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EAST multicenter trial of simulation-based team training for pediatric trauma: Resuscitation task completion is highly variable during simulated traumatic brain injury resuscitation

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Abstract

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.amjsurg.2019.07.037.

Background: Best practices for benchmarking the efficacy of simulation-based training programs are not well defined. This study sought to assess feasibility of standardized data collection with multicenter implementation of simulation-based training, and to characterize variability in pediatric trauma resuscitation task completion associated with program characteristics.

Methods: A prospective multicenter observational cohort of resuscitation teams (N = 30) was used to measure task completion and teamwork during simulated resuscitation of a child with traumatic brain injury. A survey was used to measure center-specific trauma volume and simulation-based training program characteristics among participating centers.

Results: No task was consistently performed across all centers. Teamwork skills were associated with faster time to computed tomography notification ($r = -0.51$, $p < 0.01$). Notification of the operating room by the resuscitation team occurred more frequently in *in situ* simulation than in laboratory-based simulation (13/22 versus 0/8, $p < 0.01$).

Conclusions: Multicenter implementation of a standardized pediatric trauma resuscitation simulation scenario is feasible. Standardized data collection showed wide variability in simulated resuscitation task completion.

Introduction

Injury is the leading cause of mortality in children.[1] Most pediatric trauma-related deaths occur early after injury, with 74% of fatalities occurring within the first 24 h after injury.[2] Hospital care within 60 min for trauma patients in shock has been associated with improved outcomes, emphasizing the importance of high-quality early trauma care.[3] Strategies focused on improving the initial resuscitation and timely treatment of critically injured patients have the greatest potential to decrease mortality.[4] Critically injured children are often resuscitated at designated trauma centers[5–7] which use multidisciplinary teams for resuscitation during highest-level trauma activations. Multidisciplinary team-based resuscitation requires leadership, coordination, and teamwork, with poorly functioning teams posing a barrier to optimal resuscitation.[8,9] Breakdowns in communication during team-based resuscitation can lead to medical errors,[10,11] which commonly occur during the initial trauma resuscitation.[10,12] National training curricula such as the American College of Surgeons (ACS) Advanced Trauma Life Support (ATLS) course and the Emergency Nurses Association (ENA) Trauma Nursing Core Course (TNCC) have historically focused on individual provider training and have not included components that address multidisciplinary team-based trauma resuscitation.[13,14]

The use of simulation-based training is one strategy for improving the performance of trauma resuscitation teams, but the widespread implementation of this methodology is limited by a lack of evidence supporting its use.[15] One of the primary limitations of the existing evidence is a lack of standardized reporting of outcome measures that can be used to compare training methodologies across studies.[16,17] Several single-center studies examining simulation-based team training for trauma resuscitation have used variable training methods with a wide range of reported outcomes. Variability in training factors included training context (in a simulation laboratory versus *in situ* simulation at the

clinical point of care), type of providers trained (individual disciplines such as surgical residents or nurse practitioners, compared to multidisciplinary training), and frequency and duration of training.[18–27] In addition to variability in training methods, these studies reported differing outcome measurements, including provider confidence, teamwork skills during actual trauma resuscitation, checklist assessment, and time to resuscitation task completion. The heterogeneity of training methods and outcome measures used in these prior studies limits comparisons and the generalizability of their findings. Establishing feasibility of standardized reporting of outcomes across multiple centers is the first step towards addressing this gap in the literature.

The purpose of this pilot study was to test the feasibility of multicenter implementation of a standardized patient scenario with uniform data collection. The secondary aims of this study were to a) determine variability in pediatric traumatic brain injury (TBI) resuscitation practices among a cohort of US trauma centers, b) evaluate factors associated with improved team performance and resuscitation quality, and c) understand organizational and program characteristics associated with feasible implementation. We hypothesized that implementation would be feasible within centers having favorable perceptions of simulation as an intervention, a tendency to adopt new interventions, and few perceived barriers to intervention. Our secondary analyses explored associations between a) measures of teamwork skills and measures of resuscitation quality, b) center-level clinical and training program characteristics with measures of resuscitation quality and teamwork skills, c) simulation training context (*in situ* or in laboratory) with measures of resuscitation quality and teamwork skills, and d) annual number of conducted simulation-based training sessions with organizational climate, perceptions, and barriers.

