

## Surgical Intensive Care Unit (SICU) Models of Care: Current Practices & Perspectives

Aisha Shaheen MD, MHA<sup>1</sup>, Benjamin Kohl MD, FCCM<sup>2</sup>, Abhay Mathur, B.S<sup>3</sup>  
& Michael S. Weinstein MD, FCCM, FACS<sup>4</sup>

### Abstract

**Introduction:** Surgical critical care services are delivered through a variety of practice models. Increased intensivists involvement in the ICU has been shown to improve care and clinical outcomes for patients. However, data regarding actual practices in ICU models of care has as of yet not been quantified. This study seeks to characterize current practices and perceptions of intensivists involvement in ICUs with surgical critical care training programs. **Methods:** A 25-question survey on an internet-based platform was sent to program directors of all ACGME-approved surgical critical care programs that were registered with Surgical Critical Care Program Directors Society (SCCPDS). Participants were queried on the setting of their ICU, their current staffing and management models (e.g. open versus closed ICU) and asked to describe their optimal model of care for an ICU. **Results:** Fifty-two of one hundred (52%) contacted completed the questionnaire. Respondents were largely affiliated with academic medical centers (82.7%) and represented twenty-seven states in the continental U.S. Respondents currently based in both open (71.4%) and closed (81.3%) units largely favored a high-intensity staffing model with mandatory intensivists consultation. Those surveyed reported conflicts between the primary surgeon and intensivists were usually resolved by consensus (71.4%) and not deferral to either the ICU or primary surgical team. **Conclusions:** Current practices of ICU models of care are presented and intensivists education, responsibilities, and authority in clinical decision-making are characterized. Intensivists in our study overwhelmingly favored closed units and high-intensity involvement.

### 1.1 Introduction:

Delivery of surgical critical care services encompasses a broad spectrum of practice models<sup>1-4</sup>. A major discriminating organizational factor of such services is the level of intensivists involvement. In a "closed" unit, physicians with critical care training assume primary responsibility for patients admitted to the ICU.<sup>2,3</sup> Closed units can involve both patients being transferred to the intensivists service or remaining under the surgeon-of-record's service. However, the defining feature of a closed unit model is that management decisions are ultimately at the discretion of the intensivists. The intensivists in this model of care is often responsible for providing care to patients without concurrent emergency or elective surgical or outpatient clinical responsibilities. Studies have shown an improvement in mortality and better resource utilization when intensivists primarily manage critically ill patients<sup>4-8</sup>.

Critics of closed ICU organization point to a lack of continuity in care provided by the primary surgeon, insufficient patient-specific knowledge by the intensivists and a reduction in the use of perceived necessary subspecialists.<sup>4,5</sup>

<sup>1</sup> Division of Acute Care Surgery, Department of Surgery, Thomas Jefferson University, Philadelphia, PA, USA. [aisha.shaheen@jefferson.edu](mailto:aisha.shaheen@jefferson.edu)

<sup>2</sup> Division of Anesthesiology and Critical Care, Thomas Jefferson University, Philadelphia, PA, USA. [benjamin.kohl@jefferson.edu](mailto:benjamin.kohl@jefferson.edu)

<sup>3</sup> Sidney Kimmel Medical College, Thomas Jefferson University, Philadelphia, PA, USA. [abhay.mathur@jefferson.edu](mailto:abhay.mathur@jefferson.edu)

<sup>4</sup> Division of Acute Care Surgery, Department of Surgery, Thomas Jefferson University, Philadelphia, PA, USA.  
[michael.weinstein@jefferson.edu](mailto:michael.weinstein@jefferson.edu)

They instead advocate for an organizational paradigm in which the primary surgeon continues to maintain full responsibility for his patient throughout hospitalization, including the ICU period. The intensivists' role in this setting is at the discretion of the primary surgeon. Management decisions and order entry are guided by the surgeon-of-record and performed by his or her service or team members.

