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Research Paper

Impact of lower level trauma center proliferation on patient outcomes

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HIGHLIGHTS

- Unguided lower level trauma center proliferation has a minimal effect on mortality.
- Interfacility transfer rate is higher after lower level trauma center proliferation.
- The post-proliferation period is not a predictor of survival.
- Rapid trauma center proliferation may worsen penetrating trauma mortality.

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ABSTRACT

Background: In attempt to increase trauma system coverage, our state added 21 level 3 (L3TC) and level 4 trauma centers (L4TC) to the existing 7 level 1 trauma centers from 2008 to 2012. This study examined the impact of adding these lower-level trauma centers (LLTC) on patient outcomes.

Methods: Patients in the state trauma registry age ≥ 15 from 2007 to 2012 were queried for demographic, injury, and outcome variables. These were compared between 2007 (PRE) and 2008–2012 (POST) cohorts. Multivariate logistic regression was performed to assess independent predictors of mortality. Subgroup analyses were performed for Injury Severity Score (ISS) ≥15, age ≥ 65, and trauma mechanisms.

Results: 143,919 adults were evaluated. POST had significantly more female, geriatric, and blunt traumas (all $p < 0.001$). ISS was similar. Interfacility transfers increased by 10.2 %. Overall mortality decreased by 0.6 % ($p < 0.001$). Multivariate logistic regression analysis showed that being in POST was not associated with survival (OR: 1.07, CI: 0.96–1.18, $p = 0.227$). Subgroup analyses showed small reductions in mortality, except for geriatric patients. After adjusting for covariates, POST was not associated with survival in any subgroup, and trended toward being a predictor for death in penetrating traumas (OR: 1.23; 1.00–1.53, $p = 0.059$).

Conclusions: Unregulated proliferation of LLTCs was associated with increased interfacility transfers without significant increase in trauma patients treated. LLTC proliferation was not an independent protector against mortality in the overall cohort and may worsen mortality for penetrating trauma patients. Rather than simply increasing the number of LLTCs within a region, perhaps more planned approaches are needed.

Key message: This is, to our knowledge, the first work to study the effect of rapid lower level trauma center proliferation on patient outcomes. The findings of our analysis have implications for strategic planning of future trauma systems.

Introduction

The first half of the war-torn 20th century saw significant advancements in surgical care of the traumatically injured. This led to the realization that such care was needed in a civilian population increasingly suffering from trauma-related morbidity and mortality. The first dedicated trauma center in the United States opened its doors in 1961, with several similar centers opening throughout the 1960's and 1970's. The organizing principle of these centers was to provide multispecialty care in treating complex traumatic injuries [1]. Later efforts

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developed regional trauma systems, which integrated prehospital transportation, injury treatment, rehabilitation, education, scientific study of injury, and injury prevention to reduce the impact of injury on a region's population. These networks incorporated Level I and II trauma centers (L1TC, L2TC, respectively) to treat the most severely injured patients, with Level III and IV centers (Lower-Level Trauma Centers, or LLTCs) to treat the non-severely injured patients, and to expand trauma system access and coverage [2].

In 2007, the Arizona trauma system consisted of seven state-designated L1TCs and no LLTCs [3]. The years between 2008 and 2012 saw the unregulated establishment of 21 LLTCs without adding any L1TCs (Fig. 1). Previous studies show LLTCs increase trauma system access and may improve mortality. For many patients, they may be the only trauma center available [4,5]. Nevertheless, none of the prior studies to our knowledge has analyzed the impact on clinical outcome of such a drastic increase in the number of LLTCs in a short period of time in a system that previous did not have any LLTCs. Therefore, we aimed to determine the impact of LLTC proliferation on trauma system access and patient outcomes by comparing the 2007 cohort (PRE) against the 2008–2012, post-proliferation cohort (POST). Previous works suggests that too many trauma centers within a system can result in deterioration of outcomes secondary to a dilution of resources and experience [6–8]. Hence, we hypothesized that LLTC proliferation may increase trauma system access, but worsen patient outcomes.

