How much green does it take to be orange? Determining the cost associated with trauma center readiness

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BACKGROUND: Readiness costs are real expenses incurred by trauma centers to maintain essential infrastructure to provide emergent services on a 24/7 basis. Although the components for readiness are well described in the American College of Surgeons' *Resources for Optimal Care of the Injured Patient*, the cost associated with each component is not well defined. We hypothesized that meeting the requirements of the 2014 *Resources for Optimal Care of the Injured Patient* would result in significant costs for trauma centers.

METHODS: The state trauma commission in conjunction with trauma medical directors, program managers, and financial officers of each trauma center standardized definitions for each component of trauma center readiness cost and developed a survey tool for reporting. Readiness costs were grouped into four categories: administrative/program support staff, clinical medical staff, in-house operating room, and education/outreach. To verify consistent cost reporting, a financial auditor analyzed all data. Trauma center outliers were further evaluated to validate variances. All level I/level II trauma centers (n = 16) completed the survey on 2016 data.

RESULTS: Average annual readiness cost is US $10,078,506 for a level I trauma center and US $4,925,103 for level IIs. Clinical medical staff was the costliest component representing 55% of costs for level Is and 64% for level IIs. Although education/outreach is mandated, levels I and II trauma centers only spend approximately US $100,000 annually on this category (1%–2%), demonstrating a lack of resources.

CONCLUSION: This study defines the cost associated with each component of readiness as defined in the *Resources for Optimal Care of the Injured Patient* manual. Average readiness cost for a level I trauma center is US $10,078,506 and US $4,925,103 for a level II. The significant cost of trauma center readiness highlights the need for additional trauma center funding to meet the requirements set forth by the American College of Surgeons. (*J Trauma Acute Care Surg.* 2019;86: 765–773. Copyright © 2019 American Association for the Surgery of Trauma.)

LEVEL OF EVIDENCE: Economic and value-based evaluations, level III.

KEY WORDS: Readiness costs; trauma center; survey.

The Centers for Disease Control reported the total health care expenditures in America for 2015 to be US $3.2 trillion.[1] In 2013, total estimated life time medical and work loss costs associated with fatal and nonfatal injuries in the United States were a staggering US $671 billion.[2] Velopulos et al[3] looked at the cost of national inpatient trauma care and noted that yearly cost to be over US $37 billion. Trauma continues to be an expensive, urgent public health concern.

The Georgia Trauma Commission was formed in 2007 by the Georgia General Assembly with the charge to oversee the development and fund distribution of the state trauma system.[4] The budget for the system is approximately US $16 million annually, which does not cover all the cost.[5] Therefore, it is imperative that every expenditure for the system be scrutinized and funds distributed appropriately. Designated trauma centers are an expensive component of the state trauma system with cost comprised of two large categories: readiness costs and treatment costs.[6,7]

Readiness costs are extraordinary cost over and above patient treatment cost that are not normally allocated to trauma patient care by hospital allocation formulas. These costs are required by trauma center regulations to maintain essential infrastructure and capacity to provide emergent services on a 24/7 basis. These are nonpatient care cost, which the hospital would not have to pay if it were not a trauma center and are incurred before the first patient is seen or treated. Although the trauma center regulations or requirements for readiness are well described in the American College of Surgeons' *Resources for Optimal Care of the Injured Patient*, associated cost is not.[8] There is no national consensus on the cost of these readiness requirements.[6]

In 2004, Taheri et al[7] attempted to quantify the cost of trauma center readiness within the state of Florida and noted that the combined average total medical cost of readiness for each level I and level II trauma center was approximately US $2.7 million annually. He also noted that "the answers required some judgment by the respondents and considerable effort." This was an excellent first attempt to quantify costs; however, without standardized definitions on how costs are allocated, there can

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be great variability from center to center in reporting these costs. The Trauma Commission noted similar difficulties with the first Georgia statewide survey in 2008 that revealed that the average annual readiness cost for a level I trauma center was US $5,600,372 and the average cost for a level II trauma center was US $1,956,966.[6] To alleviate reporting variability of costs in the survey, the Georgia Trauma Commission developed a survey tool in collaboration with chief financial officers, trauma medical directors, and trauma program managers at Georgia's level I and level II trauma centers throughout the state based on requirements for readiness as noted in the American College of Surgeons' 2006 *Resources for Optimal Care of the Injured Patient*.[8] Stakeholders from each trauma center came to a consensus providing standardized cost definitions for each of the proposed readiness requirements. This study on 2011 data revealed that the average annual readiness cost for a level I trauma center was US $6,821,064 and the average cost for a level II trauma center was US $2,333,113.[6] Reaching a consensus on defining and standardizing readiness costs resulted in less variability in survey results. However, the survey was based on self-reporting by each center without any review for accuracy. In addition, since the previous survey, the American College of Surgeons updated the *Resources for Optimal Care of the Injured Patient* in 2014.[9] To further refine and verify consistent cost reporting and update the survey tool to reflect the changes in the 2014 version, the Commission decided to repeat the survey with the updated definitions and added an evaluation by an independent financial auditor. We hypothesized that meeting the requirements of the 2014 *Resources for Optimal Care of the Injured Patient* would result in significant costs for trauma centers.

