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Original Research Article



Evaluating the change in patterns of traumatic injury in the setting of pandemic and social distancing restrictions: An analysis of a level 1 trauma center

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ABSTRACT

Background: Social distancing measures and quarantine during the COVID-19 pandemic have led to reported changes in traumatic injury patterns. We set to examine the effects of these restrictive guidelines in our trauma center.

Methods: This is a retrospective chart review of all patients evaluated for traumatic injuries at a Level 1 trauma center during two time periods: March–June 2020 (COVID) and March–June 2019 (Pre-COVID).

Results: Overall trauma volume did not differ significantly between the two time periods. Changes seen during COVID included increases in penetrating injuries (12.5% vs 6.7%, $p < 0.001$), particularly those due to firearms (7.5% vs 3.7%, $p < 0.001$). Hospital length of stay, intensive care unit length of stay, and days on the ventilator remained consistent between the two groups. Trends toward increased injuries in the home and non-accidental trauma were not statistically significant.

Conclusion: Traumatic injury patterns have changed as a result of social distancing in both the adult and pediatric trauma populations. Analyzing the effects of social distancing on trauma can lead to a better development of preventive strategies.

1. Introduction

First identified in December 2019, the novel coronavirus (COVID-19) spread rapidly across continents and, in a few months, was declared a global pandemic by the World Health Organization (WHO).¹ As the first case was identified in the United States,² implementation of social distancing measures at both the local and state levels were initiated to reduce the total number of infections and slow the spread of the disease. Throughout March 2020, a series of increasingly restrictive guidelines were placed in the state of Texas by the Governor under the “Work Safe, Stay Home Order No. 16”.³ On March 13, 2020, the first case of COVID-19 was identified in El Paso, stay-at-home orders were instituted by the city, county and state governments, and the United States-Mexico border was closed to all non-essential travel and trade.⁴ Reports generated by the United States Department of Transportation Bureau

revealed that total number of border crossings along the El Paso-Juarez border dropped from 1,051,583 in March 2019 to 492,953 in March 2020.⁵

The pandemic has had major effects to our healthcare systems but has also had a significant psychosocial impact on the population secondary to the need for social distancing and quarantine. To sustain health systems during these times, elective surgeries had been placed on hold and we transitioned to virtual based clinics in order to divert resources and encourage safety.^{6,7,8}

Overall, trauma centers reported an initial decline in overall trauma admissions in the initial setting of social distancing measures^{6,7,9,10,11}; however, this downtrend was temporary. Trauma centers in various parts of the country have seen an increased trend of penetrating injury, especially involving interpersonal violence and firearms. Gun sales increased by an estimated 91% in March of 2020 compared to

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2019.^{10,12,13} Additionally, increases in substance abuse have been identified. In a multicenter study performed by McGraw et al., a significant increase in patients presenting positive for alcohol and drugs was demonstrated across several states.

Of additional importance are the effects that the pandemic has had upon the pediatric population, including changes in school instruction, different primary caretakers, and altered interaction with peers. Pediatric trauma centers have likewise observed a change in the trauma volume, and changes in injury patterns.^{14,15,16} The psychosocial impact of the pandemic in this population has raised concerns for increase in child abuse, with the potential for under reporting secondary to the closure of schools, which is often the primary center for reporting these cases.^{16,17}

As the only level 1 trauma center within a 270-mile radius, serving two states and two countries, we sought to examine the consequences of social distancing and quarantine on traumatic injury patterns in our area. We hypothesized an overall decline in the number of injuries and changes in injury patterns, with a trend towards increase in interpersonal violence or self-harm.

2. Methods

This is a retrospective study approved by the institutional review board at the Texas Tech University Health Sciences Center El Paso. All data was obtained from University Medical Center of El Paso, Texas (an ACS verified level 1 trauma center caring for adults and children) and El Paso Children's Hospital. Data was extracted from our institutional trauma registry covering two time periods: March–June 2019 (Pre-COVID) and March–June 2020 (COVID).