Methods

Study Design and participants

This multicenter study combined a cross-sectional center survey and a prospective observational cohort of resuscitation teams nested within pediatric trauma centers with existing simulation-based training programs. Institutional review board approval was obtained at the central data coordinating site and at each participating site. Participating centers were recruited via the Eastern Association for the Surgery of Trauma (EAST) Multicenter Trials website and through the International Network for Simulation-based Pediatric Innovation, Research, and Education (INSPIRE) listserv. Centers that had an existing simulation-based training program into which the standardized traumatic brain injury (TBI) simulation could be integrated were eligible to participate. Data collection occurred during a three-month time period between April and June 2017. The primary outcome of feasibility was assessed by percent of completed scenarios for each center and by percent of complete recording of standardized data. Secondary outcomes were assessed with prospectively collected resuscitation process task completion frequency, resuscitation process completion times, and standardized assessment of teamwork skills.

Trauma center characteristics survey

An online survey was distributed to trauma simulation co-ordinators using Research Electronic Data Capture (REDCap) software[28]. The survey addressed center characteristics, perceptions of barriers to implementation and perceptions of implementation factors. Center characteristics included annual trauma resuscitation volume, annual resuscitation volume of severe TBI requiring emergent craniotomy, presence of an institutional standardized TBI resuscitation protocol, and annual number of simulation-based training sessions for both medical and trauma resuscitations. Specific characteristics related to simulation centers and trauma simulation leadership were also queried. Barriers to implementation were assessed by asking centers to rank barriers from 1 — 'greatest barrier' to 10 — 'insignificant barrier'. Queried barriers included funding; staff/faculty time; technical expertise; debriefing expertise; supporting evidence; clinical demands of patient throughput, ED safety; lack of buy-in from emergency physicians, surgeons, or nurses; and lack of leadership. The Perceived Characteristics of Intervention Scale (PCIS) was used to determine provider perceptions of simulation-based training. The Implementation Climate Scale (ICS) was used to determine perceptions of hospital support of evidence-based practices. The PCIS is a 20-item tool that assesses healthcare provider perceptions of proposed interventions to predict likelihood of their adoption.[29] The ICS is an 18-item validated measure that quantifies ratings of perceived prioritization and valuation of evidence-based practices.[30] All responses to the PCIS and ICS were on a scale of 1-strongly disagree to 7-strongly agree.

Simulation-based training scenario and implementation

A standardized simulated TBI scenario was developed and piloted for feasibility across five sites by the study team for training and to pilot data collection. The standardized module was formatted to the Association of American Medical Colleges MedEdPORTAL template for simulation curricula.[31] Items included in the standardized module were: goals and objectives, facilitator guidelines including a pre-briefing script, common errors and prevention strategies, simulated scenario script and progression with simulator code files, equipment setup instructions, associated assessments including the trauma nontechnical skills (T-NOTECHS) instrument, and supplemental materials including laboratory data (VBG with hematocrit), digital images of portable x-rays (pre- and post-intubation chest x-ray, cervical spine x-ray, pelvic x-ray), digital video loops of the focused assessment with sonography in trauma (FAST) exam (four standard views), and scripted responses to phone calls outside of the room (neurosurgery, otolaryngology or difficult airway team, operating room, blood bank, and lab). The scenario was designed *a priori* to progress rapidly to oxygen desaturation and the occurrence of a Cushing response with bradycardic arrest within 10 min of patient arrival if the team did not secure an airway and administer volume resuscitation and neuroprotective interventions. The scenario ended when the team verbalized the decision to move to computed tomography (CT) of the head. The scenario was incorporated into existing simulation-based training programs. The same scenario was implemented three times at each of ten participating centers over a three-month period, resulting in a total of 30 scenarios. Center leads were asked to conduct the scenario using their usual training context (e.g., *in situ* or in the simulation lab), scheduling methods (announced or unannounced) and participants (single discipline or multidisciplinary).

