Understaffed and overworked: The stark reality of acute care surgeon staffing in the United States, an Eastern Association for the Surgery of Trauma multicenter study

Patrick B. Murphy, MD, MPH, MSc, Jamie J. Coleman, MD, Danielle J. Wilson, MD, Morgan Maring, MS, Jaclyn Gellings, MD, Elise Biesboer, MD, Tovy H. Kamine, MD, MBA, Kaushik Mukherjee, MD, Stephanie Bonne, MD, Melissa M. Boltz, DO, Robert D. Winfield, MD, Ryan P. Dumas, MD, Jason Kurle, DO, Roseanna Guzman-Curtis, MD, Jason D. Sciarretta, MD, Baila Maqbool, MD, Bryan C. Morse, MD, Michael W. Cripps, MD, Stephen Gondek, MD, Galinos Barmparas, MD, Jordan Lilienstein, MD, Jeffry Nahmias, MD, MHPE, Lee Faucher, MD, Charles V. Bayouth, MD, Tanya Egodage, MD, Lisa Marie Knowlton, MD, John D. Berne, MD, Charles Fasanya, MD, Meredith Shaddix, DO, Lewis E. Jacobson, MD, Michael S. Farrell, MD, Luis G. Fernandez, MD, Benjamin M. Manning, MD, R. Shayn Martin, MD, Jordan M. Kirsch, DO, Ilya Rakitin, MD, Michael S. Englehart, MD, Stephanie C. Montgomery, MD, Benoit Blondeau, MD, Brent Emigh, MD, Katherine McKenzie, DO, Sharven Taghavi, MD, Leah C. Tatebe, MD, Kyle W. Cunningham, MD, Marc A. de Moya, MD, *and* **The ACS Staffing Authorship Group***, Milwaukee, Wisconsin*

OBJECTIVES: Rightsizing the workforce to clinical demand requires a balance of work intensity, productivity, and a definition of clinical full-time equivalent (cFTE). We hypothesized a shortage of acute care surgeons based on a 204-shift per year (average, 17 per month) definition of a 1.0 cFTE established in our prior mixed-methods study (two service weeks plus five calls per month).

METHODS: This multicenter study used mixed methods, integrating clinical schedules (CY2022), work relative value units, and qualitative insights from semistructured interviews (July 2023 to June 2024). Schedules were converted to shifts (8–14 hours). Hospitals were short-staffed when shift demand exceeded supply based on each surgeon's cFTE. Interviews explored clinical demand and staffing challenges. Descriptive analysis and a deductive-inductive thematic analysis were performed.

RESULTS: Forty Level I/II hospitals representing 412 acute care surgeons (287 cFTEs) from 25 states were included. Seventy-nine percent of hospitals were short-staffed. Compared with well-staffed hospitals, short-staffed hospitals had fewer cFTEs (6.5 [interquartile

Submitted: December 8, 2024, Revised: April 28, 2025, Accepted: May 8, 2025, Published online: July 4, 2025.

From the Division of Trauma and Acute Care Surgery, Department of Surgery (P.B.M., M.A.d.M.), Medical College of Wisconsin, Milwaukee, Wisconsin; Department of Surgery (J.J.C.), University of Louisville, Louisville, Kentucky; Department of Surgery (D.J.W., J.G., E.B.), and Department of ? (M.M.), Medical College of Wisconsin, Milwaukee, Wisconsin; Department of Surgery (T.H.K.), UMass Chan Medical School—Baystate, Springfield, Massachusetts; Division of Acute Care Surgery (K. Mukherjee), Loma Linda University Health, Loma Linda, California; Department of Surgery (S.B.), Hackensack University Medical Center, Hackensack, New Jersey; Division of Trauma, Acute Care, and Critical Care Surgery, Department of Surgery (M.M.B.), Penn State Hershey Medical Center, Hershey, Pennsylvania; Division of Acute Care Surgery, Trauma, and Surgical Critical Care (R.D.W.), University of Kansas Medical Center, Kansas City, Kansas; Division of General and Acute Care Surgery, University of Texas Southwestern Medical Center (R.P.D.), Dallas, Texas; Department of Surgery, Detroit Medical Center (J.K.), Detroit, Michigan; Department of Surgery (R.G.-C.), SUNY Upstate Medical University, Syracuse, New York; Department of Surgery Emory University School of Medicine (J.D.S.), Atlanta, Georgia; Department of Surgery (B.M.), University of New Mexico, Albuquerque, New Mexico; Maine Medical Center (B.C.M.), Portland, Maine; Department of Surgery (M.W.C.), University of Colorado, Aurora, Colorado; Division of Trauma, Surgical Critical Care, and Emergency General Surgery (S.G.), Vanderbilt University Medical Center, Nashville, Tennessee; Department of Surgery (G.M.), Cedars-Sinai Medical Center, Los Angeles; Department of Surgery (J.L.), UCSF Fresno, Fresno; Department of Surgery (J.N.), University of California, Irvine, Orange, California; Department of Surgery (L.F.), University of Wisconsin—Madison, Madison, Wisconsin; SWAT Surgical Associates, Covenant Medical Center (C.V.B.), Lubbock, Texas; Department of Surgery (T.E.), Cooper University Hospital, Camden, New Jersey; Department of Surgery (L.M.K.), Stanford University, Stanford, California; Department of Surgery and Trauma, Broward Health Medical Center (J.D.B.), Fort Lauderdale, Florida; Department of Trauma and Surgical Intensive Care (C.F.), Good Samaritan University Hospital, West Islip, New York; Division of General and Trauma Surgery, Department of Surgery (M.S.), Ascension Sacred Heart Pensacola, Pensacola, Florida; Department of Surgery, Ascension St. Vincent Hospital (L.E.J.), Indianapolis, Indiana; Department of Surgery (M.S.F.), Lehigh Valley Health Network, Allentown, Pennsylvania; Department of Surgery, University of Texas Health Science Center (L.G.F.), Tyler, Texas; Department of Surgery (B.M.M.), Prisma Health, Greenville, South Carolina; Department of Surgery (R.S.M.), Atrium Health Wake Forest Baptist, Winston Salem, North Carolina; Division of Trauma and Acute Care Surgery (J.M.K.), Westchester Medical Center, New York Medical College, Valhalla, New York; Division of Acute Care Surgery (I.R.), Henry Ford Hospital, Detroit, Michigan; Trauma & General Surgery (M.S.E.), Billings Clinic, Billings, Montana; Department of Surgery, University of Connecticut Medical Center (S.C.M.), Farmington, Connecticut; Department of Surgery (B.B.), HealthPartners Regions Hospital, St. Paul, Minnesota; Department of Surgery (B.E.), Warren Alpert Medical School of Brown University, Providence, Rhode Island; Department of Surgery (K. McKenzie), Jamaica Hospital Medical Center, Richmond Hills, New York; Department of Surgery (S.T.), Tulane School of Medicine, New Orleans, Louisiana; Department of Surgery (L.C.T.), Northwestern University, Chicago, Illinois; and Division of Acute Care Surgery (K.W.C.), Atrium Health Carolinas Medical Center, Charlotte, North Carolina.

This study was presented at the 38th annual meeting of the EAST Annual Scientific Assembly, January, 17, 2025, in Tucson, Arizona.

Supplemental digital content is available for this article. Direct URL citations appear in the printed text, and links to the digital files are provided in the HTML text of this article on the journal's Web site (www.jtrauma.com).

