Introduction

In hospital critical care units, many of the individual challenges confronting other hospital units intersect, making the critical care setting the most complex environment in the healthcare facility. While other units may need to manage one or two of these challenges at a time, critical care settings must manage them all simultaneously while remaining focused on the delivery of safe patient care. These challenges include managing a high-tech environment and ensuring staff competency in operating the equipment, providing high-quality care to the facility's sickest patients, and tending to the needs of staff members working in a very stressful environment. The interplay of high technology and high acuity in critical care makes the intensive care unit (ICU) environment one of the most complicated for healthcare facilities. To help healthcare facilities navigate the complexities of critical care, ECRI Institute has prepared this guide, *Critical Care Safety: Essentials for ICU Patient Care and Technology*, a comprehensive resource for information on patient safety, technology management, and optimal healthcare staffing and competency.

Critical care is the specialized medical care of patients with or at high risk for life-threatening, or "critical," conditions requiring constant monitoring and comprehensive care consisting of complex therapies and interventions. Most hospitalized patients with critical conditions are cared for in ICUs, patient care areas designed to provide extraordinary treatment by specially trained healthcare professionals, often with the use of high-tech equipment. More than three-quarters of acute care hospitals in the United States provide critical care services, and the national number of ICU beds continues to increase each year (Halpern et al.).

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More than 4 million U.S. patients receive care in ICUs each year, at an annual cost of more than *$180 billion*, making ICUs a high-volume and high-cost environment—a challenging combination for ICU staff, whose primary goal is safe patient care (Pronovost PJ).

Patients cared for in ICUs include those with severe trauma, major head injury or coma, respiratory and/or hemodynamic insufficiency, or failure of one or more organ systems and those with intensive monitoring needs following major surgery. The medical needs of ICU patients are often complex, requiring of caregivers, who work under stressful conditions, a high degree of knowledge and skill. Despite the dedication and competency of ICU caregivers, mortality rates for critical care patients remain high, ranging from 10% to 20% (Leapfrog Group).

Critically ill patients are at high risk for complications due to the severity of their medical conditions, the complex and invasive nature of critical care treatments and procedures, and the use of drugs and technology that carry risks as well as benefits. Complications contributing to morbidity and mortality in ICUs include those related to the performance of invasive procedures, ventilator-associated pneumonia (VAP), infections such as central-vascular-catheter-associated bloodstream infection, and pressure ulcers. Omission of therapies also accounts for significant and preventable morbidity, mortality, and costs associated with ICU care (Pronovost PJ et al. "Developing and Pilot Testing").

In addition to complications of care, adverse events and errors—many of which are serious—are major risks in ICUs. The 2005 Critical Care Safety Study, supported in part by the Agency for Healthcare Research and Quality (AHRQ), found that adverse events in ICUs occur at a rate of 81 per 1,000 patient-days and that serious errors occur at a rate of 150 per 1,000 patient-days (Rothschild et al.),* supporting the findings of an earlier study indicating that nearly all ICU patients suffer potentially harmful events (Donchin). According to data released by one state-mandated patient safety event-reporting system, ICU reports are 20% more likely than other hospital event reports to be reported as serious (Pennsylvania Patient Safety Authority). Indeed, death was the most common outcome in liability claims arising in the ICU for one malpractice insurance company (Ranum).

▷ Adverse events in ICUs occur at a rate of 81 per 1,000 patient-days and serious errors occur at a rate of 150 per 1,000 patient-days.

Nearly half (45%) of the adverse events in the Critical Care Safety Study were deemed preventable. Common ICU errors are treatment and procedure errors especially errors in ordering or carrying out medication orders; errors in reporting or communicating clinical information; and failures to take precautions or follow protocols (Rothschild et al.).

The sheer variety of medical devices and the complexity of the technology used in critical care units also contribute to the occurrence of errors and adverse events. For example, endotracheal tubes and ventilators save and extend lives by delivering oxygen and artificial ventilation. However, airway incidents (e.g., tube dislodgment) and ventilator disconnections can cause injury or brain damage due to lack of oxygen if the event goes unnoticed. Other devices that carry technology-related risks include equipment with clinical alarms, invasive lines and tubes (vascular and enteral), intravenous pumps and drug delivery systems, physiologic monitors, and special care beds and mattresses. Although these devices enable the delivery of cutting-edge treatment, their safe use depends on many factors, such as proper device selection and use, education and training of ICU staff, and preventive maintenance.

All these considerations underscore the high risks of caring for patients in the ICU and the need for comprehensive patient safety programs for critical care.

Patient Safety in the ICU

Several important factors play a role in fostering patient safety in the ICU, including the following:

Hospital and ICU culture. Having a culture that supports and promotes safety activities is a key element in improving safety and reducing accidents and errors (Singer et al.). Being able to work collaboratively and communicate effectively are two important characteristics of staff committed to a culture of safety.