Methods

Data were sourced from the publicly available, de-identified portion of the Arizona State Trauma Registry (ASTR), a validated registry, which is prospectively maintained by the Arizona Department of Health Services [9]. All state-designated trauma centers are required to submit data to the registry quarterly. Patients at least 15 years of age in the ASTR from 2007 to 2012 was queried for demographic, injury, and outcome variables. Patients with burn injuries were excluded. Since a publicly available, de-identified database was used for this study, IRB review was not required.

Demographic variables captured for this study were gender, age, injury severity score (ISS), and trauma mechanism (blunt and penetrating). Primary outcome assessed was inpatient mortality. Secondary outcomes assessed were hospital length of stay (LOS), intensive care unit (ICU) LOS, ventilator-dependent days, interfacility transfer rate, and discharge to medical facilities including skilled nursing facilities (SNFs), long term acute care facilities (LTACs), and inpatient rehabilitation facilities (IPRs). Patients discharged to home with home health, jail, or psychiatric facilities were categorized as discharged home.

Demographic and outcome variables were compared between PRE (2007) and POST (2008–2012). This analysis was also performed for the following predetermined subgroups: critically injured patients (ISS $\geq$ 15), geriatric patients (age $\geq$ 65), blunt injuries, and penetrating injuries. To account for maturation period of newly established trauma centers, we also specifically compared 2007 to 2010. 2010 was chosen because only one L4TC was added, which was the least number of LLTC added during the study period, and eight LLTC were added from 2008 to 2009. Finally, trauma system access was assessed by annual trauma volume normalized with state population from the same year [10].

Continuous variables were compared using Student's *t*-tests and Mann-Whitney *U* test. Categorical variables were compared with Chi-squared test. Multivariate logistic regression was performed for the overall cohort and for each predetermined subgroup to assess for independent predictors of mortality after adjusting for gender, age, trauma mechanism, and ISS. A *p*-value <0.05 was deemed statistically significant. Means in this study are reported as mean ± standard deviation, and medians are reported as median, 25th–75th percentile. Odds ratios are also presented with 95 % confidence intervals. All analyses were performed using IBM SPSS Statistics 28 (Armonk, NY).

Results

From 2007 to 2012, a total of 143,919 trauma patients were included in this study: 21,480 in the PRE cohort and 122,439 in the POST cohort. The overall cohort consisted of 34.8 % female patients and 15.5 % geriatric patients. Critically injured patients with ISS ≥15 accounted for