Secondary outcome variables: resuscitation task completion and assessment of teamwork skills

Data related to each scenario were collected in real-time by designated observers and included characteristics related to implementation and the times to resuscitation task completion. Implementation characteristics included training location (simulation lab or *in situ* training), scheduling methodology (announced, partially announced to some providers, or fully announced to all providers), disciplines present at the simulation, scenario start time, pre-briefing time, 'patient arrival' time and whether a scenario was aborted. Resuscitation tasks were assessed for whether they were performed and the time to completion when performed. Tasks that were assessed included request for rapid sequence intubation (RSI) medications, administration of RSI medications, inclusion of lidocaine with RSI, placement of an endotracheal tube, completion of primary survey, administration of hypertonic saline (3% NaCl), administration of mannitol, placement of the bed in a reverse Trendelenburg position, operating room (OR) notification, CT notification, neurosurgery consult request and decision to move to CT.

Teamwork skills were assessed with the T-NOTECHS instrument, a validated measure of trauma teamwork[23] using video review of the simulations. Each center identified three raters to review the videos. Before proceeding with T-NOTECHS assessment, raters reviewed a 15-min training video that showed the use of the T-NOTECHS instrument with objective anchors and examples of objective scores. Completed T-NOTECHS assessments were collected from all raters for each scenario at each site.

Statistical Analysis

Center characteristics were collected once from each of the ten sites. Standardized simulation scenario data was collected three independent times from each of the ten sites for a total of 30 events. Each TBI simulation was scored by three raters using the T-NOTECHS assessment. The five items in the T-NOTECHS score were summed to produce a total T-NOTECHS score for each rater and then were averaged to produce an average T-NOTECHS score for each event. Inter-rater reliability was assessed for the total T-NOTECHS score using the intra-class correlation obtained from a mixed model that accounted for the nesting of raters and simulations within sites.

The median and interquartile ranges were reported for continuous variables as measures of central tendency and variation to avoid outliers due to the small sample size. Frequency counts and the percentages were reported for categorical data. Time to resuscitation task completion was calculated by subtracting the arrival time from the time the specified task was completed. If any task was completed before the time of arrival (i.e., request for RSI drugs and OR notification of severe TBI), the time to completion was reported as zero.

We used bivariate analyses to determine the association between resuscitation task completion and teamwork skills/team performance metrics, and the association between simulation use and various implementation scales. Spearman's correlations were performed to assess associations between two continuous variables. The Wilcoxon-Mann-Whitney test was used to determine association between continuous outcomes and dichotomous

exposures. Logistic regression was used to determine association between a dichotomous outcome and continuous exposure. The Chi-square test was used to determine association between categorical variables. Fisher's exact test was performed if expected counts were less than five. Individual center data was combined in the analysis. Associations were considered significant for a 0.05. Statistical analyses were performed using SAS software v. 9.4 (SAS Institute Inc.).

Results

Clinical, training, and organizational characteristics of participating centers

Annual trauma activation volume and annual number of acute severe TBI resuscitations were variable across participating (Table 1). Half of the centers had a standardized TBI resuscitation protocol. Annual self-reported simulation frequency ranged from once every two months to twice-per-month, with three centers using primarily laboratory-based (sim-lab) simulation training and seven centers using primarily *in situ* simulation. Simulation centers were most commonly (50%) directed by emergency medicine physicians. Trauma simulation programs were most commonly (90%) directed by an emergency medicine physician or a surgeon. Simulation programs were primarily hospital administered (90%) and funded (80%).

