Critical care delivery in the intensive care unit: Defining clinical roles and the best practice model

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Patients receiving medical care in intensive care units (ICUs) account for nearly 30% of acute care hospital costs, yet these patients occupy only 10% of inpatient beds (1, 2). In 1984, the Office of Technology Assessment concluded that 80% of hospitals in the United States had ICUs, >20% of hospital budgets were expended on the care of intensive care patients, and approximately 1% of the gross national product was expended for intensive care services (3). With the aging of the U.S. population, greater demand for critical care services will occur. At the same time, market forces are evolving that may constrain both hospitals' and practitioners' abilities to provide this increasing need for critical care services. In addition, managed care organizations are requesting justification for services provided in the ICU and for demonstration of both efficiency and efficacy. Hospital administrators are continually seeking methods to provide effective and efficient care to their ICU patients. As a result of these social and economic pressures, there is a need to provide more data about the type and quality of clinical care provided in the ICU.

In response, two task forces were convened by the Society of Critical Care Medicine leadership. One task force (models task force) was asked to review available information on critical care delivery in the ICU and to ascertain, if possible, a "best" practice model. The other task force was asked to define the role and practice of an intensivist. The task force memberships were diverse, representing all the disciplines that actively participate in the delivery of health care to patients in the ICU. The models task force membership consisted of 31 healthcare professionals and practitioners, including statisticians and representatives from industry, pharmacy, nursing, respiratory care, and physicians from the specialties of surgery, internal medicine, pediatrics, and anesthesia. These healthcare professionals represented the practice of critical care medicine in multiple settings, including nonteaching community hospitals, community hospitals with teaching programs, academic institutions, military hospitals, critical care medicine private practice, full-time academic practice, and consultative critical care practice.

This article is the consensus report of the two task forces. The objectives of this report include the following: (1) to describe the types and settings of critical care practice (2); to describe the clinical roles of members of the ICU healthcare team (3); to examine available outcome data pertaining to the types of critical care practice (4); to attempt to define a "best" practice model; and (5) to propose additional research that should be undertaken to answer important questions regarding the practice of critical care medicine.

The data and recommendations contained within this report are sometimes based on consensus expert opinion; however, where possible, recommendations are promulgated based on levels of evidence as outlined by Sacket in 1989 (4) and further modified by Taylor in 1997 (5) (see Appendix 1).

DEMOGRAPHICS AND PATTERNS OF CARE IN ICUS IN THE UNITED STATES

Several databases have described the demographics and patterns of care in ICUs in the United States. This section

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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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describes the methods used to establish these databases and their major findings, focusing primarily on critical care practice patterns.

Society of Critical Care Medicine Study (1991)

In 1992 and 1993, the Society of Critical Care Medicine (SCCM) reported the results of a 1991 survey of all ICUs in the United States (6, 7). The American Hospital Association provided the database used for the survey. The survey response rate was 40%, with 1,706 hospitals providing data on 2,876 separate ICUs with 32,850 ICU beds and 25,871 patient admissions. The survey demonstrated that nationally, 8% of all licensed hospital beds were designated as intensive care. Adult and pediatric ICUs averaged 10–12 beds per unit, whereas neonatology units averaged 21 beds. Overall, ICU occupancy averaged 84% of total ICU beds. Small hospitals with <100 beds usually had only one ICU, whereas larger hospitals, particularly those exceeding 300 beds, tended to have multiple ICUs, most commonly designated as medical, surgical, and coronary care.

Management and organizational structure varied widely. Departments of medicine had responsibility for 36% of the ICUs, whereas 22% had no formal departmental affiliation. Internists directed 63% of all ICUs. Most surgical and neurologic units were directed by surgeons, as were 21% of the mixed medical/surgical units. Full-time unit directors were present in 20% to 60% of the different hospitals surveyed. The smaller hospitals (<100 beds; 20% had full time directors) were less likely to employ a full-time unit director compared with larger hospitals (>500 beds; 60% had full time directors). Further findings indicated that 61% of directors were part-time, 51% were unpaid, and 56% were not certified in critical care medicine. Smaller hospitals (20%) had a lower percentage of board-certified unit directors compared with larger hospitals (56%). The ICU medical director, or designee, authorized admissions to the ICU in 12% of all the ICUs surveyed. Pediatric (31%), neonatal (30%), and surgical units (20%) were most likely to have medical directors who authorized unit admissions. As hospital size increased, the likelihood that the unit director had final authority regarding admissions also increased. In hospitals with <100 beds, the unit director had such authority in 9% of the hospitals, whereas in hospitals with >500 beds, this authority was present in 56%. Responsibility for patient care was transferred to the ICU service in 15% of all units surveyed. The ICU service had exclusive medical order-writing authority in 22% of the units (closed unit). Open units were those in which any physician could write orders. Resident physicians dedicated to the ICU were present in 6% of the smallest hospitals compared with 95% in the largest hospitals. The percent of nurses that were certified as critical care RNs increased as hospital size increased: 16% ≤100 beds; 21% >500 beds. Forty-eight percent of units reported having dedicated respiratory therapists, with a median of two therapists per unit.

Pediatric ICU Survey Data (1989)

In 1993, the results of telephone surveys conducted in 1989 of all pediatric ICUs in the United States were published (8). Of 301 hospitals initially believed to have pediatric ICUs (PICUs), data were collected from 235 (78%). Most PICUs had four to six beds (40%). Only 6% had >18 beds. The ICU mortality rate differed significantly among ICU size groups, with the largest units having the highest mortality (7.8 ± 0.8%). Full-time ICU medical directors were present in 80% of the hospitals. In 64% of the units, the medical director or designee was involved in the care of >90% of the patients. A consistent charge nurse was available in 90.6% of the units.

Committee on Manpower for the Pulmonary and Critical Care Societies (COMPACCS; 1997)

To document current and future needs for critical care and pulmonary specialists, the American Thoracic Society, the American College of Chest Physicians, and the SCCM organized COMPACCS in 1995. As part of this study, random samples of hospitals and hospital-appointed ICU directors were surveyed. Pediatric ICUs and units designated as cardiac care were excluded from the COMPACCS survey.

In the survey, ICU directors described the characteristics of their units and patients on the day the survey was completed. To characterize the role of intensivists in ICU care, the ICU directors used the following definitions to describe the care provided to their patients.

a) Full-time intensivist model, wherein all or most of a patient's care is directed by an intensivist (where an intensivist was defined as an attending physician who, by training or experience, provides care for the critically ill in a role broader than that provided by a consultant specialist).
b) Consultant intensivist model, wherein an intensivist consults for another physician to coordinate or assist in critical care but does not have primary responsibility for care.
c) Multiple consultant model, wherein multiple specialists are involved in the patient's care (a pulmonologist or intensivist might be consulted for ventilator management, but no one is designated specifically as the consultant intensivist).
d) Single physician model, wherein the primary physician provides all ICU care without involvement of an intensivist or other consultant.

