of the optimal time interval for defining ICU readmissions. *Med Care* 2013; 51:706–714
278. Campbell AJ, Cook JA, Adey G, et al: Predicting death and readmission after intensive care discharge. *Br J Anaesth* 2008; 100:656–662
279. Frost SA, Alexandrou E, Bogdanovski T, et al: Severity of illness and risk of readmission to intensive care: A meta-analysis. *Resuscitation* 2009; 80:505–510
280. Arsenault KA, Hamielec CM: Prediction of readmission: ICU risk and prognostic models. In: American Thoracic Society International Conference. Vol. 181. ATS (Ed). New Orleans, LA, American Journal of Respiratory and Critical Care Medicine, 2010
281. Beck V: Predictors of readmission to a cardiac surgical intensive care unit. In: 2010 Annual Meeting of the Canadian Anesthesiologists' Society. Vol. 57. CAS (Ed). Montreal, QC, Canada, Canadian Journal of Anesthesia, 2010, pp S136–S137
282. Ligtenberg B, Dieperink W, Dijkema L, et al: Early readmission to the ICU: A recurrent problem. In: 24th Annual Congress of the European Society of Intensive Care Medicine. Vol. 37. ESICM LIVES (Ed). Berlin, Germany, Intensive Care Medicine, 2011, p S216
283. Nassar AP, Salles LD, Brauer L: Patients readmitted to intensive care: Who they are and what happens to them? In: 6th International Symposium on Intensive Care and Emergency Medicine for Latin America. Vol. 15. Sao Paulo, Brazil, Critical Care, 2011, p 28
284. Park HP, Lee HN, Lee JH, et al: The discharge revised acute physiology and chronic health evaluation score as a predictor of readmission after discharge from surgical intensive care unit. In: 40th Critical Care Congress of the Society of Critical Care Medicine. Vol. 38. San Diego, CA, Critical Care Medicine, 2010, p A145
285. Santamaria J, Duke G, Pilcher D: Discharge planning in Australasian intensive care units. In: Intensive Care Annual Scientific Meeting of the Australian and New Zealand Intensive Care Society and Australian College of Critical Care Nurses. Vol. 39. Brisbane, QLD, Australia, Anaesthesia and Intensive Care, 2011, pp 1146–1147
286. Baker DR, Pronovost PJ, Morlock LL, et al: Patient flow variability and unplanned readmissions to an intensive care unit. *Crit Care Med* 2009; 37:2882–2887
287. Abu-Awwad R, Buran G: Failure of the swift score to predict readmission to the ICU. In: 2012 Annual Meeting of the Society of Hospital Medicine. Vol. 7. SHM (Ed). San Diego, CA, Journal of Hospital Medicine, 2012, p S88
288. Badawi O, Breslow MJ: Readmissions and death after ICU discharge: Development and validation of two predictive models. *PLoS One* 2012; 7:e48758
289. Chandra S, Kashyap R, Smairat R, et al: Bedside implementation of a readmission prediction model (Stability and Workload Index for Transfer) in the medical intensive care unit. In: CHEST. Vol. 140. Honolulu, HI, Chest, 2011
290. Gajic O, Malinchoc M, Comfere TB, et al: The Stability and Workload Index for Transfer score predicts unplanned intensive care unit patient readmission: Initial development and validation. *Crit Care Med* 2008; 36:676–682
291. Roehrig C, Antonio AC, Castro P, et al: Swift score predict ICU-readmission in South America? In: 24th Annual Congress of the European Society of Intensive Care Medicine. Vol. 37. ESICM LIVES (Ed). Berlin, Germany, Intensive Care Medicine, 2011, S216
292. Kastrup M, Powollik R, Balzer F, et al: Predictive ability of the stability and workload index for transfer score to predict unplanned readmissions after ICU discharge. *Crit Care Med* 2013; 41:1608–1615
293. Araujo TG, Rieder Mde M, Kutchak FM, et al: Readmissions and deaths following ICU discharge: A challenge for intensive care. *Rev Bras Ter Intensiva* 2013; 25:32–38