All trauma admissions ages 0–105 presenting to our trauma center were analyzed between March 1, 2020 to June 30, 2020, with the same time period in 2019 used as the historical control.

Patient demographics, place of injury, injury of mechanism, and International Classification of Disease (ICD)-10 codes were used to identify injury etiology. Injury severity scores, patient comorbidities, post emergency department (ED) disposition, length of stay, intensive care unit length of stay, ventilator days, funding type, drug and alcohol screens, and discharge disposition were also collected. Primary outcome interests were trauma admission trends and mechanism of injury. An additional limited evaluation was performed of trauma admissions during our local COVID peak in November of 2020 to February of 2021 to evaluate effects of rising cases on local trauma patterns.

Qualitative variables were summarized using frequency and percentages while quantitative variables were summarized using mean and standard deviation for normally distributed parameters as well as median with interquartile range (IQR) for skewed parameters. Data was compared between pre and post COVID-19 time periods. A Fisher's exact test and chi-square test was used to compare the categorical parameters between pre and post COVID-19 hospitalizations. An unpaired *t*-test was used to compare the mean differences of normally distributed parameter and rank-sum test was used to compare the continuous but skewed parameters between pre and post COVID-19 hospitalization. A *p* value of <0.05 was considered statistically significant. All data analysis was conducted using standard statistical software Stata 15.1 (Copyright 1985–2017 StataCorp LLC StataCorp, 4905 Lakeway Drive, College Station, Texas 77845 USA).

3. Results

Trauma data from two time periods were analyzed comparing March–June 2020 (COVID) to March–June 2019 (Pre-COVID) data. Trauma volume was similar, with 1145 admissions in 2020 and 1020 admissions in 2019. After implementation of social distancing restrictions in March 2020, there was a slight decline in trauma admissions during April, with a rebound of numbers exceeding those of 2019 in May and June. (Table 1). Only 7 trauma patients were recorded as COVID

Table 1

Breakdown of admissions by month.

Injury Month	Pre-COVID (2019)	COVID (2020)	<i>p</i> = 0.047
March	229 (22.45%)	261 (22.79%)	
April	238 (23.33%)	216 (18.86%)	
May	290 (28.43%)	309 (26.99%)	
June	263 (25.78%)	359 (31.35%)	

positive during this time, though universal testing of admitted patients had not yet been implemented due to limited availability of tests (see Table 2).

There was an absolute rise in both blunt and penetrating injuries in 2020, but the proportion of penetrating injuries increased while the proportions of the blunt injury decreased. Statistical significance was seen in penetrating injuries (143 [12.5%] vs 68 [6.7%], *p* < 0.001), with higher number of injuries resulting from the use of firearms (86 [7.5%] vs 43 [4.2%], *p* = 0.001). Traumatic injuries due to machinery also exhibited an upward trend, though not statistically significant.

Investigation of injury circumstances revealed an increase in suspected abuse/assault, self-inflicted injuries, and non-accidental traumas. In the COVID group, 32 self-inflicted injuries were identified, and of those, 25 were penetrating in mechanism and 9 due to firearms. The Pre-COVID group comparatively revealed 21 self-inflicted injuries, of which 5 were penetrating.

Firearm injuries increased in 2020, with 86 in the COVID group compared to 44 Pre-COVID. Of the 86 firearm-related injuries in 2020, 31 (36%) were attributed to accidents, 46 (53%) to assault and/or abuse, and 9 (10%) were self-inflicted. Of the 44 injuries in 2019, 14 (32%) were attributed to accidental causes, 24 (55%) to assault and/or abuse, and 3 (7%) were self-inflicted.

The location of trauma accidents revealed a rise in occurrences at private residences and in the wilderness, though this was not statistically significant. A similar proportion of injuries occurred on roadways in both time periods. There were no school or sport accidents reported in 2020, as expected with school and extracurricular sport cancellation. Additional trends noted included an increase in those with recorded substance abuse disorder and current smokers, though these did not reach statistical significance. A review of our pediatric trauma data reflected an increase in penetrating injury involving firearms, and trends towards increases in self-harm and non-accidental trauma cases.