General ICU Statistics. At the time of the survey, there were 5,979 noncoronary ICUs in the United States, consisting of 72,500 beds with an average occupancy of 77% (average number of beds per unit was 12, with an average census of 9.2). The large majority of ICU beds and patients were in general medical or general surgical units, with an approximate national ICU census, in the spring of 1997, of about 53,000 patients (personal communication; 9).

Patterns of Care. Nearly all of the patients described in the survey could be classified into one of the four patterns of medical care described previously. Of the 53,000 patients, 23.1% were treated in an ICU utilizing the full-time intensivist model, 13.7% utilizing the consultant intensivist model, 45.6% using the multiple consultant specialist model, 14.2% using the single physician model, and 3.4% using some other model. The demographics of the care patterns are described in Table 1 (personal communication; 9).

Regression analysis of these data indicate that the use of the full-time intensivist was statistically associated with larger hospitals, higher managed care penetration, and medical ICUs (MICUs). There was no consistent relationship between patient population size and the full-time intensivist model.

ICU Organization and Staffing. Of all ICUs surveyed, the administrative re-

Table 1. Demographics of care patterns

	Full-Time Intensivist	Consultant Intensivist	Consultant Specialist	Single Physician
Hospital size				
Small	12[a]	07	50	30
Medium	09	14	55	20
Large	40	14	37	04
Very large	36	19	34	10
Type of ICU				
General (33,112)[b]	19	13	46	17
MICU (16,752)	47	17	33	03
SICU (7,510)	21	18	45	14
Specialty (5,455)	21	13	52	14

ICU, intensive care unit; MICU, medical ICU; SICU, surgical ICU.

[a]Values reflect percent of total care provided by each model in each row; total may not add up to 100% because "other" category was not included in the table; [b]numbers in parentheses represent the total patients nationally in that category.

sponsibility was assigned to clinical departments as follows: anesthesia, 0.6%; medicine, 36.7%; surgery, 16%; free standing, 29.1%; and other, 17.6%. Intensivists provided clinical care in 60% of surveyed ICUs, with an average of 12.7 staff members identified by the ICU director as intensivists. Training and/or board certification in critical care were common for these intensivists, ranging from an average of 50% for general internists to 88% for pulmonologists.

In-hospital physician coverage varied. Hospital staff physicians, in roles that varied from attending physician to admitting physician to emergency back-up physician, were formally assigned to cover 30% of the ICUs. During daytime hours on weekdays, this role was fulfilled, on average, by 3.6 staff physicians geographically assigned as follows: full-time presence in the ICU, 27%; presence elsewhere in the hospital, 44%; or presence off-site, 24%. On nights and weekends, 70% of the full-time coverage was directed from off-site and, on average, by two staff physicians. Residents were assigned to cover 44% of all ICUs. Residents were assigned full-time ICU coverage in 53% of hospitals surveyed, in-hospital presence with ICU cross-coverage in 42%, and other in 5%. Fellows were assigned to cover 21% of the ICUs surveyed, with 47% full-time in the ICU, 40% cross-coverage in the hospital, and the remainder off site. Less than 10% of surveyed ICUs reported using nurse practitioners or physician assistants. This coverage almost always required their presence in the hospital, and approximately half of this coverage was full-time in the ICU.

From these data, generated from surveys conducted about 10 yrs apart and primarily in adult critical care units, there are some consistent patterns. About one third of the ICUs are administered by the department of medicine, one-fourth have no departmental affiliation, and 60% of all ICU patients are in general ICU units. The full-time intensivist treated 23% of all ICU patients. This role was particularly common in large hospitals and especially in MICUs. House staff and fellow coverage were employed in 44% and 21% of all ICUs, respectively. In contrast, ICU coverage by nonphysicians was very uncommon.

CRITICAL CARE PRACTICE MODELS

Multidisciplinary Critical Care

The information derived from the aforementioned surveys can be used to describe various models of critical care practice. In a joint position statement, published in 1994, SCCM and the American Association of Critical Care Nurses advocated for a multidisciplinary approach to the administrative and clinical practice of intensive care medicine (1, 10, 11). The governing bodies of the organizations espoused collaboration and shared responsibility for ICU team leadership as a fundamental part of optimizing the medical care provided to critically ill patients. Carlson et al. (12) further outlined five characteristics of the multidisciplinary, collaborative approach to ICU care:

1. Medical and nursing directors with authority and co-responsibility for ICU management.
2. Nursing, respiratory therapy, and pharmacy collaboration with medical staff in a team approach.
3. Use of standards, protocols, and guidelines to assure consistent approach to medical, nursing, and technical issues.
4. Dedication to coordination and communication for all aspects of ICU management.
5. Emphasis on practitioner certification, research, education, ethical issues, and patient advocacy.

This multidisciplinary approach to the management of critically ill patients may be an important factor in the quality of care provided in the ICU. The presence of a team of health professionals from various disciplines, working in concert, may improve efficiency, outcome, and the cost of care for patients hospitalized in the ICU (12–31). An essential element of the ability of a multidisciplinary team to effectively attain specified objectives is team dynamics. Only recently has the impact of team dynamics been applied to medical care delivery teams, and it is important to note that team dynamics may differ given the time allowed to accomplish the objective (i.e., emergently, urgently, routine). As a result, in the ICU, it is essential that the physician team leader and the critical care nurse manager collaborate in the education, structure, and evaluation of the team's dynamics (32, 33).

A detailed description of this multidisciplinary approach to critical care practice has been further outlined by recent American College of Critical Care Medicine (ACCM) and American Academy of Pediatrics recommendations for services and personnel required to provide critical care medicine to adults and children hospitalized in ICUs (34, 35). These recommendations represent the consensus report of experts in critical care medicine.

Certain aspects of the document pertaining to adult ICUs require clarification to highlight the recommendations and support for the multidisciplinary approach to critical care medicine (34).

1. Comprehensive critical care units should be directed by an intensivist, as defined by the SCCM, in collaboration with a defined nursing director (36).
2. Patient management should be directed by an attending physician who is credentialed by the hospital medical staff to provide care to critically ill patients.

3. Critical care attending physicians should be available to provide bedside care within 30 mins, and in-hospital ICU physician coverage must have sufficient expertise to provide emergency management including, but not limited to, airway emergencies.
4. All nursing care should be provided by critical care trained nurses.
5. Respiratory therapists with a working knowledge of the principles of respiratory failure management should be dedicated to the ICU 24 hrs per day.
6. Pharmacy services should be available to provide ICU-dedicated pharmaceutical care and consultation.

