Chapter 4
Organization and Structure of the Cardiothoracic Intensive Care Unit

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ABSTRACT

The purpose of this chapter is to emphasize and describe the team nature of critical care medicine in the Cardiothoracic Intensive Care Unit. The chapter will review the importance of various team members and discuss various staffing models (open vs closed, high intensity vs low intensity, etc.) on patient outcomes and cost. The chapter will also examine the roles of nurse practitioners and physician assistants (NP/PAs) in critical care, and will briefly review the growing role of the tele-ICU. Most studies support the concept that a multi-disciplinary ICU team, led by an intensivist, improves patient outcomes and decreases overall cost of care. The role of the tele-ICU and 24 hour in-house intensivist staffing in improving outcomes is controversial, and more research is needed in this area. Finally, a brief discussion of billing for critical care will be discussed.

INTRODUCTION

Modern critical care medicine is the ultimate team sport with all the members of the multidisciplinary critical care team contributing their expertise in the care of the critically ill patient. There is a large body of knowledge and evidence describing and supporting the team nature of critical care delivery.

The objective of this chapter is to review the organization and structure of the CT ICU team emphasizing the importance of the multidisciplinary nature of modern critical care delivery models, physician staffing models, the role of the tele-ICU, the growing field of critical care nurse practitioners and physician assistants (NP/PAs), and finally, will provide a brief overview of critical care billing practices.

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HIGH-RELIABILITY ORGANIZATIONS (ICUs)

Because individual humans and teams can fail, the ideal ICU should be organized and structured in such a way to minimize failure and optimize patient care. Critical care is complex, dangerous, and time sensitive. Other industries such as coal mining, nuclear power, and commercial aviation are also complex, dangerous, and time sensitive, yet in these industries failure cannot be tolerated and the failure rate must be zero. How did these high risk high reliability organizations (HRO) accomplish this and how could this be applied to healthcare? Niedner et al (2013) in a fantastic review article describe how this could be done in a pediatric ICU. Several studies have shown that evidence based care is provided only about 50-60% of the time (McGlynn et al., 2003) and in 2000 the Institute of Medicine's (IOM) "To Err is Human" paper described the ICU (and the operating room) as an area most prone to errors and preventable harm (Kohn, Corrigan, & Donaldson, 2000). To put this in perspective, Larsen et al (2007) showed that in a 20-bed PICU it is estimated that there would be 1416 moderate and 44 serious adverse events per year! Clearly we have room to improve.

Reliability is expressed as the inverse of the failure rate. So if a process fails 1 in 10 times, the failure rate is 10% and the reliability level is 10^{-1}. 10^{-1} systems have very few processes, but rely on individual knowledge and individual work, and training and reminders (like signs in the locker and bathrooms). 10^{-2} systems are a bit better, such as using quality tools and evidence-based protocols (like central line insertion checklists). 10^{-3} systems begin to use even more standardized policies and procedures (Cady, 2008). [See Table 1] Of course the goal would be for all ICUs to perform at the level of six-sigma (3.4 errors in 1,000,000 opportunities), similar to the airline industry. How would we do it? Niedner et al

Table 1. Levels of Reliability

			Opportunities	Real-World	Health Care
Level	**Reliability**	**Success**	**Per Failure**	**Example**	**Example**
Chaotic	$<10^{-1}$	<90%	<10	Annual mortality if >90 years old	Achievement of best-practice processes in outpatient care
1	10^{-1}	90%	10	Mortality of climbing Mt. Everest	Achievement of best-practice processes in inpatient care
2	10^{-2}	99%	100	Mortality of Grand Prix racing	Deaths in risky surgery (American Society of Anesthesiologists grades 3-5)
3	10^{-3}	99.9%	1000	Helicopter crashes	Deaths in general surgery
4	10^{-4}	99.99%	10,000	Mortality of canoeing	Deaths in routine anesthesia
5	10^{-5}	99.999%	100,000	Chartered flight crashes	Deaths from blood transfusions
6	10^{-6}	99.9999%	1,000,000	Commercial airline crashes	—

Note. Levels of Reliability. Adapted from "The High-Reliability Pediatric Intensive Care Unit," by M.F. Niedner, S.E. Muething, and K.M. Sutcliffe, 2013, *Pediatric Clinics of North America, 60,* p. 564. Copyright 2013 by the Elsevier. Adapted with permission.

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