Address for correspondence: Patrick B. Murphy, MD, MPH, MSc, Division of Trauma and Acute Care Surgery, Department of Surgery, Medical College of Wisconsin, 8701 W Watertown Plank Rd, Milwaukee, WI 53226; email: pmurphy@mcw.edu.

DOI: 10.1097/TA.0000000000004700

range (IQR), 3] vs. 8.6 [IQR, 3], $p < 0.05$), a higher demand for clinical work (1,889 [IQR, 933] vs. 1,388 [IQR, 674] shifts, $p = 0.05$) and a higher work relative value unit/cFTE (8,779 vs. 7,456, $p = 0.12$). The aggregate clinical demand exceeded available surgeon capacity by 21% overall. Based on volume, a 1.0 cFTE is needed for every 285 (IQR, 169) trauma admissions. There was a deficit of 75 cFTEs across the centers. Key themes identified were related to the value of acute care surgery and balancing unpredictable demand, intensity, and efficiency.

CONCLUSION: There appears to be a shortage of acute care surgeons in the United States when a definition of 204 shifts per year cFTE is applied. Hospitals face significant financial and administrative barriers to workforce expansion despite the overabundance of clinical volume. Future research is needed to ascertain the effects of expanding the existing workforce on both clinical outcomes and surgeon well-being. (*J Trauma Acute Care Surg.* 2025;99: 560–570. Copyright © 2025 Wolters Kluwer Health, Inc. All rights reserved.)

LEVEL OF EVIDENCE: Prognostic and Epidemiologic; Level III.

KEY WORDS: Acute care surgery; FTE; full-time employment; shortage.

The delivery of emergency surgical care in the United States has been transformed over the past two decades through the development of acute care surgery (ACS).[1–4] While the ACS model integrates trauma, emergency general surgery, and surgical critical care, the scope of ACS continues to expand to include elective surgery, surgical rescue, and burn care.[5,6] Concurrently, evidence suggests that there is a growing shortage of surgeons caring for these patients, particularly as patient volume and complexity increase.[7–9] Patients with ACS needs now represent 20% of hospital admissions and 25% of hospital costs.[10,11] This mismatch between workforce capacity and clinical need highlights the critical nature of staffing shortages, which impact surgeons, patients, and health systems.

Nonsurgical specialties with unpredictable clinical demands like emergency medicine and critical care have worked toward standardized definitions of a 1.0 clinical full-time equivalent (cFTE).[12–15] Although no such standardized definition currently exists in ACS, previous research has proposed a definition of a cFTE (1.0 cFTE): 204 shifts annually, typically structured as two service weeks plus five call shifts per month.[16,17] This standardized metric allows comparison across a diverse specialty where there is considerable variability in scheduling (weeks, days, shifts, hours) and staffing practices. The extent to which current hospitals and practices meet this proposed definition of a 1.0 cFTE, however, remains unknown. Quantifying the number of acute care surgeons needed to staff hospitals across the country is critical for workforce planning, surgeons, systems, and patients. An accurate assessment helps health care systems appropriately determine staffing needs, distribute surgical resources, ensure adequate coverage for clinical demand, and maintain schedules that may mitigate burnout among surgeons.[18–20] Without proper staffing levels, hospitals risk delays in care and increased surgeon turnover due to strain on existing personnel.

This multicenter study represents a comprehensive examination of acute care surgeon staffing across US trauma centers. Understanding the true scope of ACS staffing shortages will enable evidence-based advocacy for increased staffing, inform national workforce policy, and help hospital systems develop sustainable coverage models. We hypothesized a significant proportion of trauma centers operate understaffed when a standardized definition of a 1.0 cFTE is applied.

PATIENTS AND METHODS

We performed a multicenter, prospective study of Level I/II trauma centers. Centers were recruited through the Eastern Association for the Surgery of Trauma (EAST), and participation was voluntary. Enrolment was open to ACS centers via the EAST website, contingent upon leadership approval at each institution. Institutional review board approval was obtained by the lead center, and all participants provided informed consent. To capture the complexity of acute care surgeon staffing, we used a mixed-methods approach. Quantitative and qualitative data collection occurred from August 1, 2023, to April 19, 2024.

Quantitative Data

Quantitative data were gathered via standardized data collection forms completed by division leaders (e.g., division chiefs or trauma medical directors). These forms included characteristics of trauma centers (e.g., annual volume of admissions, activations) and hospitals (e.g., size, beds, teaching status), ACS system design (e.g., service line configuration, staffing models), and the leader's definition of a 1.0 cFTE. This included the assigned cFTE for each faculty member, 2022 work relative value units (wRVUs) for each faculty member, and the median division salary. Furthermore, each center provided their clinical coverage calendar from January 1, 2022, to December 31, 2022.

To ensure standardized comparison, we converted all clinical coverage into equivalent 8- to 14-hour shifts. We also converted all clinical demand to equivalent shifts. For example, a week of trauma service from Monday to Friday, 7 AM to 5 PM, was considered five shifts. An overnight call from 5 PM to 7 AM was considered one shift. A 24-hour call was considered two shifts. This standardization allowed meaningful comparison across institutions despite varying scheduling and practice models. Additionally, different types of call were prorated: in-house call was counted as a full shift, home-call was 0.5 of a shift, and back-up call was 0.25 of a shift. In centers without an explicit back-up call schedule, we asked for norms surrounding who would be called for back-up to ensure complete capture of clinical work. Once converted, each center reviewed and confirmed the calculations to ensure accuracy.

Semistructured Interviews

We conducted semistructured interviews with surgeon stakeholders at each participating site, via a cloud-based secure audio/video platform (Zoom; Zoom Video Communications, San Jose, CA). Participants included ACS leadership from each center: the division leader, trauma medical director or another surgeon stakeholder, or a combination thereof. Participants were selected using purposeful key informant and snowball sampling.[21] Interview guides were developed based on our prior

two studies and were conducted by study staff experienced in conducting qualitative interviews (P.B.M. and J.J.C.).[16,17] The interview guide first confirmed and clarified the data collection form and 2022 schedules. Subsequently, it focused on surgeon staffing and the considerations, if any, that went into determining appropriate staffing. This included the definition of a 1.0 cFTE, the concept of rightsizing the number of service lines, questions around work type, volume and intensity, and challenges faced when staffing the division. Additional questions addressed the role of fellows and the minimum work needed to maintain competency. Some of the study participants may have known study staff prior to the interviews. The interviews were audio recorded and transcribed verbatim via the video platform and subsequently manually corrected as needed. Finally, the interviews were coded based on a preliminary coding structure (deductive coding) developed from the discussion guide and our prior work, with inductive codes added through iterative discussions of emergent themes.[22,23] Interviews were coded in duplicate by members of the study team (P.B.M., D.J.W, J.G, M.M., E.B.). Intercoder reliability measures were not used given the interpretive nature of our analysis and our emphasis on capturing nuanced subjective experiences that benefit from multiple perspectives rather than consensus coding.

Analysis

We *a priori* defined a 1.0 cFTE as 204 shifts per year based on our prior work.[16,17] This was calculated by converting 2 weeks of service to 14 shifts and adding 5 call shifts per month for 11 months, which accounts for 4 weeks of vacation. We then subtracted five shifts for continuing medical education per year. The number of shifts each surgeon should work was determined by taking their assigned cFTE and multiplying by 204. This expected value was then compared with the actual shifts worked in 2022 based on calendar data and was limited to trauma, emergency general surgery, surgical intensive care, and burns services as well as on-call work. Clinical demand was determined based on the number of shifts required to staff each center's ACS services. For example, if a service line covered Monday through Friday during the daytime hours, this would represent 260 shifts per year. Centers were classified as "short-staffed" when their clinical demand exceeded their available surgeon supply based on this metric and "well-staffed" if surgeon supply was greater than demand. Data on elective surgery outside scheduled ACS work were excluded from the analysis.