Though a higher number of patients were admitted to the intensive care unit (ICU) in 2020, the median length of stay was similar between both time periods. Finally, proportions of patients discharged home, to long term care hospitals, skilled nursing facilities, and inpatient rehabilitation remained stable despite reported limited resources around the country.

Analysis of the months where local COVID 19 numbers peaked, revealed surprisingly consistent patterns with minor differences. Overall trauma volume for the months of November 2020–February 2021 exhibited a moderate decline to 956, revealing a difference of 189 from the time state and federal restrictions were placed (Table 3). Of the 956, 8.7% of those tested positive for COVID on admission. Consistent with peak COVID 19 cases in our city, the highest percentage (13%) of positive patients were in December 2020. Compared to the data from March 2020–June 2020, the percentage of blunt and penetrating injuries were consistent. Median hospital lengths of stay, ICU lengths of stay and ventilators days did increase by one day for all three categories. Post discharge dispositions were also consistent (see Table 4).

4. Discussion

Secondary to the COVID-19 pandemic, stay-at-home orders implemented at all levels of government have impacted trends seen in the adult and pediatric trauma patient. This retrospective study of a single level 1 trauma center is unique. Our data presents results from a center

Table 2
Patient characteristics comparing Pre-COVID and COVID time periods.

Patient Characteristics	Patients, No (%)		p value
	Pre-COVID n = 1020	COVID n = 1145	
Gender			0.075
Female	322 (31.57%)	403 (35.20%)	
Male	697 (68.33%)	742 (64.80%)	
Age (years), mean (SD)	42.90 (25.96)	43.44 (25.63)	0.62
Mechanism of Injury			
Penetrating	68 (6.7%)	143 (12.5%)	<0.001
Blunt	920 (82.1%)	971 (84.8%)	<0.001
Crush	7 (0.69%)	5 (0.44%)	0.57
Burn	20 (1.96%)	27 (2.36%)	0.56
Other	5 (0.49%)	4 (0.35%)	0.74
Injury Circumstances			<0.001
Accidents	790 (86.4%)	955 (83.3%)	
Assault/Abuse	132 (12.9%)	152 (13.2%)	
Self-inflicted/Suicide	19 (1.86%)	33 (2.88%)	
Post ED Disposition			<0.001
Floor	414 (40.59%)	465 (40.65%)	
Intensive Care Unit (ICU)	227 (22.25%)	297 (25.96%)	
Interventional Radiology	4 (0.39%)	5 (0.44%)	
Observation Unit (ED Obs)	1 (0.10%)	3 (0.26%)	
Operating Room	114 (11.18%)	157 (13.72%)	
Other	204 (20.00%)	99 (8.65%)	
Step Down Unit	56 (5.49%)	118 (10.31%)	
Injury Severity Score (ISS), median (IQR)	5.00 (4.00, 10.00)	5.00 (4.00, 10.00)	0.99
ISS score >15	151 (14.83%)	180 (15.79%)	0.55
Patient Outcomes			
Length of Stay (LOS), median (IQR)	3.00 (2.00, 6.00)	3.00 (2.00, 6.00)	0.27
Intensive Care Unit Length of Stay (ICU LOS), median (IQR)	2.00 (2.00, 5.00)	2.00 (2.00, 4.00)	0.19
Days on Ventilator, median (IQR)	3.00 (2.00, 8.00)	3.00 (2.00, 8.00)	0.58
Co-morbidities			
Substance abuse	23 (2.25%)	39 (3.41%)	0.12
Current smoker	107 (10.49%)	171 (14.93%)	0.002
COVID-19 Status			<0.001
Positive	0 (0.00%)	7 (0.75%)	
Funding			<0.001
Medicare	253 (24.80%)	283 (24.76%)	
Medicaid	237 (23.24%)	295 (25.81%)	

Table 2 (continued)

