


How Did the COVID-19 Pandemic Affect Trauma Volume at an Urban Level I Trauma Center?

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Abstract

Introduction: The COVID-19 pandemic changed the face of health care worldwide. While the impacts from this catastrophe are still being measured, it is important to understand how this pandemic impacted existing health care systems. As such, the objective of this study was to quantify its effects on trauma volume at an urban Level I trauma center in one of the earliest and most significantly affected US cities.

Methods: A retrospective chart review of consecutive trauma patients admitted to a Level I trauma center from January 1, 2017 to December 31, 2020 was completed. The total trauma volume in the years prior to the pandemic (2017-2019) was compared to the volume in 2020. These data were then further stratified to compare quarterly volume across all 4 years.

Results: A total of 4138 trauma patients were treated in the emergency room throughout 2020 with 4124 seen during 2019, 3774 during 2018, and 3505 during 2017 in the pre-COVID-19 time period. No significant difference in the volume of minor trauma or trauma transfers was observed ($P < .05$). However, there was a significant increase in the number of major traumas in 2020 as compared to prior years (38.5% vs 35.6%, $P < .01$) and in the volume of penetrating trauma (29.1% vs 24.0%, $P < .01$).

Discussion: During the COVID-19 outbreak, trauma remained a significant health care concern. This study found an increase in volume of penetrating trauma, specifically gunshot wounds throughout 2020. It remains important to continue to devote resources to trauma patients during the ongoing COVID-19 pandemic.

Keywords

COVID-19, trauma volume, mechanism of injury

Introduction

Beginning in early March 2020, the COVID-19 pandemic caused by the SARS-CoV-2 virus changed the face of health care. This viral outbreak has far-reaching effects on the entire United States health care system. Due to the emerging threat from the virus, elective operative procedures and routine clinic appointments were canceled in a widespread manner. Originally, these decisions were made at the discretion of individual hospitals and hospital systems, but with the rapid intensification and early surge, elective cases were restricted on a national level.¹

Concurrently, most hospitals reported dramatic declines in non-COVID volume from baseline. This phenomenon included medical emergencies such as strokes and major cardiac events which generated significant concern that patients were avoiding medical attention

even in life-threatening circumstances.^{2,3} National stay-at-home orders, patient fear, and other societal changes such as unprecedentedly high unemployment levels were likely all contributing factors to this decrease.⁴

Emergency services, such as trauma care, are not amenable to the national shutdown and therefore required

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a continued devotion of resources and staffing throughout the national shutdown. In Louisiana, injury has been consistently ranked as the third leading cause of death statewide, yearly.⁵ It was unclear, however, whether injury-related emergency visits would decrease despite widespread restrictions. In fact, early reports released from other US urban centers suggest that penetrating trauma, specifically gun violence, not only continued but selectively increased during the peak of the first wave.⁶ In Orleans parish, the total number of homicides increased from 120 in 2019 to 196 during 2020. This represents a 63% increase in the number of homicides and the highest number since 2011.⁷

The first presumptive positive case of COVID-19 in Louisiana was reported on March 9, 2020.⁸ The state's number of COVID-19 cases grew 67.8% to 837 in the first 2 weeks after the initial diagnosis, outpacing New York, which saw its cases grow by 66.1% after the first diagnosis.⁹ Most of the cases were reported in the New Orleans area, with Orleans parish reporting 106.9 confirmed cases per 100 000 residents, a mark that was fifth highest among counties in the country behind New York County and Westchester County in New York. By April 2, 2021, 1498 people were hospitalized with COVID-19, 490 who required ventilators.¹⁰ These numbers down trended precipitously in the subsequent 2 weeks and then cases followed the national trends with a summer peak in July/August 2020 and winter peak from late November through January of 2021. Vaccination efforts began on December 14, 2020.¹¹

The pandemic has had far-reaching effects on the entire health care system with long-term effects still evolving. At present, however, it is imperative to reflect as trending the effects and repercussions on the health care system may help prepare for the response to future crises. Therefore, the objective of this study was to quantify the effect of the COVID-19 pandemic on trauma volume at an urban Level 1 trauma center in one of the earliest and most significantly affected US cities.

Methods

A retrospective chart review of all consecutive trauma patients presenting to a Level 1 trauma center in New Orleans, LA, from January 1, 2017 to December 31, 2020 was completed. All trauma patients presenting as activations or seen as trauma consults from 2017 to 2020 were included in the analysis. Institutional Review Board approval was obtained from Louisiana State University.