Statistical analysis included standard descriptive statistics to evaluate relationships between hospital size, trauma volume (admissions/activations), and staffing requirements. For qualitative data, we used a deductive-inductive thematic analysis according to Braun and Clarke,[22] with independent coding by multiple investigators to ensure reliability. The codes were iteratively refined as themes emerged until thematic saturation was achieved, and remaining interviews were used for supportive anonymized quotations.[24] Anonymized quotations from interview participants were used to illustrate themes relating back to the original research questions. Transcripts were not reviewed by participants, and no interviews were repeated.

Stata (StataCorp, College Station, TX) and MaxQDA (VERBI Software, Berlin, Germany) were used for the quantitative and qualitative analyses, respectively. We adhered to the Enhancing the Quality and Transparency of Health Research network guidelines, specifically the Consolidated Criteria for Reporting Qualitative Research,25 based on our qualitative study design, with the checklist available as Supplementary Digital Content (Supplementary Data 1, http://links.lww.com/TA/E658).

RESULTS

Of 51 eligible centers, 40 (78.4%) were included (Table 1). Eleven centers (21.6%) responded to the online recruitment but were excluded because of the following reasons: division chief declined (n = 5), no response to follow-up (n = 4), unable to schedule interviews (n = 1), and Level III trauma center (n = 1). The 40 included centers represented 25 states and all 5 regions of the United States (Fig. 1). The amount of clinical demand, delivery models, and number of surgeons and cFTEs varied widely across centers (Table 2).

Quantitative Analysis

Of the 40 included centers, 38 had complete calendar data and were included in the final data analysis. Two centers were missing calendar data for one or more of their service lines. The data represent 412 individual surgeons and 287 cFTEs. Of the 38 included centers, 30 (79%) were identified as short-staffed where clinical demand in shifts was greater than the available supply (Fig. 2). On average, this represents an additional 55 shifts per year worked per 1.0 cFTE. When considering individual surgeons (number of shifts worked compared with number of shifts expected), on average, a 1.0 cFTE worked 26 shifts more than expected in 2022. Among hospitals classified as "well-staffed" in the quantitative analysis, four (50%) were vulnerable to becoming understaffed with the loss of <1.0 cFTE (i.e., they were within 204 shifts of clinical demand exceeding supply).

Short-staffed hospitals attempted to deliver care with significantly fewer cFTEs (median, 6.5 [interquartile range (IQR), 2.9] vs. 8.5 [IQR, 3.3]; $p = 0.05$) while facing higher clinical demands (Table 3). For instance, among the 31 hospitals with available wRVU data, surgeons at short-staffed hospitals had a median wRVU/cFTE of 8,779 versus 7,456 at well-staffed hospitals, although this did not reach statistical significance ($p = 0.12$) (Table 3). There was also no statistically significant difference in per shift wRVU productivity between surgeons at well-staffed centers and short-staffed centers (median, 42 wRVUs per shift vs. 35; $p = 0.18$; Table 3).

We analyzed the relationship between trauma admission and staffing and determined that 1.0 cFTE is required for approximately every 285 trauma admissions (IQR, 169).

Finally, a sensitivity analysis was performed using different definitions of a 1.0 cFTE—184 shifts per year and 224 shifts per year (Supplementary Digital Content, Supplementary Tables S1 and S2, http://links.lww.com/TA/E659). With these definitions, the number of centers classified as "short-staffed" would be 87% and 71%, respectively.

Qualitative

When asked directly, 65% of centers described themselves as short-staffed, and 45% were investigating expansions of services (e.g., community work, splitting services teams to reduce density of work, adding elective surgery). The qualitative analysis

TABLE 1. Demographics of Included Centers

Hospital	Region	Hospital Beds*	Trauma Activations*	Trauma Admissions*	Level of Trauma Center	EGS Verified	Dedicated Division of ACS	Burn Coverage	Additional Community Sites
1	West	300–400	2,500–2,750	2,250–2,500	1	No	Yes	No	No
2	Northeast	800–900	2,750–3,000	2,000–2,250	1	No	Yes	No	No
3	Northeast	400–500	1,750–2,000	2,250–2,500	1	No	Yes	No	No
4	Midwest	800–900	1,500–1,750	2,500–2,750	1	Yes	Yes	No	No
5	Southwest	800–900	3,500–3,750	1,750–2,000	1	No	Yes	Yes	Yes
6	Midwest	400–500	2,000–2,250	Over 4,000	1	No	Yes	No	No
7	Midwest	300–400	2,500–2,750	1,000–1,250	2	No	Yes	No	No
8	Northeast	400–500	1,000–1,250	750–1,000	1	No	Yes	Yes	No
9	Southeast	900–1,000	>4000	>4000	1	No	Yes	Yes	No
10	Southwest	500–600	>4000	3250–3500	1	No	Yes	No	No
11	Northeast	600–700	3000–3250	>4000	1	No	Yes	Yes	No
12	West	600–700	1750–2000	2500–2750	1	No	No	Yes	No
13	Southeast	>1,000	>4,000	>4,000	1	No	Yes	Yes	Yes
14	West	800–900	1,000–1,250	1,000–1,250	1	No	Yes	No	No
15	West	600–700	1,500–1,750	3,500–3,750	1	No	Yes	Yes	No
16	West	400–500	Over 4,000	2,750–3,000	1	No	Yes	Yes	No
17	Midwest	700–800	3,000–3,250	2,750–3,000	1	No	Yes	No	Yes
18	Midwest	700–800	2,750–3,000	3,000–3,250	1	No	Yes	No	Yes
19	Southwest	300–400	1,000–1,250	1,000–1,250	2	No	Yes	No	No
20	Northeast	600–700	2,500–2,750	3,750–4,000	1	No	Yes	No	No
21	West	600–700	2,250–2,500	2,000–2,250	1	No	Yes	No	Yes
22	Southeast	600–700	2,750–3,000	2,250–2,500	1	No	Yes	No	Yes
23	Northeast	400–500	500–750	1,500–1,750	2	No	Yes	No	No
24	Southeast	500–600	750–1,000	1,250–1,500	2	No	Yes	No	No
25	Midwest	800–900	2,750–3,000	2,750–3,000	1	No	Yes	No	No
26	Northeast	800–900	1,250–1,500	2,750–3,000	1	No	Yes	Yes	Yes
27	Southwest	400–500	750–1,000	500–750	1	No	Yes	No	Yes
28	Southeast	700–800	3,500–3,750	2,750–3,000	1	No	Yes	No	No
29	Southeast	800–900	1,750–2,000	3,000–3,250	1	No	Yes	Yes	No
30	Northeast	700–800	1,750–2,000	2,750–3,000	1	No	Yes	Yes	No
31	Northeast	600–700	2,250–2,500	1,500–1,750	1	No	Yes	No	Yes
32	Midwest	800–900	500–750	1,250–1,500	1	No	Yes	No	Yes
33	West	300–400	750–1,000	1,000–1,250	2	No	No	No	No
34	Northeast	600–700	750–100	1,250–1,500	1	No	Yes	No	No
35	Midwest	500–600	750–1,000	>4,000	1	No	Yes	Yes	No
36	Northeast	700–800	>4,000	>4,000	1	No	Yes	No	No
37	Northeast	400–500	1,750–2,000	2,250–2,500	1	No	Yes	No	No
38	Southeast	400–500	3,500–3,750	2,500–2,750	1	No	Yes	Yes	Yes
39	Midwest	800–900	750–1,000	1,000–1,250	1	Yes	Yes	No	No
40	Southeast	800–900	>4,000	>4,000	1	No	Yes	No	Yes

*Ranges given for anonymity, actual value used for analysis 2022 data.

revealed two dominant themes related to individual and division-level staffing considerations, value, and funding models (Table 4).