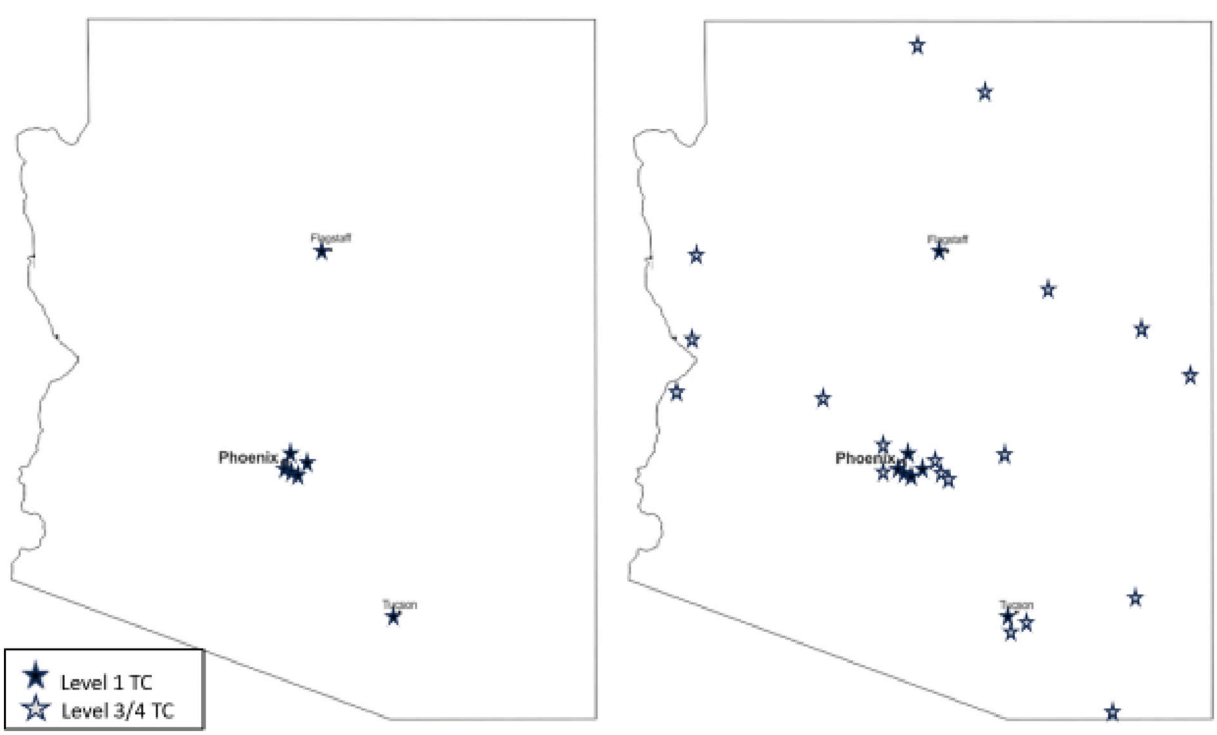

Fig. 1. Trauma center distribution in Arizona in 2007 (Left pane) and 2012 (Right pane). Black star: Level 1 Trauma Center (L1TC), Grey star: Level III or Level IV Trauma Center (LLTC).

15.9 %. The median ISS was 5 (2−10). Blunt mechanisms accounted for 89 % of injuries. The interfacility transfer rate was 10.3 %. The overall inpatient mortality was 3 %. In terms of secondary outcomes, the median hospital length of stay (LOS) was 3.6 days, ICU LOS was 1 day, and ventilator days was zero. The rate of discharge to medical facilities such as SNF, LTAC, or IPR was 8.1 %.

Overall comparison

Comparing the two time periods, the POST cohort consisted of more females (35.2 % vs 32.4 %, $p < 0.001$), geriatric patients (16.3 % vs 9.4 %, $p < 0.001$), and blunt trauma patients (89.1 % vs 88.3 %, $p < 0.001$). The PRE and POST median ISS was clinically similar at 5 (Table 1). The POST cohort experienced 11.4 % more interfacility transfers, greater LOS by 1 day, but shorter ICU LOS. There was no significant change in median ventilator dependent days. Discharge to medical facilities was increased in POST by 3 %. The POST cohort had a 0.6 % lower mortality compared to the PRE cohort ($p < 0.001$, Table 2). However, after adjusting for gender, age, trauma mechanism and ISS, the multivariate logistic regression analysis showed that being in the POST cohort was not protective against mortality (OR 1.07, 0.96–1.18, Table 3).

Subgroup analyses

The same analyses performed for the overall cohort were repeated for each subgroup. There were significantly more female patients and geriatric patients in the POST cohort for each of the subgroups. All subgroups had more blunt traumas in POST, but the difference was not statistically significant in ISS ≥ 15 and geriatric subgroups. ISS was clinically similar across the subgroups except in ISS ≥ 15, where POST was lower (21 vs 22, $p < 0.001$, Table 1).