Patient Characteristics	Patients, No (%)		p value
	Pre-COVID n = 1020	COVID n = 1145	
Commercial	226 (22.16%)	165 (14.44%)	
HMO/PPO	51 (5.00%)	96 (8.40%)	
Other	149 (14.61%)	151 (13.21%)	
Uncompensated/Indigent	104 (10.20%)	153 (13.39%)	
Discharge to:			<0.001
ED/Hospital Death	24 (2.35%)	38 (3.32%)	
Home	654 (64.12%)	803 (70.13%)	
Hospice	5 (0.49%)	6 (0.52%)	
Long Term Care Hospital	10 (0.98%)	16 (1.40%)	
Other	186 (18.24%)	105 (9.17%)	
Skilled Nursing Facility/Inpatient Rehabilitation	141 (13.82%)	177 (15.46%)	

Table 3
Trauma volume during peak COVID volume.

Injury Month	Volume	COVID +
November 2020	186	18 (9.6%)
December	267	35 (13.1%)
January 2021	251	15 (5.9%)
February	252	16 (6.3%)

Table 4
Patient characteristics during peak COVID volume.

Patient Characteristics	Patients, No (%)
n = 956	
Gender	
Female	378
Male	578
Mechanism of Injury	
Penetrating	110 (85.3%)
Blunt	25 (11.5%)
Burn	25 (2.6%)
Other	5 (0.5%)
Injury Severity Score (ISS), median (IQR)	1 (1.00, 8.00)
Patient Outcomes	
Length of Stay (LOS), median (IQR)	4 (2.00, 9.00)
Intensive Care Unit Length of Stay (ICU LOS), median (IQR)	3 (2.00, 6.00)
Days on Ventilator, median (IQR)	4 (2.00, 11.00)
Discharge to:	
ED/Hospital Death	29 (3.03%)
Home	528 (55.2%)
Hospice	1 (0.2%)
Long Term Care Hospital	12 (1.3%)
Other	229 (23.9%)
Skilled Nursing Facility/Inpatient Rehabilitation	122 (12.7%)

located in an isolated region, serving a population of over 1 million, sharing its borders with Mexico, and functions as the primary center for adult and pediatric trauma patients.

Consistent with the experience of other centers globally and in the

United States,^{6,7,9,8} our trauma volumes trended down in the initial month after restrictive guidelines were mandated by government authorities. In a multicenter study performed by Berg et al. that included 85 trauma centers across the United States, there was a substantial decrease in volume, decrease in motor vehicle collisions, a decrease in blunt injuries, and increase in penetrating injuries.¹⁸ Similar findings were noted in yet another multicenter study by Pelzl et al. where they too found a decrease in patient volume, increase in penetrating injuries, higher acuity and an increase in in-hospital mortality.¹⁹

Our center experience reflects that of the studies above in decline in blunt injuries and increase in penetrating injuries, but, interestingly, we observed an initial decline followed by an uptick in trauma numbers, and even return to pre-pandemic numbers. In June 2020, the number of trauma admissions at our institution surpassed that of the previous year. Overall trauma admissions within the studied time periods were consistent in comparison between 2019 and 2020. We hypothesized that the smaller effect on trauma volume seen in our study compared to similar studies in other parts of the country might be related to the relatively low case numbers reported in our area in the study period. Between the months of March–June 2020, a total of 2420 cases were reported, with less than 60 cases reported daily, 321 hospitalizations, and 112 deaths. COVID-19 cases in our area did not peak until November and December 2020, with cases at that time averaging 500 per day and totaling over 30,000 cases, 1000 hospitalizations, and 438 deaths.²⁰ Analysis of trauma data from November 2020–February 2021 did reveal only a modest decline of 189 despite the peak. It is possible that our sustained trauma volume during this time was a result of shift in trauma referrals in our region. Many regional hospitals were off and on diversion due to COVID-related admissions during this period, and our hospital never stopped accepting trauma transfers, instead accommodating patients in overflow and other emergency units. On the other, it could also be a reflection of seasonal variation as these were within the winter months.

