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Trauma center funding: time for an update

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ABSTRACT

Background Uncompensated care (UC) is healthcare provided with no payment from the patient or an insurance provider. UC directly contributes to escalating healthcare costs in the USA and potentially impacts patient care. In Texas, there has been a steady increase in the number of trauma centers and UC volumes without an increase in trauma funding of UC. The method of calculating UC trauma funds in Texas is imprecise as it is driven by Medicaid volumes and not actual trauma care costs.

Methods Five years of annual trauma UC disbursement reports from the Texas Department of State Health Services were used to determine changes in UC economic considerations for level I, II, and III trauma centers in the largest urban trauma service areas (TSAs). Data for UC costs, compensation, and TSA demographics were used to assess variations. Statistical significance was determined using a Kruskal-Wallis test with Dunn's pairwise comparison post-hoc analysis and logistic regression.

Results TSA-E (Dallas-Fort Worth area) has 33% of the level I trauma centers in Texas (n=6) and yet serves only 27% of the total state population across 14 metropolitan and 5 non-metropolitan counties. Since 2015, TSA-E has shown higher UC costs ($p<0.02$) and lower reimbursement ($p<0.01$) than the second largest urban hub, TSA-Q (Houston area). TSA-E level I trauma centers trended towards decreased UC reimbursements.

Discussion The unregulated expansion of trauma centers in Texas has led to an unprecedented increase in hospitals participating in trauma care. The unbalanced allocation of UC funding could lead to further economic instability, compromise resource allocation, and negatively impact patient care in an already fragile healthcare environment.

Level of evidence Level IV; Retrospective economic analysis and evaluation.

BACKGROUND

Gaps in the public insurance system and the lack of affordable private coverage have left millions of Americans without health insurance. In 2013, an estimated 44 million Americans lacked health insurance coverage. In 2014, the Affordable Care Act (ACA) expanded coverage to nearly 20 million of previously uninsured Americans through the expansion of Medicaid and the establishment of the Health Insurance Marketplace. As a result, the number of uninsured patients nationwide decreased. Unfortunately, by 2017 the number of individuals without insurance coverage started to rise again.[1]

National estimates suggest one in five trauma patients lacks health insurance.[2] Given the low reimbursement rates for patients without insurance, trauma centers are often considered the most financially vulnerable healthcare entities.[3] In the USA, trauma-related healthcare expenditures are second only to those related to cardiovascular disease. Trauma-related healthcare costs and trauma-specific administrative expenses threaten to overwhelm institutions treating large numbers of uninsured, severely injured patients. Previous studies have suggested that there is a correlation between inadequate reimbursement and patient transfer practices.[4 5]

The American Hospital Association (AHA) defines uncompensated care (UC) as the overall measure of hospital care provided for which no payment was received from the patient or insurer. The AHA calculates UC by adding a hospital's bad debt and the financial assistance it provides for services for which hospitals neither received, nor expect to receive, payment due to the patient's inability to pay.[6] Consistent expansion of the uninsured population has increased the cost of providing UC.

Texas is 1 of 19 states that chose not to expand Medicaid program coverage to low-income adults as provided under the ACA (figure 1). In 2015, the Texas Medical Association estimated 4.3 million adult residents lacked insurance coverage, representing a 75% increase over the national average.[7] Currently, approximately 5.3 million Texans are uninsured, making Texas the state with the highest rate of uninsured individuals (21.8%) in the USA.[8] This estimate does not take into account undocumented residents in Texas.

In Texas, financial support to cover UC historically came from the Driver Responsibility Program and state traffic fines (Account 5111).[9] Account 5111 dispersals for UC occur in the form of a trauma add-on. Compensation rates received by level I, II, and III centers are 28.3%, 18.1%, and 3.1%, respectively, of their Medicaid volume and standard dollar amount (SDA) (RULE §355.8052). However, the number of trauma care providers continues to grow without corresponding increases in financial support to cover UC or patient need. The total available funding resources have remained static whereas the number of organizations pulling from the funding pool continues to expand. The number of designated level I–III trauma centers has increased by 38.9% in Texas since 2010 with 22 institutions 'in active pursuit of (trauma) designation'.[10]