PATIENTS AND METHODS

During the summer of 2016 through early Spring 2017, the Georgia Trauma Commission charged the readiness cost subcommittee with updating Georgia's previous readiness cost survey tool to reflect the changes in the American College of Surgeons' 2014 *Resources of Optimal Care of the Injured Patient*. For consistency, the survey remained formatted in the same four cost categories: administrative/program support staff, clinical medical staff, in-house operating room (OR), and education/outreach. Several conference calls and in-person subcommittee meetings were held to compile all changes and add them to the most appropriate cost category. In late summer 2017, all state designated trauma centers were required to participate in a statewide instructional webinar explaining how to complete the new survey tool. Consensus was reached on defining and standardizing reporting cost of all new requirements. The surveys were completed by all trauma centers in October of 2017(6 level I/10 level II). The total number of patients reported during the 2016 survey was 24,488. The level I centers saw 15,660 patients with an average of 2,933 patients per center. The level II centers saw 8,828 patients with an average of 883 patient per center.

Procedures to produce consistency and validity of reported costs were developed by the readiness cost subcommittee and a third-party firm. Conference calls were held with individual centers and the third-party firm to clarify any missing information or discuss outliers that appeared unusual or distinctly different from other centers of the same level. Some centers were asked to resubmit their surveys for completeness and clarification. This process was completed in December 2017.

From December 2017 to March 2018, various cost components were tested for each center to validate consistent an accurate reporting. The samples were as follows:

Level I: selected 5 cost components for each level I trauma center;

Level II: selected 4 cost components for each level II trauma center.

Trauma centers were asked to submit supporting documentation (payroll records, invoices, etc.) for the selected cost components. Overall, 32% of the total reported original cost of levels I and II trauma centers were requested to test. The original reported cost of all 6 level I trauma centers was US $60,537,547. Applying the testing process noted previously resulted in US $14,963,234 (25%) of the total original reported costs to be tested. Of the US $14,963, 234 requested to test, US $13,651,556 (91%) was noted to have appropriate documentation without exception. The original reported cost of all 10 level II trauma centers was US $51,535,207. Applying the testing process noted above resulted in US $21,189,207 (41%) of the total original reported costs to be tested. Of the US $21,189,207 requested to test, US $9,115,363 (43%) was noted to have appropriate documentation without exception. Overall, of the total dollars requested to test for all levels I and II trauma centers, 63% were noted to have appropriate documentation and were tested without exception. For those centers with exceptions, the third-party firm in collaboration with the trauma centers adjusted the cost components accordingly for any differences. The most common reasons for adjustment were owing to trauma centers misunderstanding the instructions for completing the survey, that is, grouping nontrauma patients with trauma patients in certain categories, not knowing where to get the information requested, or not knowing what information was needed. Only 5% of requested support or backup documentation was not provided.

The total cost for all 6 level I trauma centers in the original survey was US $60,537,547. Through the validation phase, total costs were decreased by US $66,511. The total cost for all 10 level II trauma centers in the original survey was US $51,535,207. Through the validation phase, total costs were decreased by US $2,284,183. Overall, total cost for levels I and II trauma centers was decreased by US $2,350,694 (−2%) for the final survey results.

From April 2018 to June 2018, a deep analysis was performed by the readiness cost survey subcommittee.

The Survey Tool

Administrative/Program Support Staff

The administrative section included cost for various staff members such as senior administrators, trauma program managers, and trauma coordinators and participation costs for state, regional, and national activities. Program support staff section included outreach coordinators, collaborative services (case management, discharge planning, social services, physical therapy, occupational therapy, and speech therapy), injury prevention coordinators, performance improvement coordinators, and trauma registrars. The standard calculation for these staff positions was salary and benefits times percent of time dedicated to trauma.