Staffing a Division — Individual and System Considerations

Staffing for Unpredictable Clinical Demand and Acuity

When considering the design of ACS systems, interviewees described a proactive approach to staffing at the faculty, resident, and advanced practice provider levels. For the main service lines covered by ACS, which are emergency general surgery, trauma, and surgical intensive care unit, coverage was determined by legacy staffing considerations (e.g., historical coverage patterns that evolved over time without systematic planning) and available funding.

Managing staffing levels in the face of unpredictable clinical demand emerged as a crucial challenge for ACS divisions. All three service lines suffer from unpredictable daily and weekly volumes, even in the face of predictable annual volumes. To ensure quality of care and patient safety, services must be staffed to accommodate the higher ends of volume fluctuations. Patient acuity was also identified by participants as an important staffing consideration in addition to volume.

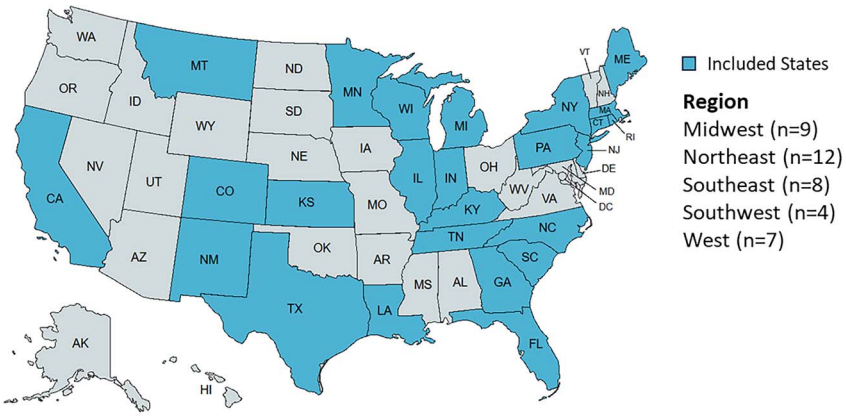

Figure 1. Geographic distribution of included centers.

Similarly, redundancy was identified as an area needing improvement. Participants drew parallels to other industries' staffing models regarding budgeting of personnel and finances. Centers described a uniform approach when asked what happens if a faculty calls in sick or requires time-off — "everybody sucks it up you know. And that's pretty much it. We don't get locums or anything like that" (HS18).

Participants described struggles with determining appropriate staffing levels for night coverage, particularly in balancing the need for in-house coverage against the cost and utilization of backup call systems. As one participant explained, "I think we'll reach a point where the nights are busy enough that we need a second person in house. The backup from home seems to be working for us and you have nights where you don't get called" (HS4). This reflects the difficult decision-making process involved in staffing optimization, where centers must weigh the frequency and intensity of night calls against resource allocation. Related to appropriate staffing was the role or presence of fellows. Centers identified as short-staffed largely accounted for the difference through independent fellows but recognized the need to hire more faculty if they no longer had fellows.

Balancing Work Intensity and Efficiency

The challenge of balancing workload intensity with operational efficiency emerged as a significant theme across participating centers. Institutions reported taking a simplified approach to shift allocation, treating all shifts as equivalent units regardless of their actual intensity or complexity. This strategy, while administratively straightforward, fails to account for the variable demands and stresses placed on acute care surgeons performing different types of work (i.e., volume, density/intensity). Centers reported using basic accounting methods to ensure equity in shift type and distribution among their surgical staff, focusing primarily on quantitative rather than qualitative measures of workload. One participant described their process: "Just try to do the accounting and make everyone equal at the end of the year. Everyone did kind of the same amount of weeks, because that's a natural way" (HS37).

Value of ACS

Standardizing Branding and Scope

The perception and valuation of ACS services within health care institutions emerged as a significant barrier to appropriate staffing. As one participant identified, "our branding is a disaster" (HS13), noting this issue as a barrier to communicating effectively with hospital administration.

This lack of consistent identity was deemed important clinically as well, and comparisons were drawn to other medical specialties, particularly those who have limited control over patient volume. Indeed, this concept was further elaborated on by a participant who related the nature of understaffed work to poor patient and physician outcomes.

Clinical and Nonclinical Value

Centers expressed frustration, feeling there was a disconnect between their essential roles and their value clinically and nonclinically. One participant drew an apt analogy: "Acute care surgeons are like firefighters. You don't pay firefighters to show up when there's a fire. You pay firefighters to stay in shape, stay proficient, stay competent to be able to do the things they need" (HS4). Specific focus on value and acuity, rather than solely on volume, was identified as important, moving beyond just simply prioritizing wRVUs.

Others expressed concern with the devaluation of "nonclinical" roles such as injury prevention, education, and even research in comparison with clinical care and the revenue it generates. Indeed, many centers described difficulty in determining cFTE with a common theme being uncertainty about whether cFTE should reduce clinical responsibilities (service time and/or call) or just increase compensation without affecting clinical workload.

Funding and Relationship With Administration

Overall, there were mixed feelings regarding the relationship between ACS leadership and hospital administration, much of which was related to funds flow, financial support, and definitions of work. Notably, relationships were more positive when clinician-administrators held leadership positions, such as in hospital administration. Traditional productivity metrics, particularly the wRVU system, appear ill-suited for capturing the value of ACS services. This misalignment is particularly evident in departmental structures, as one participant noted: "Part of the problem is that a lot of people are still reporting to their department chairman, and the department chairman is an RVU person" (HS20). This suggests that current administrative structures

TABLE 2. Work and Staffing Data at Each Included Hospital (2022 Data)

