

Maintaining quality of care 24/7 in a nontrauma surgical intensive care unit

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BACKGROUND:	Most surgical critical care literature reflects practices at trauma centers and tertiary hospitals. Surgical critical care needs and practices may be quite different at nontrauma center teaching hospitals. As acute care surgery develops as a component of surgical critical care and trauma, the opportunities and challenges of the nontrauma centers should be considered.
METHODS:	In 2001, a new surgical critical care service was created for an 800-bed urban teaching hospital with a 12-bed surgical intensive care unit (SICU). Consults, daily rounds, daily notes, and adherence to best practices were standardized over the next 9 years for a team of postgraduate year-1 and -2 surgical residents, physician assistants and surgical intensivists. The Fundamentals of Critical Care Support course was given as basic introduction, and published guidelines for ventilators, hemodynamics, cardiac, infections, and nutrition management were implemented. A "beyond FCCS" curriculum was repeated every resident rotation. A 12-bed stepdown unit was developed for the more stable patients, mostly run by SICU physician assistants with SICU attending coverage. The first 5 years, night coverage was by the daytime intensivist from home. The last 4 years, night coverage was in-unit surgical intensivists or cardiac surgeons.
RESULTS:	Data for 13,020 patients drawn from 152,154 operations over 9 years is reported. Surgery grew 89% to 24,000 cases/year in 2010. Half the patients were general, gastrointestinal oncology, or vascular surgery. Ninety-two percent were perioperative. The 8% nonoperative patients were mostly gastrointestinal bleeding, abdominal pain, or pancreatitis. In the first year, annual SICU mortality decreased from an average of 4.5% the 5 previous years to 1.96% (2002) and remained 1.75% (2003), 2.1% (2004), 1.9% (2005), 1.5% (2006), 1.5% (2007), 2.2% (2008), 2.4% (2009), and 2.1% (2010).
CONCLUSION:	Annual mortality immediately improved at a busy nontrauma hospital with rapid, structured consultation by the SICU team, comprehensive daily rounds guided by critical care best practices, and daytime in-unit surgical intensivists. Low mortality was maintained over 9 years as surgery volume nearly doubled but did not improve further with 24/7 in-unit coverage by surgical intensivists and cardiac surgeons. The process of care in an SICU may be more important than 24 hour a day, 7 days a week intensivists. (<i>J Trauma Acute Care Surg.</i> 2012;73: 202–208. Copyright © 2012 by Lippincott Williams & Wilkins)
LEVEL OF EVIDENCE:	Therapeutic study, level II.
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Who should care for critical surgical illness at nontrauma hospitals? Outcomes research^{1–4} suggests the process of critical care may be as important to good outcome in intensive care unit (ICU) patients as individual decisions and technologies. So what is the best structure/process for a surgical ICU (SICU) to optimize integration of care from multiple disciplines and providers with cost-effective resource utilization? Most surgical intensivists train at tertiary centers or trauma centers, and these centers develop most of the literature on acute care surgery as the third arm of surgical critical care.^{5–7} But what of the nontrauma hospital? As the future of surgical critical care, trauma, and acute care surgery is debated, greater consideration should be given to the needs of nontrauma (or low trauma volume) hospitals.

In 2001, the SICU at Beth Israel Medical Center restructured to immediate resident/physician assistant (PA) consultation with prompt surgical intensivist review, structured daily rounds/progress notes, and adherence to published guidelines for ICU admission/discharge, ventilator management/acute respiratory distress syndrome, cardiac risk, nutrition, sepsis, and infection.^{8–14} Insufficient surgery residents for workload necessitated recruitment/training of surgical residency-trained or surgically-experienced PAs credentialed with the Fundamental Critical Care Support (FCCS) course.¹⁵ The first 5 years, night coverage for consults and problems was provided by surgical intensivists from home, who came in when necessary. In 2007, 24/7 in-unit coverage by surgical intensivists or FCCS-certified cardiac surgeons began. Evolution and outcomes of this service are reported.