In addition to the positions listed previously, trauma medical directors, emergency department liaisons, surgical intensive care unit (ICU) liaisons, orthopedic liaisons, and neurosurgical liaisons were included. The formula used to calculate their associated cost was administrative stipend if contracted, or if employed, salary and benefits times percent of time spent on trauma center administrative functions. The final piece included in the administrative section was cost associated with hardware and software for registry activities; screening, brief intervention, and referral to treatment (SBIRT); and thromboelastography.

Clinical Medical Staff

This section covered trauma medical staff compensation, which was complicated, because the state had a mix of community and academic medical centers. All specialties listed as required by the American College of Surgeons Committee on Trauma along with stipends or other payments for trauma call were included. For employed physicians, net cost was determined by salary plus benefits minus professional fee reimbursement and then estimating portion attributable to trauma. Surgical resident costs for time spent on trauma were reported for the academic medical centers.

In-house OR

This section included OR availability costs to maintain a room 24/7. There were some specific caveats related to OR cost. If an OR was maintained and dedicated exclusively for trauma, the estimated net cost was included (less reimbursement). If a facility maintained 24-hour in-house OR availability but did not maintain a specific dedicated OR staffed exclusively for trauma, the cost for a nightshift registered nurse and OR technician 7 days a week was included.

Education and Outreach

This section of the survey included cost for community outreach, injury prevention, professional education, and outlying hospital education. It also included costs for up to 16 hours of trauma continuing medical education for the following personnel: trauma medical director, trauma program manager, trauma program coordinator, trauma registrars, emergency department liaison, surgical ICU Liaison, neurosurgical liaison, and orthopedic liaison. The final piece of this section included specific costs associated with trauma-related hospital staff education involving the emergency department, ICU, and surgery and postanesthesia care unit.

The full survey tool is listed in Appendix A (Supplemental Digital Content 1, http://links.lww.com/TA/B302).

RESULTS

Table 1 shows levels I and II trauma center's total and mean cost, number of trauma centers reporting costs, and the range in each category for administrative/program support staff. Total costs

TABLE 1. Administrative and Program Support Staff Costs

Administrative	LI TC Mean, US $	No.	Range (US $000s)	LII TC Mean, US $	No.	Range (US $000s)	Totals, US$
Senior administrator support	41,424	6	12–120	34,119	9	12–80	589,739
Program administrator: trauma director	81,522	4	46–165	45,752	6	14–171	946,653
Trauma program manager	113,269	5	92–213	88,169	8	77–136	1,561,303
Trauma coordinator	109,978	4	38–390	26,190	3	61–107	921,769
Participation costs for state, regional, and national activities	7,282	6	3–10	3,547	10	1–14	79,165
Program support staff:							
Education/outreach coordinator	57,216	4	41–132	41,003	5	5–229	753,331
Case management, discharge planning, and social services	638,267	6	269–1,257	234,041	10	6–471	6,170,010
Physical therapy	651,115	6	74–1,373	255,546	10	7–493	6,462,146
Occupational therapy	593,093	6	43–1,326	242,012	10	7–473	5,978,684
Speech therapy	591,401	6	42–1,427	235,546	10	7–466	5,903,865
Injury prevention coordinator	90,507	6	41–234	39,000	4	11–235	933,045
Research coordinator	16,118	2	22–75	—	0	0	96,709
PI coordinator	46,397	3	56–129	9,582	1	96–96	374,204
Trauma registrar — employed	183,430	6	49–362	48,457	7	17–120	1,585,144
Trauma registrar — contract	85,621	3	11–259	3,632	1	36–36	550,039
Trauma program secretary	25,488	4	26–49	10,141	3	9–60	254,342
TMD	153,850	4	35–726	44,314	9	8–144	1,366,239
TMD participation costs	8,983	4	8–18	1,416	7	0–6	68,062
ED liaison	4,817	2	14–15	1,283	3	3–6	41,727
ICU surgical liaison	4,062	3	3–17	563	1	6–6	29,995
Orthopedic liaison	14,370	3	9–50	9,827	3	12–57	184,486
Neurosurgeon liaison	6,044	3	2–21	4,716	3	2–29	83,422
Registry hardware and software	10,821	6	5–18	11,473	10	4–20	179,654
SBIRT	4,650	2	1–27	930	1	9–9	37,197
TEG	59,623	4	27–175	990	1	10–10	367,640
Total	3,599,350			1,392,247			35,518,570

ED, emergency department; LI TC, level I trauma center; LII TC, level II trauma center; PI, performance improvement; TEG, thromboelastography; TMD, trauma medical director.

for all levels I and II trauma centers were US $35,518,570 with a level I mean cost of US $3,599,350 and a level II mean cost of US $1,392,247. The largest administrative personnel costs were trauma program managers at US $1,561,303. Under program support staff, case management, discharge planning, social services, physical therapy, occupational therapy, and speech therapy, all had significant costs with physical therapy reporting the largest cost at US $6,462,146. Trauma registrar support (employed and contract) was the next largest cost at US $2,135,183. Less than half the trauma centers reported costs associated with the required liaisons. The most significant cost, however, was the orthopedic liaison category, which was US $184,486.