The large increase in interfacility transfers observed in the overall analysis was likewise seen in each subgroup in the POST cohort (all $p < 0.001$). Inpatient LOS was clinically similar in all subgroups except in blunt traumas, where the POST group experienced 1 day longer ($p < 0.001$). ICU LOS decreased in both blunt and penetrating traumas but was clinically similar for severely injured patients and geriatric patients. Average ventilator-dependent days remained zero for the geriatric and blunt subgroups, fell in the penetrating subgroup (1.5 to 1 day, $p < 0.001$), and increased from 1 to 2 days in the critically injured subgroup.

Table 1
Demographics.

	PRE ($n = 21,480$)	POST ($n = 122,439$)	*p*-Value
Overall	**21,480**	**122,439**	
Female	32.4 %	35.2 %	<0.001
Age ≥ 65	9.4 %	16.6 %	<0.001
Blunt	88.3 %	89.1 %	<0.001
ISS (median, IQR)	5.0 (2–11)	5.0 (2–10)	<0.001
ISS ≥ 15	**3881**	**18,931**	
Female	26.4 %	29.8 %	<0.001
Age ≥ 65	15.1 %	24.4 %	<0.001
Blunt	88.6 %	89.6 %	0.057
ISS (median, IQR)	22.0 (17–29)	21.0 (17–27)	<0.001
Age ≥ 65	**2009**	**20,350**	
Female	47.7 %	51.2 %	0.003
Blunt	96.8 %	97.4 %	0.122
ISS (median, IQR)	9.0 (4–17)	9.0 (4–14)	<0.001
Blunt	**18,968**	**109,116**	
Female	35.1 %	37.7 %	<0.001
Age ≥ 65	10.3 %	18.2 %	<0.001
ISS (median, IQR)	5.0 (2–12)	5.0 (2–10)	<0.001
Penetrating	**2512**	**13,323**	
Female	12.1 %	15.2 %	<0.001
Age ≥ 65	2.5 %	4.0 %	<0.001
ISS (median, IQR)	4.0 (1–10)	4.0 (1–9)	<0.001

PRE, trauma patients from 2007; POST, trauma patients from 2008 to 2012; ISS, injury severity score; IQR, interquartile range 25 %–75 %.

Table 2
Overall outcomes: 2007 vs 2008–2012.

	PRE		POST		p-Value
	Median/ percent	IQR	Median/ percent	IQR	
Overall	n = 21,480		n = 122,439		
Interfacility transfers	1.6 %		13.0 %		**<0.001**
Inpatient LOS	0.3	0.2–2.1	1.2	−0.2–3.5	**<0.001**
ICU LOS	2.0	1–4	1.0	0–3	**<0.001**
Ventilator dependent days	0.0	0–2	0.0	0–1	0.436
Discharge to medical facility	6.7 %		9.7 %		**<0.001**
Mortality	3.4 %		2.8 %		**<0.001**

PRE, trauma patients from 2007; POST, trauma patients from 2008 to 2012; IQR, interquartile range 25 %–75 %; LOS, length of stay; ICU, intensive care unit; Medical facility discharges include skilled nursing, long term care, and rehab facilities.

Table 3
Multivariate regression for mortality predictors: 2007 vs 2008–2012.

	OR	CI (95 %)	p value
Overall			
POST	1.07	0.96–1.18	0.227
Male	1.14	1.05–1.25	**0.002**
Age	1.3	1.28–1.33	**<0.001**
Penetrating	6.98	6.35–7.67	**<0.001**
ISS	1.15	1.15–1.16	**<0.001**
ISS ≥ 15			
POST	1.07	0.95–1.19	0.281
Male	1.05	0.95–1.16	0.342
Age	1.22	1.19–1.25	**<0.001**
Penetrating	8.3	7.41–9.29	**<0.001**
ISS	1.12	1.12–1.13	**<0.001**
Age ≥ 65			
POST	1.06	0.85–1.33	0.618
Male	1.38	1.20–1.60	**<0.001**
Age	1.52	1.39–1.67	**<0.001**
Penetrating	6.68	5.03–8.87	**<0.001**
ISS	1.15	1.14–1.16	**<0.001**
Blunt			
POST	1.01	0.90–1.14	0.82
Male	1.20	1.09–1.32	**<0.001**
Age	1.31	1.28–1.33	**<0.001**
ISS	1.14	1.14–1.15	**<0.001**
Penetrating			
POST	1.23	1.00–1.53	0.059
Male	0.9	0.72–1.13	0.356
Age	1.24	1.18–1.30	**<0.001**
ISS	1.19	1.18–1.19	**<0.001**