294. Diya L, Van den Heede K, Sermeus W, et al: The relationship between in-hospital mortality, readmission into the intensive care nursing unit and/or operating theatre and nurse staffing levels. *J Adv Nurs* 2012; 68:1073–1081
295. da Silva MC, de Sousa RM, Padilha KG: Factors associated with death and readmission into the Intensive Care Unit. *Rev Lat Am Enfermagem* 2011; 19:911–919
296. Elliott M, Worrall-Carter L, Page K: Factors contributing to adverse events after ICU discharge: A survey of liaison nurses. *Aust Crit Care* 2013; 26:76–80
297. Frankel HL, Foley A, Norway C, et al: Amelioration of increased intensive care unit service readmission rate after implementation of work-hour restrictions. *J Trauma* 2006; 61:116–121
298. Hess DR, Tokarczyk A, O'Malley M, et al: The value of adding a verbal report to written handoffs on early readmission following prolonged respiratory failure. *Chest* 2010; 138:1475–1479
299. Levin PD, Worner TM, Sviri S, et al: Intensive care outflow limitation—frequency, etiology, and impact. *J Crit Care* 2003; 18:206–211
300. Abir M, Davis MM, Sankar P, et al: Design of a model to predict surge capacity bottlenecks for burn mass casualties at a large academic medical center. *Prehosp Disaster Med* 2013; 28:23–32
301. Keller AS, Kirkland LL, Rajasekaran SY, et al: Unplanned transfers to the intensive care unit: The role of the shock index. *J Hosp Med* 2010; 5:460–465
302. Sebat F, Winters B: Background and need for rapid response systems. In: Designing, Implementing, and Enhancing a Rapid Response System. Sebat F, Lighthall G, Kleinpell R, Baldisseri M, Wax R (Eds). Chicago, IL, Society of Critical Care Medicine, 2009, pp 1–7
303. Armitage M, Eddleston J, Stokes T; Guideline Development Group at the NICE: Recognising and responding to acute illness in adults in hospital: Summary of NICE guidance. *BMJ* 2007; 335:258–259
304. DeVita MA, Smith GB, Adam SK, et al: "Identifying the hospitalised patient in crisis"—a consensus conference on the afferent limb of rapid response systems. *Resuscitation* 2010; 81:375–382
305. Konrad D, Jäderling G, Bell M, et al: Reducing in-hospital cardiac arrests and hospital mortality by introducing a medical emergency team. *Intensive Care Med* 2010; 36:100–106
306. Peberdy MA, Cretikos M, Abella BS, et al: Recommended guidelines for monitoring, reporting, and conducting research on medical emergency team, outreach, and rapid response systems: An Utstein-style scientific statement. A Scientific Statement from the International Liaison Committee on Resuscitation; the American Heart Association Emergency Cardiovascular Care Committee; the Council on Cardiopulmonary, Perioperative, and Critical Care; and the Interdisciplinary Working Group on Quality of Care and Outcomes Research. *Resuscitation* 2007; 75:412–433
307. Santamaria J, Tobin A, Holmes J: Changing cardiac arrest and hospital mortality rates through a medical emergency team takes time and constant review. *Crit Care Med* 2010; 38:445–450
308. Opdam HI: Medical emergency teams in teaching hospitals. In: Medical Emergency Teams. DeVita MA, Hillman K, Bellomo R (Eds). New York, NY, Springer, 2006, pp 152–162
309. Sebat F, Musthafa AA, Johnson D, et al: Effect of a rapid response system for patients in shock on time to treatment and mortality during 5 years. *Crit Care Med* 2007; 35:2568–2575
310. Sharek PJ, Parast LM, Leong K, et al: Effect of a rapid response team on hospital-wide mortality and code rates outside the ICU in a Children's Hospital. *JAMA* 2007; 298:2267–2274
311. Beitler JR, Link N, Bails DB, et al: Reduction in hospital-wide mortality after implementation of a rapid response team: A long-term cohort study. *Crit Care* 2011; 15:R269
312. Winters BD, Weaver SJ, Pfroh ER, et al: Rapid-response systems as a patient safety strategy: A systematic review. *Ann Intern Med* 2013; 158:417–425