Baseline patient demographics including age, gender, race, Injury Severity Score (ISS), and mechanism of injury were collected for each patient. Mechanism of injury was categorized as penetrating (gunshot wound, stab wound, and animal bite), blunt (motor vehicle crash,

Table 1. Study Demographics and Clinical Outcomes for Patients Presenting to a Level I Trauma Center.

Demographics	Pre-COVID (2017- 2019)	COVID (2020)	P value
Penetrating Mechanism, n (%)	n = 11 403	n = 4138	
Age, mean years (SEM)	40.0 (.2)	39.1 (.3)	.02
Male gender, n (%)	8384 (73.5)	3043 (73.5)	1.0
Caucasian, n (%)	4575 (40.1)	1470 (35.5)	<.01
Black, n (%)	5857 (51.4)	2339 (56.5)	<.01
Trauma activations			
Major traumas, n (%)	4062 (35.6)	1592 (38.5)	<.01
Minor traumas, n (%)	4663 (40.9)	1698 (41.0)	.88
Trauma consults, n (%)	2678 (23.5)	848 (20.5)	<.01
Trauma transfers, n (%)	1901 (16.7)	689 (16.7)	1.0
Injury information			
Penetrating, n (%)	2738 (24.0)	1204 (29.1)	<.01
ISS, mean (SEM)	8.0 (.08)	7.5 (.1)	<.01
Clinical outcomes			
COVID-19+, n (%)	0	87 (2.1)	<.01
Admitted, n (%)	7220 (63.3)	2526 (65.0)	.01
ICU admission, n (%)	2931 (25.7)	977 (23.6)	<.01
HLOS, mean days (SEM)	4.6 (.1)	4.5 (.1)	.57
ICU LOS, mean (days)	5.4 (.1)	5.7 (.2)	.14
In-hospital mortality, n (%)	600 (5.5)	220 (5.3)	.90
Operative procedure, n (%)	3896 (34.2)	1363 (32.9)	.16

motorcycle crash, pedestrian vs motor vehicle, fall, and assault), and miscellaneous including burns.

The primary outcome investigated for this study was the trend in trauma volume in 2020 as compared to prior years, represented by the data from 2017 to 2019. Secondary outcomes included volume of major traumas, volume of penetrating vs blunt trauma, volume of trauma by mechanism, percent of patients admitted, ICU admissions, ICU length of stay (LOS), hospital LOS, in-hospital mortality, and volume of operative traumas.

In order to examine the volume of trauma during the COVID-19 pandemic, each calendar year was divided into 4 equal quarters: (1) January 1-March 31; (2) April 1-June 30; (3) July 1-September 30; and (4) October 1-December 31. The first quarter included the first confirmed case of COVID-19 in the United States as well as the beginning of Louisiana's stay-at-home order. The second period included the peak of the first wave in Louisiana, the continuation of the stay-at-home order, and Phase One of the state and city's reopening. The third included the initiation of the statewide mask mandate as well as the second wave of the pandemic in the state. And the last quarter included

Table 2. Detailed Information on the Mechanism of Trauma Broken Down into the Pre-COVID-19 Cohort and COVID-19 Cohort.

	Pre-COVID (2017-2019)	COVID (2020)	P value
Penetrating mechanism, n (%)	n = 2738	n = 1204	
Gunshot wound	1784 (65.2)	853 (70.8)	<.01
Stabbing	912 (33.3)	338 (28.1)	<.01
Animal bite	42 (1.5)	13 (1.1)	.30
Blunt mechanism, n (%)	n = 8669	n = 2934	
Motor vehicle collision	2947 (34.0)	1236 (42.1)	<.01
Motorcycle collision	664 (7.7)	187 (6.4)	.02
Pedestrian	1215 (14.0)	346 (28.7)	<.01
Fall	2053 (23.7)	639 (21.8)	.04
Crush	52 (.6)	21 (.7)	.50
Assault	957 (11.0)	260 (8.9)	<.01
Miscellaneous, n (%)	781	245	
Burn	418 (53.5)	108 (44.1)	.01

the third wave as well as the initiation of vaccine distribution.

Descriptive statistics were used to summarize demographic characteristics and patient outcome data. Categorical variables were reported as numbers and percentages and continuous variables were reported as means with the SEM. Results were compared with univariate analyses for statistical significance using an unpaired two-tailed Student's *t*-test for continuous variables and Fisher's exact test or chi-squared for categorical variables. Data were analyzed using GraphPad software (version 5, La Jolla, CA) and IBM SPSS (version 27, Armonk, NY). A *P* value $\leq .05$ was considered statistically significant.