MATERIALS AND METHODS

At the outset, 24/7 rapid, standardized consultation was provided any surgeon requesting help by postgraduate year (PGY)-I surgery residents or ICU-trained PAs with immediate attending intensivist review. The on-call intensivist's office is next to the SICU. SICU admission required specific life-threatening or potentially life-threatening conditions.⁸ Daytime SICU team

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included a surgical intensivist, a PA, a PGY-2, and two PGY-1 surgery residents. SICU daily rounds required ~30 minutes/patient and stepdown required ~10 minutes/patient.

The first 2 years, daytime coverage was provided by a surgical intensivist alternating weeks with part-time medical intensivists. From 2003 to 2009, two surgical intensivists alternated weeks. Since 2009, three surgical intensivists rotate every third week. Nighttime in-unit coverage was provided by a PGY-1 plus a PGY-3 surgery research resident or SICU PA. The daytime intensivist was contacted at home for consults/emergencies and sometimes returned. In mid 2007, 24/7 surgical intensivist/cardiac surgeon in-house coverage was begun.

FCCS certification¹⁵ expanded over 9 years to include all surgical PGY-1s, PAs, and SICU nurses. SICU care followed published guidelines for ventilators, shock, sepsis, nutrition, cardiac prophylaxis, and surgical infections from the Society of Critical Care Medicine,^{9,14} American College of Chest Physicians,^{10,11} American Heart Association,¹² American Society of Parenteral and Enteral Nutrition,¹⁴ and Surgical Infection Society.¹³ A manual and series of lectures "Beyond FCCS" on specific issues in surgical critical care were repeated with each group of residents, medical, and PA students (Table 1). The Medical Knowledge Self-Assessment Program of the American Board of Internal Medicine versions 13, 14, and 15¹⁶ were used as a guide to treatment of medical conditions outside the normal practice of surgical critical care.

Record Keeping

A computerized "Daily Progress Note" template is filled in overnight by the on-call PGY-1. The two-page template includes a medical summary with comorbidities, prehospital medications, operative procedure, perioperative events, and current medications. The note contains "Objective Data" sec-

tions for neurology, cardiac, hemodynamic, pulmonary, gastrointestinal, hepatic, nutritional, renal, fluid/electrolytes, endocrine, hematologic, infection, lines, and skin. The SICU attending edits this on rounds. Nurses use the "Assessment and Plan" as a guide to the plan for the day. The note also serves as a communication tool to consultants.

The SICU log includes patient name, medical record number, date of birth, surgeon, surgical service, admission and discharge date, procedure, readmissions, infection control events, and mortality. (Ventilator days were added in 2005).

Data Analysis

Mortality/year was analyzed for respective annual patient volumes and compared with mortality/year from 1996 to 2001 using χ^2 tests, SPSS version 17.0. Two-sided 95% confidence intervals were calculated.

RESULTS

Over 9 years, four nearby hospitals closed and main operating room (OR) workload increased 89% from 8,500 cases in 2002 to 15,820 cases in 2010. Programmatic growth occurred in gastrointestinal cancer, otolaryngologic cancer resection/flap reconstruction, vascular/endovascular surgery, and neurosurgery. Single system orthopedic, neurosurgical, and otolaryngologic trauma presented, but fewer than 10 major multisystem trauma patients presented to the emergency department (ED)/year.

Data for 13,020 SICU/stepdown patients drawn from 88,119 total main OR patients over 9 years are presented and compared with the previous 6 years (Table 2). (64,035 cases were performed in the 6 OR outpatient facility but only 3 cases in 9 years were transferred to SICU.) The SICU service grew from 844 admissions to SICU in 2002 to 1,800 admissions in SICU/stepdown in 2009 to 2010. Sixty-nine to eighty-five percent of patients were admitted from OR or recovery room; 6% to 12% from ED; 5% to 7% from surgical floors; and 2% to 4% transfers from medicine to surgery. Forty-three to fifty-nine percent of patients were general, abdominal oncology, or vascular.