313. Chan PS, Jain R, Nallmothu BK, et al: Rapid response teams: A systematic review and meta-analysis. *Arch Intern Med* 2010; 170:18–26
314. Ranji SR, Auerbach AD, Hurd CJ, et al: Effects of rapid response systems on clinical outcomes: Systematic review and meta-analysis. *J Hosp Med* 2007; 2:422–432
315. Winters BD, Pham JC, Hunt EA, et al: Rapid response systems: A systematic review. *Crit Care Med* 2007; 35:1238–1243
316. Hillman K, Chen J, Cretikos M, et al; MERIT Study Investigators: Introduction of the medical emergency team (MET) system: A cluster-randomised controlled trial. *Lancet* 2005; 365:2091–2097
317. Chen J, Bellomo R, Flabouris A, et al; MERIT Study Investigators for the Simpson Centre; ANZICS Clinical Trials Group: The relationship between early emergency team calls and serious adverse events. *Crit Care Med* 2009; 37:148–153
318. Cretikos MA, Chen J, Hillman KM, et al; MERIT Study Investigators: The effectiveness of implementation of the medical emergency team (MET) system and factors associated with use during the MERIT study. *Crit Care Resusc* 2007; 9:205–212
319. Barbetti J, Lee G: Medical emergency team: A review of the literature. *Nurs Crit Care* 2008; 13:80–85
320. Gao H, McDonnell A, Harrison DA, et al: Systematic review and evaluation of physiological track and trigger warning systems for identifying at-risk patients on the ward. *Intensive Care Med* 2007; 33:667–679
321. Schneider AG, Calzavacca P, Mercer I, et al: The epidemiology and outcome of medical emergency team call patients treated with non-invasive ventilation. *Resuscitation* 2011; 82:1218–1223
322. Panico M, Pisani M, Jenq G, et al: Outcomes following a rapid response and the impact on transfer to the Intensive Care Unit. In: American Thoracic Society International Conference. Vol. 183. ATS (Ed). Denver, CO, American Journal of Respiratory and Critical Care Medicine, 2011
323. Arabi YM, Qahtani S, Al-Dorzi HM, et al: Implementation Of Critical Care Response Team (CCRT) is associated with reduction of in-hospital cardiac arrests and ICU readmissions. In: C24 Identifying Patients at Risk of and Rescuing Them. Vol. 181. New Orleans, American Thoracic Society International Conference, 2010, A4095
324. Dacey MJ, Mirza ER, Wilcox V, et al: The effect of a rapid response team on major clinical outcome measures in a community hospital. *Crit Care Med* 2007; 35:2076–2082
325. Elmer J, Froemming B, Harris P et al: Impact of a rapid response team on a medical ICU. In: 39th Critical Care Congress of the Society of Critical Care Medicine. Vol. 37. Miami Beach, FL, Critical Care Medicine, 2010, A371
326. Jones D, Drennan K, Hart GK, et al: Rapid Response Team composition, resourcing and calling criteria in Australia. *Resuscitation* 2012; 83:563–567
327. Shearer B, Marshall S, Buist MD, et al: What stops hospital clinical staff from following protocols? An analysis of the incidence and factors behind the failure of bedside clinical staff to activate the rapid response system in a multi-campus Australian metropolitan health-care service. *BMJ Qual Saf* 2012; 21:569–575
328. Sandroni C, Cavallaro F: Failure of the afferent limb: A persistent problem in rapid response systems. *Resuscitation* 2011; 82:797–798
329. Trinkle RM, Flabouris A: Documenting rapid response system afferent limb failure and associated patient outcomes. *Resuscitation* 2011; 82:810–814
330. Adelstein BA, Piza MA, Nayyar V, et al: Rapid response systems: A prospective study of response times. *J Crit Care* 2011; 26:635.e11–635.e18
331. Mackintosh N, Rainey H, Sandall J: Understanding how rapid response systems may improve safety for the acutely ill patient: Learning from the frontline. *BMJ Qual Saf* 2012; 21:135–144