Self-reported PCIS ratings demonstrated favorable perceptions of simulation as an intervention across all domains for all participating centers, with no correlation between PCIS ratings and annual number of simulations completed within centers (Supplemental Table 1). Implementation Climate Scale ratings were also strongly favorable for all domains except 'Reward for Evidence Based Practice' and 'Selection for Evidence Based Practice' sub-scales, and similarly did not correlate with number of annual simulation-based training sessions conducted (Supplemental Table 2). Most queried barriers were perceived as mild to moderate, with the greatest perceived barriers to implementation being 1) clinical demands, high patient volume, and impact on patient flow, and 2) lack of funding for staff and faculty time to run the simulations. Lack of buy-in from surgeons was the only barrier that correlated with a lower number of simulations conducted (Supplemental Table 3).

Feasibility of implementation and sources of variability

The standardized scenario was completed three times at each of ten trauma centers within the specified data collection period (three months). Complete standardized data collection was achieved, including resuscitation process task completion, resuscitation process times (when completed), and video-based T-NOTECHS assessment. Variability in implementation of the scenario was captured, with seven of ten trauma centers using *in situ* simulation only and 73% were pre-announced to at least some of the participating providers (Supplemental Table 4). All scenarios included multidisciplinary and large (median 14 members) teams, but the composition of teams was not consistent across scenarios at each center. Emergency medicine physicians, surgeons, emergency room nurses, respiratory therapists, emergency room technicians, pharmacists and radiology technicians were the most common participants and present for at least 50% of the scenarios.

Assessment of resuscitation task completion and teamwork skills

None of the twelve pre-defined resuscitation tasks were consistently completed (3/3 scenarios) across all ten participating sites (Fig. 1). Endotracheal intubation was performed in 29/30 scenarios, but administration of RSI medications was only consistently performed in two out of ten centers. Resuscitation task completion times showed variability between scenarios, but mostly proceeded in the expected order (Table 2). Teamwork skills measured by pooled three-rater T-NOTECHS assessment showed mediocre to above-average overall teamwork skills (median total T-NOTECHS Score 18.5, IQR: 15, 20.7). Inter-rater reliability for the T-NOTECHS assessment was high (ICC = 0.77).

Secondary analyses: associations between center characteristics, measures of teamwork skills, and measures of resuscitation quality

Higher T-NOTECHS scores were strongly associated with faster time to CT notification, but were not associated with any other resuscitation task (Table 3). Higher T-NOTECHS scores were also not associated with annual trauma resuscitation volume, annual acute severe TBI resuscitation, annual number of simulations, or team size (Table 4). Higher annual volume of highest-level trauma resuscitations was associated with longer time to completion of the primary survey (Table 4). A larger team size was associated with shorter time to intubation, increased odds of OR notification, and decreased odds of using hypertonicsaline. Annual number of severe TBI resuscitations was not associated with the time to completion of any task, but centers with more annual severe TBI resuscitations were more likely to place the patient in reverse Trendelenburg position. No significant difference was observed in team skills or resuscitation task completion times between laboratory-based and *in situ* simulation (Table 5). Administration of hypertonic saline occurred more frequently in the laboratory setting while OR notification was only completed in the *in situ* setting. Centers with TBI resuscitation protocols were associated with higher T-NOTECHS scores (median 20 vs 15, $p = 0.02$), but the presence of a TBI resuscitation protocol was not associated with either a difference in resuscitation process times or frequency of resuscitation task completion (Supplemental Table 5).

Discussion

This prospective multicenter pilot study of team-based simulation for pediatric TBI resuscitation showed the feasibility of multicenter standardized data collection within a sample of centers with positive perceptions of simulation-based training, favorable implementation climates, and relatively modest perceived local barriers to implementation. We have shown considerable variability in training practices and resuscitation task completion. Teamwork skills did not always correlate with faster or higher frequency of task completion. *In situ* simulation was not associated with better task performance metrics. These data suggest that the resuscitation of a pediatric TBI patient differs depending on the center providing the care, or even within an individual center, depending on the team members involved. These limits in correlation may reflect limitations in this small pilot study. Additional study is needed to infer how behavior in simulation relates to behavior in actual practice and translates to clinical outcomes.