The 12-bed SICU did not change over 9 years. In 2004, a 12-bed surgical stepdown unit managed by SICU PAs and intensivists was created. SICU admission thereafter was for the more unstable patients with ventilatory, hemodynamic, cardiac, hemorrhagic, neurologic, electrolyte, renal, hepatic, or infectious issues (priority 1 and 3).⁸ SICU graduates and complex-but-stable patients (priority 2) were admitted to stepdown. A 9-bed otolaryngology stepdown managed by otolaryngology was created in 2005. A 7-bed oncology surgery stepdown was created in 2010, managed by oncology surgery. Figure 1 demonstrates aggregate annual percent mortality for SICU and stepdown for 9 years.

Initially, improved timeliness/thoroughness of consults, daily rounds, daily note, best practices, and daytime surgical intensivist coverage decreased annual mortality from an average 4.55% the previous 5 years (1996–2000) to 1.9%, 1.75%, 2.1%, 1.9%, and 1.5% the 5 subsequent years (2002–2007). The SICU log before 2001 did not include deaths in recovery room or ED while awaiting SICU evaluation/transfer or post-ICU on the floor. The post-2002 log does.

TABLE 1. Beyond FCCS Resident and Physician Assistant Lectures (Monthly)

How surgical critical care differs from medical critical care
Preoperative surgical optimization
Resuscitation, inotropes and pressors
ICU arrhythmia: diagnosis and treatment
Central venous access
Basic ventilator management and noninvasive ventilation
ARDS: pathophysiology, treatment and avoidance
Intra-abdominal infection and sepsis- pathophysiology and antibiotic guidelines
Coordinating surgical and ICU care in ischemic bowel disease
Abdominal compartment syndrome
Metabolic and nutritional issues in surgery and surgical critical care
Renal failure in the surgical ICU and basic renal replacement therapy
Hepatic failure in surgical critical care
Endocrine issues in surgical critical care
Transfusion and coagulopathy in surgical critical care
Immunosuppression in surgical patients
Soft tissue infections
Deep venous thrombosis prevention
Fever in ICU patients
Sedation guidelines.

TABLE 2. Surgical Patients Admitted to a Surgical ICU at a Nontrauma Urban Teaching Hospital

Year of Study	SICU	Stepdown	Service Total	Mortality (Number/%)	Ventilator Day	In SICU >7 d (%)	% Admits General or Vascular Surgery
1996–2000*	3,853	none	3,853	175 (4.5% [2.9–6.5%])	NR [†]	NR	NR
2001 [‡]	706	none	706	24 (3.4)	NR	9.6	68
2002	844	none	844	16 (1.96)	NR	7.9	48
2003	1,097	none	1,097	20 (1.75)	NR	6.8	48
2004	1,208	none	1,208	26 (2.1)	NR	4	59
2005	1,100	300+	1,400	21 (1.9)	NR	8	42
2006	855	505	1,360	21 (1.5)	25	7	43
2007	730	700	1,430	22 (1.5)	55	6	45
2008	922	739	1,661	37 (1.96)	33	8	50
2009	867	716 [§]	1,807 [§]	38 (2.11)	45	10	50
		(+224 Recovery Room)					
2010	910	415	1,836	39 (2.12)	41	11	50
		(+435 Recovery Room)					

* Previous system of consult policy and care. Before 2002, deaths in patients not accepted (in bold) for surgical ICU or outside SICU were not reflected in SICU log.
[†] Not recorded.
[‡] Transition year—new system began August 1, 2001.
[§] As stepdown unit reached capacity, 224 patients in 2009 and 435 in 2010 consulted to SICU service remained in recovery room overnight.