Table 2 shows levels I and II trauma center's total and mean cost, number of trauma centers reporting costs, and the range in each category for trauma clinical medical staff support by specialty. The total costs for all levels I and II trauma centers were US $64,919,786 with a level I mean cost of US $5,533,876 and a level II mean cost of US $3,171,653. The largest surgical specialty cost was for trauma surgery at US $18,821,337. This was followed by orthopedics at US $13,782,424 and neurosurgery at US $6,506,891. Almost all trauma centers reported significant costs in each of these categories. For nonsurgical required medical specialists, internal medicine was the highest reported cost at US $6,034,570.

The in-house OR availability total costs for all levels I and II trauma centers were US $7,502,486 with a level I mean cost of US $830,148 (range of US $3,000–3,679,000 with six reporting cost) and a level II mean cost of US $252,160 (range of US $175,000–640,000 with 7 reporting cost).

Table 3 shows levels I and II trauma center's total and mean cost, number of trauma centers reporting costs, and the range in each category for education and outreach. The total costs for all levels I and II trauma centers were US $1,781,219 with a level I mean cost of US $115,132 and a level II mean cost of US $109,043. The largest education and outreach costs were hospital staff education in the emergency department followed by injury prevention and community outreach. Interestingly, there were more costs reported on trauma-related hospital staff education in the emergency department than for injury prevention and community outreach combined.

Table 4 shows levels I and II trauma center's total readiness costs and their mean. The total costs for all Georgia's levels I and II trauma centers was US $109,722,061 with a level I mean cost of US $10,078,506 and a level II mean cost of US $4,925,103. For each of the 24,488 patients admitted to Georgia's levels I and II trauma centers in 2016, the total readiness cost amounted to US $4,480.

DISCUSSION

This study defines the cost associated with each component or regulation of readiness as defined in the latest edition of the American College of Surgeons' *Resources for Optimal Care of the Injured Patient*. Through this stringent process, the current

TABLE 2. Clinical Medical Staff

Clinical Medical Staff	LI TC Mean, US $	No.	Range (US $000s)	LII TC Mean, US $	No.	Range (US $000s)	Totals, US $
Trauma/surgical subspecialists:							
Trauma surgery	1,388,013	5	193–2,904	1,049,326	9	91–3,563	18,821,337
Trauma physician extender	187,141	2	179–944	94,361	4	76–503	2,066,461
Orthopedics	1,099,369	6	107–2,149	718,621	9	107–1,997	13,782,424
Neurosurgery	539,953	6	72–1,656	326,717	9	102–845	6,506,891
Anesthesia	296,122	5	6–686	121,764	5	6–566	2,994,375
Hand	122,249	3	3–548	52,269	4	3–329	1,256,182
Microvascular	—	0	0	—	0	0	—
Cardiothoracic	221,693	5	0–524	30,306	4	0–264	1,633,217
OB/GYN	36,701	4	5–187	17,710	2	2–176	397,309
Ophthalmology	227,024	6	5–477	16,672	5	5–137	1,528,861
Oral/maxillofacial	50,166	3	35–193	87,011	4	0–450	1,171,102
ENT	87,121	5	2–267	38,940	7	2–152	912,129
Plastics	237,612	5	4–548	40,059	4	4–365	1,826,257
Critical care medicine	5,891	1	35–35	165,893	7	17–666	1,694,277
Radiology	108,086	1	649–649	72,053	4	26–423	1,369,042
Urology	46,547	4	1–183	22,066	6	1–100	499,945
Vascular	164,066	4	160–381	16,374	3	0–91	1,148,136
Medical specialists:							
Internal medicine	555,683	4	30–3,040	270,047	4	138–2,238	6,034,570
Gastroenterology	4,033	3	0–20	8,396	3	0–82	108,157
Infectious disease	4,208	2	2–23	—	0	0	25,248
Pulmonary medicine	40,129	2	0–240	12,348	4	0–94	364,257
Nephrology	1,947	2	4–8	10,718	3	3–100	118,864
Surgical resident support	110,124	5	49–236	—	0	0	660,745
Total clinical medical staff	$5,533,876			$3,171,653			$64,919,786

ENT, ears, nose, and throat; OB/GYN, obstetrics and gynecology; LI TC, level I trauma center; LII TC, level II trauma center.