The most notable finding in this study was the inconsistency in resuscitation task completion across centers. No single task was performed across all scenarios at each center. Other tasks, such as administration of hypertonic saline, were performed inconsistently, with only two centers performing this task in all three simulations. This inconsistency in task completion may reflect important differences in provider or institutional practices. Variability in task completion across centers may also indicate differences in teamwork skills, which is supported by the association with higher T-NOTECHS scores and faster notification of CT. Standardization of TBI resuscitation may play a role in decreasing variability in resuscitation practices. Simulation training can be useful to test and refine these protocols.

This study had additional unexpected findings. Centers with more annual trauma resuscitations were associated with longer time to completion of primary survey. Neither high-volume simulation nor high-volume severe TBI was associated with faster resuscitation. These findings suggest that more experience with pediatric TBI resuscitation is not always associated with faster resuscitation. Many factors may affect the speed of a pediatric TBI resuscitation. For example, use of a resuscitation checklist has been associated with improvements in the number of tasks completed and the time to task completion.[32,33] We did not, however, find a difference in number of tasks completed or time to task completion in centers using a TBI resuscitation protocol. Further standardization of simulation training and data collection may help define factors which lead to a fast and effective resuscitation.

This study revealed other differences in simulation methodology. Sim-lab teams always administered RSI drugs prior to intubation, while *in situ* teams only gave RSI drugs just over half of the time. Sim-lab teams failed to notify the operating room in every scenario — while the *in situ* teams notified the operating room over half the time. These differences in task completion suggest important differences between sim-lab and *in situ* simulation. Fidelity may be maximized in the *in situ* setting and may be an important factor in explaining these differences. Previous work has shown that providers prefer *in situ* over sim-lab training,[19] but further work is needed to understand if this finding reflects differences in training outcomes or institutional variability. Next steps will focus on the impact of a sustained *in situ* TBI resuscitation program to decrease variability in task completion.

This study has several limitations. The main limitation was a small sample size of simulation programs. Participants in this study were required to have established simulation-based training programs. All centers performed frequent simulation-based training, had favorable PCIS ratings of simulation and favorable implementation climates, and did not report significant barriers to the usage of simulation training. This sample of pediatric trauma centers likely represents ‘early adopters’ and may not be representative of a broad range of approaches to simulation-based training. Due to the small sample size and limited power, a second limitation was that many comparisons in this pilot study may be limited by a type II error. A third limitation was that performance metrics within centers may have been confounded by provider and institutional factors. While we queried centers about the presence of a standardized resuscitation protocol, we did not define components of an institution’s protocol and did not measure protocol adherence during simulated resuscitation. A fourth limitation was that we could not determine if providers participated in more than

one simulation or if they had prior simulation training. Centers using *in situ* simulation are more likely to have repeat participants, biasing toward more consistency in the *in situ* scenarios. A final limitation was that the same three T-NOTECHS raters were used in only six out of ten sites. Despite lacking defined raters, we were able to achieve reliable results using the T-NOTECHS instrument that were similar to previous studies.[23,34]

This multicenter pilot study using a simulated resuscitation of a child with a TBI established feasibility of standardized data collection associated with simulation-based training. Our results showed variability in training practices and inconsistent resuscitation task completion. Efforts to address this variability in task completion warrant investigation, such as standardized resuscitation protocols or standardized repetitive simulation-based training specific to TBI resuscitation. Expansion of this work into a national simulation registry with standardized reporting of training methods and outcomes assessment is needed to compare the impact of specific training methodologies on resuscitation processes and clinical outcomes.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

Financial disclosure summary

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Conflicts of interest

None of the authors has received any financial consideration for participation in this study and there are no conflicts of interest to disclose.