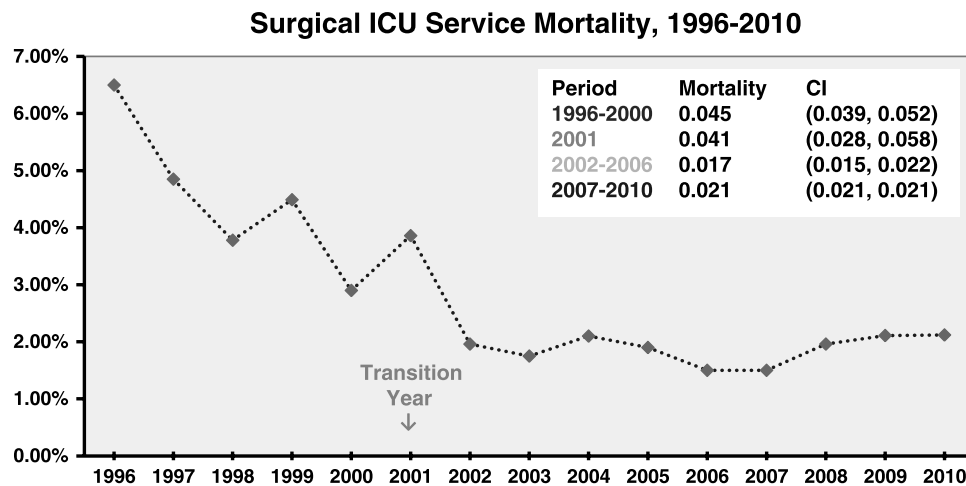


Figure 1. Surgical ICU mortality/year with corresponding confidence intervals for years 1996 through 2010. 1996 to 2000 mortality rate is prior to prompt, organized 14-system consultation by PAs with immediate attending intensivist review, adherence to evidence-based best practices/guidelines and structured 14-system SICU note, and daily review. 2001 was a transition year of reorganization (beginning August 1, 2001) and implementation. From 2002 to 2006, 24/7 care was provided by inunit surgery residents and PAs adhering to best practices with daytime on-site attending intensivists taking night call from home. 2007 to 2010 represents the addition of 24/7 on-site attending surgical intensivists or cardiac surgeons in addition to 24/7 resident and PA staffing and adherence to best practices. SICU service admission and discharge criteria remain the same from 2001 to 2010.

Operations such as esophagectomy, gastrectomy, hepatectomy, pancreatectomy, major orofacial/laryngeal resection/free flap, aneurysmectomy, and craniotomy for bleed or tumor increased over 9 years (Table 3). As stepdown developed and epidural pain control increased, major complex surgery patients were not necessarily admitted to SICU postop unless unstable.

American College of Chest Physicians weaning and acute respiratory distress syndrome net guidelines were followed throughout the 9 years. Ventilator days as a proportion of SICU workload were first recorded in 2006 and increased from 27% of days to 44% to 48% in 2009 to 2010. SICU

patients fell into two groups, “short stay” with complex surgery or readily resolvable comorbidity (such as heart failure) and “long stay.” Patients in SICU more than 7 days varied from 4% to 11% over the course of study and used 31% of total days of care in 2004; 40% in 2005, 2006, and 2007; 35% in 2008; 30% in 2009; and 48% in 2010. But “long stay” patients still had 30-day survival of 75% to 88%.

Initially, SISVista severity scoring¹⁷ was recorded. This score divides ICU patients into three terciles with mortality of 1.2% for a score less than 20, 7.8% for a score 20 to 39, and 26.2% for a score above 40. Major determinants of the

TABLE 3. Beth Israel Medical Center SICU-Primary Service/Surgery Procedure 2010

Service	Cases	Workload (%)
General surgery	338	38.5
Mastectomy with free flap reconstruction	51	
Bowel Obstruction	19	
Whipple	13	
Gastrectomy	8	
Colectomy	17	
Complex plastic debridement/flaps	14	
Esophagectomy	3	
Abdominoperineal resection	2	
Hepatectomy	1	
Vascular Surgery	120	14
Aneurysm	28	
Carotid endarterectomy	48	
Otolaryngology	148	17
Complex resection with free flap	42	
Glossectomy with free flap	12	
Glossectomy/mandibulectomy/free flap	13	
Laryngopharyngectomy/free flap	10	
Maxillectomy/fibular free flap	6	
Pharyngoesophagectomy/free flap	3	
Neurosurgery	103	12
Intracranial hemorrhage requiring surgery	33	
Craniotomy for tumor	33	
Orthopedics/spine surgery	55	6.25
Gastrointestinal bleeding	31	3.5
Urology	24	2.75
Medicine boarders	18	2
Obstetrics/gynecology	17	2
Pancreatitis	9	1
Invasive radiology	5	0.5
TOTAL	880	

Table lists only patients admitted to SICU requiring ventilatory, hemodynamic, lytic, neurologic, renal/electrolyte or other support, the removal of which would place life at immediate risk. Free flap patients are on hypervolemic, analgesic and ventilator protocol.