TABLE 3. Education and Outreach Costs

Education and Outreach	LI TC Mean, US $	No.	Range (US $000s)	LII TC Mean, US $	No.	Range (US $000s)	Totals, US $
Injury prevention	31,338.17	4	5–126	15,223	8	0–126	340,262
Community outreach	20,903	4	2–104	5,965	6	0–42	185,063
Professional education	13,715	4	2–60	8,911	7	2–63	171,404
Outlying hospital education	4,250	3	3–13	—	0	0	25,500
Required physician CME (16 h/y)							
Trauma medical director	4,157	6	2–6	2,996	10	0–8	54,897
Trauma program manager	3,886	6	0–12	1,051	6	0–3	33,825
Trauma program coordinator	1,527	3	0–8	646	4	0–3	15,627
Trauma registrar	2,063	2	0–12	839	4	0–5	20,765
ED liaison	1,762	5	0–5	201	2	0–2	12,579
ICU liaison	1,708	3	3–5	50	1	0–0	10,750
Neurosurgical liaison	1,833	4	1–5	514	3	0–4	16,140
Orthopedic liaison	1,870	4	1–5	825	2	4–5	19,471
Trauma-related hospital staff education:							
Emergency department	20,412	4	8–57	45,834	9	7–201	580,804
ICU	5,708	2	10–24	14,002	9	0–76	174,265
Surgery/PACU		0	0	11,987	5	0–95	119,867
Total education and outreach	115,132			109,043			1,781,219

CME, continuing medical education; ED, emergency department; LI TC, level I trauma center; LII TC, level II trauma center; PACU, post anesthesia care unit.

average readiness cost for a Georgia level I and level II trauma center is US $10,078,506 and US $4,925,103, respectively.

The validation process was an important addition to the survey because it provided oversight for reporting and resulted in 32% of the total reported original cost of levels I and II trauma centers to be tested. Overall, of the total dollars requested to test for all levels I and II trauma centers, 63% were noted to have appropriate documentation and were tested without exception. For those centers with exceptions, the third-party firm in collaboration with the trauma centers adjusted the cost categories accordingly for any differences. The difference between the original reported cost and the final survey results was relatively small at US $2,350,694 or −2%. We believe that this shows the positive impact of our efforts to work with all trauma centers to develop consensus on the definitions for defining costs and continuously providing education on the survey process.

The current survey (2016 data) represents an average readiness cost increase of 32% for a level I trauma center and a 53% increase for a level II trauma center from 2011, as the previous survey revealed that the average readiness cost for a level I trauma center was US $6,821,064 and US $2,333,113 for a level II center. It is reasonable to expect readiness costs to increase over time consistent with other health care costs because health care spending in the United States increased substantially from 1995 to 2015 and comprised 17.8% of the economy in 2015.[10] We also believe that part of the increase is associated with a more precise survey tool and accurate reporting of cost data.

It is interesting to note that the average cost of a level I center is almost double the cost of a level II center. This is striking because the only difference between the two according to the *Resources for Optimal Care of the Injured Patient* should be education and research.[9] The difference is not explained by costs in the education and outreach category, as the average for a level I is US $115,132 and US $109,043 for a level II. The most significant difference appears to be in the categories of clinical medical staff and administrative/program support staff. Although both level I and level II centers must provide the same surgical specialties, the cost to provide these specialties is much greater in the level I centers, as the average cost is US $5,533,876 versus US $3,171,653 for the level II centers. Likewise, in administrative/program support staff, the average cost for a level I and level II trauma center is US $3,599,350 and US $1,392,247, respectively. The most significant driver of this difference is the combination of physical therapy, occupational therapy, and speech therapy, as these costs are almost triple for a level I trauma center compared with a level II center (Table 1). One explanation may be that the

TABLE 4. 2016 Trauma Center Readiness Cost

Cost Category	Level I Total, US $	Level I Mean, US $	Level II Total, US $	Level II Mean, US $	Levels I and II Totals, US $
Administrative/program support staff	21,596,099	3,599,350	13,922,471	1,392,247	35,518,570
Clinical medical staff	33,203,255	5,533,876	31,716,531	3,171,653	64,919,786
In-house OR availability	4,980,890	830,148	2,521,596	252,160	7,502,486
Education and outreach	690,793	115,132	1,090,426	109,043	1,781,219
Totals	60,471,037	10,078,506	49,251,024	4,925,103	109,722,061

increased costs are associated with trauma volume, as the level I centers see more trauma patients on an annual basis.