Results

Trauma Patient Demographics

A total of 4138 trauma patients were seen in the emergency room over the course of 2020. In the pre-COVID-19 era, 4124 were seen during 2019, 3774 during 2018, and 3505 during 2017 resulting in 11 403 total patients. Patient characteristics and outcome information are outlined in Table 1.

Patients seen during 2020 were younger ($39.1 \pm .2$ vs $40.0 \pm .3$, *P* = .02). There was an increased incidence of trauma among black individuals (35.5% vs 40.1%, *P* < .01). No significant difference in the volume of minor trauma or trauma transfers was observed. However, there was a significant increase in the number of major traumas in 2020 as compared to prior years (38.5% vs 35.6%, *P* < .01). Minor trauma was defined as a Tier 2 activation,

known as a "Trauma Bay" at our institution, while major trauma was defined as a Tier 1 activation or "Room 4." Interestingly, the average ISS was significantly higher (8 vs 7.5, *P* < .01) in the pre-COVID era compared to the 2020 year. Meanwhile, there was a significant increase in the volume of penetrating trauma (29.1% vs 24.0%, *P* < .01). No significant difference in hospital LOS, ICU LOS, in-hospital mortality, or patients requiring an operative procedure was observed in 2020 when compared to historical data. 87 patients (2.1%) were incidentally found to be positive for COVID-19 when presenting to the hospital in 2020.

Volume by Mechanism

When broken down by mechanism (Table 2), the number of patients with trauma due to gunshot wounds significantly increased (*n* = 853/1204, 70.8% vs *n* = 1784/2738, 65.2%, *P* < .01) while the number of stab wounds significantly decreased (*n* = 338/1204, 28.1% vs 912/2738, 33.3%, *P* < .01). The trauma volume due to motor vehicle collisions (*n* = 1236/2934, 42.1%, vs *n* = 2947/8669, *P* < .01) and pedestrian vs MVC (*n* = 346/2934, 28.7% vs *n* = 1215/8669, 14%, *P* < .01) also significantly increased, while those due to motorcycle crashes (*n* = 187/2934, 6.4% vs *n* = 664/8669, 7.7%, *P* = .02), falls (*n* = 639/2934, 21.8% vs *n* = 2053/8669, 23.7%, *P* = .04), and blunt assault (*n* = 260/2934, 8.9% vs *n* = 957/8669, 11%, *P* < .01) significantly decreased in 2020 compared to prior years.

Figure 1 demonstrates the yearly trends in the volume of penetrating trauma, as broken down by quarters. When compared to previous years, where a seasonal variation with a summer peak was observed, the 2020 year showed a continuous upward trajectory in volume of penetrating trauma. Most notably, there were 375 patients seen with injuries secondary to penetrating trauma seen in the last quarter of 2020. This accounted for 32.6% of all trauma patients seen that quarter, the highest of any quarter in the last 4 years.

Trends in Trauma Activations

The yearly trends, broken down by quarters, for the volume of blunt trauma are shown in Figure 2. There was a steep decline in the volume of blunt trauma seen during the second quarter of the 2020 year with only 571 blunt trauma patients during those 3 months. This is the lowest volume of blunt trauma seen in any quarter of the last 4 years.

When examining the volume of trauma in 2019 compared to 2020, monthly changes in trauma volume were most significant between March and May 2020 with an average decrease of 23%. Intensive care unit admissions from trauma patients decreased by an average of

