



Title: Effect of adding Level II trauma centers to a large trauma system

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Introduction: Prior to 2015, there were 2 adult and 2 children's Level I trauma centers in the area served by the SouthEast Texas Regional Advisory Council (SETRAC) and no Level II trauma centers. SETRAC is an administrative organization responsible for trauma system coordination in a 9-county region surrounding Houston, Texas. Multiple Level III trauma centers began upgrading to Level II trauma designation beginning in January 2015. SETRAC embarked on an analysis to evaluate the impact of adding Level II trauma centers to the system that had none with regards to patient volume, demographics, injury characteristics, and outcomes.

Methods: This study is a historical cohort analysis of 2013-2019 trauma registry data from SETRAC Level I and II trauma centers. Only adult patients age 16 and older were included. Patients treated at Level II trauma centers were included during the period these facilities were in active pursuit of Level II trauma designation or after receiving designation. For calculation of transport time (scene to ED) only, transfer patients were excluded. Proportions were compared with chi square tests and the Wilcoxon Rank Sum test was used to compare continuous variables. Institutional Review Board approval was provided by the Committee for the Protection of Human Subjects at the University of Texas Health Science Center at Houston.

Results: 90,770 patient records were included in this analysis. Patient volume at Level I trauma centers increased 8.8% during the study period, from 8,723 in 2013 to 9,488 in 2019. The number of patients treated at Level I or II trauma centers nearly doubled to 16,433 in 2019, with 6,945 patients treated at Level II trauma centers in 2019. All comparisons are significant at $p < 0.001$ unless otherwise noted. There were significant differences in patient characteristics between the Level I and II trauma centers, with lower median age (42, IQR:27-59 vs. 57 IQR:34-76) and higher percentages of males (70.9% vs 56.2%), penetrating trauma (9.3% vs. 4.7%), non-white race (61.5% vs. 34.7%) and Hispanic ethnicity (30.0% vs. 16.8%) at Level I centers. The median Injury Severity Score was higher at Level I trauma centers (9, IQR:4-14 vs, 5, IQR:4-10) and a higher percentage of patients were classified as self-pay (29.5% vs. 21.2%). Patients treated at Level II trauma centers were more likely to be injured due to a fall (49.3% vs. 29.6%), and were discharged to a skilled nursing or rehabilitation facility at higher rates (22.3% vs. 11.7%). Median transport time by ambulance decreased significantly over the period from 56 minutes to 39 minutes. Unadjusted mortality rates decreased slightly during the study period from 4.8% to 4.3% ($p=0.007$), but differed between Level I and II trauma centers (4.6% vs. 3.4%). However, mortality was not significantly different between centers after adjustment for ISS and other confounders in a logistic regression model. Similarly, median hospital length of stay was longer among patients receiving care at a Level I vs. a Level II trauma center (3.5, IQR:1.5-7.2 vs. 2.9 IQR: 1.0-6.0).

Conclusions: Adding Level II trauma centers increased trauma care capacity for the region, bringing the SETRAC region into compliance with the recommended number of trauma centers based on population. Mortality as well as transport times among patients receiving care at a Level I or II center decreased overall. It is likely that the geographic distribution of Level I and II trauma centers within SETRAC impacted the populations served by each. Most Level II trauma centers are located in suburban areas and see an older population more likely to be injured due to a fall. Level I trauma centers are located within a 1 square mile radius within the urban center of Houston and treat a younger, predominantly male population that is more likely to be Black or Hispanic, with a higher percentage of penetrating trauma and a higher ISS.