ICU structure and staffing model. Closed ICUs are units in which the care of ICU patients is directed and managed by intensivists—physicians with specialized training in critical care medicine. Hospitals that have intensivists in their ICUs have lower mortality rates and lower hospital lengths of stay than hospitals that have open

* The authors of the AHRQ Critical Care Safety Study translate these rates into a daily rate of 0.8 adverse events and 1.5 serious errors for a 10-bed critical care unit.

ICUs with no intensivists or elective intensivist consultation (Pronovost PJ et al. "Physician Staffing Patterns").

Environment of the critical care unit. The work environment can affect the ability of caregivers to interact productively, make vital decisions, and perform medical interventions safely. Stress, distractions, and fatigue increase the likelihood of mistakes, errors, and adverse events. The use of sophisticated devices and technology adds to the complexity of ICU care.

Improvement Efforts Pay Off

Strategies to improve safety in the ICU have been implemented by pioneering healthcare institutions with marked results. Johns Hopkins Hospital (Baltimore, Maryland) is one such institution. Critical care safety initiatives adopted at the hospital have resulted in improved patient outcomes, as evidenced by lower infection rates, lower rates of VAP, and reduced lengths of stay. In addition, in Johns Hopkins's critical care units, where a culture of safety prevailed, error reporting increased, learning occurred, and systems improved (Pronovost and Goeschel). Investments in teamwork and communication training for critical care providers and staff have reduced staff turnover and improved patient outcomes—all serving the ultimate goal of improving safety for ICU patients.

The use of sophisticated devices and technology adds to the complexity of ICU care.

A Road Map to ICU Safety

Improving ICU safety begins with an assessment of the current state of critical care services, as described in this guide. The assessment process can include the use of safety attitude or safety culture surveys, the collection of baseline quality and performance data, an analysis of event-reporting data and liability claims, and the use of an assessment tool such as ECRI Institute's *Critical Care Patient Safety Self-Assessment Questionnaire,* which is reproduced on the CD-ROM accompanying this guide. A review of pertinent critical care literature, such as the resources cited throughout this report and listed in Chapter 8, "Resources and Standards," can also provide background information and benchmark data for comparison.

ICU safety initiatives must also involve leadership support for ICU patient safety and identify physician and nurse champions. As outlined in subsequent chapters, additional strategies for improving ICU safety include establishing priorities for action regarding identified safety defects and developing a plan for improvement that includes measurement of effectiveness.

Education and training in teamwork and communication skills is essential to creating an ICU culture that values learning, improvement, and accountability. Several resources and tools to assist with training and education have been provided in this guide and on the accompanying CD-ROM. To fuel the momentum for ongoing improvement efforts, the facility should give staff continuous feedback on "how we are doing" with regard to providing safer critical care.

Using This Guide

This guide is designed to assist healthcare facilities with critical care services in reducing risks and improving safety in their ICUs. It provides clinicians, managers, and administrators with guidance on issues including the following:

- Understanding the need to improve the safety of critical care and the factors affecting the ability of ICUs to provide safe, high-quality care (Chapter 1)
- Assessing the ICU culture and environment in order to identify priorities for improvement, obtain baseline information with which postintervention data can be compared, and evaluate whether safety improvement measures are effective (Chapter 2)
- Educating ICU staff about patient safety and promoting the development of skills and knowledge with regard to safety (Chapter 3)
- Appreciating the impact of optimal ICU environment structure, staffing, and design on patient care and safety (Chapter 4)
- Developing a sound credentialing program for critical care providers and validating the skills of critical care nurses and other ICU staff members (Chapter 4)
- Understanding important ICU patient safety concerns and identifying solutions to address the concerns (Chapter 5)
- Utilizing current research findings on clinical "bundles" and evidence-based interventions that improve patient outcomes and reduce complications of ICU care (Chapter 5)
- Emphasizing safe selection and use of medical devices and technology in the ICU (Chapter 6)
- Developing and implementing ICU risk management and quality improvement plans that include patient safety as a core value (Chapter 7)
- Considering the importance of patient and family communication and involvement in ICU care and decision making leading to safe, quality care (Chapter 7)

This guide also includes tools and resources to assist facilities in developing their own ICU improvement plans or assessing and enhancing existing plans. Various Web resources* are highlighted throughout the guide. Additional tools provided within this guide and reproduced on the accompanying CD-ROM include the following:

- Self-assessment tools that facilities can use to evaluate their ICUs and other critical care units with regard to patient safety
- Sample policies, forms, checklists, and education tools such as slide shows and teaching plans
- In Chapter 8, "Resources and Standards," is a comprehensive resource list that can be used to find additional information on the topics discussed.*

Web Resources

This symbol will appear throughout the guide. It indicates that additional tools and resources are available on the Web.

This symbol will appear throughout the guide. It indicates that sample tools have been reproduced and are available on the CD-ROM accompanying this guide.

The links in the Web resources and in Chapter 8 were correct as of April 2007. Some links may be revised after publication of this guide. ECRI Institute is not responsible for updating dead links.

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