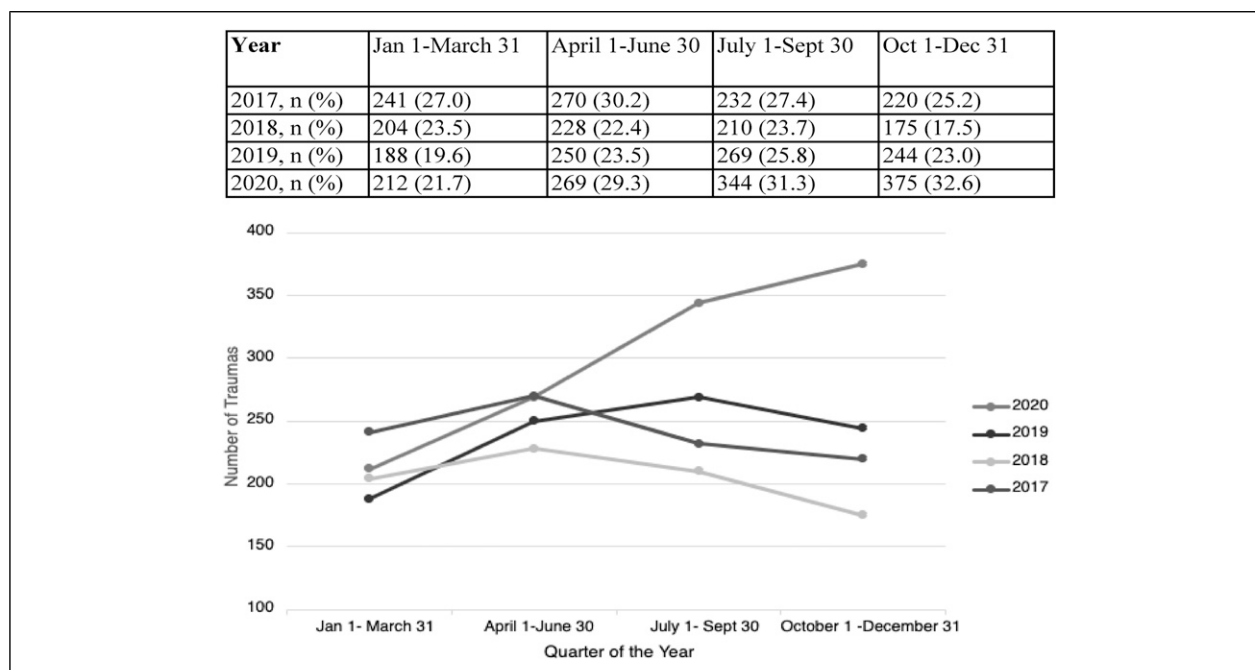


Figure 1. Breakdown of total number of patients presenting to an urban Level I trauma center with a penetrating trauma mechanism based upon quarter of presentation.

30% during the height of the pandemic. However, by June 2020, trauma activations and trauma ICU volume returned to pre-pandemic levels, and they have since continued to remain there.

Discussion

The coronavirus pandemic has had and continues to have an incredible impact on society. While the stay-at-home order instituted at a state and national level at the outset of the pandemic drove people away from electively seeking medical attention, this paradigm shift was short-lived. As coronavirus lingers in our midst, however, there will likely be long-lasting effects that may be difficult to quantify. This retrospective cohort study demonstrates the unique effects of the COVID-19 pandemic on trauma volume in New Orleans, Louisiana. Though trauma volume is subject to yearly and seasonal variation, the changes observed in the number of trauma patients both seen and admitted to the hospital have been significantly impacted by the pandemic. While there was no significant difference in the minor trauma volume during 2020 as compared to years prior, there was a significant increase in major trauma. This situation is likely related to the increased incidence of trauma due to gunshot wounds and gun violence seen during this time period.

Although the yearly trauma volume has been steadily rising from 2017 to 2020, there was not a significant increase in the trauma volume during 2020 as compared to 2019. This is likely explained by the large decline in blunt

trauma and overall trauma seen during the second quarter of 2020, or the peak of the initial wave of the COVID-19 pandemic, when the stay-at-home order was in place. Cavalea et al demonstrated a considerable decrease in trauma volume seen in the first 2 weeks following the implementation of the stay-at-home order, which helps to explain the similarities in overall trauma volume between 2019 and 2020.¹² Interestingly, penetrating trauma was unaffected in volume as compared to prior years and thus made up a larger proportion of the activations (29.3%).

To our knowledge, this is one of the first reports that look at the impact of the pandemic on trauma center volume throughout 2020.^{2,6,13,14} One of the most notable observations of this study is the steady increase in penetrating trauma throughout the last year. The increase in violent crime across New Orleans during this period echoes the increase in gun violence and penetrating trauma seen in other populated urban areas.^{13,14} In fact, Abdallah et al found that the proportion of patients with injuries from gunshot wounds nearly doubled (12.6% vs 22.9%) when comparing pre- and post-stay-at-home order volumes.¹⁵ This finding was echoed in the pediatric literature, where Sanford et al found an increase in penetrating trauma encounters during the epoch of the pandemic while blunt encounters decreased.¹⁶ These studies, however, only examined the immediate impact of the COVID-19 pandemic on trauma volumes at their centers.