In the pediatric document, published jointly in 1993 by the American Academy of Pediatrics and SCCM, the multidisciplinary approach to critical care medicine is described for the pediatric ICU. Characteristics of the medical and nursing directors, types and availability of physician staffing, and availability of a dedicated team of healthcare practitioners specifically trained in the area of pediatric medicine are described (35). A state government, in formulating statewide quality standards for PICUs regarding equipment, space, and personnel (37), has recognized the multidisciplinary approach to pediatric critical care medicine, outlined in this article.

Physician Component—The Intensivist

In 1992, the SCCM guidelines committee described the functions of and requirements to be an intensivist (36). Specific qualifications and responsibilities for an intensivist are outlined in Appendix 2. The most important role of the physician intensivist on the critical care team is as the coordinator and leader of the multidisciplinary, and often multispecialty, approach to the care of the critically ill patient. The critically ill patient is defined as any patient who is at risk for decompensation or any patient who is physiologically unstable, requiring constant surveillance and minute-to-minute titration of therapy according to the evolution of the disease process. The geographic location of the patient in the hospital does not limit the need for critical care, but rather, it is the nature of the illness that defines the care needed. The treatment of the critically ill patient begins immediately on recognition of the severity of illness, continues as the patient is transferred into the ICU, and extends into the recovery phase until the potential for decompensation is sufficiently low.

An intensivist is responsible for coordinating and providing integrated care to the patient with acute and chronic complex illnesses. To accomplish this, proximity to the patient is required. During scheduled intervals, the intensivist practitioner must be immediately available to the patient in the ICU and have no higher priority that would interfere with the prompt delivery of patient care. At times, other specialty consultation is necessary. When multiple consultants are involved, the intensivist, acting as the multispecialty team leader, coordinates the care provided by the consultants, thus providing an integrated approach to the patient and family.

The intensivist participates in and coordinates ICU management activities necessary for the safe, efficient, timely, and consistent delivery of care. Key to these ICU management responsibilities is vesting the authority and providing resources and administrative medical staff leadership. These responsibilities include the following: 1) patient triage based on admission and discharge criteria, bed allocation, and discharge planning; 2) development and enforcement of, in collaboration with other ICU team disciplines, clinical and administrative protocols that are intended to improve the safe and efficient delivery of clinical care and to meet regulatory requirements; 3) coordination and assistance in the implementation of quality improvement activities within the ICU.

The intensivist takes a lead role in meeting the emotional and informational needs of the family during a patient's admission to the ICU. He/she facilitates and collaborates with other team members to provide support for the family in conjunction with that of nursing, ministerial services, and social service team members. The intensivist has the skills to counsel families and to address ethical issues of care by providing the family with the knowledge and support that is needed to make informed decisions regarding the patient's care. This includes, but is not limited to, end-of-life decisions.

The physician component of critical care practice can assume several patterns. Categorizing critical care practice patterns is difficult because there are many variations depending on institutional bias, geographic distribution of physician manpower, and regional availability of financial resources. These critical care practice patterns begin by describing the physician intensivist role in the coordination of care for critically ill patients and often further describe the interrelationships between the physician intensivist and ICU administrative structure.

Much of the medical literature categorizes ICUs as "open" or "closed." These terms have been defined in several ways. In the analysis published by Groeger et al. (6), open refers to units wherein any physician could write medical orders and closed refers to units wherein only the ICU physician staff could write medical orders. Others have defined the terms in a broader context and added a third type of unit called "transitional" (12, 38). As described by Carlson et al. (12), and further adapted here, the characteristics, advantages, and disadvantages for the units are outlined below.

Open Units. Any attending physician with hospital admitting privileges can be the physician of record and direct ICU care; the presence or absence of a dedicated intensivist physician and nursing unit directors; the presence of ICU-dedicated house officers variable; the potential for duplication of services, the lack of a cohesive plan, and inconsistent night coverage.

Closed Units. An intensivist is the physician of record for all ICU patients; full-time ICU directors (physician and nursing); house officers usually present and usually full-time dedicated to the ICU; all orders and procedures carried out by ICU staff; potential for improved efficiency and standardized protocols for care; potential to lock-out private physicians and increase physician conflict.

Transitional Units. An intensivist director, trainees, and intensivist team are present as locally available; standard policies and procedures usually present; shared co-managed care between ICU staff and private physician; encourages optimal communication between ICU staff and community physician; may reduce physician conflict; ICU staff is the final common pathway for orders and procedures; potential for confusion and conflict regarding who has final authority and responsibility for patient care decisions.

ACCM has also described practice pattern models and definitions as follows (personal communication).

Attending Physician of Record. An ICU is an "open unit" when any attending

physician with appropriate hospital admitting privileges can be the patient's physician of record and has ultimate responsibility for the quality and coordination of care. All other physicians are consultants. An ICU is "closed" when the intensivist automatically becomes the attending physician of record for all patients admitted to the ICU. All other physicians are consultants.

Physician Commitment. There can be a spectrum of commitment to the ICU. One example includes the full-time intensivist group of physicians, geographically dedicated to the 24-hr coverage of the ICU, wherein a qualified physician is immediately available to the ICU and has no clinical commitments other than the ICU. In contrast are physicians who provide intermittent coverage by making rounds and responding to emergencies but who also have simultaneous clinical responsibilities other than the ICU.

It is the assertion of this task force that the aforementioned ACCM definitions and those described by Carlson et al. (12) encompass nearly all patterns of medical practice in the ICU setting that pertain to the physician-patient practice pattern. In examining outcome data, these unit classifications and physician practice patterns are often cited, and as such, the definitions are important.

Nursing Component

Although an in depth description of critical care nursing practice is beyond the scope of this document, specific standards of care and practice are outlined in Appendix 3. The section below describes nursing practice in the ICU, focusing on the relationship between nursing and physician practice in the ICU.

Critical care nursing traditionally includes, but is not limited to, the roles of staff nurse, nurse manager, clinical nurse specialist, and acute care nurse practitioner. Critical care nursing practice focuses on several areas.

1. Understanding and supporting technical medical care, including diagnosis, treatment, care planning, and priority setting. In this role, the nurse partners with the ICU attending physician to provide care and oversight to the plan of care ensuring that consultants and ancillary care providers demonstrate practice consistent with this plan. The nurse ensures that the attending physician is aware of changes in the patient's condition and that interventions are consistent with accepted standards of practice.
2. Hospital systems expertise include organizational leadership, implementation of unit-based protocols, quality improvement expertise, and analysis of data from outcome pathways, staff and patient satisfaction, and sentinel events.