score are age and hypercarbia, bilirubin, PAO₂/FIO₂ ratios, albumin, BUN/creatinine, and glucose. This score was chosen because it included preoperative albumin, an important perioperative morbidity factor in elective surgery. However, lack of preoperative albumins in required preop laboratories for same day surgery admissions, a large number of SICU consults, compromised accurate score-keeping. Imperfect SISVista scores (mostly based on age) did not change much over the 9 years, remaining in the mid 20s (predicting a second tercile mortality of 7.8%¹⁷).

Medicare case mix index in 2010 was 1.7 for general surgery, 1.7 for colorectal surgery, 2.3 for vascular surgery, 2.4 for gastrointestinal oncology surgery, and 3.2 for otolaryngology. Post hoc power analysis at the 0.8 level of the difference between 4.5% mortality (1996–2000) and 1.9% mortality (2002–2010) required a sample size of approximately 800 patients/group. (Post hoc power analysis of “pre-24/7” mortality (1.8%) and “post-24/7” mortality (1.9%) would

require more than 226,000/group to reach a power of 0.8.) In 2009, the hospital joined the National Surgery Quality Improvement Project¹⁸ (NSQIP) to better compare institutional (but not specifically SICU) outcomes and better permit multivariate study and analysis.

Although SICU log before 2002 did not capture all mortality from surgical critical care outside SICU, 22 to 50 deaths occurred/year in SICU itself from 1996 to 2000 (175 total deaths in 3,853 patients, or aggregated 4.5% mortality). In 2002, this decreased to 16 for all sites where SICU was consulted or care provided and included follow-up post-SICU discharges. Twenty deaths occurred in 2003, 26 in 2004, 21 in 2005, 21 in 2006, 22 in 2007, 37 in 2008, 38 in 2009, and 39 in 2010. In-unit attending coverage 24 hour a day/7 days a week began in mid 2007, but percent mortality did not change (Fig. 1).

DISCUSSION

The National Surgical Quality Improvement Project’s risk-adjusted data suggests that higher hospital surgical mortality is not because of a higher occurrence of complications, but probably to differences in management of complications.¹⁸ This report shows that SICU mortality at a nontrauma teaching hospital could be halved with timely assistance, structured consults, prompt attending intensivist review, adhering to nationally recognized guidelines, and daily multisystem review/progress note and could be kept at 2% as surgery volume doubled over 9 years. Although PGY-1s and 2s rotated in SICU, PAs played a major role in efficiency, triage, adherence to standards, and communication. In-unit coverage 24 hours a day/7 days a week by surgical intensivists or cardiac surgeons did not further improve mortality.

SICU in-hospital mortality in published studies varies between 1.7%¹⁹ and at least 16%.²⁰ The 5,795 hospitals in the United States vary considerably in the process of surgical critical care, and comparing a gross statistic such as mortality is difficult. Percent mortality could always be improved just by admitting healthier patients to SICU—although standard admission and discharge criteria⁸ were adhered to unchanged through the course of this study. The hospital’s database did not, at time of inception, provide severity correction data nor permit multivariate statistical study. But the Medicare case mix indices in the 9th year of this report are quite high. These difficulties with comparison are a major reason for hospitals to participate in NSQIP (and for NSQIP to expand ICU-specific data). However, the 2% mortality outcome achieved is a benchmark that can probably be matched by any similar SICU team in a hospital approximating Beth Israel’s demographic and surgical case mix.

The earlier critical illness is diagnosed and treated, the better the outcome,²¹ and the standard for the period of this report was 1 hour to PA/resident evaluation and 1 hour to attending review. All PAs and house staff performing consults were FCCS-certified. The FCCS course emphasizes initial assessment and care in the first 24 hours to 48 hours of critical illness. Its lectures emphasize “sentinel events,” diagnosis and therapy of common ICU problems and it includes patient scenarios and simulation skills teaching. This provides new ICU

caregivers well-accepted basic thresholds and initial diagnostic/management guidelines.