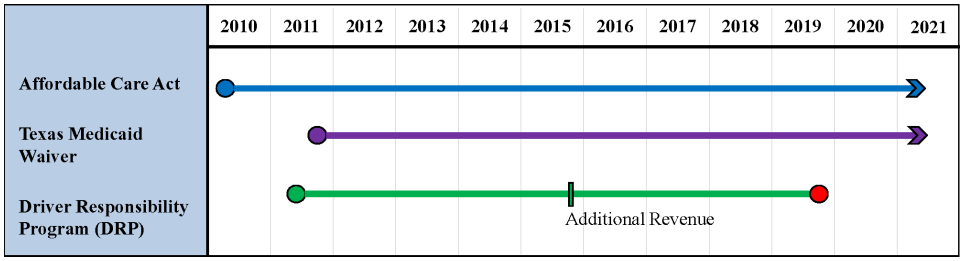

Figure 1 Texas management of uncompensated care since 2010. After the enactment of the Affordable Care Act, Texas opted for the 1115 Medicaid waiver and started the Driver Responsibility Program (DRP). The DRP was the primary source of state revenue for the Designated Trauma Facility and Emergency Medical Services Account (5111). Due to insufficient revenue, additional revenue streams were incorporated into the DRP in 2015. The DRP was later repealed in September 2019. As of 2020, no programs have been identified as revenue stream replacements for Account 5111.

Designation based on population density, admission volumes, or geographic location is essential for responsible use of resources. To date, no effective universal means for needs-based designation of trauma centers has been accepted. In an attempt to meet this need, the Needs-Based Assessment of Trauma Systems (NBATS) and NBATS-2 tools were defined, but they have been ineffective at establishing specific community needs.[11 12] Trauma service area (TSA) need must also consider available resources, both financial and personnel. Observed trends within our TSA suggested the current UC funding apparatus to be inadequate. Therefore, we sought to describe how the unregulated proliferation of trauma centers in Texas could negatively affect the financial stability of existing centers.

METHODS

Research was conducted through the collection and study of publicly available data. The records were maintained in such a manner that subjects cannot be identified, directly or through identifiers linked to subjects.

Trauma service areas

TSAs in Texas are defined and managed by Regional Advisory Councils (RACs); all 17 Texas TSAs are independently managed by their respective RAC. The Department of Social and Health Services (DSHS) classifies counties as urban/metropolitan (≥50 000 inhabitants), rural/non-metropolitan (<50 000 inhabitants), or frontier (≤6 people per square mile) based on population densities and distance from urban hubs. In Texas, Dallas-Fort Worth (TSA-E), Austin (TSA-O), and Houston (TSA-Q) have the greatest number of level I–III designated trauma facilities and include an urban hub. Together, they were selected to model variations in UC reimbursement within the state by designation level.

Uncompensated trauma care

DSHS annual reports for Account 5111 dispersal of funds were queried from fiscal year 2013 through 2017 to assess changes to UC funding among Texas' designated trauma hospitals. Data were harmonized to generate a single file for level I, II, and III facilities within TSA-E, TSA-O, and TSA-Q for all years based on the designation and name of each facility as of 2019 (figure 2 and online supplemental tables 1–3). Complete annual dispersal reports for 2014 were not available.

TSA-E

Payer distribution of all adult level I, II, and III trauma centers within TSA-E was obtained through the Dallas-Fort Worth Hospital Council (DFWHC) Foundation (DFWHC Foundation Regional Data (Q1–Q4, 2016–2018); DFWHC Foundation, Irving, Texas (2019)) and the MyIQ Analytics tool (Texas Hospital Inpatient Discharge Public Use Outpatient and Ambulatory Surgical Center Data File, (Q1–Q4, 2016–2018); Texas Department of State Health Services, Center for Health Statistics-Texas Health Care Information Collection, Austin, Texas (2019)). The data report was generated as payer classification of trauma admits by year. Single institutional data were obtained from the local trauma registry (Digital Innovation (DI) V.5 Trauma Registry, DI Report Writer, 2017). Single institution