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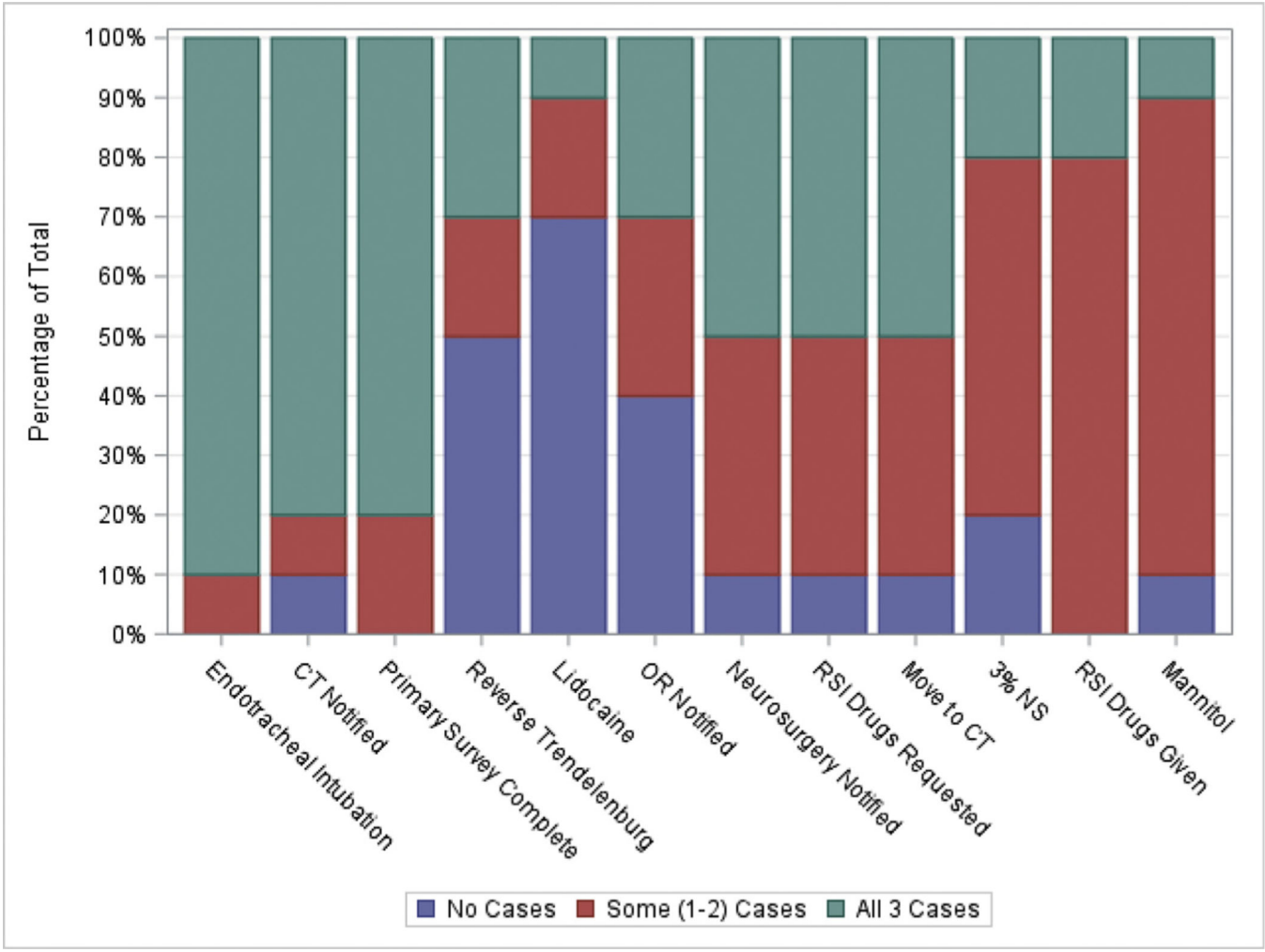

Fig. 1.

Proportion of resuscitation task completion within centers (N = 10) across three standardized TBI simulated resuscitation scenarios.

Table 1

Self-reported characteristics of participating centers with active simulation training programs (N = 10).