POST, 2008–2012 cohort; OR, odds ratio; CI, confidence interval; ISS, injury severity score.

Similar to the overall analysis, all subgroups also demonstrated decreased discharge to medical facilities (Table 4).

Critically injured patients (ISS ≥ 15) and patients with penetrating injuries saw no significant difference in mortality between PRE and POST. In contrast, reductions in mortality were seen in the geriatric and blunt trauma subgroups, with the highest reduction in the geriatric subgroup (7.3 to 4.8 %, $p < 0.001$) (Table 4). Multivariate regression analyses showed that being in the post-proliferation cohort was not independently associated with survival for all subgroups analyzed. Additionally, being in the POST cohort was trending to be an

Table 4
Subgroup outcomes: 2007 vs 2008–2012.

	PRE		POST		p-Value
	Median/ percent	IQR	Median/ percent	IQR	
ISS ≥ 15	n = 3881		n = 18,931		
Interfacility transfers	1.7 %		16.8 %		**<0.001**
Inpatient LOS	6.0	3–12	6.0	3–11	**<0.001**
ICU LOS	3.0	1–7	3.0	1–6	**<0.001**
Ventilator dependent days	1.0	0–5.5	2.0	1–7	**<0.001**
Discharge to medical facility	32.2 %		30.5 %		**0.04**
Mortality	15.7 %		15.0 %		0.268
Age ≥ 65	***n* = 2009**		**n = 20,350**		
Interfacility transfers	3.7 %		17.2 %		**<0.001**
Inpatient LOS	4.0	2–7	4.0	2–6	**<0.001**
ICU LOS	2.0	1–5	2.0	1–3	**<0.001**
Ventilator dependent days	0.0	0–1	0.0	0–3	**<0.001**
Discharge to medical facility	14.4 %		9.8 %		**<0.001**
Mortality	7.3 %		4.8 %		**<0.001**
Blunt	**n = 18,968**		***n* = 109,116**		
Interfacility transfers	1.7 %		11.5 %		**<0.001**
Inpatient LOS	2.0	1–5	3.0	1–5	**<0.001**
ICU LOS	2.0	1–4	1.0	0–3	**<0.001**
Ventilator dependent days	0.0	0–1	0.0	0–2	**<0.001**
Discharge to medical facility	6.2 %		5.0 %		**<0.001**
Mortality	2.8 %		2.4 %		**<0.001**
Penetrating	***n* = 2512**		***n* = 13,323**		
Interfacility transfers	1.4 %		14.3 %		**<0.001**
Inpatient LOS	2.0	1–5	2.0	1–5	**<0.001**
ICU LOS	2.0	1–4	1.0	0–3	**<0.001**
Ventilator dependent days	1.5	0–6.3	1.0	0–2	**<0.001**
Discharge to medical facility	3.0 %		2.2 %		**0.01**
Mortality	7.7 %		7.3 %		0.405

PRE, trauma patients from 2007; POST, trauma patients from 2008 to 2012; ISS, injury severity score; LOS, length of stay; ICU, intensive care unit; Medical facility discharges include skilled nursing, long term care, and rehab facilities; IQR, interquartile range 25 %–75 %.

independent predictor of death for penetrating traumas patients (OR: 1.23; 1.00–1.53, $p = 0.059$; Table 3).