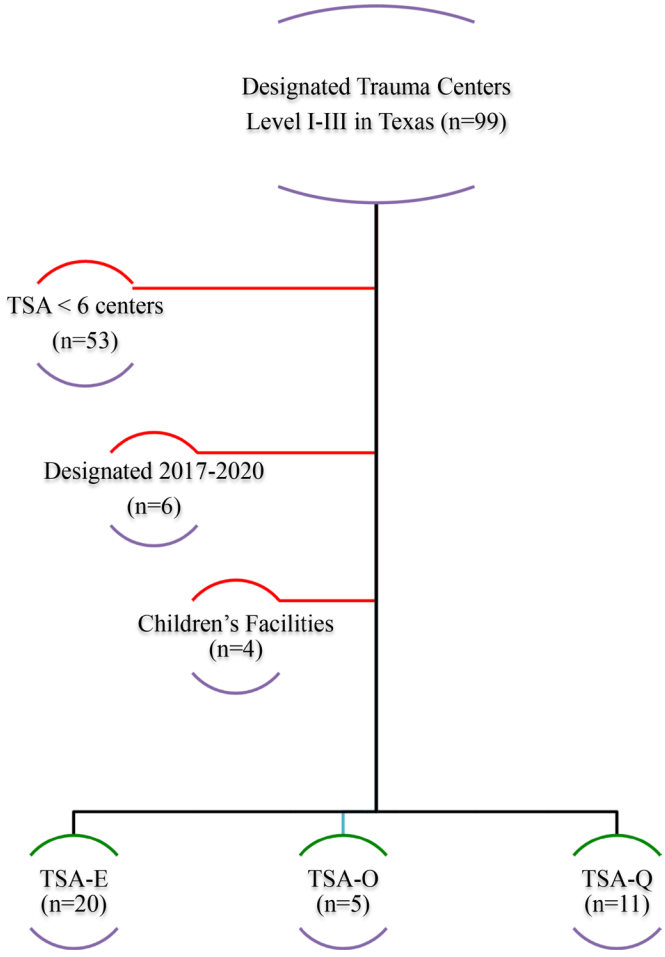

Figure 2 Number of trauma centers included and excluded in analysis of variation between trauma service areas (TSAs). TSA-E, Dallas-Fort Worth area; TSA-O, Austin area; TSA-Q, Houston area.

Table 1 Designated trauma centers by service area and population

	Number of designated centers*				Total population (millions)	Density Level I and II per million persons
	Level I	Level II	Level III	Total		
TSA-E DFW Metro Area	6 (33.3%)	7 (28.0%)	12 (21.8%)	25 (25.5%)	7.7	1.7
TSA-O Austin Metro Area	2 (11.1%)	3 (12.0%)	1 (1.8%)	6 (6.1%)	2.2	2.3
TSA-Q Houston Metro Area	3 (16.7%)	3 (12.0%)	9 (16.4%)	15 (15.3%)	6.2	1.0

*Does not include centers actively pursuing trauma designation.
DFW, Dallas-Fort Worth; TSA, trauma service area.

data were used to validate DFWHC database query results for TSA-E and provide context for the findings.

Statistical analysis

Statistical analyses were completed with Stata V.16 (StataCorp, College Station, Texas, USA). As data were non-normally distributed, Kruskal-Wallis equality of populations and Dunn Test post-hoc assessment were used to assess variance between years and TSAs. Correlation was determined with Spearman's correlation hypothesis testing. Logistic regression controlling for annual 5111 funds was then performed to further validate findings. Results are presented as mean±SD. Outliers were defined as any value greater than two SDs from cohort mean and replaced as missing values prior to analysis. One TSA-E level I institution was removed from bulk analyses in years 2016 and 2017 after meeting outlier criteria. Pediatric facilities were excluded from all analyses. Statistical significance was defined as $p<0.05$.

RESULTS

The number of designated level I, II, or III trauma centers in Texas increased an average of 7% per year whereas population only increased by 3.2% annually (2010–2019). Although population growth correlated with trauma center designation ($\rho=1$; $p<0.001$), this growth was disproportionate. New center designations have continued to propagate in close proximity to urban hubs, creating large trauma care clusters.

Trauma service areas

TSA-E (n=25), TSA-O (n=6), and TSA-Q (n=15) are the largest TSAs in Texas in regard to both service population and number of designated trauma centers (table 1). All three TSAs include an urban hub with a cluster of designated trauma facilities. As of May 2020, TSA-E (n=4) and TSA-Q (n=8) contained multiple hospitals actively seeking designation. Residential areas greater than a 30-minute drive from a designated trauma center within TSA-E, TSA-O, or TSA-Q are rare. The level I and II facilities within these TSAs met or exceeded the recommended 1.0 facility per million people.