Hospital	No. Daytime Jobs (M–F)†	In-house Overnight	At-home Overnight‡	Clinical Demand in Shifts†,§	No. Surgeons at End of Year§	No. FTEs†	Median Compensation (Thousands)
1	3	1	0	1,500–1,750	10–12	7.25	300–400
2	2	1	1	1,000–1,250	4–6	3.3	400–500
3	3	2	1	1,750–2,000	10–12	7.2	400–500
4	3	1	0	1,250–1,500	10–12	8.9	400–500
5	6	1	1	2,500–2,750	16–18	9.5	N/A
6	3	0	1	1,750–2,000	8–10	6.3	500–600
7	4	1	1	1,750–2,000	8–10	5.6	300–400
8	3	1	1	2,000–2,250	8–10	4.26	300–400
9	6	2	0	2,500–2,750	14–16	9.2	400–500
10	4	1	1	1,750–2,000	10–12	4.5	300–400
11	5	1	1	1,250–1,500	10–12	8.2	500–600
12	3	1	1	1,500–1,750	8–10	5.1	300–400
13	8	1	1	Over 4,000	16–18	10.1	400–500
14	3	1	0	1,750–2,000	10–12	6.8	400–500
15	7	1	1	2,750–3,000	12–14	10.7	600–700
16	6	1	2	2,750–3,000	10–12	7.47	500–600
17	6	1	0	1,750–2,000	12–14	7.2	400–500
18	6	2	0	2,500–2,750	16–18	10.75	400–500
19	3	1	0	500–750	4–6	4.25	600–700
20	4	1	0	2,500–2,750	14–16	10.5	400–500
21	3	0	1	1,250–1,500	8–10	5.6	300–400
22	3	1	0	1,250–1,500	12–14	11.6	300–400
23	2	2	1	1,500–1,750	6–8	5.4	400–500
24	3	1	0	2,000–2,250	8–10	7	400–500
25	4	1	2	2,000–2,250	12–14	10.2	600–700
26	5	1	0	2,250–2,500	10–12	9	500–600
27	1	1	0	500–750	4–6	4.4	600–700
28	5	1	0	2,000–2,250	6–8	5.9	600–700
29	5	1	0	2,500–2,750	10–12	6.6	400–500
30	3	1	0	1,250–1,500	8–10	8	400–500
31	4	1	1	1,750–2,000	8–10	7.2	400–500
32	5	2	0	2,250–2,500	14–16	11	400–500
33	2	1	0	750–1,000	8–10	3.2	500–600
34	3	1	0	1,250–1,500	8–10	4.7	500–600
35	3	1	0	2,000–2,250		6.7	500–600
36	5	1	1	2,000–2,250	8–10	5.8	N/A
37	3	1	0	1,250–1,500	12–14	6.2	400–500
38	3	1	2	1,750–2,000	4–6	4.2	300–400
39	2	0	1	1,000–1,250	6–8	3.8	500–600
40	6	1	0	2,500–2,750	16–18	13.6	400–500

*For clinical coverage of trauma/ACS/SICU.
**Contributing more than 10% of FTE to trauma/ACS/SICU coverage.
†Contributing coverage to trauma/ACS/SICU; shift defined as 9 to 14 hours; 24-hour call counts as two shifts.
‡Excluding back-up.
§Range given for anonymity, actual value used for analysis.
FTE, full-time equivalent; M–F, Monday-Friday; N/A, not available; SICU, surgical intensive care unit.

and productivity metrics may need to be reconsidered to better reflect the unique value proposition of ACS services, which includes maintaining constant emergency surgical availability regardless of volume. Another participant voiced the need to stop "including [us] in the elective surgeons' world. Like, [we] just don't belong there" (HS12). The concept of "being available" was a recurring theme and distinctly contrasted with the role of elective surgeons, whose focus is often bringing business to the hospital through scheduled procedures.

Finally, one solution suggested by a participant was taking a more regulatory, nationally standardized approach. This participant suggested establishing minimum requirements for surgeon cFTE requirements as part of trauma center accreditation, similar to existing requirements for registrar FTEs based on trauma

Figure 2. Bar graph of clinical shift deficit (red) or surplus (green) per hospital (January 1, 2022, to December 31, 2022) and line graph of cFTEs (1.0 cFTE = 204 shifts per year) compared with needed cFTEs. There is a shortage of 392 shifts (red line) or 2.1 cFTE per hospital on average.

volume. This approach would potentially allow trauma centers to decouple staffing needs from wRVU production, taking the onus off of local leadership and instead to negotiate with hospital administration for adequate staffing.

DISCUSSION

Matching the clinical need for acute care surgeons with an adequate workforce to provide that care remains a challenge. The findings of this EAST multicenter study highlight important considerations for health care administrators and the surgical community regarding ACS workforce planning and resource allocation. Using a standardized definition of a 1.0 cFTE for acute care surgeons, nearly 80% of participating centers in our study were shown to operate with insufficient staffing. Considering that elective surgery requirements and additional clinical workloads were not captured in this study, this number is likely underestimating the true nature of staffing shortages. This represents a deficit of 75 cFTEs across the included 40 Level I and Level II trauma centers. Moreover, individual surgeons work on average 26 shifts above our 1.0 cFTE definition of 204 shifts per year. We identified a number of important qualitative themes to inform workforce planning nationally and locally.

Acute care surgeons face an unprecedented crisis of professional burnout, with studies indicating burnout rates as high as 40% to 60%.[26] The nature of ACS work, characterized by atypical work hours, increasing patient load, high-stakes decision making, and repeated exposure to injuries and death, creates a perfect storm for emotional exhaustion. Many surgeons report symptoms of depression, emotional detachment, and compassion fatigue, which not only affects their personal well-being but can also negatively impact patient care and surgical outcomes.[20,27,28] Despite their reputation for resilience, acute care surgeons lead the way in burnout and were ranked third for depression among surgical specialties.[29] Unfortunately, this trend is not improving and has only worsened in recent years.[30] While our work did not measure surgeon-related outcomes, the evidence would suggest that the extra workload carried by acute care surgeons, approximately 26 extra shifts per year per 1.0 cFTE, likely contributes to poor surgeon and potentially patient outcomes. [20,27,28]

Our qualitative results explain and expand upon many of our quantitative findings. Many centers still rely on legacy staffing strategies, although some have begun a more planned approach in determining the number of faculty needed to provide high-quality patient care based on volume.[31,32] Even with this approach, most included centers did not consider work volume or intensity and lacked a framework to identify a need for either additional service lines or faculty. This is perhaps best highlighted in data where centers that are "well-staffed" generate more wRVUs per shift. Several plausible explanations exist for this productivity differential. First, these centers may experience higher patient volumes or acuity levels coupled with fewer clinical service options, naturally driving increased productivity metrics per shift. Alternatively, the "well-staffed" designation might afford surgeons additional administrative time to optimize

TABLE 3. Comparison of Well-Staffed to Short-Staffed Centers (2022 Data)

	Well-Staffed Center (n = 8)	Short-Staffed Center (n = 30)	Total (n = 38)	*p*
Clinical FTEs, median (IQR)	8.6 (3.3)	6.5 (2.9)	6.9 (3.7)	0.05
Shift demand per center, median (IQR)	1,388 (674)	1,889 (933)	1,859 (928)	0.05
Clinical FTEs needed, median (IQR)	6.8 (3.3)	9.4 (4.1)	9.2 (4.0)	0.11
Clinical FTE surplus/shortage, median (IQR)	+1.0 (1.4)	−2.4 (2.5)	−2.1 (3.4)	<0.001
wRVU per cFTE, median (IQR)	7,456 (3,791)	8,779 (2,478)	8,321 (2,510)	0.12
wRVU per shift, median (IQR)	42 (13.5)	35 (11)	36 (12)	0.18

FTE, full-time equivalent.