2007 versus 2010

We analyzed the year 2007 versus 2010 to account for time needed for maturation of new LLTC in the system. A total of 21,480 patients were treated in 2007, and 23,805 patients were treated in 2010. In 2010, the cohort consisted of more females (35.4 vs 32.4 %, $p < 0.001$) and more geriatric patients (16.3 % vs 9.4 %, $p < 0.001$). Both groups experienced similar percentage of penetrating traumas (11.5 % vs 11.7 %, $p = 0.436$) and had similar median ISS of 5 ($p = 0.057$).

In terms of outcomes, results of the 2007 versus 2010 analysis showed similar trend as the 2007 versus 2008–2012 analyses. Specifically, 2010 cohort had higher interfacility transfer rate, longer total inpatient LOS, and higher rate of discharge to medical facilities. ICU LOS decreased while ventilator dependent days stayed similar in 2010 (Table 5). In 2010, mortality decreased by 0.6 % (Table 5), and multivariate logistic regression analysis demonstrated that POST was not associated with survival (Table 6).

Table 5
Overall outcomes: 2007 versus 2010.

	2007		2010		p-Value
	Median/ percent	IQR	Median/ percent	IQR	
Overall	n = 21,480		n = 23,805		
Interfacility transfers	1.6 %		13.0 %		**<0.001**
Inpatient LOS	0.3	0.2–2.1	1.2	0.2–3.5	**<0.001**
ICU LOS	2.0	1–4	1.0	0–3	**<0.001**
Ventilator dependent days	0.0	0–2	0.0	0–1	0.057
Discharge to medical facility	6.7 %		9.7 %		**<0.001**
Mortality	3.4 %		2.8 %		**0.001**

PRE, trauma patients from 2007; POST, trauma patients from 2008 to 2010; ISS, injury severity score; LOS, length of stay; ICU, intensive care unit; medical facility discharges include skilled nursing, long term care, and rehab facilities; IQR, interquartile range 25 %–75 %.

Table 6
Multivariate regression for mortality predictors: 2007 vs 2010.

	OR	CI (95 %)	p value
POST	1.07	0.934–1.22	0.333
Male	1.16	1.00–1.35	0.059
Age	1.29	1.25–1.34	**<0.001**
Penetrating	6.74	5.70–7.96	**<0.001**
ISS	1.15	1.15–1.16	**<0.001**

POST, 2010 cohort; OR, odds ratio; CI, confidence interval; ISS, injury severity score.

Trauma system access

Annual state trauma volume captured by ASTR ranged from 21,480 in 2007 to 28,214 in 2012. When these were normalized with state population, the percentage of trauma patients per state population annually increased by 0.08 % from 2007 to 2012 (Fig. 2).

Discussion

In this analysis of ASTR, we assessed the impact on clinical outcomes and trauma system access after the creation of 21 LLTCs in a trauma system that had no LLTC previously. The results demonstrated POST had non-significant to small reduction of unadjusted inpatient mortality. However, POST was not associated with survival in any of the analyses performed in this study. In fact, POST was trending to be an independent predictor of death for patients with penetrating injuries. The study also showed that LLTC proliferation was associated with a significant 10.2 % increase in interfacility transfer rate, but only a 0.08 % increase in annual treated trauma patients per capita.

In our analysis of the overall groups, we found a minimal decrease in mortality of 0.6 % in POST. The largest reduction in mortality was 2.5 %, seen in the geriatric patient subgroup. However, our multivariate regression analyses found that the post-proliferation period was not protective against mortality in either the overall cohort or any of the subgroups analyzed. Notably, the POST cohort trended toward an independent association with death for patients that sustained penetrating trauma. This may be the result of changes in the trauma volume at each individual center after the proliferation. In a similar analysis of nationwide trauma center expansion, Truong et al discovered an increase in injury-related mortality in states with an expansion of the number of trauma centers, and an association between having more trauma centers in a state and significantly higher mortality [6]. How could more trauma centers result in higher mortality? Mortality is a key quality metric for a trauma system, and maintaining a high volume of cases is key to delivery of quality trauma care [2]. Therefore, when new