Within the spectrum of ICU organizational structures there are also "mixed" models of care based on a variable degree of collaboration between the intensivists and the surgeon-of-record. In "high-intensity" staffing models, the ICU may be closed or open, but all admitted patients receive a mandatory intensivists consultation and there is intensivists coverage in the ICU throughout the day. In contrast, a "low-intensity" model has elective intensivists consultation and no guarantee of intensivists presence in the intensive care unit. (Table 1: Intensive Care Unit (ICU) Models of Care).

Despite the wide-variance in ICU models of care, a growing body of evidence supports high-intensity models as providing better outcomes for patients<sup>11</sup> even the addition of nighttime intensivists staffing to a low-intensity ICU staffing model has been shown to reduce mortality.<sup>12</sup> Improved outcomes are particularly notable in high-risk surgical patients.<sup>11,13</sup> Studies on current coverage practices are limited. A previous study surveyed 24/7 in-house intensivists coverage at academic medical centers in the United States.<sup>14</sup> Our study attempts to describe intensivists autonomy in clinical decision-making and their perceptions of an "optimal" model for intensive care units. We predict the intensivists surveyed would prefer a "closed" model where they could drive decision making and patient management in the intensive care unit. We also examine the current status of intensivists background and training as well as fellow involvement in intensive care units with surgical critical care training programs.

## **2.0 Materials and Methods:**

We distributed a twenty-five (25)-question survey using an Internet-based platform to one hundred (100) program directors of the Accreditation Council of Graduate Medical Education (ACGME)-approved surgical critical care fellowships in the United States. Program directors were identified through their registration with the Surgical Critical Care Program Directors Society (SCCPDS) and contacted by email in July 2015. We received 52 total responses. Prior to survey distribution, Institutional Review Board (IRB) approval was received from our home institution.

The survey was designed to query respondents on the background and training of other physicians in their surgical intensive care units as well as the level of collaboration between intensivists and the surgeon-of-record in regards to clinical decision-making for critically ill patients. Respondents were also asked about their perceptions of "optimal" intensive care unit management. Queries on fellowship training and involvement were also included in the survey.

## **3.0 Results:**

The survey was distributed to all one hundred Program Directors (PD) of ACGME-approved surgical critical care training programs who were also registered with the Society of Critical Care Program Directors Society (SCCPDS). We received 52 (52%) FD responses from 27 states (FIGURE 1: Distribution of Responses by Region). Respondents were largely based in academic (university-affiliated) medical centers (43/52= 82.7%) followed by community based, non-university affiliated hospitals (9/52 =17.3%). All survey participants reported practicing in a designated Level I Trauma Centers (52/52= 100%). The number of adult critical care beds in each of the intensive care units ranged in number between 11- 20 beds (27/52 = 51.9%) followed by greater than 21 beds (24/52 =46.2%). Only one respondent reporting working in an ICU with less than 10 staffed beds (1/52 = 1.9%). [TABLE 1]

### **3.1 Intensivists Background and Staffing**

Respondents reported diverse training backgrounds among physicians staffing their intensive care units: surgical critical care (51/91 = 56.0%), anesthesia (21/91 = 23.1%), emergency medicine (9/91= 9.9%) and medicine/pulmonary critical care (7/91 = 7.7%). A small portion of respondents reported including non-intensivists in their staffing model (3/91 =3.3%). The Intensivists to ICU Bed ratio was also variable. The majority of respondents reported a staffing ratio of greater than 10 patients per intensivists (42/51= 82.3%).

Respondents reporting staffing ratios of less than 1:6 and greater than 1:20 were 3/51 (5.8%) and 4/51 (7.8%), respectively. [TABLE 2: Demographics, Intensives Background, Bed Ratio, Fellowship Characteristics]