Adherence to best critical care practices⁸⁻¹⁴ across all critical care disciplines might result in similar mortality outcomes for SICU patients regardless of the critical care caregiver's primary discipline. However, efficiency, resource utilization, and length of stay for surgical critical care should be better with intensivists familiar with the normal recovery curve of complex surgery and with enough experience to identify deviations from the expected course. Some internal medicine critical care fellowships will have this experience, but many do not. (M.A.M. and A.G. trained in both Internal Medicine and Surgery and have taught in both Internal Medicine and Surgical Critical Care Fellowships). Surgery and anesthesia intensivists should be able to maintain quality of care for SICU patients with lower resource utilization.

Despite the programmatic emphasis, the percent compliance with best practices in this study is not known. However, studies of compliance with best practices suggest considerable room for improvement: Nationwide efforts implementing sepsis guidelines in Spain and Italy achieved compliance of only 15%¹ and 35%,² but mortality still improved. Using guidelines to improve care thus requires both identifying best practices and ensuring implementation (perhaps with a checklist).²² Nurses, PAs, and residents are more proximate to patients and may actually better ensure compliance with best practices 24/7 than attending intensivists.²³

Debate continues over "open" ICUs (where anyone writes orders) versus "closed" ICUs (where only the ICU team writes orders and may have veto power over admitting and consultant services). Although many medical ICUs are "closed," it may not be possible to "close" an SICU in the same way. The operating surgeon often has operative/anatomic/experiential information important to SICU decision making. In the Beth Israel SICU, admission, discharge, analgesia, ventilator, hemodynamic, cardiac, nutritional, renal, fluid, electrolyte, endocrine, transfusion, and antibiotic decisions are determined by surgical intensivists following nationally recognized guidelines. Decisions pertinent to the surgery are shared between SICU and surgical teams (with attending-to-attending conversation on difficult issues). This model of SICU care is neither "open" nor "closed" but "concurrent."

In the first years of this program, variability of PGY-1 knowledge/interest in type of surgery admitted to SICU, or medical comorbidities, or perioperative care itself was so great as to not permit entrusting them with initial intake. (Seventy-six percent of PGY-1 SICU house staff were not categorical general surgery.) The PA role in SICU was developed with an on-site PA educator with 30 years' ICU experience.²³ PAs perform all consults and work 2-hour to 25-hour shifts (with naps in an in-unit call room) per week, providing significant continuity over the day. PGY-1s learn SICU protocols and procedures (such as ultrasound-guided line placement) from PAs. There is currently increased interest in ICU PAs, but 9 years' experience leads to the caution that PAs should not be "set up to fail" by expecting too much too early. A PA really cannot function at the level expected in the Beth Israel SICU until they have had at least a year of ICU mentoring on top of a previous year of surgical training or experience. The approximate experience/qualifications necessary for the responsibilities are listed in Table 4.

Accreditation Council for Graduate Medical Education-imposed resident work hour limitations necessitate a stronger 24/7 role for nonphysician practitioners and attendings.²⁴ Over most of the 9 years, PGY-1s worked 27-hour shifts. They now work 15-hour shifts, creating substantial signout/communication challenges. (PGY-2s work 12-hour day shifts.) Although a "checklist" or "signout sheet" helps, an accurate daily progress note and 12 to 14 system plan of care on each SICU patient is essential to communicate multiple complex issues of multiple complex patients to the next team of caregivers. If surgery residencies make SICU a mostly PGY-1 rotation with less senior resident participation, July to August PGY-1s may be caring for complications of complex surgery they have not yet seen and cannot even describe (Table 3). In-unit presence of experienced PAs and/or attending intensivists 24/7 seems critical to SICU efficiency and patient safety.