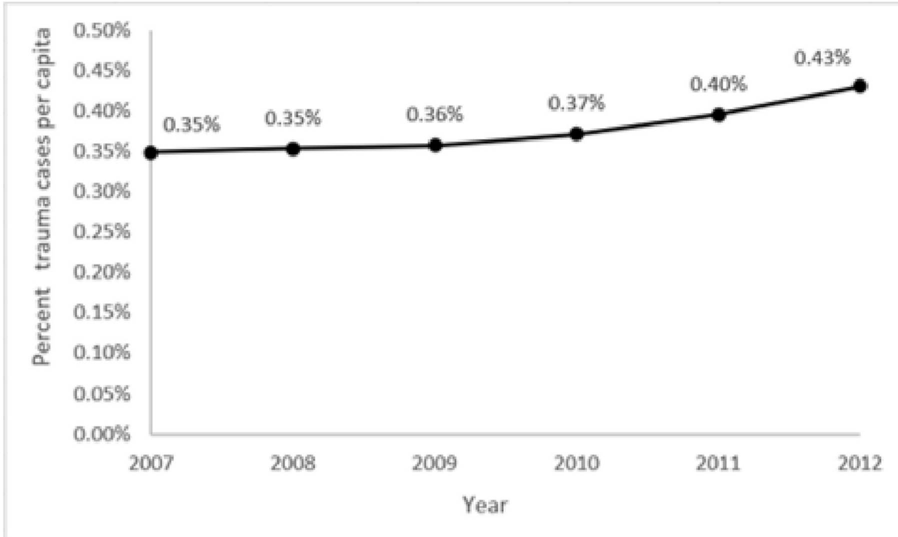

Fig. 2. Trauma patients per capita in Arizona by year.

centers are added without an increase in regional trauma burden, the trauma volume at individual trauma center is diluted [7,10]. This dilution may degrade the quality of care provided at the trauma centers, and may worsen mortality for the entire trauma system [7,10].

Another vital role of LLTCs is to increase trauma coverage and access [2]. As shown in Fig. 1, some LLTC in the post-proliferation period were established away from urban centers to increase trauma access. The results from this study showed a 10.2 % increase in interfacility transfer rate. However, when we compared annual trauma patients per capita across the study period, we found an increase of only 0.08 % from 2007 to 2012 (Fig. 2). The discrepancy between the two rates may reflect inappropriate transfer and triage practices rather than an increase in trauma system access. Indeed, Jones et al examined transfers from other L1TC in Arizona to their L1TC over a 5-year period. The authors discovered that 1.1 % of their trauma volume during this time consisted of these inappropriate transfers. Most of these transfers were for definitive management of brain, spine, or cerebrovascular injuries, services to which the sending hospital already had access, but whose providers were either unavailable or deemed the injury beyond their capability [11].

In addition to the inappropriate transfers highlighted by Jones et al., under triage due to suboptimal trauma center placement may also account for lack of access and the increased interfacility transfer rate seen in the POST cohort. In their analysis of the mature trauma system in Pennsylvania, Horst et al. found that under triage to non-trauma centers was highest in areas where access to trauma centers was lowest – namely, in rural areas [12]. As much of Arizona is rural, with great distances between LLTCs and L1TCs, its trauma system is faced with a similar issue. Given that the interfacility transfer rate rose in the POST cohort, it is possible that the placement of the new LLTCs did not appropriately expand access to trauma care in these rural areas. In a recent nationwide analysis of trauma center proliferation, Ferre et al. found that after a 14 % increase in the number of trauma centers, only 3 % of census tracts analyzed were previously unserved by a trauma center [13].