TABLE 4. Qualitative Themes With Exemplary Quotes

Theme and Subthemes	Exemplary Quotes
Staffing a division — individual and system considerations	
Staffing for unpredictable clinical demand and acuity	"The average volume might be 20, but in the summer it might be 35 to 40. When we looked at the amount of work that we need to safely cover it. We need a dedicated ICU person. We need a dedicated EGS person. We needed a dedicated trauma person, and then we needed a backup." (HS4) "I think that's the variability that you have to kind of watch for in your overall trauma service because that acuity is going to make a big difference." (HS5). "Other industries budget 80%, so that they can have a 20% flex capability. You have to look at the clinical workload then you ramp up the clinical workload by 20% and see what you need for that." (HS21) "I think we'll reach a point where the nights are busy enough that we need a second person in house. The backup from home seems to be working for us and you have nights where you don't get called." (HS4) "You could be taking someone to the OR but also on call for trauma, and then still trying to cover 'X' amount of patients on the wards. So, [you're] trying to be at 3 different places at the same time." (HS9) "And it will frequently feel like only one thing needs to happen before something's gonna fail." (HS10)
Balancing work intensity and efficiency	In response to a shift — "We don't weigh it in any way. It is basically a shift as a shift, as a shift." (HS37) "Just try to do the accounting and make everyone equal at the end of the year. Everyone did kind of the same amount of weeks, because that's a natural way." (HS37) "And so a big part of it was just saying, the numbers we currently have make no sense. We were talking about the whole 1 to 14 model, like SCCM says. Most everybody's like that's crazy. That's way too little. So we ended up saying 16 to 18, 2 extra patients." (HS9)
Value of ACS	
Standardizing branding and scope	"You can't communicate effectively to hospital administrators, because when you say trauma, they might be like, oh, I'm thinking about this slice and so on." (HS13) "I compared us to emergency medicine. I said emergency medicine physician, you don't expect to work every day of the week. And then I said, we're also like pulmonary critical care. You don't expect them to be in the unit every single week. So we're like that too. We're also like general surgery. So we have to do all that stuff." (HS12) "It's just [we] get pulled in so many different directions. And we're used to that, like this is the nature of what we do. But when it becomes excessive, you just start feeling that you know — just not doing the right thing for the patients and for yourself." (HS14)
Clinical and nonclinical value	"You may spend the entire night with a blunt trauma patient resuscitating them and not operating on them. And those decisions do matter. That is actually experience that you cannot really quantify on paper because what is our RVU that we are going to produce with that? Like you may not even bill for that, right? You're up all night with a blunt trauma patient that's dying on you and you may bill like 30 minutes of critical care. That's not it. You cannot reflect on that. But for trauma cases the volume remains very low." (HS14). "I think the biggest challenge is understanding our roles and responsibilities, and the value that we bring to the institution." (HS4) "Acute care surgeons are like firefighters. You don't pay firefighters to show up when there's a fire. You pay firefighters to stay in shape, stay proficient, stay competent to be able to do the things they need." (HS4) ""But the clinical work we do candidly, is probably the least important thing we're doing in the program here. Candidly, if I take society is a big picture perspective, absolutely important things incredibly important not to deny it. But all your stuff is so much more valuable. And so I think when you just focus on the clinical FTE you're saying all this other stuff doesn't matter. Forget about H-fit, forget about injury prevention, forget about educating all this, I mean. And I know that's not what we think. But that's why I do worry when we focus so much of the clinical, that we devalue the rest." (HS9) With respect to the cFTE — "It's a made up number, totally. I mean there are real titles to attach to it, but it's very freely given down knowing that trauma care has to be covered. We're all committed to covering it, so we cover it. You know it's not, it's not a good reflection of what our actual workload is." (HS10)
Funding and relationship with administration	"Yes, he's a hospitalist by training. So, he understands hospital-based work as opposed to RVU based work, which is why he doesn't care about what the RVUs are." (HS20) "And see, part of the problem is that a lot of people are still reporting to their department chairman, and the department chairman is an RVU person." (HS20) "Well, I think that they have no idea what we do. They're not medical people at all, but I think one thing that we did that was different as we call ourselves surgical hospitalists because you say that medicine has pretty much figured this out — and so if you think of us as surgical hospitalists, but we also have clinic, respond to the ED, and also operate. We're doing 4 different jobs to their one job. They have like at least 10 times the faculty." (HS10)

billing practices or dedicate more attention to time-intensive billing activities such as critical care documentation or bedside procedures (e.g., supervising a tube thoracostomy or laceration repair). This relationship between staffing and productivity represents a significant finding deserving further investigation to identify the precise mechanisms at work.

There is little evidence in ACS to suggest the "right" number of patients per surgeon. The decision to add another service or split a current service into two because of volume can be quite complex, as it often requires more than just hiring additional surgeons but may require additional clinical support such as residents, Advanced Practice Providers, and/or administrative

support. Indeed, nearly half of included centers indicated a desire to expand services even though over half of centers indicated they were short-staffed. These seemingly contradictory findings present an interpretive challenge. However, collectively, they reflect a complex reality wherein hospitals face mounting pressure to accommodate additional clinical volume, sometimes without corresponding resource increases, while also recognizing the need to address high work intensity by dividing teams to reduce individual workload, ultimately resulting in an increased number of total shifts. Directly adding to this complexity is the inconsistent nature of ACS itself, where availability is required but clinical work is not guaranteed. The work that is performed also may not be commensurate with the number of wRVUs generated.[5,33] Thus, it may not be surprising that most centers in this study expressed interest in moving away from wRVU compensation models, which, while easy to measure, fail to capture the value of availability; the downstream revenue from other specialties, including orthopedic and neurosurgery, because of the acute care surgeon's availability and presence; and the actual clinical work provided by acute care surgeons. Viewing acute care surgeons as part of the hospital infrastructure was a common theme identified and requires a definition of a cFTE in ACS. This may represent an opportunity to move away from volume-based compensation.[16,17] Financial support for this model may come in the form of the often-scrutinized trauma activation fee, which by design should help offset cost of resources needed for 24/7/365 care, since these fees require the employment of acute care surgeons.[34,35]

Strategies are needed for workforce planning to guide centers in determining the number of acute care surgeons required to meet their clinical demand.[36] Although other specialties have defined a 1.0 cFTE, these specialties are nonsurgical and may not be directly transferrable to surgeons.[12–15] Important variations in shift intensity, patient acuity, surgical complexity, and even timing of shifts can impact surgeon workload and stress levels. Local assessment of volume, density, and intensity, as well as financial viability, must also be considered. With the ongoing shortage of both acute care surgeons and general surgeons in the United States, each system must develop systematic approaches to address both short- and long-term needs and recognize that the demand for surgeons has outpaced supply.[8,9,37] Transparent definitions of a 1.0 cFTE nationally or locally can facilitate workforce planning and offer the added benefit of establishing a clear relationship between clinical and nonclinical time expectations.

Alternative methods, such as volume-based measures, are less nuanced. This study identified a relationship between trauma volume and required cFTEs (1.0 cFTE per 289 admissions). This provides a potential starting point for workforce planning at individual centers. However, the wide IQR reflects the complex reality that staffing needs vary significantly based on local factors such as case complexity, geographic distribution, and available support staff. Most importantly, this metric does not consider the volume of emergency general surgery and surgical critical care patients, which varies widely and is not necessarily a reflection of the trauma center level or annual trauma volume.

Our study has limitations. First, while we captured data from all geographic regions of the United States, our data only represent 25 of 50 states. Second, while calendar data were objective, the assigned cFTE was self-reported by divisional leadership. There are numerous factors that may contribute to an individual surgeon's cFTE, including compensation packages, funded and unfunded nonclinical responsibilities, and overall division finances. Furthermore, the assigned cFTE has significant impact on whether a center was deemed short-staffed or well-staffed, and this limits our overall results. There may be some bias in the reporting of staffing based on existing relationships with administration that are not accounted for in this study. We also did not include elective surgery, often performed outside service time, or any clinical responsibilities outside of the three traditional pillars of ACS, which likely leads to an underestimation of staffing shortages. Additionally, the study lacks overall financial data (collections and individual surgeon salaries), which undoubtedly affect staffing decisions.