### 3.2 Training Program & Trainee Demographics and Staffing

Survey respondents were evenly split between surgical critical care training programs started before and after 1995 (26/52 = 50% each). Most programs had three or fewer critical care fellows per year (42/52 = 80.8%). Three fellowship programs reported having more than seven (7) critical care trainees per year (3/52= 5.77%). Respondents reported that trainees in their programs were primarily based in either surgical and/or trauma intensive care units (44/52= 84.6%). A smaller portion of respondents trained their fellows in ICUs with a multi-specialty patient mix of medical, surgical, trauma, neurosurgical and cardiac surgery patients (5/52 = 9.62%). [Figure 2: ICU Setting/ Primary Patient Mix] In-house call requirements for critical care fellows was split almost evenly with 51% (26/51) of FD respondents reporting mandatory in house call for their trainees, and 49% (25/51) of respondents denying this requirement. Trainees who took in-house call most often did so less than once a week (Call q5 or greater 25/31 = 0.6%). TABLE 2: Fellowship Demographics and Fellow Training]

### 3.3 ICU Models & Decision Making

A mix of ICU models was reported among respondents' practices. Greater than half (29/52= 55.7%) of the FDs surveyed reported a high-intensity staffing model with mandatory intensives consultation. A third of respondents were based in a closed ICU model in which all treatment decisions are directed primarily by the intensives (17/52= 32.7%). Finally, a small minority of ICU's had an open model, where treatment decisions were primarily or completely directed by a non-intensives (7/52= 13.5%). [Figure 3: ICU Models] Respondents who practiced in closed ICUs favored this practice as the optimal model for an intensive care unit (13/16= 81.2%). Most had practiced in a closed ICU model for three or more years (15/16=93.8%). [Table 3: Perceptions of Closed and Open Units]

For those respondents practicing in open ICU practice models the majority favored high intensity intensives staffing, that is a mandatory intensives involvement (24/35=68.6%). When queried directly, the majority of open ICU model based respondents (23/35=65.7%) denied favoring a closed model where all treatment decision are directed by the intensives and further denied any future plans to "close" their ICUs (30/35= 85.7%). As expected in open or semi-open units, the intensives team tended to neither enter all orders (25/35=71.4%) nor transfer patients to the intensives service the vast majority of the time (25/35= 71.4%). [Table 3: Open Unit Preferences] Interestingly, in all ICU models, the intensives respondents reported conflicts with the primary surgical teams being largely resolved in a collaborative fashion with discussion and consensus both in closed and non-closed ICU models, 93.8% (15/16) and 82.9% (29/35), respectively.

### 4.0 Discussion:

Our study explores current practices and perceptions of ICU models of care in surgical intensive care units with critical care training programs. Strengths of this survey include a high response rate (52%) and broad geographic sample representation. There are several limitations to this study. The first is not all program directors of surgical critical care programs in the United States were surveyed. We exclusively surveyed program directors that were registered with the Surgical Critical Care Program Directors Society (SCCPDS) which may result in a selection bias. Secondly, because the surveys included identifying factors including state and type of program, respondents may have felt discouraged from providing accurate answers or providing answers that present themselves or their programs in an unfavorable manner. Although a list of common terms and definitions were provided, respondents understanding or personal experiences with "closed" and "open" units and what these terms imply may have biased respondents in their responses. Personal understanding of these terms may vary and influence the answers respondents selected on the surveys. Our survey was multiple choice only and therefore the closed-ended nature of the questions was also a limitation. Additionally, many programs have separate acute care surgery training programs and as we specifically queried sites with surgical critical care training programs, the former group was not represented in our results.

Finally, this survey study queried only the intensives and not querying and not the primary surgeon and therefore is limited in its ability to assess the successfulness of communication and collaboration between the two groups.

## 5.0 Conclusions:

Our results show a wide-variety of organizational models within surgical intensive care units, with varying degrees of intensives involvement. We found respondents tended to view their current model as “optimal.” Those currently based in closed units pointed to the improved outcomes found in high-intensity intensive care units and the efficiency of decision-making that did not rely on waiting on the primary surgeon. In contrast, respondents based in open units tended to prefer the continuity of care provided to the surgeon-of-record and the ability to collaborate with the primary surgeon on clinical decision making for the complex critically ill patient in their care. Surprisingly, our study found that despite their current model of care, an overwhelming amount of respondents reported being able to successfully communicate and collaborate with the surgeon-of-record on differences in management. Perhaps this more than anything suggests that despite the current model of care employed at any facility, the distinctions between open and closed units can be successfully blurred when the focus is on patient care.