Critical care nurses do the majority of patient assessment, evaluation, and care in the ICU. The ratio of patients to bedside nurses is typically 2:1. This allows the critical care nursing staff to spend several hours per patient per shift collecting and integrating information and incorporating it into meaningful patient care. Through their caring practices, they improve the ICU experience for both patients and their families, and through their critical thinking skills, experienced nurses readily recognize clinical changes to prevent further deterioration in these patients. They are familiar with the complications that may be seen in these patients and attempt to prevent them. When practicing in a multiple consultant model, nurses are often faced with reconciling competing orders and unclear lines of both authority and responsibility for patient care.

An advanced practice nurse (APN) is a nurse who has received education at the graduate level, or higher. APNs provide health care to patients and families and may demonstrate a high level of independence. Advanced practice nurses collaborate with the critical care team in developing and implementing a plan of care that is dynamic. In some ICUs, the APN may alter the plan of care. APNs combine clinical practice with education, research, consultation, and leadership. APNs, including clinical nurse specialists and nurse practitioners, teach and mentor nursing staff, educate patients and families, and create teaching materials for a specific type of patient. Counseling families about the short- and long-term management of a patient's illness is an important component of the practice of an APN.

Pharmacy Component

Appendix 4 and a review by Rudis et al. (39) describe specific details of pharmacists' responsibilities in the ICU. General responsibilities of the pharmacist in the ICU include comprehensive monitoring of medication usage to provide cost-effective pharmacotherapy and to intervene as necessary in the medication delivery process to maximize patient outcomes. The pharmacist and pharmacy services may function from an ICU satellite pharmacy or from centralized pharmacy services. Pharmacists participate in drug therapy evaluations either prospectively (before a medication order) or retrospectively (after the medication order). Based on institutional resources, the pharmacist's responsibility in providing pharmacotherapy services is fulfilled using several different practice models.

In one model, pharmacists retrospectively evaluate medication orders but usually do not attend ICU rounds. In a second model, pharmacists are assigned to a critical care satellite pharmacy, with simultaneous responsibilities including dispensing of medications, prospective evaluation of medication orders, and attending ICU rounds. In a third model, pharmacists are exclusively assigned to direct patient care responsibilities, including attending daily unit rounds, obtaining medication histories, and prospectively evaluating drug therapy. Pharmacist consultative services in pharmacotherapy, nutrition support, or pharmacokinetics may be available as an added service to any of the practice models.

Respiratory Therapy Component

The role of the respiratory care practitioner as an integral member of the ICU clinical team focuses primarily on management of the patient/ventilator system, airway care, delivery of bronchodilators, monitoring of hemodynamics and blood gases, and the delivery of protocol-regulated respiratory care. As outlined below, several trials have demonstrated the importance of respiratory care practitioners in facilitating weaning from mechanical ventilation and improving the allocation of respiratory care services.

Current evidence suggests that respiratory therapist-directed ventilator weaning, via protocol, results in a shorter duration of mechanical ventilation compared with traditional physician-directed weaning. Additional benefits include reduced costs, a decrease in nonlethal complications, and reduced re-intubation rates (21–25). These trials represent prospective, randomized, controlled trials in single institutions using concurrent controls and demonstrate the value of the

integration of respiratory therapy into the healthcare team in the ICU. In addition, resource allocation is improved with respiratory therapist-driven protocols to optimize equipment and personnel utilization (26–30).

OUTCOME DATA—MODELS AND PATTERNS OF CRITICAL CARE PRACTICE

Overall Assessment of the Literature

There are numerous problems associated with evaluation and comparison of the medical literature regarding models and patterns of critical care delivery. Recent literature, focused primarily on the organization of the physician's role at the bedside or unit level, has created disparate views of unit organization. Is there a critical care team? Is the ICU open or closed? Should there be 24-hr in-house coverage? There are often large differences among MICUs, surgical ICUs, and pediatric ICUs. There are differences among highly specialized university hospitals, regional community tertiary facilities, and small to medium nonteaching community hospitals. There are differences between ICUs in cities and in rural settings, as well as in large urban inner-city facilities.

In addition, there are multiple confounding factors, usually not addressed in the literature, that further complicate any analysis of outcomes based on models of critical care practice. These confounding variables include the presence or absence of nonphysician providers, quality, quantity, and type of bedside nursing care, regionalization of medical care, and lack of standard definitions for ICU administrative management. Few studies address differences among various mid-level care providers, such as house staff, fellows, acute care nurse practitioners, physician assistants, critical care nurse specialists, respiratory therapists, pharmacists, and nutritionists. There are few studies dealing with different bedside nursing patterns or personnel composition, such as licensed practical nurses, masters trained nurses, certified critical care nurses, ICUs with stable nursing patterns, those with shortages at night or on weekends, or those that have high use of "traveling" nurses. There are few studies related to regionalization, or remote critical care attending services via telemedicine, or the impact of intermediate care (step-down/progressive care) on ICU outcome data. Measures are not well standardized regarding the evaluation of ICU management that could form the basis of useful comparisons of models of care. These measures should include an organizational assessment of leadership, culture, coordination, communication, conflict management, and team cohesion and perceived unit effectiveness (40). Most standardized outcome measures of severity-adjusted mortality and resource use may not be sensitive to these management measures. Few studies relate ICU models of care to quality-of-life outcomes and patient/family/caregiver satisfaction. For families, continuity of care with previously known and respected physicians would seem important. Also fewer moves while in the hospital would likely lead to high satisfaction scores (41). Despite the aforementioned limitations, there is an emerging literature that addresses ICU outcome and the pattern of practice within the ICU.

Medline-PubMED and the Cochrane Library were searched using the following key words: practice patterns; organizational characteristics; ICU; outcomes assessment; outcome; intensivist; pharmacist; critical care nurse; respiratory therapist. Articles were abstracted for further review if they described outcome assessment attributed to or associated with a model of clinical critical care practice. Examining the bibliography of articles previously abstracted identified additional references. By using this methodology, 143 articles were identified. The following sections summarize the data identified that pertain to outcome and practice patterns of critical care medicine. Some of the studies that describe outcomes associated with specific practitioner types, but within an overall critical care practice model, are discussed separately.