332. Peebles E, Subbe CP, Hughes P, et al: Timing and teamwork—an observational pilot study of patients referred to a Rapid Response Team with the aim of identifying factors amenable to re-design of a Rapid Response System. *Resuscitation* 2012; 83:782–787
333. Garcea G, Thomasset S, McClelland L, et al: Impact of a critical care outreach team on critical care readmissions and mortality. *Acta Anaesthesiol Scand* 2004; 48:1096–1100
334. Elliott S, Chaboyer W, Ernest D, et al: A national survey of Australian Intensive Care Unit (ICU) Liaison Nurse (LN) services. *Aust Crit Care* 2012; 25:253–262
335. Endacott R, Boulanger C, Chamberlain W, et al: Stability in shifting sands: Contemporary leadership roles in critical care. *J Nurs Manag* 2008; 16:837–845
336. Australian I.C.U. Liaison Nurse Forum: Uptake and caseload of intensive care unit liaison nurse services in Australia. *Crit Care Resusc* 2012; 14:221–226
337. Mellinghoff J, O'Shea P, Dawson D, et al: Delayed discharges revisited: Impact of a liaison post on patients' transition from ICU to ward care. In: 32nd International Symposium on Intensive Care and Emergency Medicine. Vol. 16. Brussels, Belgium, Critical Care, 2012, S182
338. Chaboyer W, Thalib L, Foster M, et al: The impact of an ICU liaison nurse on discharge delay in patients after prolonged ICU stay. *Anaesth Intensive Care* 2006; 34:55–60
339. Endacott R, Chaboyer W, Edington J, et al: Impact of an ICU Liaison Nurse Service on major adverse events in patients recently discharged from ICU. *Resuscitation* 2010; 81:198–201
340. Endacott R, Elliott S, Chaboyer W: An integrative review and meta-synthesis of the scope and impact of intensive care liaison and outreach services. *J Clin Nurs* 2009; 18:3225–3236
341. Green A, Edmonds L: Bridging the gap between the intensive care unit and general wards—the ICU Liaison Nurse. *Intensive Crit Care Nurs* 2004; 20:133–143
342. Priestley G, Watson W, Rashidian A, et al: Introducing Critical Care Outreach: A ward-randomised trial of phased introduction in a general hospital. *Intensive Care Med* 2004; 30:1398–1404
343. Baker-McCleary D, Carmel S: Impact of critical care outreach services on the delivery and organization of hospital care. *J Health Serv Res Policy* 2008; 13:152–157
344. Elliott SJ, Ernest D, Doric AG, et al: The impact of an ICU liaison nurse service on patient outcomes. *Crit Care Resusc* 2008; 10:296–300
345. Esmonde L, McDonnell A, Ball C, et al: Investigating the effectiveness of critical care outreach services: A systematic review. *Intensive Care Med* 2006; 32:1713–1721
346. Butcher BW, Vittinghoff E, Maselli J, et al: Impact of proactive rounding by a rapid response team on patient outcomes at an academic medical center. *J Hosp Med* 2013; 8:7–12
347. Niven DJ, Bastos JF, Stelfox HT: Critical care transition programs and the risk of readmission or death after discharge from an ICU: A systematic review and meta-analysis. *Crit Care Med* 2014; 42:179–187
348. Brill R, Spevetz A, Branson RD, et al; American College of Critical Care Medicine Task Force on Models of Critical Care Delivery. The American College of Critical Care Medicine Guidelines for the Definition of an Intensivist and the Practice of Critical Care Medicine: Critical care delivery in the intensive care unit: Defining clinical roles and the best practice model. *Crit Care Med* 2001; 29:2007–2019
349. The Joint Commission: Performance Measurement. Available at: http://www.jointcommission.org/performance_measurement.aspx. Accessed May 2, 2016
350. Chassin MR, Loeb JM, Schmaltz SP, et al: Accountability measures—using measurement to promote quality improvement. *N Engl J Med* 2010; 363:683–688