The most significant costs for readiness for both levels I and II trauma centers were noted in the category of clinical medical staff. This category covers all costs associated with maintaining support for each surgical specialty. Of the US $10,078,506 average costs for a level I trauma center, medical staff costs consisted of US $5,533,876 or 55%. Of the US $4,925,103 average costs for a level II trauma center, medical staff costs consisted of US $3,171,653 or 64%. This is consistent with our previous 2008 and 2011 surveys, which also showed that clinical medical staff yielded the most significant readiness costs for the trauma center.[6] This is understandable because there are a large number of surgical specialties that are required to be immediately available 24/7. In addition, almost all the level I and level II trauma centers report costs for on-call stipends for trauma surgery, orthopedic surgery, and neurosurgery with over half reporting on-call costs for other supportive surgical subspecialties (Table 2). In addition to the surgical specialties, trauma centers are required to have several medical specialties readily available and many centers are now reporting on-call costs to maintain this level of support. In 2004, Taheri et al[7] noted similar findings for levels I and II trauma centers in Florida, as the median cost of readiness for each trauma center, levels I and II combined, was approximately US $2.7 million annually with the majority of cost, US $2.1 million, being ascribed to physician compensation for on-call coverage.[7]

Administrative and program support staff costs were the second largest costs for trauma centers. Of the US $10,078,506 average costs for a level I trauma center, the administrative and program support staff costs consisted of US $3,599,350 or 36%. Of the US $4,925,103 average costs for a level II trauma center, the administrative and program support staff costs consisted of US $1,392,247 or 28%. The trauma program managers accounted for the largest personnel costs in the administrative category followed closely by trauma coordinators. In the category of program support staff, physical therapy accounted for the largest personnel costs followed closely by case management, occupational therapy, and speech therapy. The next largest program support costs were trauma registrars (both employed and contract). Approximately half of the level I trauma centers and one third of the level II trauma centers reported costs for supporting the trauma liaisons. Of note is the low cost reported for providing an SBIRT related to alcohol abuse. The average cost for level I centers is US $4,650 and level II centers US $930. This may represent under reporting, or possibly, centers are still developing their process for meeting this requirement. Regardless, this deserves further study.

The lowest cost reported was in the category of education and outreach. Of the US $10,078,506 average costs for a level I trauma center, the education and outreach costs consisted of only US $115,132 or 1%. Of the US $4,925,103 average cost for a level II trauma center, the education and outreach costs consisted of only US $109,043 or 2%. Injury prevention was the most significant outreach cost for both levels I and II centers but averaged only US $31,338 for level I centers and US $15,223 for level II centers. In fact, for the entire state, only US $340,262 was reported as cost by all levels I and II centers combined. This is not surprising because this is an unfunded mandate for the trauma centers and funds to support this process must come from cost shifting or sometimes philanthropy. This is an important area that must be supported by external funding sources.

Now that we have solid data that establishes the annual readiness cost for a levels I and II trauma center, the question of "What is the appropriate trauma activation fee?" can be addressed. The revenue code 068x was implemented in January 1, 2004, by the Department of Health and Human Resources and the Centers for Medicare and Medicaid Services to allow trauma centers to bill for a trauma response.[11,12] Until now, there have been little data to align these fees with the appropriate cost of readiness, resulting in wide variation in the application from hospital to hospital. Dividing the total readiness cost of all levels I and II trauma centers by the number of levels I and II trauma patients in our state resulted in an average readiness cost for each patient of US $4,480. This appears to be a reasonable and simple starting point for aligning readiness cost with activation fees. Mabry et al[13] used a different methodology to evaluate total patient care cost for trauma centers in the Arkansas Trauma System using the Medicare Cost Report and survey data from each center. In their subgroup analysis looking at readiness costs, they noted that the decision to become a level I or II trauma center added US $1,500 of additional costs per patient. We did not evaluate uncompensated care in this study because we specifically wanted to focus on direct costs associated with meeting the requirements in the *Resources for Optimal Care* manual. However, one could make the argument that uncompensated care expenses should be incorporated into the readiness cost equation because these costs must be covered by the trauma center. This area deserves further study and discussion.