Characteristics	**N = 10**
	Median (IQR)
Annual Number of Highest Level Activations, CY 2016	42 (25, 80)
Annual Number of Acute Severe TBI Resuscitations[a], CY 2016	11.5 (6, 15)
	N (%)
Standardized TBI Resuscitation Protocol in Place	5 (50%)
	Median (IQR)
Annual Total Number of Trauma Simulations Conducted, CY 2016	16 (6, 24)
Number of in situ simulations	6 (3, 12)
Number of in laboratory simulations	4 (0, 15)[c]
Annual Total Number of Medical Code Simulations Conducted, CY 2016	195.5 (36, 342)
Number of in situ simulations	47.5 (12, 60)
Number of in laboratory simulations	106 (20, 180)
Number of Full-Time Staff Employed by Simulation Center	5 (3, 6)
	N (%)
Primary Specialty of Medical Director of Simulation Center	
Pediatrics (or Pediatric Medical Subspecialty)	2 (20%)
Surgeon (or Surgical Specialty)	1 (10%)
Emergency Medicine	5 (50%)
Anesthesiology	1 (10%)
No Director	1 (10%)
Primary Specialty of Director of Trauma Simulation Program	
Trauma Surgeon	5 (50%)
Emergency Physician	4 (40%)
Trauma Education Specialist	1 (10%)
Primary Administrator of Simulation Center	
Medical School	1 (10%)
Hospital	9 (90%)

Characteristics	N = 10
	Median (IQR)
Primary Funding Source for Trauma Simulation Program[b]	
Medical School, Yes	2 (20%)
Hospital, Yes	8 (80%)
Departmental, Yes	1 (10%)
Trauma Program, Yes	1 (10%)
Unfunded, Yes	1 (10%)
Philanthropy, Yes	1 (10%)

[a] GCS less than 8 or requiring urgent operative intervention, excluding transfers.

[b] Primary funding sources are not mutually exclusive. N (%) represents the total number of sites and the percentage that were reported to have received funding from the specified sources.

[c] Four out of ten reported 0 lab simulations.

Table 2

Resuscitation task completion frequency and time (minutes).

Resuscitation Task	All (N = 30)	
	N(%)	Time
RSI Drugs Requested	23 (76.7)	2 (0, 5)
RSI Drugs Administered	19 (63.3)	5(2,11)
Endotracheal Intubation (overall)	29 (96.7)	7 (3, 18)
with RSI Drugs	19 (65.5)	8 (5, 18)
without RSI Drugs	10 (34.5)	5 (3, 9)
Primary Survey Complete	26 (86.7)	4(1,12)
Lidocaine Administration	6 (20.0)	4.5 (2, 5)
3% NS Administration	13 (43.3)	9 (5, 17)
Mannitol Administration	16 (53.3)	9 (4, 23)
Patient Placed in Reverse Trendelenburg Position	12 (40.0)	10 (4, 14)
CT Notification	26 (86.7)	8 (1, 16)
Decision to Move to CT	22 (73.3)	12 (9, 17)
OR Notification	13 (43.3)	4 (0, 18)
Neurosurgery Notification	22 (73.3)	7 (1, 18)

Time data expressed as Median (IQR).

Table 3

Association between teamwork skills (T-NOTECHS) and time-to resuscitation task completion (for consistently performed tasks) and likelihood of task completion (for inconsistently performed tasks).

Consistently performed task	N	r	p-value
Time to RSI Drug Request	23	−0.26	0.24
Time to Intubation — With RSI Drugs	19	−0.23	0.34
Time to Intubation — Without RSI Drugs	10	0.14	0.69
Time to Notification of CT	26	−0.51	<0.01
Time to Completion of Primary Survey	26	−0.41	0.06
Inconsistently performed task	**N completed**	**OR**	**95% CI**
3% NS Used	13	1.08	(0.87, 1.33)
Mannitol Used	16	1	(0.81, 1.22)
Reverse Trendelenburg	12	0.98	(0.80, 1.21)
OR Notified	13	0.99	(0.81, 1.22)

Data expressed as Spearman's r for time associations with T-NOTECHS scores, and odds ratio with 95% confidence interval generated with univariate logistic regression for binary (completed/not completed) tasks associated with T-NOTECHS scores.