We applied a standard definition of a cFTE based on our prior work, but this is not unanimously agreed upon. To provide a broader perspective, we performed a sensitivity analysis, and most centers were "short-staffed" even with a more flexible 1.0 cFTE definition of 224 shifts per year. Relatedly, we discounted home call and back-up call to 0.5 and 0.25 shifts, respectively, but this fails to account for local differences in the acuity and volume of both. Furthermore, the number of surgeons staffed on each service was not specifically evaluated. For instance, one center may staff two surgeons on a similar number of patients as another center, thereby arbitrarily doubling the shifts performed without a change in patient/clinical volume. Also, we limited our inclusion criteria to Level I/II trauma centers, which, although allowing for a more homogenous sample, limits broader applicability to Level III centers. The volume of nontrauma patients was not accounted for, nor was the support from residents, fellows, and/or advanced care providers. Relatedly, only centers who volunteered were included, and 11 centers were excluded, some declining participation. This represents potential sampling bias and must be considered in the context of the results. Additionally, because of a low number of centers that were "well staffed," we were unable to perform analyses to identify variables associated with optimal staffing. Finally, the study lacks pertinent clinical and surgeon variables and outcomes related to the aspect of intensity per shift, which undoubtedly influence staffing.

CONCLUSION

This study provides evidence of a critical understaffing of trauma centers in the United States. The current approach to staffing threatens long-term sustainability for trauma centers, surgeons, and their ability to provide high-quality patient care. Despite clear evidence of clinical need, hospitals face significant financial and administrative barriers to workforce expansion. Future research must address the impact of these staffing shortages on clinical outcomes and surgeon well-being while developing sustainable funding models that acknowledge the value of ACS services beyond traditional measures.

AUTHORSHIP

P.B.M., J.J.C., and M.A.d.M. contributed in the conception and study design. P.B.M. contributed in the literature review. P.B.M. and J.J.C.

contributed in the data acquisition. P.B.M., J.J.C., D.J.W., M.M., J.G., E.B., and M.A.d.M. contributed in the data analysis and interpretation. P.B.M., J.J.C., D.J.W., M.M., J.G., E.B., K. Mukherjee, S.B., M.M.B., R.D.W., R.P.D., J.K., R.G.-C., J.D.S., B.M., B.C.M., M.W.C., S.G., G.B., J.L., J.N., L.F., C.V.B., T.E., L.M.K., J.D.B., C.F., M.S., L.E.J., M.S.F., L.G.F., B.M.M., R.S.M., T.H.K., J.M.K., I.R., M.S.E., S.C.M., B.B., B.E., K. McKenzie, S.T., L.C.T., K.W.C., and M.A.d.M. contributed in the drafting of the manuscript. P.B.M., J.J.C., D.J.W., M.M., J.G., E.B., K. Mukherjee, S.B., M.M.B., R.D.W., R.P.D., J.K., R.G.-C., J.D.S., B.M., B.C.M., M.W.C., S.G., G.B., J.L., J.N., L.F., C.V.B., T.E., L.M.K., J.D.B., C.F., M.S., L.E.J., M.S.F., L.G.F., B.M.M., R.S.M., T.H.K., J.M.K., I.R., M.S.E., S.C.M., B.B., B.E., K. McKenzie, S.T., L.C.T., K.W.C., and M.A.d.M. contributed in the critical revision.

DISCLOSURES

Conflicts of Interest: Author Disclosure forms have been supplied and are provided as Supplemental Digital Content (http://links.lww.com/TA/E660).

The ACS Staffing Authorship Group all meet the criteria for authorship and include the following: Xian Luo-Owen, MD, PhD, Department of Trauma Services, Loma Linda University Health; Scott B. Armen, MD, FACS, Division of Trauma, Acute Care and Critical Care Surgery, Department of Surgery, Penn State Hershey Medical Center, Hershey, Pennsylvania; Jennifer L. Hartwell, MD, FACS, Division of Acute Care Surgery, Trauma, and Surgical Critical Care, University of Kansas Medical Center, Kansas City, KS; Brandon Burns, MD, MBA, UT Southwestern Medical Center, Dallas, TX; Jason Smith, MD, PhD, MBA, Department of Surgery, University of Louisville, Louisville, KY; Moustafa Hassan, MD, SUNY Upstate Medical University; S. Rob Todd, MD, Emory School of Medicine, Atlanta, GA; Sonlee West, MD, Department of Surgery, University of New Mexico, Albuquerque, NM; Whitney R. Jenson, MD, Department of Surgery, University of Colorado, Aurora, CO; Mayur Patel, MD, FACS, Division of Trauma, Surgical Critical Care, and Emergency General Surgery, Vanderbilt University Medical Center, Nashville, TN; Daniel R. Margulies, MD, Department of Surgery, Cedars-Sinai Medical Center, Los Angeles, CA; Lawrence Sue, MD, Department of Surgery, UCSF Fresno, Fresno, CA; Negaar Aryan, MD, Department of Surgery, University of California, Irvine, Orange, CA; Ben L. Zarzaur, MD, MPH, Department of Surgery, University of Wisconsin—Madison, Madison, WI; John Porter, MD, Department of Surgery, Cooper University Hospital, Camden, NJ; Kristan Lea Staudenmayer, MD, MS, Department of Surgery, Stanford University, Stanford, CA; Dalier Mederios-Rodriguez, MD, Broward Health Medical Center, Fort Lauderdale, FL; Abenamar Arrillaga, MD, Department of Trauma and Surgical Intensive Care, Good Samaritan University Hospital, West Islip, NY; Kyle Leneweaver, DO, Division of General and Trauma Surgery, Department of Surgery, Ascension Sacred Heart Pensacola, Pensacola, FL; Jamie M. Williams, MSML, BSN, RN, CCRP, Ascension St. Vincent Hospital, Indianapolis, IN; Mark D. Cipolle, MD, MS, PhD, Department of Surgery, Lehigh Valley Health Network, Allentown, PA; Scott Norwood, MD, University of Texas Health Science Center, Tyler, TX; John D Cull, MD, MD, Department of Surgery, Prisma Health, Greenville, SC; Jason Hoth, MD, Department of Surgery, Atrium Health Wake Forest Baptist, Winston Salem, NC; Kristina Kramer, MD, FACS, Department of Surgery, UMass Chan, Medical School—Baystate; Kartik Prabhakaran, MD, Division of Trauma and Acute Care Surgery, Westchester Medical Center, New York Medical College, Valhalla, NY; Anthony Falvo, DO, Division of Acute Care Surgery, Henry Ford Hospital, Detroit, MI; Gordon M. Riha, MD, Trauma & General Surgery, Billings Clinic, Billings, MT; Taylor Fusco-Ruiz, BS, RN, University of Connecticut Medical Center, Farmington, CT; Charles A. Adams, MD, Department of Surgery, Warren Alpert Medical School of Brown University, Providence, RI; R. Jonathan Robitsek, PhD, Department of Surgery, Jamaica Hospital Medical Center, Richmond Hills, NY; T. Gerrit, BS, Department of Surgery, Tulane School of Medicine, New Orleans, LA; Marjorie Liggett, MD, Department of Surgery, Northwestern University, Chicago, IL; Addison K. May, MD, MBA, Division of Acute Care Surgery, Atrium Health Carolinas Medical Center, Charlotte, NC.