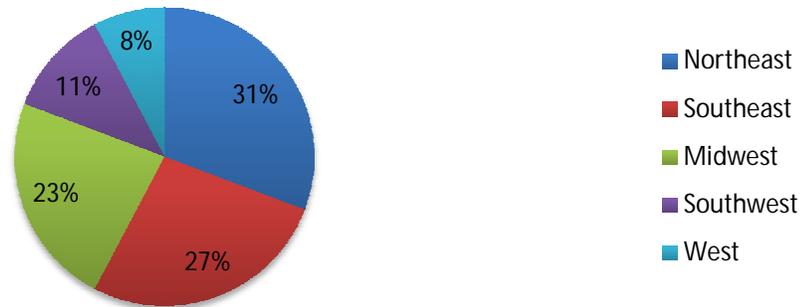
## 6.0 References

- Haupt MT, Bekes CE, Brill R, Carl LC, Gray AW, Jastremski MS, Naylor DF, Rudis M, Spevetz A, Wedel SK, et al. Guidelines on critical care services and personnel: Recommendations based on a system of categorization of three levels of care. *Crit Care Med.* 2003; 31(11):2677-83.
- Garland A, Gershengorn HB: Staffing in ICUs: Physicians and alternative staffing models. *Chest.* 2013; 143(1):214-21.
- Lustbader D, Fein A: Emerging trends in ICU management and staffing. *Crit Care Clin.* 2000;16(4):735-48.
- Barie PS, Bacchetta MD, Eachempati SR. The contemporary surgical intensive care unit. *Surg Clin North Am.* 2000;80(3):791-804.
- Gutsche JT, Kohl BA. Who should care for intensive care unit patients? *Crit Care Med.* 2007;35(2):S18-S23.
- Pronovost PJ, Angus DC, Dorman T, Robinson KA, Dremsizov TT, Young TL. Physician staffing patterns and clinical outcomes in critically ill patients. *JAMA.* 2002; 288(17):2151-62.
- Hanson CW, Deutschman CS, Anderson HL, Reilly PM, Behringer EC, Schwab CW, Price J. Effects of an organized critical care service on outcomes and resource utilization: A cohort study. *Crit Care Med.* 1999;27(2):270-4
- Levy MM, Rapoport J, Lemeshow S, Chalfin DB, Phillips G, Danis M. Association between critical care physician management and patient mortality in the intensive care unit. *Ann Intern Med.* 2008;148(11):801-9.
- Gajic O, Afessa B, Hanson AC, Krpata T, Yilmaz M, Mohamed SF, Rabatin JT, Evenson LK, Aksamit TR, Peters SG, et al. Effect of 24-hour mandatory versus on-demand critical care specialist presence on quality of care and family and providers satisfaction in the intensive care unit of a teaching hospital. *Crit Care Med.* 2008;36(1):36-44.
- Wilcox ME, Chong CA, Niven DJ, Rubinfeld GD, Rowan KM, Wunsch H, Fan E. Do Intensivist staffing patterns influence hospital mortality following ICU admission? A systematic review and meta-analyses. *Crit Care Med.* 2013;41(10):2253-74.
- Van der Sluis FJ, Slagt C, Leibman B, Beute J, Mulder JW, Engel AJ. The impact of open versus closed format ICU admission practices on the outcome of high risk surgical patients: A cohort analysis. Available online at [www.biomedcentral.com](http://www.biomedcentral.com). Accessed (DATE ACCESSED)
- Wallace DJ, Angus DC, Barnato AE, Kramer AA, Kahn JM. Nighttime intensivist staffing and mortality among critically ill patients. *N Engl J Med.* 2012, 366(22): 2093:2101.
- Pronovost PJ, Jenckes MW, Dorman T, Garrett E, Breslow MJ, Rosenfeld BA, Lipsett PA, Bass E. Organizational characteristics of intensive care units related to outcomes of abdominal aortic surgery. *JAMA.* 1999;281(14):1310-7.
- Diaz-Guzman E, Colbert CY, Mannino DM, Davenport DL, Arroliga AC. 24/7 In-house Intensivist coverage and fellowship education: A cross-sectional survey of academic medical centers in the United States. *Chest.* 2012;141(4):959-66.