One limitation of the study is that the standardization of definitions on readiness costs in the survey tool was the consensus of Georgia stakeholders. These definitions are not absolute or concrete and reflect our best effort to develop a template for reporting cost. Other states, however, can easily apply these definitions to their state survey because they are specific to the cost categories required in the *Resources for Optimal Care of the Injured Patient* and not state specific.

If desired, states may make changes to the definitions that reflect the consensus of their stakeholders. Another potential limitation is that all cost data did not undergo third party testing for accuracy. A sample of cost components was chosen from the survey for each center for testing. It is possible that choosing different components may have resulted in different results. However, appropriate financial guidelines for sampling were followed.

CONCLUSIONS

This study defines the cost associated with each component or regulation of readiness as defined in the American College of Surgeons' *Resources for Optimal Care of the Injured Patient*. The Georgia Trauma Commission working with clinical and financial stakeholders from all the state's levels I and II trauma centers has standardized the definitions for trauma center readiness cost reporting and has added a financial validation process to assess accuracy of data reported in the survey tool. Through this stringent evaluation, the average readiness cost for a level I trauma center is US $10,078,506 and the cost for a level II center is US $4,925,103. The significant cost of trauma center readiness highlights the need for additional trauma center

funding to meet the requirements set forth by the American College of Surgeons.

AUTHORSHIP

D.W.A., T.J.J., R.S.M., E.V.A., G.S., and D.A. participated in the study design, data collection, analysis and interpretation of data, drafting of the article, and critical revision. D.W.A., R.S.M., E.V.A., and T.J.J. participated in the analysis and interpretation of data and critical revision. G.S., D.A., C.H.F., R.F.M., and C.J.D. participated in the critical revision.

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DISCUSSION

JOHN J. FILDES, M.D. (Las Vegas, Nevada): Good morning. I'd like to first thank the AAST and the Program Committee for inviting me to discuss this paper, and for the authors for providing me the manuscript well in advance.

The authors describe the third statewide analysis of cost preparedness for Level 1 and Level 2 trauma centers in Georgia. The methods were defined and refined, and a survey tool was built to include standardized definitions, web-based instructional training, and validation by external parties. The resulting cost data is sound, but it only tells part of the story.

I have three questions:

1. The first is that you state that the increased cost of preparedness was primarily due to updated requirements set forth in the Orange Book, yet, in the transition from the Green to the Orange Book, the number of significant changes around staff, structure and process were actually small. The nuance is that they were refinements.

You did not discuss the contribution of increased cost of living, increased negotiated salaries and union contracts, market forces driving competitive salaries, compensation models, new technology. And you did not discuss the rising cost of healthcare as a more global issue that could be responsible for these changes. What other factors did you consider, or was it just the American College of Surgeons Optimal Resource document?

2. You state that the difference between Level 1 and Level 2 trauma centers are research, education and outreach, but you did not discuss the costs associated with residency training and the increased requirements for faculty and supervision and programmatic improvement.

How did you reconcile the increase but the necessity, the necessary costs being associated with GME at the Level 1 centers?

3. In your discussion of activation fees, which was present in the manuscript but not as much in the podium presentation, you based an assumption entirely on the cost of preparedness by calculating a per patient cost for Level 1 or Level 2 preparedness when, in fact, activation fees are based upon the total

operating expenses minus the total compensation to facility and provider divided by the number of patients treated.

Uncompensated and under-compensated care are important drivers in this calculation. Do you plan to modify those recommendations for activation fees? Or do you plan to expand that conversation?

You and your work group at the Georgia Research Institute for Trauma are to be congratulated, both for your longitudinal commitment to this important issue and the high quality of this work. Thank you very much.

SAMIR M. FAKHRY, M.D. (Mclean, Virginia): Dennis, congratulations on this outstanding work. Your commitment to getting some of these answers has been lengthy and is very valuable, and your whole group is to be commended.

I would like to ask you an important question that we have faced which is how do you translate the total cost to the institution, however we end up calculating it, into how much we should charge each patient?

In other words, how do we quantitate the per-patient cost, taking into consideration all the different variables.

If you figure $10 million for a Level 1 trauma center annually, if they see 2,000 patients, that's $5,000 a patient; if they see 1,000 patients, that's $10,000 a patient.

So, the question that the payers are asking us, and that they know is a difficult question to answer, is how do you translate that into the payment that they're providing, which is based on patient volume?