351. Accountability Measure List: Available at: http://www.jointcommission.org/accountability_measures.aspx. Accessed May 2, 2016
352. Berenholtz SM, Dorman T, Ngo K, et al: Qualitative review of intensive care unit quality indicators. *J Crit Care* 2002; 17:1–12
353. SEMICYUC: Quality Indicators in Critically Ill Patients. Available at: http://www.semicyuc.org/sites/default/files/quality_indicators_update_2011.pdf, 2011, 1–188
354. Rhodes A, Moreno RP, Azoulay E, et al; Task Force on Safety and Quality of European Society of Intensive Care Medicine (ESICM): Prospectively defined indicators to improve the safety and quality of care for critically ill patients: A report from the Task Force on Safety

- and Quality of the European Society of Intensive Care Medicine (ESICM). *Intensive Care Med* 2012; 38:598–605
355. Luce JM: A history of resolving conflicts over end-of-life care in intensive care units in the United States. *Crit Care Med* 2010; 38:1623–1629
 356. Medical futility in end-of-life care: Report of the Council on Ethical and Judicial Affairs. *JAMA* 1999; 281:937–941
 357. Consensus statement of the Society of Critical Care Medicine's Ethics Committee regarding futile and other possibly inadvisable treatments. *Crit Care Med* 1997; 25:887–891
 358. Fair Allocation of Intensive Care Unit Resources: American Thoracic Society. *Am J Respir Crit Care Med* 1997; 156:1282–1301
 359. Burns JP, Truog RD: Futility: A concept in evolution. *Chest* 2007; 132:1987–1993
 360. Schneiderman LJ, Jecker NS, Jonsen AR: Medical futility: Its meaning and ethical implications. *Ann Intern Med* 1990; 112:949–954
 361. BANE: Nonbeneficial or futile medical treatment: Conflict resolution guidelines for the San Francisco Bay area. Bay Area Network of Ethics Committees (BANE) Nonbeneficial Treatment Working Group. *West J Med* 1999; 170:287–290
 362. Jecker NS, Schneiderman LJ: Futility and rationing. *Am J Med* 1992; 92:189–196
 363. Schneiderman LJ, Jecker NS, Jonsen AR: Medical futility: Response to critiques. *Ann Intern Med* 1996; 125:669–674
 364. Murphy DJ, Matchar DB: Life-sustaining therapy. A model for appropriate use. *JAMA* 1990; 264:2103–2108
 365. Teno JM, Murphy D, Lynn J, et al: Prognosis-based futility guidelines: Does anyone win? SUPPORT Investigators. Study to Understand Prognoses and Preferences for Outcomes and Risks of Treatment. *J Am Geriatr Soc* 1994; 42:1202–1207
 366. Frick S, Uehlinger DE, Zuercher Zenklusen RM: Medical futility: Predicting outcome of intensive care unit patients by nurses and doctors—a prospective comparative study. *Crit Care Med* 2003; 31:456–461
 367. Prendergast TJ, Luce JM: Increasing incidence of withholding and withdrawal of life support from the critically ill. *Am J Respir Crit Care Med* 1997; 155:15–20
 368. Lee Char SJ, Evans LR, Malvar GL, et al: A randomized trial of two methods to disclose prognosis to surrogate decision makers in intensive care units. *Am J Respir Crit Care Med* 2010; 182:905–909
 369. Prendergast TJ: Futility and the common cold. How requests for antibiotics can illuminate care at the end of life. *Chest* 1995; 107:836–844
 370. Hariharan S, Moseley HS, Kumar AY, et al: Futility-of-care decisions in the treatment of moribund intensive care patients in a developing country. *Can J Anaesth* 2003; 50:847–852
 371. Palda VA, Bowman KW, McLean RF, et al: "Futile" care: Do we provide it? Why? A semistructured, Canada-wide survey of intensive care unit doctors and nurses. *J Crit Care* 2005; 20:207–213
 372. Huynh TN, Kleerup EC, Wiley JF, et al: The frequency and cost of treatment perceived to be futile in critical care. *JAMA Intern Med* 2013; 173:1887–1894
 373. Luce JM, Rubenfeld GD: Can health care costs be reduced by limiting intensive care at the end of life? *Am J Respir Crit Care Med* 2002; 165:750–754