<b>Table 1: Intensive Care Units (ICU) Models of Care</b>	
Open Unit	Patient management directed by surgeon-of-record or affiliated team members
Closed Unit	Patient management directed by a dedicated critical care service
High Intensity	Mandatory intensivist consult and coverage of intensive care unit
Low Intensity	Elective intensive consult and variable daytime coverage

<b>Table 2: Hospital &amp; Fellowship Descriptive Statistics</b>		
	Total	Percentage
Type of hospital setting (n=52)		
Academic Medical Center	43	82.7%
Community Teaching Hospital	9	17.3%
Trauma designation (n=52)		
Level I	52	100.0%
Region of hospital (n=52)		
Northeast	16	30.8%
Southeast	14	26.9%
Midwest	12	23.1%
Southwest	6	11.5%
West	4	7.7%
Number of beds in intensive care unit (n=52)		
>20	24	46.2%
11--20	27	51.9%
<10	1	1.9%
Intensivist to bed ratio (n=51)		
1:1 - 1:5	3	5.9%
1:6 - 1:10	6	11.8%
1:11 - 1:15	21	41.2%
1:15 -1:20	17	33.3%
> 1:20	4	7.8%
Intensivist training background (n=91)		
Surgery	51	56.0%
Anesthesia	21	23.1%
Emergency Medicine	9	9.9%
Medicine/Pulmonary	7	7.7%
Non-Intensivist	3	3.3%
Year fellowship program started (n=52)		
Before 1995	26	50.0%
After 1995	26	50.0%
Number of fellows per year (n=52)		
<4	42	80.8%
4--7	7	13.5%
>7	3	5.8%
In-house call requirement, calls per week (n=51)		
None	20	39.2%
q1-q3	2	3.9%
q4-q7	23	45.1%
>q7	6	11.8%

<b>Table 3: Perceptions of Open and Closed Units</b>		
	Total	Percentage
<b>Respondents in Closed Units</b>		
Opinion of optimal model for ICU (n=16)		
Closed	13	81.3%
Open	0	0.0%
High-Intensity Staffing	3	18.8%
Low-Intensity Staffing	0	0.0%
How long has unit been closed (n=16)		
1-2 years	1	6.3%
3-5 years	4	25.0%
6-10 years	2	12.5%
> 10 years	9	56.3%
How are conflicts between primary surgeon and intensivist resolved (n=19)		
Discuss and and come to consensus	15	78.9%
Defer to ICU team	3	15.8%
Defer to primary surgical team	1	5.3%
No conflicts - ICU team makes all decisions	0	0.0%
No conflicts	0	0.0%
<b>Respondents in Open Units</b>		
Opinion of optimal model for ICU (n=35)		
Closed	9	25.7%
Open	0	0.0%
High-Intensity Staffing	25	71.4%
Low-Intensity Staffing	1	2.9%
Prefer to have a closed ICU (n=35)		
Yes	12	34.3%
No	23	65.7%
Plans to close ICU (n=35)		
Yes	5	14.3%
No	30	85.7%
Does ICU team enter all orders (n=35)		
Yes	10	28.6%
No	25	71.4%
Are patients transferred to Intensivist service (n=35)		
Always	0	0.0%
Sometimes	10	28.6%
Never	25	71.4%
How are conflicts between primary surgeon and intensivist resolved (n=42)		
Discuss and and come to consensus	30	71.4%
Defer to ICU team	4	9.5%
Defer to primary surgical team	8	19.0%
No conflicts - ICU team makes all decisions	0	0.0%
No conflicts	0	0.0%

**Figure 1: Distribution of Responses by Region****Figure 2: Primary Intensive Care Unit Setting**