Moreover, the financial cost associated with trauma center proliferation is likely substantial. While ASTR does not capture financial data in our state, Taheria et al. examined 20 trauma centers in Florida in 2003, and reported an annual cost of $2.7 million per center that was necessary for the centers to receive trauma patients [14]. This figure is only the fixed cost, and did not account for the additional variable cost associated with the volume of patients at each center Using this as a crude approximator, it would have cost $56.7 million annually to maintain the 21 LLTCs in our state in 2003 and $95.8 million in 2023 [15]. Although this is a substantial sum, it is still likely a gross underestimation of the overall cost since it does not include the cost to transform a non-trauma center to a trauma center nor any variable cost associated with patient volume (e.g. interfacility transfer costs). We need to carefully consider this significant financial burden when interpreting the impact on trauma patient outcome demonstrated in this study.

As possible solutions to the previously mentioned issues, our previous work on the Ohio trauma system showed that a regionalized, collaborative trauma system that shares common triage and transfer practices amongst trauma centers and emergency medical service providers was associated with both reduced mortality and earlier delivery of definitive care [18]. Other studies of collaborative trauma systems both in the U.S. and internationally reached similar conclusions [16–22]. In regard to optimization of trauma center location, geospatial modeling tools such as the Needs Based Assessment of Trauma Systems 2 (NBATS-2) have shown promise both in elucidating the effect of previous trauma center additions on trauma volume, as well as predicting the effects of future trauma center creation on the volume of a trauma system based on the needs of its region [23–27]. Rather than unguided trauma center proliferation, geospatial modeling-based tools allows a more planned and data-driven approach to regional trauma system expansion.

Our study has several limitations. Due to the nature of the data in the publicly available, de-identified portion of ASTR, we did not have the pre-hospital variables necessary to perform a more detailed analysis on access to trauma care. However, to our knowledge, we are the first to assess trauma access after a substantial increase in LLTCs in a system that did not have any LLTCs before. Similarly, ASTR did not capture our data prior to 2007. Consequently, we had unequal comparison group size and could not perform any analysis on transfer pattern prior to 2007. Moreover, new trauma centers take time to mature and achieve optimal patient outcomes [11]. While we could not fully control for these two issues, we did attempt to correct for these in our comparison of 2007 versus 2010 cohorts. This analysis showed similar results as our overall group analysis. Lastly, our study is only limited to Arizona, and may not be generalizable to other states. Although, it is unclear how much regulation is in place in state/region that have a formal trauma center designation process, our results may be applicable to many states experiencing trauma center proliferation as this is a nationwide phenomenon [22].

Conclusion

Unregulated proliferation of LLTCs was associated with increased interfacility transfers without a significant increase in the number of trauma patients treated. LLTC proliferation was not an independent protector against mortality in the overall patient population, and may worsen mortality for penetrating trauma patients. Rather than simply increasing the number of LLTCs within a geographical region, perhaps more planned approaches are needed to improve regional trauma mortality and access.

Level of evidence

Level III.

Funding

No funding was necessary or received for the generation of this study or manuscript.

Ethical approval statement

No ethics approval was indicated for this study.

Presentations

The above work was presented as a poster at the Southwest Trauma & Acute Care Symposium on November 17th 2022, as a podium presentation at the annual meeting of the Academic Surgical Congress on February 7th 2023, and a podium presentation at the American College of Surgeons Wyoming, Montana, Idaho and Utah chapter meeting on March 31st, 2023.

Credit authorship contribution statement

Taylor W. Norton: Writing – review & editing, Writing – original draft, Methodology, Investigation. **Michael Zhou:** Writing – review & editing, Methodology, Investigation, Formal analysis. **Kelsey Rupp:** Methodology, Investigation, Formal analysis. **Michele Wang:** Writing – review & editing, Investigation. **Rebecca Paxton:** Writing – review & editing, Investigation. **Nisha Rehman:** Writing – review & editing, Investigation. **Jack C. He:** Writing – review & editing, Supervision, Resources, Project administration, Methodology, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

None of the authors has any financial or personal interests to disclose.

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