In this series, 24/7 in-unit coverage by experienced surgical intensivists/cardiac surgeons did not improve SICU mortality. Organizations such as Leapfrog are advocating a practice pattern that is actually not achievable with current numbers of intensivists/trainees in the United States. The principal value of 24/7 intensivists may be their reflexive adherence to best practices. In this report, significant mortality benefit was initially

TABLE 4. Levels of Practice/Experience of SICU Physician Assistants

	Experience	Certification	Expectation
Level 0	None	ACLS	Shouldn't be in SICU unsupervised
Level 1	1 yr surgery or Surgical pa residency	ACLS, FCCS	SICU Consultation with immediate attending review emphasizing "best practices." Participate in routine SICU care Surgery Morbidity & Mortality Conference
Level 2	1-2,500 SICU patients	FCCS instructor	SICU Consultation, Manage Stepdown Unit, Senior in SICU days, Nighttime call with Attending backup ICU Quality Assurance Conference Surgery M&M's Teach PGY-1 procedures and guidelines
Level 3	2,000-5,000 patients	FCCS, ATLS Complete SCCM Board Review course	Collect clinical/research data Ensure PGY1 adherence to best practices & SICU protocols Teach "beyond FCCS" Curriculum Nighttime senior call in SICU
Level 4	5-10,000 patients	FCCS Course Director	Research coordinator organize CME contributing author
Level 5	>10,000 patients	PhD or FCCM Certification	Participation in research First author and principle investigator

achieved emphasizing 24/7 compliance with guidelines through PAs, surgical residents, and ICU nurses with ICU attendings on call from home. Emphasis on team building with 24/7 adherence to best practices may still provide mortality benefit in institutions unable to afford/recruit 24/7 intensivists.

Fifty to seventy percent of patients are admitted to hospitals at night or on weekends.²⁵ In some studies, afterhours admission to both hospitals and ICUs seemed to increase mortality, which 24 hour a day/7 day a week on-site intensivist coverage might mitigate. However, other studies have not shown night and weekend effect. This variation might reflect institutional differences in utilization of best practices and education/integration/empowerment of residents, midlevel practitioners, and nurses in following them.

In this report, the majority of SICU consults and admissions were in the afternoon or evening for elective surgery. Daytime attending intensivists present until 7:00 PM reviewed consults with the PAs and evening rounded with the on-call PA and PGY-1. Fifteen to thirty-one percent of SICU admissions were emergent/unexpected, or 300 to 600 emergency admissions/year, about 150 to 300 of whom will be at night, or 3 to 6 per week. If all emergency SICU admissions are cared for following FCCS principles and best practices, does the benefit of 24/7 in-unit surgical intensivists justify the cost and organizational complexity required?

The lack of mortality benefit of 24/7 attending coverage in this study might be partly related to the many 36-hour attending shifts used to achieve coverage. Sleep research shows functional impairment after 36 hours of continuous work equivalent to driving legally drunk.²⁶ Although night activity permitted napping, it did not allow for more than 3 hours uninterrupted sleep per night. Mortality outcome might have improved more if attendings had not frequently worked 36-hour shifts; study of safety and outcome in ICUs with 24/7 coverage should control for potential (negative) impact of 36-hour shifts on attending function in hours 24 to 36.²⁷

There is debate whether SICU care might suffer at night if on-call surgical intensivists were in the OR performing trauma or acute care surgery. The data in this report suggest the principle mortality benefit was from rapid response, team building with best practices, continuity and communication, and surgical intensivist leadership and proximity (as initiated in 2001–2007). Under the majority of circumstances, inhouse surgical intensivists should be able to cover both SICU and trauma or acute care surgery the same night.

CONCLUSION

At an urban, nontrauma teaching hospital, surgical intensivists restructured SICU care, emphasizing timeliness of consultation and team structure relying heavily on PAs and best practices. This lowered SICU mortality from 4.55% for the previous 5 years to 2%, which was then maintained for 9 years while surgical volume increased 89%. No further mortality benefit occurred with 24/7 in-unit nighttime coverage by surgical intensivists or cardiac surgeons. Although 24/7 attending intensivist coverage of SICU is desirable; unit mortality may not benefit.

AUTHORSHIP

M.A.M. takes responsibility for the integrity of the data and the accuracy of the data analysis. All authors participated in the study's conception. M.A.M., N.B., and D.S.G. acquired and analyzed the data. M.A.M., N.B., and D.H. wrote the manuscript, for which M.A.M. and N.B. prepared tables, figures, and statistics. All authors participated in editing the paper, and all approve of its final form.

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DISCLOSURE

The authors declare no conflicts of interest.

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