Table 4

Association of clinical volume, annual simulation use, and team size with assessment of teamwork skills (T-NOTECHS), time-to resuscitation task completion (for consistently performed tasks), and with likelihood of completing resuscitation tasks (for inconsistently performed tasks) as measured in simulated TBI resuscitation.

	Annual number of highest level trauma activations		**Annual number of severe TBI resuscitations**		**Annual number of trauma simulations**		**Team Size**	
	r	**p-value**	**r**	**p-value**	**r**	**p-value**	**r**	**p-value**
Consistently performed task								
Time to Intubation	0.11	0.56	0.26	0.18	0.18	0.34	−0.39	0.04
Time to Notification of CT	−0.11	0.59	0.04	0.99	0.05	0.82	−0.11	0.60
Time to Completion of Primary Survey	0.44	0.02	0.14	0.54	−0.38	0.06	0.09	0.68
Inconsistently performed task	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
3% NS Used	0.99	(0.97, 1.02)	1.13	(1.00, 1.28)	1.05	(1.00, 1.11)	0.76	(0.60, 0.97)
Mannitol Used	1	(0.98, 1.02)	0.92	(0.83, 1.02)	0.96	(0.92, 1.01)	1.17	(0.95, 1.45)
Reverse Trendelenburg	1.02	(0.99, 1.04)	1.43	(1.08, 1.90)	1.04	(1.00, 1.09)	0.86	(0.70, 1.07)
OR Notified	0.99	(0.97, 1.01)	0.91	(0.81, 1.02)	1	(0.96, 1.04)	1.3	(1.02, 1.65)
Average T-NOTECHS	−0.11	0.57	0.07	0.73	0.03	0.88	−0.08	0.66

N = 30 except for time to intubation (N = 29), notification of CT (N = 26), and completion of primary survey (N = 26). Data expressed as Spearman's r for time associations with clinical volume, simulation volume, and team size; and odds ratio with 95% confidence interval generated with univariate logistic regression for binary (completed/not completed) tasks associated with clinical volume, simulation volume, and team size.

Table 5

Comparison across scenario implementation context (*in situ* versus in the simulation lab) of teamwork skills, time to completion for consistently performed resuscitation tasks and frequency of completion for inconsistently performed resuscitation tasks.

	Laboratory simulation N = 8			***In situ* simulation N = 22**			**p-value[a]**
	N	**Median**	**IQR**	**N**	**Median**	**IQR**	
Average T-NOTECHS Score	8	18.5	(15, 20)	22	18.3	(15,21)	0.69
Consistently performed task							
Time to RSI Drug Request	8	2.5	(0[c],4)	15	2.0	(1, 3)	0.92
Time to Intubation — with RSI Drugs	7	8.0	(7, 10)	12	7.0	(6, 8.5)	0.27
Time to Intubation — without RSI Drugs	0	n/a	n/a	10	5.0	(4, 7)	n/a
Time to Notification of CT	8	10.0	(5, 13)	18	8.0	(5, 10)	0.50
Time to Completion of Primary Survey	6	3.0	(2, 10)	20	4.0	(2, 9)	0.95
Inconsistently performed task	**N (%)**			**N (%)**			**p-value[b]**
3% NS Used	7 (87.5%)			6 (27.3%)			<0.01
Mannitol Used	2 (25.0%)			14 (63.4%)			0.10
Reverse Trendelenburg	5 (62.5%)			7 (31.8%)			0.21
OR Notified	0 (0%)			13 (59.1%)			<0.01

Times are expressed in minutes.

[a] Wilcoxon-Mann-Whitney.

[b] Chi-square or Fisher's exact test (for counts less than 5).

[c] 3 out of 8 reported 0 min.