Despite a positive correlation between compensation and costs of UC ($\rho=0.78$; $p<0.001$), data demonstrated that reimbursement for providing UC by level I centers were inadequate (figure 3). All service areas demonstrated inadequate reimbursement for UC (table 2). However, average level I compensation and UC costs in TSA-Q were higher than those in TSA-E ($p<0.03$) and TSA-O ($p<0.01$). Level I centers within TSA-Q received greater compensation in 2016 and 2017 than those in TSA-E or TSA-O (figure 4). Significant variation in compensation remained for TSA-Q level I centers relative to those in

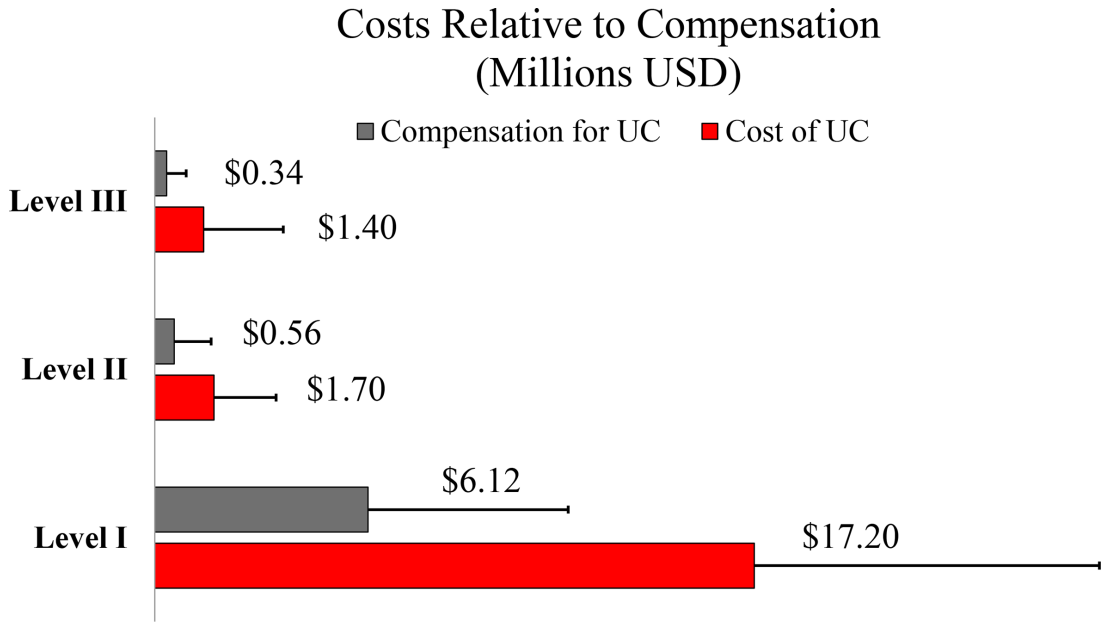

Figure 3 Costs and compensation for providing uncompensated care (UC) in millions of US dollars (USD). Costs of providing UC increase with trauma designation from level III to level II ($p=0.01$) and level I ($p<0.01$). Current average funding per center is less than 50% of costs for all center levels examined in Texas.

Table 2 Annual costs of providing uncompensated care relative to compensation received through trauma add-on

		TSA-E DFW Metro Area	TSA-O Austin Metro Area	TSA-Q Houston Metro Area	p-P value
Care costs Average UC (millions USD)	Level I	11.7±4.8	12.4±1.7	31.5±3.9	**<0.01**
	Level II	2.0±2.2	1.9±1.2	0.7±0.4	0.09
	Level III	1.3±2.8	0.1±0.05	1.7±1.9	**<0.01**
Compensation Average payments (millions USD)	Level I	4.4±0.3	2.7±0.9	11.9±7.8	**0.03**
	Level II	0.8±1.5	0.3±0.2	0.3±0.2	0.29
	Level III	0.1±0.09	0.04±0.02	0.6±0.7	**<0.01**
P value		**<0.01**	**<0.01**	**<0.01**	

Statistical signifigance was defined as p<0.05 and is displayed in bold.
DFW, Dallas-Fort Worth; TSA, trauma service area; UC, uncompensated care; USD, US dollar.