Nonrandomized Studies

There are a number of small, nonrandomized studies primarily using historical controls (level IV) that support the presence of an intensivist in the ICU compared with a prior model without an intensivist. These studies were usually done when there was a change in ICU organizational structure, primarily the addition of an intensivist. ICU outcome data (usually mortality) from a time period before the addition of the intensivist are compared with data for a time period after the addition of the intensivist. These studies suggest that ICU mortality and cost are lower with an intensivist present in the ICU. Although it is tempting to perform a meta-analysis, we do not believe this approach would be productive because of the methodological problems associated with combining multiple studies with design flaws into an analysis with a large number of patients and the same design flaws. We will, however, summarize the findings of many of the individual studies outlined above. Data available only in abstract format have been omitted.

Reynolds NH, Haupt MT, Thill-Baharozian MC, et al: Impact of critical care physician staffing with septic shock in a university hospital medical intensive care unit. *JAMA* 1988; 260:3446–3450 (42) (level IV evidence)

In a retrospective review of MICU records, two consecutive 12-month periods of time were compared. During the first time period, the ICU was without critical care-trained faculty, and during the second time period, the ICU was supervised by critical care-trained faculty. Severity of illness scores were comparable during the two time periods. Mortality was significantly decreased during the postcritical care medicine time period.

Pollack MM, Katz RW, Ruttimann UE, et al: Improving the outcome and efficiency of intensive care: The impact of an intensivist. *Crit Care Med* 1988; 16:11 (14) (level IV evidence)

This article was a retrospective review of PICU records comparing two time periods with and without an intensivist. A greater use of therapeutic monitoring and favorable effects on bed utilization occurred during the intensivist time period. No effect on mortality or length of stay was demonstrated.

Brown JJ, Sullivan G: Effect on ICU mortality of a full-time critical care specialist. *Chest* 1989; 96:127–129 (43) (level IV evidence)

A retrospective review was conducted of two time periods (consecutive years) in a MICU, before and after the addition of a trained critical care specialist (intensivist). Despite similar severity of illness, the mortality rate was significantly lower during the intensivist time period.

Baggs JG, Ryan SA, Phelps CE, et al: The association between interdisciplinary collaboration and patient outcomes in a medical intensive care unit. *Heart Lung* 1992; 21:18–24 (44) (level IV evidence)

A prospective survey of nurses and residents in a MICU was conducted regarding their view of collaboration at the time of ICU discharge. The nurse's report of collaboration (nonvalidated survey tool) was positively correlated with patient outcome after controlling for severity of illness.

Pollack MM, Cuerdon TT, Patel KM, et al: Impact of quality of care factors on pediatric intensive care unit mortality. *JAMA* 1994; 272:941–946 (45) (level III evidence)

Data were collected from a national survey of 16 representative pediatric ICUs. The ICUs differed significantly with respect to descriptive statistics. Risk-adjusted mortality data indicated that the presence of a pediatric intensivist was significantly associated with improved patient survival. The presence of pediatric residents was associated with an increased mortality risk. The conclusions in this study have been challenged because of the diverse nature of the ICUs studied.

Carson SS, Stocking C, Podsadecki T, et al: Effects of organizational change in the medical intensive care unit of a teaching hospital: A comparison of 'open' and 'closed' formats. *JAMA* 1996; 276:322–328 (13) (level III evidence)

This was a prospective cohort study that examined two consecutive time periods of ICU care. The first encompassed an open ICU organizational structure, wherein critical care specialists consulted on all ICU patients and made recommendations, but the admitting attending physician retained primary responsibility for patient care. Under the closed format, the critical care attending physician assumed primary responsibility for all patient care and the admitting physician was a consultant. Despite significantly higher severity of illness scores during the closed ICU organization, the risk-adjusted mortality score was 0.78 compared with 0.90 in the open ICU organization. Resource utilization did not increase during the closed unit structure, despite higher severity of illness.

Pollack MM, Patel KM, Ruttimann UE, et al: Pediatric critical care training programs have a positive effect on pediatric intensive care mortality. *Crit Care Med* 1997; 25:1637–1642 (46) (level IV evidence)

This was a cohort study of 16 volunteer PICUs (eight with PICU fellowships and eight without fellowships). Pediatric ICUs with fellowship training programs had better risk-adjusted mortality rates compared with those without training programs.

Rosenthal GE, Harper DL, Quinn LM, et al: Severity adjusted mortality and length of stay in teaching and nonteaching hospitals: Results of a regional study. *JAMA* 1997; 278:485–490 (47) (level IV evidence)

This was a retrospective cohort study examining 30 hospitals in Ohio. Risk-adjusted mortality and length of stay were lower in teaching hospitals compared with nonteaching hospitals.

Manthous CA, Amoateng-Adjepong Y, Al-Kharrat T, et al: Effects of medical intensivist on patient care in a community teaching hospital. *Mayo Clin Proc* 1997; 72:391–399 (48) (level IV evidence)

This was a retrospective review of MICU patient admissions comparing two consecutive time periods before and after the addition of a medical intensivist. Patient severity of illness was similar during the two time periods. Mortality for pneumonia, mean length of hospital stay, and MICU stay were all reduced after the addition of the medical intensivist.

Multz, AS, Chalfin DB, Samson IM, et al: A closed medical intensive care unit (MICU) improves resource utilization when compared with an open MICU. *Am J Respir Crit Care Med* 1998; 157: 1468–1473 (49) (level IV evidence)

A complicated methodology was used, wherein a retrospective analysis of two time periods in one hospital was compared as the ICU administrative structure changed from an open organizational structure to a closed one (retrospective analysis). In addition, another cohort of patients was prospectively analyzed, wherein one group from one hospital managed in an open ICU organizational structure was compared with another group from another hospital managed in a closed ICU organizational structure (prospective analysis). Illness severity and primary diagnostic categories between groups were comparable. ICU and hospital length of stay was less in closed units. An open ICU format was associated with greater mortality prediction.

Ghorra S, Reinert SE, Cioffi W, et al: Analysis of the effect of conversion from open to closed surgical intensive care unit. *Ann Surg* 1999; 229:163–171 (50) (level IV evidence)

This is a retrospective review comparing two time periods (open unit vs. closed unit) in a surgical ICU. Mortality and overall complications were significantly higher in the open-unit group compared with the closed-unit group.

Cole L, Bellomo R, Silvester W, et al: A prospective, multicenter study of the epidemiology, management, and outcome of severe acute renal failure in a "closed" ICU system. *Am J Respir Crit Care Med* 2000; 162:191–196 (51) (level III evidence)

This was a prospective, observational study examining the outcome of acute renal failure requiring replacement therapy (severe acute renal failure) within closed ICU systems in Australia. The study was conducted over a 3-month period in all nephrology units and ICUs in the state of Victoria (all closed ICUs with critical care physicians in charge of all patients), Australia. Demographic, clinical, and outcome data using standardized case report forms were collected. By using the SAPS II score or a recently validated renal-failure specific score, the predicted mortality for these patients was shown to be 59%. Actual mortality was 49.2%. The authors concluded that patients with renal failure managed in closed ICU systems in Australia had favorable outcomes compared with predicted mortality.