In our initial work on this at the TCAA, we found a huge range in charges that varied tremendously between what some hospitals charged and what others charged. So I don't know if you have any thoughts on how do we quantitate that on a per-patient basis in a way that's fair and transparent. Thank you.

SHELDON H. TEPERMAN, M.D. (Bronx, New York): So, in my own state of New York, we just wholesale adopted the Orange Book. Our President (AAST) was front and center when we did that.

And a back-of-the-napkin calculation from your data would suggest that it's costing New York State to get Orange $300 million, yet, we're a DRG state, so we can't do activation fees, and we don't have a pick-up on our driver's licenses to pump up the trauma system, so how would you suggest that a state like New York pays this $300 million back to its trauma centers?

ROBERT D. WINFIELD, M.D. (Kansas City, Kansas): One of the requirements of being a Level 1 trauma center, in terms of verification, is a research requirement. I'm curious if you have any information about the costs associated with meeting that research requirement for a Level 1.

OMAR K. DANNER, M.D. (Atlanta, Georgia): Good job, Dennis, on a well-done presentation. My question is, in addition to research, critical care management in the ICU is an important aspect of running a level 1 or level 2 trauma center.

As it has been estimated that it costs on the magnitude of about $2 million to have a dedicated surgical critical care service, were these costs factored in to the estimation of the cost associated with trauma center readiness in your analysis? Or is this consequently an under-estimation of overall cost considering these other factors? Thank you.

DENNIS W. ASHLEY, M.D. (Macon, Georgia): Thank you, Dr. Fildes and all the discussants, for your comments. I think Dr. Fildes made a very profound statement when he said this only tells part of the story.

No doubt these numbers will be quoted frequently, and they only define the cost of readiness associated with meeting the requirements in the Orange Book. There are many other variables in the market place that Dr. Fildes describes that could increase the cost of readiness. Our focus was strictly linking cost of readiness to each requirement in the Orange Book. This was important to the Trauma Commission because we are responsible for distribution of taxpayer funds fairly to all trauma centers. We had to define and provide some standardization to this entity called Readiness Costs.

There is not a lot in the literature about readiness costs, so how do we define it? The trauma medical directors, trauma program managers, and chief financial officers from each trauma center met and reviewed all regulations in the Orange Book. We developed a consensus on how to define costs for each regulation. This was the Georgia consensus and it standardized reporting across the state. This is not absolute as other states may define these costs differently. However, other states could easily use our methodology to define costs. That was the genesis of this study.

With that being said, the external forces that Dr. Fildes pointed out so eloquently were not captured. We wanted to capture just the forces that were mandated in the resource manual. We recognize that these external forces in U.S. healthcare have the potential to increase the cost of readiness. One example would be the variation in salaries throughout the state over time.

Defining the cost of readiness for resident training can be a complicated issue as residents at each level usually have different salaries. This is further complicated by the mix of residents and number of residents on the trauma service as each trauma team may be staffed differently. Therefore, we asked each trauma center to give us the salaries and benefits for the residents dedicated to the trauma service minus reimbursement by the Federal government. We came up with a global number, which is approximately $110,000 per center for the Level I's.

We did not go into any further detail about graduate medical education. Obviously with the increased requirements of graduate medical education, more observation time by attendings, and so on, these costs may continue to increase. In future surveys, it would be interesting to see what these drivers are.

Dr. Fildes and Dr. Fakhry asked about activation fees. Since activation fees have great variability across the country and are based on little data, it has been difficult to discuss this issue. At least now we have an average readiness cost for each trauma center based on regulations in the Orange Book. An activation fee for each patient could be calculated by dividing the readiness cost for each center by the number of trauma patients seen at each center. This would be one way to standardize activation fees.

Should uncompensated care be added? Probably so. This could be considered a readiness cost that is not reimbursed and must be covered if trauma centers are going to remain ready to go 24/7. This will hopefully lead to further discussions in the future. I would ask the AAST, as well as other trauma

organizations, to weigh in on this issue. If we don't, external forces will decide how that equation is developed.

Dr. Danner asked about critical care. We did incorporate critical care costs. If there was "trauma specific" critical care, we allowed centers to include that as a cost.

Dr. Winfield asked about research. We do not have data on the research component but think this would be an excellent addition to the next survey.

Dr. Teperman asked about reimbursement in New York. I would suggest you use this data to work with your insurance companies and develop carve outs for trauma care. You can also work with your legislature to show them a sustainable source of trauma funding is needed for the trauma system.

Again, I'd like to thank the AAST for the privilege of the podium. Thank you.