REFERENCES

1. Jurkovich GJ, Davis KA, Burlew CC, et al. Acute care surgery: an evolving paradigm. *Curr Probl Surg*. 2017;54:364–395.
2. Ball CG, Hameed SM, Brenneman FD. Acute care surgery: a new strategy for the general surgery patients left behind. *Can J Surg*. 2010;53:84–85.
3. Santry HP, Madore JC, Collins CE, et al. Variations in implementation of acute care surgery: results from a national survey of university-affiliated hospitals. *J Trauma Acute Care Surg*. 2015;78:60–68.
4. Murphy PB, DeGirolamo K, Van Zyl TJ, et al. Meta-analysis on the impact of the acute care surgery model of disease- and patient-specific outcomes in appendicitis and biliary disease. *J Am Coll Surg*. 2017;225:763–777.e13.
5. Kutcher ME, Sperry JL, Rosengart MR, et al. Surgical rescue: the next pillar of acute care surgery. *J Trauma Acute Care Surg*. 2017;82:280–286.
6. Jurkovich GJ. Acute care surgery: trauma, critical care, and emergency surgery. *Journal of Trauma - Injury, Infection and Critical Care*. 2005;58:614–616.
7. Rao MB, Lerro C, Gross CP. The shortage of on-call surgical specialist coverage: a national survey of emergency department directors. *Academic Emergency Medicine*. 2010;17:1374–1382.
8. Elkbuli A, Sutherland M, Sanchez C, Liu H, Ang D, McKenney M. The shortage of trauma surgeons in the US. *American Surgeon*. 2022;88:280–288.
9. Cohn SM, Price MA, Villarreal CL. Trauma and surgical critical care workforce in the United States: a severe surgeon shortage appears imminent. *J Am Coll Surg*. 2009;209:446–452.e4.
10. Bernard A, Staudenmayer K, Minei JP, et al. Macroeconomic trends and practice models impacting acute care surgery. *Trauma Surg Acute Care Open*. 2019;4:e000295.
11. Knowlton LM, Minei J, Tennakoon L, et al. The economic footprint of acute care surgery in the United States: implications for systems development. *J Trauma Acute Care Surg*. 2019;86:609–616.
12. Nurok M, Flynn BC, De Chambrun MP, Kazemian M, Geiderman J, Nunnally ME. A review and discussion of full-time equivalency and appropriate compensation models for an adult intensivist in the United States across various base specialties. *Crit Care Explor*. 2024;6:E1064.
13. Lilly CM, Oropello JM, Pastores SM, et al. Workforce, workload, and burnout in critical care organizations: survey results and research agenda∗. *Crit Care Med*. 2020;48:1565–1571.
14. Moorhead JC, Gallery ME, Mannle T, et al. A study of the workforce in emergency medicine. *Ann Emerg Med*. 1998;31(5):595–607.
15. Stenson BA, Anderson JS, Davis SR. Staffing and provider productivity in the emergency department. *Emerg Med Clin North Am*. 2020;38:589–605.
16. Murphy PB, Coleman J, Maring M, et al. Early career acute care surgeons' priorities and perspectives: a mixed-methods analysis to better understand full-time employment. *Journal of Trauma and Acute Care Surgery*. 2023;95:935–942.
17. Murphy PB, Coleman J, Karam B, Morris RS, Figueroa J, De Moya M. A national study defining 1.0 full-time employment in trauma and acute care surgery. *J Trauma Acute Care Surg*. 2022;92(4):648–655.
18. Robinson C, Lawless R, Zarzaur BL, Timsina L, Feliciano DV, Coleman JJ. Physiologic stress among surgeons who take in-house call. *Am J Surg*. 2019;218:1181–1184.
19. Coleman JJ, Robinson CK, Zarzaur BL, Timsina L, Rozycki GS, Feliciano DV. To sleep, perchance to dream: acute and chronic sleep deprivation in acute care surgeons. *J Am Coll Surg*. 2019;229:166–174.
20. Coleman JJ, Robinson CK, von Hippel W, Lawless RA, McMasters KM, Cohen MJ. Home is not always where the sleep is: effect of home call on sleep, burnout, and surgeon well-being. *J Am Coll Surg*. 2024;238:417–422.
21. Malterud K. Qualitative research: standards, challenges, and guidelines. *Lancet*. 2001;483–488.
22. Braun V, Clarke V. Using thematic analysis in psychology, qualitative research in psychology. *J Chem Inf Model*. 2008;3:77–101.
23. Braun V, Clarke V. What can "thematic analysis" offer health and wellbeing researchers? *Int J Qual Stud Health Well-Being*. 2014;9:26152.
24. Hennink M, Kaiser BN. Sample sizes for saturation in qualitative research: a systematic review of empirical tests. *Soc Sci Med*. 2022;292:114523.
25. Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care*. 2007;19:349–357.
26. Brown CVR, Joseph BA, Davis K, Jurkovich GJ. Modifiable factors to improve work-life balance for trauma surgeons. *Journal of Trauma and Acute Care Surgery*. 2021;90:122–128.
27. Coleman JJ, Robinson CK, Von Hippel W, et al. What happens on call doesn't stay on call. The effects of in-house call on acute care surgeons' sleep and burnout: results of the Surgeon Performance (SuPer) Trial. *Ann Surg*. 2023;278:497–505.

28. Dimou FM, Eckelbarger D, Riall TS. Surgeon burnout: A systematic review. *J Am Coll Surg*. 2016;222:1230–1239.
29. Balch CM, Shanafelt TD, Sloan JA, Satele DV, Freischlag JA. Distress and career satisfaction among 14 surgical specialties, comparing academic and private practice settings. *Ann Surg*. 2011;254:558–568.
30. Ortega MV, Hidrue MK, Lehrhoff SR, et al. Patterns in physician burnout in a stable-linked cohort. *JAMA Netw Open*. 2023;6:E2336745.
31. Di Pietro Martinelli C, Haltmeier T, Lavanchy JL, Perrodin SF, Candinas D, Schnüriger B. Work characteristics of acute care surgeons at a Swiss tertiary care hospital: a prospective one-month snapshot study. *World J Surg*. 2022; 46:330–336.
32. Vaziri K, Roland JC, Robinson L, Fakhry SM. Optimizing physician staffing and resource allocation: sine-wave variation in hourly trauma admission volume. *Journal of Trauma - Injury, Infection and Critical Care*. 2007;62: 610–614.
33. Peitzman AB, Sperry JL, Kutcher ME, et al. Redefining acute care surgery: surgical rescue. *J Trauma Acute Care Surg*. 2015;79:327.
34. Zitek T, Pagano K, Mechanic OJ, Farcy DA. Assessment of trauma team activation fees by US region and hospital ownership. *JAMA Netw Open*. 2023; 6:e2252520.
35. Knowlton LM, Haut ER. Trauma activation fees—a fair approach to reimburse trauma readiness costs or a pathway to profitability? *JAMA Netw Open*. 2023;6:e2252526.
36. Murphy PB, Nahmias J, Bonne S, Coleman J, de Moya M. Defining the acute care surgeon: American Association for the Surgery of Trauma (AAST) panel discussion on full-time employment, compensation and career trajectory. *Trauma Surg Acute Care Open*. 2024;9:e001500.
37. Association of American Medical Colleges. 2023 US Physician Workforce Data Dashboard. Available at: https://www.aamc.org/data-reports/data/2023-us-physician-workforce-data-dashboard. Accessed November 22, 2024.