Blunt MC, Burchett KR: Out-of-hours consultant cover and case-mix-adjusted mortality in intensive care. *Lancet* 2000; 356:735–736 (52) (level IV evidence)

A historical case control study examined standardized mortality ratios in 452 patients admitted to an ICU after an intensivist joined the staff compared with 372 patients before the intensivist's arrival. Severity of illness scores were comparable in both groups; however, the standardized mortality ratio improved significantly in the intensivist group (0.81 vs. 1.11; ratio, 0.73 [95% confidence interval, 0.55–0.97]).

Practitioner-Specific Studies

Mitchell P, Armstrong S, Simpson T, et al: American Association of Critical Care Nurses Demonstration Project: Profile of excellence in critical care nursing. *Heart Lung* 1989; 18:219–226 (53) (level IV evidence)

This study demonstrated that improved patient outcomes were associated with nurse staffing levels, nurse credentials, model of nursing care delivery, a model of shared or participative governance, and the degree of collaboration between nursing and medicine.

Tarrow-Mordi WG, Hau C, Warden A, et al: Hospital mortality in relation to staff workload: A 4-yr study in an adult intensive care unit. *Lancet* 2000; 356: 185–189 (20) (level IV evidence)

This article describes a 4-yr study of all admissions to an adult ICU in the United Kingdom, wherein adjusted mortality was more than two times higher when the nursing workload was higher compared with when it was lower.

Montazeri M, Cook DJ: Impact of a clinical pharmacist in a multidisciplinary intensive care unit. *Crit Care Med* 1994; 22:1044–1048 (19) (level III evidence)

This prospective observational study describes pharmacist interventions during a 3-month period in a medical-surgical ICU. During the study, there were 10.7 ± 5.0 pharmacist interventions per day. These interventions included providing drug information to physicians and nurses, drug order clarification, pharmacokinetic information, and adverse reaction reporting. The pharmacist-initiated therapeutic interventions resulted in significantly reduced drug costs ($67,664.24 annualized) compared with historical controls.

Overall Best Studies in the Literature

Pronovost PJ, Jenckes MW, Dorman T, et al: Organizational characteristics of intensive care units related to outcomes of abdominal aortic surgery. *JAMA* 1999; 281:1310–1317 (54) (level III evidence)

This is a large observational, nonrandomized study using contemporaneous controls. The study was done using the Maryland Health Discharge Data Set, with a focus on patients undergoing major abdominal aortic surgery ($n = 2987$). The study compiled data from 39 of 46 acute care hospitals in the state of Maryland. The authors used a multitiered, multivariable analytic technique and showed that daily rounds in the ICU by an ICU physician was associated with reduced in-hospital mortality and specific postoperative medical complications. The magnitude of this mortality reduction was equivalent to that observed in other studies that compared the skill (and surgical volume) of operating surgeons. The authors used a validated survey instrument, completed by the ICU medical director of participating ICUs, to define physician organizational characteristics. There was a significant association between reduced nurse-patient staffing on the day and evening shifts and increased resource use as estimated by increased ICU and hospital days. There are at least two concerns with this study. One is that the authors could not detect a difference in mortality based on surgeon operating volume, an association that has been repeatedly shown in many other studies. The second is that even in complex studies, there is usually a suggestion of the final results found in the univariate or demographic tables. In this study, the descriptive tables and the univariate analyses presented did not seem to yield obvious or even subtle clues regarding what was ultimately shown with the multilevel technique. The authors concluded that daily rounds by an ICU physician reduce mortality and complications in the patient population studied.

Leape LL, Cullen DJ, Demspey Clapp M, et al: Pharmacist participation on physician rounds and adverse drug events in the intensive care unit. *JAMA* 1999; 282: 267–270 (18) (level II evidence)

This is a controlled clinical trial examining the incidence of preventable adverse drug events before and after the introduction of a senior clinical pharmacist (intervention) to the daily rounds in the MICU. A medical coronary care unit was used as a control unit. Preventable adverse drug events (attributable to prescribing errors) decreased by 66% after the intervention, whereas there was no change in the rate of prescribing type drug errors in the control unit.

Knaus WA, Draper EA, Wagner DP, et al: An evaluation of outcome from intensive care in major medical centers. *Ann Intern Med* 1986; 104:410–418 (55) (level III evidence)

This study is the *post hoc* analysis of the original Acute Physiology and Chronic Health Evaluation (APACHE) II database. This study was a large, nonrandomized observational study. There were 13 hospitals and 5,030 patients used to develop the APACHE II severity of illness system. The authors rank ordered the hospital ICUs by the actual or observed mortality and the predicted hospital deaths. The ICUs' medical or nursing director completed a detailed questionnaire regarding staffing, organization, policies, procedures, and extent of the critical care personnel's participation in patient care. The use of risk stratification with the standardized mortality ratio demonstrated there were differences in the organizational patterns that supported the hypothesis that the degree of coordination of intensive care services significantly influenced its effectiveness. The organizational patterns were related to both the medical and nursing components. The rank ordering did not include a confidence interval, and it is likely that the statistical difference was primarily between the top hospital and the bottom hospital. The top ICU was well organized, with protocols and policies including the cancelling of elective operating room cases if no beds were available. There was also a high proportion of bedside nurses who had master's degree. In addition, there were no interns (postgraduate year-1) in this unit. The bottom hospital did not have an organized medical program and had a substantial shortage of nursing. There was an atmosphere of distrust, and there was no coordination of care. The APACHE III study with a larger sample size and some attempt at enrolling representative hospitals was not able to confirm the relationship between management coordination and collaboration and severity-adjusted mortality outcomes. These analyses are problematic because it is difficult to evaluate the management components of care in an objective way. It is concluded that organized ICUs as defined in this review had lower mortality.

Hanson CW, Deutschman CS, Anderson HL, et al: Effects of an organized critical care service on outcomes and resource utilization: A cohort study. *Crit Care Med* 1999; 27:270–274 (56) (level III evidence)

This study compared two different concurrent care models of surgical ICU patients. One group was managed exclusively by the critical care attending service and the other by the general surgical faculty and house staff. Despite higher severity of illness scores, the critical care patient group had shorter ICU lengths of stay, fewer days of mechanical ventilation, fewer arterial blood gases, fewer consultations, fewer complications, shorter hospital lengths of stay, and fewer Medicare-adjusted charges. The critical care service model in this surgical ICU demonstrated improved quality and cost.