 374. History of CPR: Available at: http://www.heart.org/HEARTORG/CPRAndECC/WhatsCPR/CPRFactsandStats/History-of-CPR_UCM_307549_Article.jsp. Accessed May 2, 2016
 375. van Walraven C, Forster AJ, Stiell IG: Derivation of a clinical decision rule for the discontinuation of in-hospital cardiac arrest resuscitations. *Arch Intern Med* 1999; 159:129–134
 376. Bailey ED, Wydro GC, Cone DC: Termination of resuscitation in the prehospital setting for adult patients suffering nontraumatic cardiac arrest. National Association of EMS Physicians Standards and Clinical Practice Committee. *Prehosp Emerg Care* 2000; 4:190–195
 377. Eckstein M: Termination of resuscitative efforts: Medical futility for the trauma patient. *Curr Opin Crit Care* 2001; 7:450–454
 378. Hopson LR, Hirsh E, Delgado J, et al: National Association of EMS Physicians Standards and Clinical Practice Committee; American College of Surgeons Committee on Trauma: Guidelines for withholding or termination of resuscitation in prehospital traumatic cardiopulmonary arrest: A joint position paper from the National Association of EMS Physicians Standards and Clinical Practice Committee and the American College of Surgeons Committee on Trauma. *Prehosp Emerg Care* 2003; 7:141–146
 379. 2005 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. *Circulation* 2005; 112:IV1–203
 380. Ewy GA: Cardiac resuscitation—when is enough enough? *N Engl J Med* 2006; 355:510–512
 381. Cummins RO (Ed): ACLS: Principles and Practice. The Reference Textbook. Dallas, TX, American Heart Association, 2003
 382. Nolan JP, Morley PT, Vanden Hoek TL, et al: International Liaison Committee on Resuscitation: Therapeutic hypothermia after cardiac arrest: An advisory statement by the advanced life support task force of the International Liaison Committee on Resuscitation. *Circulation* 2003; 108:118–121
 383. Chen YS, Chao A, Yu HY, et al: Analysis and results of prolonged resuscitation in cardiac arrest patients rescued by extracorporeal membrane oxygenation. *J Am Coll Cardiol* 2003; 41:197–203
 384. Morrison LJ, Visentin LM, Kiss A, et al: TOR Investigators: Validation of a rule for termination of resuscitation in out-of-hospital cardiac arrest. *N Engl J Med* 2006; 355:478–487
 385. Morrison LJ, Kierzek G, Diekema DS, et al: Part 3: Ethics: 2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. *Circulation* 2010; 122:S665–S675
 386. Truog RD: Is it always wrong to perform futile CPR? *N Engl J Med* 2010; 362:2034–2037
 387. Truog RD: Is it always wrong to perform futile CPR? *N Engl J Med* 2010; 362:477–479
 388. Wijdevicks EF, Varelas PN, Gronseth GS, et al: American Academy of Neurology: Evidence-based guideline update: Determining brain death in adults: Report of the Quality Standards Subcommittee of the American Academy of Neurology. *Neurology* 2010; 74:1911–1918
 389. Office of the Attorney General, Department of Law and Public Safety, Division of Consumer Affairs: Rule Adoptions, Law and Public Safety: Division of Consumer Affairs. Board of Medical Examiners. Vol. 39. New Jersey Register May 7, 2007
 390. Cohen J, Ashkenazi T, Katvan E, et al: Brain death determination in Israel: The first two years experience following changes to the brain death law—opportunities and challenges. *Am J Transplant* 2012; 12:2514–2518
 391. Steinberg A, Sprung CL: The dying patient: New Israeli legislation. *Intensive Care Med* 2006; 32:1234–1237
 392. Liao S, Ito S: Brain death: Ethical challenges to palliative care concepts of family care. *J Pain Symptom Manage* 2010; 40:309–313
 393. Smith ML, Flamm AL: Accommodating religious beliefs in the ICU: A narrative account of a disputed death. *Narrat Inq Bioeth* 2011; 1:55–64