TSA-E (p=0.01) and TSA-O (p=0.04) after logistic regression controlling for total Account 5111 funds. Dispersal of Account 5111 funds was not available for 2014.

TSA-E

Within TSA-E, level I centers were 2.8 times more likely than level II centers (CI=2.80 to 2.99; p<0.01) and 3.2 times more likely than level III centers (CI=3.05 to 3.32; p<0.01) to care for uninsured trauma patients. However, both level II (p=0.03) and III (p=0.01) centers had a greater percentage of Medicaid trauma admits than level I centers for the study period. The number of trauma team activations at our institution increased by 52% (p=0.04) after the 2014 change in designation with no reflected increase in compensation. Since 2014, a significant decrease in year-to-year trauma activation volumes (2097±219; p=0.4) or number of trauma admits (1812±128; p=0.4) was not observed. Trauma add-on payments ($4 381 798±3 090 066) correlated with UC ($12 400 000±1 767 899) costs (r=0.84; p<0.001). The trend towards decreased UC funding specific to TSA-E level I centers is reflective of competition for Medicaid volume and not the costs of providing UC trauma care.

DISCUSSION

Public concern over healthcare access and costs continues despite ACA provisions to improve both. The cost of UC continues to burden hospitals, particularly in states with high levels of uninsured patients (eg, Texas). In non-expansion states, such as Texas, initiatives such as the Medicaid waiver are seen as alternatives to reduce UC cost by expanding access to care. This Medicaid waiver replaced the upper payment limit creating two funding pools: a hospital UC pool to provide a buffer for UC costs and a Delivery System Reform Incentive Payment (DSRIP) program targeting hospital metrics. During the 5-year waiver program, the ratio of funds allocated to the UC pool decreased whereas the DSRIP allocation increased.[13] Compensation programs are placing greater emphasis on metrics than UC.

Financial strain of this kind was reported to increase the likelihood of a center closing by up to 40%.[14] The financial burden placed on the healthcare system requires efficient use of limited resources. Previous studies have associated coverage through ACA Medicaid expansion with reduced UC costs and increased access to care resulting in improved outcomes.[15–17] In Medicaid expansion states, there was a $5 billion decrease in UC between 2013 and 2014; whereas the cost of providing UC in non-expansion states remained roughly the same.[18] In summary, hospitals which implemented Medicaid expansion had significantly increased Medicaid revenue, decreased UC, and improved profit margins compared with hospitals opting not to expand Medicaid.[19]

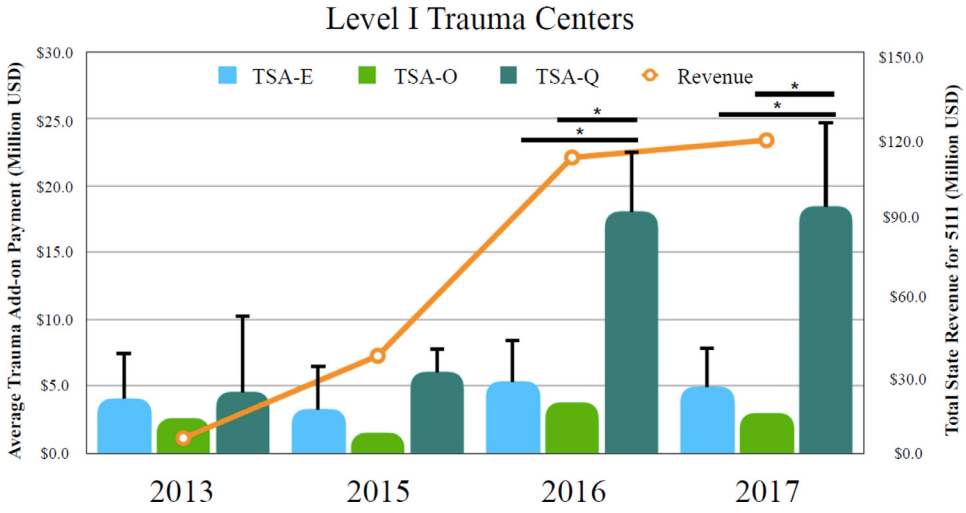

Figure 4 Payments received for the uncompensated care of trauma patients at level I trauma centers in Dallas-Fort Worth (TSA-E), Austin (TSA-O), and Houston (TSA-Q). Trend line shows total monies acquired by state revenue streams for the compensation of uncompensated trauma care (Account 5111). Data are reported in millions of dollars (USD) for fiscal years 2013 through 2017. Dispersal reports for 2014 were not available. *P<0.05. TSA, trauma service area; USD, US dollar.