Pronovost et al. (57), in a recent systematic review of the available literature regarding ICU physician staffing and outcomes, concluded that there is a consistent finding of decreased mortality and length of stay with intensivist presence. Despite the aforementioned data, there is no randomized, prospective trial that effectively compares outcome between var-

ious models of critical care delivery. In an editorial in *Critical Care Medicine*, Hall (58) questions the interpretation of the currently available outcome data. He notes that even if the differences are real, it remains unclear which components of care have resulted in the observed effects. He further suggests that future multicentered trials are clearly required.

WHAT IS THE BEST PRACTICE MODEL?

The analysis of any model of critical care delivery should be based on its ability to minimize mortality and to optimize efficiency while preserving dignity and compassion for patients. Current literature, although not clearly identifying a "best" practice model, does identify factors that are related to improved outcome as measured by reduced mortality, improved efficiency, decreased length of stay, or decreased cost of care. These are as follows.

- Timely and personal intervention by an intensivist reduces mortality, reduces length of stay, and decreases cost of care.
- In academic centers, the addition of an intensivist to the critical care team reduces mortality. It is not clear from the existing literature that 24-hr full-time presence of an intensivist vs. an 8–12 hr day is superior to having access to the intensivist in a "timely period." Further research may clarify this point.
- When an intensivist is available in an administrative role in the ICU providing benchmarking, clinical research, and standardization of care, the data suggest that length of stay, cost of care, and treatment complications can be reduced.
- The presence of a critical care pharmacist can decrease adverse drug events and reduce cost of care.
- Excessive nursing workload, as defined by hours per patient day or nurse/patient ratios, is associated with increased mortality in critically ill patients.
- The presence of full-time respiratory care practitioners dedicated to the ICU can reduce length of ICU stay, shorten ventilator days, and reduce overall ICU costs.

RECOMMENDATIONS AND CONCLUSIONS

The literature does not clearly support one model of critical care delivery over another; however, it does support a recommendation for a model wherein dedicated ICU personnel, specifically the intensivist, the ICU nurse, respiratory care practitioner, and pharmacist, all work as a team. Furthermore, this multidisciplinary group practice model should be led by a full-time critical care-trained physician who is available in a timely fashion to the ICU 24 hrs per day (**grade D recommendation**).

While leading the critical care service, the intensivist physician should have no competing clinical responsibilities (**grade E recommendation**).

ICUs with an exclusive critical care service and operating in the closed format, as described previously, may have improved outcomes. When geographic constraints, resource limitations, and manpower issues allow, this organizational structure for the delivery of critical care services may be optimal (**grade E recommendation**).

The presence of a pharmacist as an integral part of the ICU team, including but not limited to making daily ICU rounds, improves the quality of care in the ICU and reduces errors. The integration of a dedicated pharmacist into the ICU team is recommended (**grade C recommendation**).

Physician practitioners in the ICU should have hospital credentials to practice critical care medicine. These credentials should incorporate both cognitive and procedural competencies (**expert opinion**).

Additional study is crucial. Multicenter trials must be designed to answer questions regarding what aspects of care are crucial to improved outcome. To what extent does administrative or protocol implementation make a difference? Are complications reduced as a result of critical care team involvement? Does additional expertise immediately available at the bedside provide the fundamental effect to improve outcome?

The SCCM research committee should organize a multicentered, prospective trial, possibly in conjunction with other organizations, such as the American Thoracic Society or the National Institutes of Health (NIH), to answer some of the aforementioned questions. A NIH consensus panel, similar to that organized for the use of pulmonary artery catheters, may also be appropriate. As outlined at the outset, it is imperative that critical care practitioners define what constitutes ICU quality, how it should be measured, and delivered by what practice model.

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APPENDIX 1

Grading of Levels of Evidence and Recommendations

Grading of recommendations

A = Supported by at least two level I investigations

B = Supported by only one level I investigation

C = Supported by level II investigations only

D = Supported by at least one level III investigation

E = Supported by level IV or level V evidence

Levels of evidence

Level I = Large, randomized trials with clear-cut results; low risk of false-positive (α) error or false-negative (β) error

Level II = Small, randomized trials with uncertain results; moderate to high risk of false-positive (α) and/or false-negative (β) error

Level III = Nonrandomized, concurrent cohort comparisons, contemporaneous controls

Level IV = Nonrandomized, historical cohort comparisons/controls, and expert opinion

Level V = Case series, uncontrolled studies, and expert opinion

APPENDIX 2

The Intensivist

This definition of an intensivist refers to physician credentials (1), process and focus on care (2, 6, 7, 9, 10), scope of expertise (3, 4), availability (5, 6), and professional responsibility (8). An intensivist is as follows.

1. A physician who is trained and certified through a primary specialty and has successfully completed an Accreditation Council for Graduate Medical Education-approved training program in critical care medicine and/or has a certificate of special qualification in critical care.
2. Diagnoses, manages, monitors, intervenes, arbitrates, and individualizes the care to each patient at risk for, in the midst of, or recovering from critical illness.
3. Has the training and skills to manage patients with multiple health problems derived from multiple causes. These skills range on the continuum of care from acute resuscitation to management through the recovery phase of illness, including but not limited to the following.
   a. Hemodynamic instability, cardiac failure, and cardiac dysrhythmias
   b. Respiratory insufficiency or failure, with or without a need for mechanical ventilatory support
   c. Acute neurologic insult, including treatment of intracranial hypertension
   d. Acute renal failure or insufficiency
   e. Acute life-threatening endocrine and/or metabolic derangement
   f. Drug overdoses, drug reactions, and poisonings
   g. Coagulation disorders
   h. Serious infections
   i. Nutritional insufficiency requiring nutritional support
   j. End-of-life issues

Management of patients in the immediate perioperative period is as follows.

4. Is able to perform, manage, and coordinate the need for certain procedures including, but not limited to the following.
   a. Maintenance of the airway including tracheal intubation and mechanical ventilation
   b. Placement of intravascular catheters and monitoring devices including the following
      1) Arterial catheters
      2) Central venous catheters
      3) Pulmonary artery catheters
      4) Temporary dialysis catheters
   c. Placement and maintenance of temporary pacing devices
   d. Cardiopulmonary resuscitation
   e. Tube thoracostomy
   f. Other procedures that intensivists may perform include therapeutic bronchoscopy, percutaneous tracheostomy, transesophageal echocardiography, renal replacement therapy, cricothyroidotomy, EEG, and placement of intra-aortic balloon counterpulsation device.
5. Is immediately and physically available to patients in the ICU and has no competing priority that would interfere with the prompt delivery of critical care during scheduled intervals while acting as the clinical intensivist.
6. Participates in a unit-based, hospital-approved coverage system that provides 24 hr a day availability by physicians who possess similar credentials in critical care.
7. Promotes quality and humane care in the ICU while maintaining efficient use of resources.
8. Furthers the practice of critical care medicine through education of colleagues and the public.
9. Provides unit-based administrative duties that include but are not limited to the following
   a. Admission/discharge decisions
   b. Treatment protocol development and implementation
   c. Supervising and directing performance improvement activities
   d. Maintaining up-to-date equipment and techniques
   e. Responsible for unit-based data collection
   f. Promulgate links to other ancillary departments that are involved in the care of the ICU patient, e.g., pharmacy, radiology, infection control, social and pastoral care, etc.
   g. Responsible for approval of unit-based budget
10. Responsible for coordinating educational needs for unit-based as well as general hospital personnel and the public

APPENDIX 3

The Critical Care Nurse

The American Association of Critical Care Nurses (AACN) provided much of the summary outlined below.