 394. After Buddhist Dies, Legal Battle Continues: Available at: http://www.boston.com/yourlife/health/other/articles/2006/12/03/after_buddhist_dies_legal_battle_continues/. Accessed May 2, 2016
 395. Ethical considerations in the allocation of organs and other scarce medical resources among patients. Council on Ethical and Judicial Affairs, American Medical Association. *Arch Intern Med* 1995; 155:29–40
 396. Schneiderman LJ, Gilmer T, Teetzel HD: Impact of ethics consultations in the intensive care setting: A randomized, controlled trial. *Crit Care Med* 2000; 28:3920–3924
 397. Schneiderman LJ, Gilmer T, Teetzel HD, et al: Effect of ethics consultations on nonbeneficial life-sustaining treatments in the intensive care setting: A randomized controlled trial. *JAMA* 2003; 290:1166–1172
 398. Andereck WS, McGaughey JW, Schneiderman LJ, et al: Seeking to reduce nonbeneficial treatment in the ICU: An exploratory trial of proactive ethics intervention*. *Crit Care Med* 2014; 42:824–830

399. Gilmer T, Schneiderman LJ, Teetzel H, et al: The costs of nonbeneficial treatment in the intensive care setting. *Health Aff (Millwood)* 2005; 24:961–971
400. Bakitas M, Lyons KD, Hegel MT, et al: Effects of a palliative care intervention on clinical outcomes in patients with advanced cancer: The Project ENABLE II randomized controlled trial. *JAMA* 2009; 302:741–749
401. Zimmermann C, Riechelmann R, Krzyzanowska M, et al: Effectiveness of specialized palliative care: A systematic review. *JAMA* 2008; 299:1698–1709
402. Curtis JR, Treece PD, Nielsen EL, et al: Integrating palliative and critical care: Evaluation of a quality-improvement intervention. *Am J Respir Crit Care Med* 2008; 178:269–275
403. Curtis JR, Nielsen EL, Treece PD, et al: Effect of a quality-improvement intervention on end-of-life care in the intensive care unit: A randomized trial. *Am J Respir Crit Care Med* 2011; 183:348–355
404. DeCato TW, Engelberg RA, Downey L, et al: Hospital variation and temporal trends in palliative and end-of-life care in the ICU. *Crit Care Med* 2013; 41:1405–1411
405. Truog RD: Palliative care in the ICU: Lots of questions, few answers*. *Crit Care Med* 2013; 41:1568–1569
406. Temel JS, Greer JA, Muzikansky A, et al: Early palliative care for patients with metastatic non-small-cell lung cancer. *N Engl J Med* 2010; 363:733–742
407. Goodman DC, Morden NE, Chang C-H, et al: Trends in Cancer Care Near the End of Life. A Dartmouth Atlas of Health Care Brief, A Report of the Dartmouth Atlas Project. The Dartmouth Institute for Health Policy & Clinical Practice 2013
408. Teno JM, Gozalo PL, Bynum JP, et al: Change in end-of-life care for Medicare beneficiaries: Site of death, place of care, and health care transitions in 2000, 2005, and 2009. *JAMA* 2013; 309:470–477
409. Ho TH, Barbera L, Saskin R, et al: Trends in the aggressiveness of end-of-life cancer care in the universal health care system of Ontario, Canada. *J Clin Oncol* 2011; 29:1587–1591
410. Parikh RB, Kirch RA, Smith TJ, et al: Early specialty palliative care—translating data in oncology into practice. *N Engl J Med* 2013; 369:2347–2351
411. Niederman MS, Berger JT: The delivery of futile care is harmful to other patients. *Crit Care Med* 2010; 38:S518–S522
412. Temel JS, Greer JA, Muzikansky A, et al: Early palliative care for patients with metastatic non-small-cell lung cancer. *N Engl J Med* 2010; 363:733–742
413. Fine RL, Mayo TW: Resolution of futility by due process: Early experience with the Texas Advance Directives Act. *Ann Intern Med* 2003; 138:743–746
414. Truog RD, Campbell ML, Curtis JR, et al: American Academy of Critical Care Medicine: Recommendations for end-of-life care in the intensive care unit: A consensus statement by the American College [corrected] of Critical Care Medicine. *Crit Care Med* 2008; 36:953–963