Access to healthcare as a result of AHA and Medicaid expansion led to shifts in emergency department (ED) usage. A cross-sectional study studying the impact of Maryland's ACA Medicaid expansion on ED high utilizers found there was a reduction in the proportion of ED high utilizers for ambulatory care-sensitive conditions in the year after expansion.[20] In Texas, the lack of access to primary care by the uninsured and underinsured may direct them to seek primary healthcare at more expensive EDs, expanding the UC pool at hospitals.[21–23] Our group previously reported UC of undocumented immigrants occurred in 20% of trauma cases during a 3-year period.[24] This equated to a $4.3 million reimbursement discrepancy when compared with our average institutional collection rate, in spite of DSHS programs. Our loss is not unique. Other urban DSHS program-dependent Texas level I trauma centers reported a loss of $2.1 million as early as 2001.[25]

Institutional Medicaid volumes and not actual uncompensated expenses determine UC reimbursement in Texas. Our data show Medicaid SDA-based funding is inadequate to compensate for the costs of providing care to uninsured patients within TSA-E. This funding shortfall has been further exacerbated by the decision to not expand Medicaid coverage in Texas. Simply put, the number of uninsured patients needing trauma care continues to increase and the methods of determining compensation have not evolved.

Geographic distribution of designated trauma hospitals directly affects patient outcomes.[12 26–28] Current research suggests having one level I or level II designated trauma center per million people or access to a designated trauma center within an hour post-injury is adequate.[26 27 29]

Trauma system expansion based on needs assessments better assures system stability. Addition of a second trauma center in a stable region doubles the cost of necessary resources and personnel.[30] Presently, Texas does not require a certificate of need to establish a new trauma center. Also, there are no regulations controlling the number of trauma centers within a given TSA. The implementation of a system of checks and balances as it relates to the propagation of trauma centers should be considered. When considering these challenges, we recognize that Texas is more vulnerable than most states because of its size and irregular population distribution.

Data presented here suggest a standardized process is needed to ensure trauma funding for financially vulnerable trauma centers. The majority of state-designated compensation for Texas UC is derived from a single-funding stream, Account 5111. Our data demonstrate trauma center growth in Texas has exceeded population changes. Reduction to funding of Account 5111 will exacerbate those deficiencies. Failure to compensate the expanding population of uninsured and UC could threaten trauma system viability in Texas.

Assessment of TSA-E, TSA-O, and TSA-Q allows for the comparison of similar urban areas with different trauma resources. Our data demonstrate there are financial consequences when the trauma market is top-heavy and oversaturated. Decreased compensation for uninsured patients paired with the obligation to care for every injured patient affects the ability for trauma centers to provide care.

Limitations of this study are reflective of the culture of trauma care within the USA. Data are fragmented because of the independent nature of healthcare providers and variations in reporting practices. To reduce this variation in quality, our study used data from Texas. Hospital admits and patient demographics are proprietary, limiting accessible metrics to a single service area (TSA-E). Reporting limitations in Texas are reflective of the national limitations. Patient-level data permissive of center identification and data sources with granularity permitting outcome data isolation by RACs were not available. Further, complete data were not available from a single source and dispersal data for 2014 were not released by the Texas DSHS. Therefore, an innovative approach was needed to demonstrate the impact of unregulated trauma center expansion.

Unregulated expansion of trauma centers in Texas has led to an increase in hospitals participating in trauma care. Continued decreases in trauma center-specific funds could lead to further economic instability, compromise resource allocation, and negatively impact patient care in an already fragile healthcare environment. Implementation of insurance expansion policies for trauma patients has been associated with improved outcomes.[31 32] If insurance coverage expansion has the potential to enhance the financial viability of trauma centers, the implementation of Medicaid expansion policies in Texas may decrease the burden on centers. Adjustment to the funding metrics to focus on accrued costs instead of Medicaid volume is more appropriate. Next steps may also include advocating for responsible trauma center development through legislative actions and seeking additional funding resources.