1. Is a licensed professional who is responsible for ensuring that all acutely and critically ill patients receive optimal nursing care. Basic to the provision of optimal care is individual professional accountability through adherence to standards of nursing care of acutely and critically ill patients and a commitment to act in accordance with ethical principles.
2. Clinical nursing practice varies considerably depending on the setting in which nurses are employed and the patient population for which they provide care. The American Association of Critical Care Nurses *Standards for Acute and Critical Care Nursing Practice* provides the foundation for a minimum level of competent and professional care delivered to critically ill patients in a variety of settings. Broad application of these standards by critical care nurses is expected to help promote quality care and positive patient outcomes.
3. Standards of care for acute and critical care nursing are as follows.
   a. Assessment: The nurse caring for the critically ill patient collects relevant patient health data.

b. Diagnosis: The nurse caring for critically ill patients analyzes the assessment data in determining diagnoses.
c. Outcome identification: The nurse caring for the critically ill patient identifies individualized, expected outcomes for the patient.
d. Planning: The nurse caring for the critically ill patient develops a plan of care that prescribes interventions to attain expected outcomes.
e. Implementation: The nurse caring for the critically ill patient implements interventions identified in the plan of care.
f. Evaluation: The nurse caring for the critically ill patient evaluates the patient's progress toward attaining expected outcomes.

4. Standards of Professional Practice are as follows.
   a. Quality of care: The nurse caring for the critically ill patient systematically evaluates the quality and effectiveness of nursing practice.
   b. Individual practice evaluation: The nurse's practice reflects knowledge of current professional standards, laws, and regulations.
   c. Education: The nurse acquires and maintains current knowledge and competency in the care of critically ill patients.
   d. Collegiality: The nurse caring for the critically ill patient interacts with and contributes to the professional development of peers and other healthcare providers as colleagues.
   e. Ethics: The nurse's decision and actions on behalf of critically ill patients are determined in an ethical manner.
   f. Collaboration: The nurse caring for the critically ill patient collaborates with the team of patient, family, and healthcare providers in providing patient care in a healing, humane, and caring environment.
   g. Research: The nurse caring for the critically ill patient uses clinical inquiry in practice.
   h. Resource utilization: The nurse caring for the critically ill patient considers factors related to safety, effectiveness, and cost in planning and delivering patient care.

5. Certification is voluntary through the AACN Certification Corporation. The certified nurse receives a CCRN credential available for nurses who care for adults and pediatric and neonatal patients.

APPENDIX 4

The ICU Pharmacist

1. Is a practitioner who is licensed by the State Board of Pharmacy and has specialized training or practice experience providing pharmaceutical care for the critically ill patient.
2. In providing pharmaceutical care is responsible for administering the following services.
   a. Evaluation of all drug therapy for appropriate indication, dose, route, and dosage form
   b. Evaluation of all drug therapy to avoid drug, food, and nutrient allergies and interactions
   c. Evaluation of all drug therapy to maximize cost-effectiveness
   d. Monitoring all drug regimens for efficacy
   e. Monitoring all drug regimens for toxicity and recommending methods for preventing toxicity
   f. Detects, evaluates, and reports all adverse drug events
   g. Interviewing patients and their caregivers to obtain an accurate medication history
   h. Evaluation of all enteral and parenteral nutrition orders for appropriateness
   i. Providing pharmacokinetic monitoring and consultation
   j. Providing drug information, intravenous compatibility information, and poison information
   k. Educating the ICU team members on pharmacotherapy issues
3. Documents pertinent pharmaceutical care recommendations in the medical record.
4. Participates on various institution committees that involve drug-related issues in the critically ill, such as pharmacy and therapeutics, intensive care committee, adverse drug reactions, and advanced cardiac life support.
5. Participates in medication use evaluations and quality assurance activities.
6. Coordinates the development and implementation of drug-related policy, procedures, guidelines, protocols, and pathways.
7. Collaborates with medical and nursing staff in research endeavors.

APPENDIX 5

The ICU Respiratory Care Practitioner

1. Is a practitioner who is licensed by the State Respiratory Care Board (if applicable) and has specialized training or practice providing cardiorespiratory care for critically ill patients.
2. In providing cardiorespiratory care, the respiratory therapist is responsible for the following services.
   a. Evaluation of respiratory therapy orders for appropriate indication, medication, equipment, and potential efficacy
   b. Evaluation of orders for mechanical ventilatory support for appropriate indication and implementation
   c. Evaluation of all respiratory therapy procedures to maximize efficacy and cost-effectiveness
   d. Monitoring of mechanical ventilatory support to minimize complications and maximize therapeutic goals and to enhance patient comfort
   e. Monitoring of respiratory care procedures for improving efficacy, reducing adverse effects, and assuring safety
   f. Detects, evaluates, and reports all adverse events related to mechanical ventilation and respiratory care procedures
   g. Provides consultation on mechanical ventilation, respiratory therapy procedures, weaning from ventilatory support, delivery of aerosolized medications, airway management, and novel treatments
   h. Educates the ICU team members on issues related to mechanical ventilation and respiratory care procedures
3. Documents pertinent respiratory care recommendations in the medical record.
4. Participates on institution committees that involve respiratory care and mechanical ventilation issues, such as the cardiopulmonary resuscitation committee, pharmacy and therapeutics, and intensive care quality assurance committee.
5. Coordinates the development and implementation of respiratory care and mechanical ventilation procedures, guidelines, protocols, and pathways.

6. Collaborates with medical staff in research endeavors.
7. Respiratory care services should be available 24 hrs a day, 7 days a week.

APPENDIX 6

Members of the ACCM Task Force on Models of Critical Care Delivery

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APPENDIX 7

ACCM Guidelines for the Definition of an Intensivist and the Practice of Critical Care Medicine

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