This study allowed for further investigation of the impact of the pandemic throughout the course of 2020 as

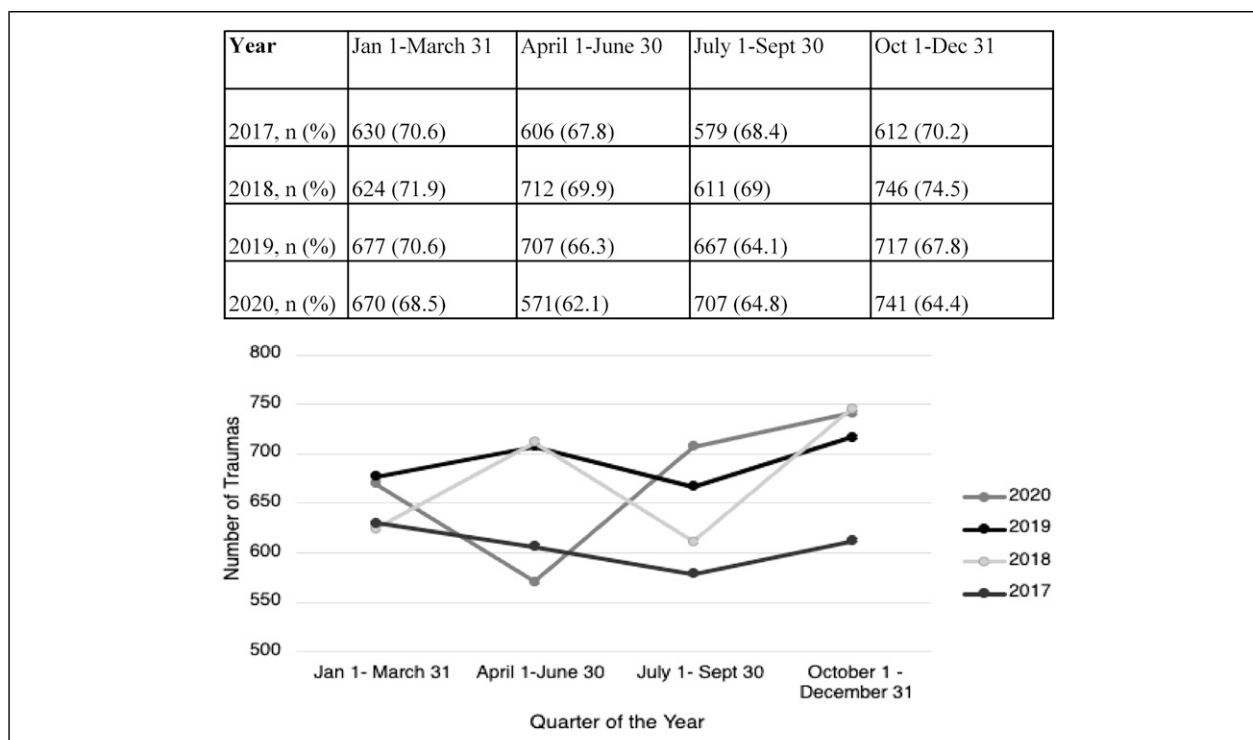


Figure 2. Breakdown of total number of patients presenting to an urban Level I trauma center with a blunt trauma mechanism based upon quarter of presentation.

spread of the virus waxed and waned. While in prior years there was a typical spring/summer violent peak, with an increasing in penetrating trauma, followed by a decline in the last quarter of the year, in 2020 the volume of penetrating trauma continued to climb to an all-time high. From October 1st until the end of 2020, 375 activations for penetrating trauma were seen accounting for 32.6% of all trauma patients during that time period. This finding is particularly concerning as the volume of blunt trauma seen during the final quarter returned to pre-pandemic levels.

It has been postulated that heightened levels of stress due and socioeconomic unrest were significant contributing factors to the increased violent crime.^{6,13} There has been a concurrent surge in the demand for guns across the country during this time as well. The US Federal Bureau of Investigation regularly publishes data on the number of firearm background checks performed each day. All top 10 days with the highest number were in 2020 and 2021 and only 1 week of the top 10 weeks was not in 2020 or 2021.¹⁷ Interestingly, several studies which also demonstrated an increase in gun violence during the pandemic found a significant association between locations of the shootings and the neighborhoods most profoundly affected by COVID.^{13,14} The hypothesis there is an overlap in the social determinants of health affecting both gun violence and disease transmission.

There are limitations to this study which merit discussion. Both the retrospective nature and use of the trauma registry data rely on accurate documentation in the charts. It is also limited by the experience of a single institution that may not represent other health systems and trauma centers across the country and worldwide.

Conclusions

Despite the “stay-at-home” order that spanned 2 months of 2020 and resulted in a decreased overall trauma volume during that time, the overall volume of trauma was unchanged as compared to 2019 and significantly increased when compared to 2017 and 2018. Most significantly the volume of penetrating trauma continued to rise throughout 2020. Given the unabating demand for trauma care, significant efforts must continue to be devoted to maintaining trauma service capacity and capability, regardless of the pandemic demands.

Author Note

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Declaration of Conflicting Interests

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