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Contributors HMGV and JDA conceived of the presented idea. HMGV and BAF developed the theory and drafted the article. HMGV performed the computations. JDA verified the analytical methods. JDA encouraged HMGV to investigate legislative components of trauma care funding and supervised the findings of this work. All authors discussed the results and contributed to the final article.

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Competing interests None declared.

Patient consent for publication Not required.

Ethics approval The study design was determined to be exempt from IRB review with waiver of consent by Aspire IRB (Santee, California, USA) based on 45CRF 46.101(b)(4).

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available in a public, open access repository. Data may be obtained from a third party and are not publicly available. Service area data aggregated in this study are immediately available open access through the US Census, the Texas Department of State Health Services, and Texas Trauma Regional Advisory Councils to anyone who wishes to access the data. Center-specific data may be requested from the Dallas-Fort Worth Hospital Council Foundation with appropriate credentials.

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Supplemental Table 1: Facility inclusion by level of designation for TSA-E

		Facility Name (2020)	Inclusion
Dallas-Fort Worth Metro Area (TSA-E)	**Level I** (n=6)	Baylor University Medical Center	2013-2017
		Children's Medical Center of Dallas	Excluded
		John Peter Smith Hospital	2013-2017
		Medical City Plano	2013-2017
		Methodist Dallas Medical Center	2013-2017
		Parkland Memorial Hospital	2013-2015
	Level II (n=7)	Baylor Scott & White Medical Center - Grapevine	2017
		Medical City Arlington	2013-2017
		Medical City Denton	2013-2017
		Texas Health Harris Methodist Hospital Fort Worth	2013-2017
		Texas Health Presbyterian Hospital Dallas	2013-2015, 2017
		Texas Health Presbyterian Hospital Plano	2013-2017
	Level III (n=12)	Baylor Scott & White All Saints Medical Center Fort Worth	2015-2017
		Baylor Scott & White Medical Center - Centennial	Est. 2020
		Baylor Scott & White Medical Center - Lake Pointe	2013-2017
		Baylor Scott & White Medical Center - McKinney	2016-2017
		Cook Children's Medical Center	Excluded
		Medical City Lewisville	2013-2017
		Medical City McKinney	2015-2017
		Medical City North Hills	2013-2017
		Methodist Charlton Medical Center	Est. 2018
		Methodist Mansfield Medical Center	Est. 2018
		Texas Health Harris Methodist Hospital Hurst Euless -Bedford	2013-2017
		Texoma Medical Center	2013-2017
		Wilson N. Jones Regional Medical Center	2015-2017

Abbreviations: TSA, trauma service area; Est, Established

Supplemental Table 2:Facility inclusion by level of designation for TSA-O

		Facility Name (2020)	Inclusion
Austin Metro Area (TSA-O)	**Level I** (n=2)	Dell Children's Medical Center	Excluded
		Dell Seton Medical Center at The University of Texas	2013-2017
	Level II (n=3)	Ascension Seton Williamson	2013-2017
		Round Rock Medical Center	2013-2017
		St. David's South Austin Medical Center	2015-2017
	Level III (n=1)	Ascension Seton Hays	2013-2017

Abbreviation: TSA, trauma service area

Supplemental Table 3:Facility inclusion by level of designation for TSA-Q

		Facility Name (2020)	Inclusion
Houston Metro Area (TSA-Q)	**Level I** (n=3)	Harris Health System Ben Taub Hospital	2013-2017
		Memorial Hermann Hospital	2013-2017
		Texas Children's Hospital	Excluded
	Level II (n=3)	HCA Houston Healthcare Clear Lake	2013-2017
		HCA Houston Healthcare Conroe	Est. 2017
		Memorial Hermann The Woodlands Medical Center	2013-2017
	Level III (n=9)	Harris Health System Lyndon B Johnson Hospital	2013-2017
		HCA Houston Healthcare Northwest	2013-2017
		HCA Houston Healthcare Southeast	Est. 2019
		HCA Houston Healthcare Tomball	Est. 2019
		Memorial Hermann Greater Heights Hospital	2013-2017
		Memorial Hermann Southeast Hospital	2013-2017
		Memorial Hermann Southwest Hospital	2013-2017
		Oakbend Medical Center	2013-2017
		St. Joseph Medical Center	2013-2017

Abbreviations: TSA, trauma service area; Est, Established