415. California Probate Code: Section 4730–4736: Available at: <http://codes.lp.findlaw.com/cacode/PROB/1/d4.7/2/4/s4730>. Accessed May 2, 2016
416. Truog RD: Tackling medical futility in Texas. *N Engl J Med* 2007; 357:1–3
417. Giacomini M, Cook D, DeJean D, et al: Decision tools for life support: A review and policy analysis. *Crit Care Med* 2006; 34:864–870
418. Halpern NA: Can the costs of critical care be controlled? *Curr Opin Crit Care* 2009; 15:591–596
419. Ward NS, Teno JM, Curtis JR, et al: Perceptions of cost constraints, resource limitations, and rationing in United States intensive care units: Results of a national survey. *Crit Care Med* 2008; 36:471–476
420. Vanhecke TE, Gandhi M, McCullough PA, et al: Outcomes of patients considered for, but not admitted to, the intensive care unit. *Crit Care Med* 2008; 36:812–817
421. Simchen E, Sprung CL, Galai N, et al: Survival of critically ill patients hospitalized in and out of intensive care. *Crit Care Med* 2007; 35:449–457
422. Edbrooke DL, Minelli C, Mills GH, et al: Implications of ICU triage decisions on patient mortality: A cost-effectiveness analysis. *Crit Care* 2011; 15:R56
423. Truog RD, Brock DW, Cook DJ, et al: Task Force on Values, Ethics, and Rationing in Critical Care (VERICC): Rationing in the intensive care unit. *Crit Care Med* 2006; 34:958–963; quiz 971
424. Hurst SA, Danis M: A framework for rationing by clinical judgment. *Kennedy Inst Ethics J* 2007; 17:247–266
425. Strosberg MA: The organizational context of ethical dilemmas: A role-playing simulation for the intensive care unit. *J Health Adm Educ* 2001; 19:173–193
426. Miller DH: The rationing of intensive care. *Crit Care Clin* 1994; 10:135–143
427. Strauss MJ, LoGerfo JP, Yeltatzie JA, et al: Rationing of intensive care unit services. An everyday occurrence. *JAMA* 1986; 255:1143–1146
428. Cook D, Giacomini M: The sound of silence: Rationing resources for critically ill patients. *Crit Care* 1999; 3:R1–R3
429. Bloomfield EL: The ethics of rationing of critical care services: Should technology assessment play a role? *Anesthesiol Res Pract* 2009; 1–8
430. Kahn JM, Hill NS, Lilly CM, et al: The research agenda in ICU telemedicine: A statement from the Critical Care Societies Collaborative. *Chest* 2011; 140:230–238
431. Young LB, Chan PS, Lu X, et al: Impact of telemedicine intensive care unit coverage on patient outcomes: A systematic review and meta-analysis. *Arch Intern Med* 2011; 171:498–506
432. Wilcox ME, Adhikari NK: The effect of telemedicine in critically ill patients: Systematic review and meta-analysis. *Crit Care* 2012; 16:R127
433. Breslow MJ, Rosenfeld BA, Doerfler M, et al: Effect of a multiple-site intensive care unit telemedicine program on clinical and economic outcomes: An alternative paradigm for intensivist staffing. *Crit Care Med* 2004; 32:31–38
434. Thomas EJ, Lucke JF, Wueste L, et al: Association of telemedicine for remote monitoring of intensive care patients with mortality, complications, and length of stay. *JAMA* 2009; 302:2671–2678
435. Houben CH, Spruit MA, Groenen MT, et al: Efficacy of advance care planning: A systematic review and meta-analysis. *J Am Med Dir Assoc* 2014; 15:477–489
436. O'Mahony S, McHenry J, Blank AE, et al: Preliminary report of the integration of a palliative care team into an intensive care unit. *Palliat Med* 2010; 24:154–165
437. Brinkman-Stoppelenburg A, Rietjens JA, van der Heide A: The effects of advance care planning on end-of-life care: A systematic review. *Palliat Med* 2014; 28:1000–1025
438. Rady MY, Johnson DJ: Admission to intensive care unit at the end-of-life: Is it an informed decision? *Palliat Med* 2004; 18:705–711