When evaluating our discharge dispositions between all three time periods, discharges to long term care facilities, skilled nursing facilities, and in-patient rehabilitation units maintained consistent. We must commend our social workers and case managers who work tirelessly to mobilize patients to their required facilities. We have a unique relationship with two states that likely allows our patients more options for disposition. An additional contributing factor was also the patient's COVID status. Prior to discharge, patients were required to acquire a negative COVID test prior to transfer. As the majority of our trauma patients were negative to begin with, this also gave our patients more options and ease for disposition.

Consistent with several centers around the country,^{18,19,21} we saw a significant increase in the total number of traumas involving firearms. The underlying reason is still up for debate, but it is clear that the potential heightened stress induced by the pandemic on the social, physical, and psychological effects is taking its toll. To better investigate, we performed a sub-analysis of injuries secondary to firearms.

Overall firearm-related injuries nearly doubled in our 2020 group, from 44 to 86. It is interesting to note that the proportion of injuries attributed to each cause remained very similar between the two time periods, showing an increase in all-cause firearm-related injury rather than a specific increase in, for example, self-inflicted injuries. This overall increase in injuries may be related to an increase in gun ownership, as evidenced in reports of an additional 1 million background checks initiated in March 2020 alone, compared to March 2019. Over 3 million firearm background checks were performed in the United States leading to the highest ever recorded firearm purchases recorded in U.S history, and many by new owners.^{10,22} It is well documented that access to firearms leads to an increase in both accidental and intentional shootings.^{23,24,22} Furthermore, within times of pandemic, violence involving firearms is more likely.²⁵ With this acute rise in new gun owners, we can hypothesize that such a rise has led to increased injuries due to unfamiliarity with safety protocols or introduction of firearms

into households without proper measures in place to secure guns against accidental discharge. This continues to provide opportunities to target risk reduction not only through implementation of educational initiatives regarding gun safety and firearm injury prevention, but also include a nationwide initiative for providing safety devices for storage.^{22,26}

The ISS scores did not differ significantly between the two time periods, though the total number of firearm incidences increased. Further analysis revealed the majority of the firearm incidences were isolated to the extremities, which likely explains this finding.

Alongside the increase of firearm incidences with interpersonal violence, there is also concern for higher risk of self-harm as access to formal psychosocial support had been limited by the pandemic. The effects on mental health have been attributed to fear, self-isolation, physical distancing, all which can also exacerbate preexisting mental illness.²⁷ Not only that, but as aforementioned, increased access to means for self-harm, including firearms, poses a serious threat. Further limitations in regular interaction with normal social circles have also been drastically altered, affecting overall well-being.

There have been a number of recent studies which have looked at the rates of patients positive for alcohol and drugs. Studies conducted by Forrester et al. and Leichtle et al. did not report significant differences in terms of positivity rates with the initiation of stay-at-home orders. Meanwhile, a multi-center study across several states, conducted by McGraw et al., 2021, revealed a significant increase in alcohol positive patients (32% vs 39%, $p = 0.007$), with an unchanged rate of drug positive patients (57% vs 52%, $p = 0.13$). We saw a small increase in substance abuse rates in our study, but these did not reach statistical significance. Though there is variability, it appears that the pandemic has exacerbated the behavior of some of those with underlying substance abuse disorders.²⁸

It is clear that there is a need for not only injury prevention, but prevention of further exacerbation of those currently struggling with mental health disorders and those who become newly diagnosed. There is a need to be able to identify those who are at risk, provide better access to mental health resources, and mitigating those who tend towards self-harm.²⁹

This analysis is that of a single institution and is retrospective in design, which is the primary limitation of this study. Chart review and interpretation, in addition to data entry accuracy into the database, present further limitations. Our data is consistent with findings of other similar centers across the world and the United States. The time period in which this data was collected, reflects that of the immediate months following social distancing and quarantine mandates. The full effects of the pandemic overall may not be recognized during our selected time periods, as mentioned previously, as our most impacted months from high volume COVID-19 cases did not reach a pinnacle until November and December of 2020. Local and state mandates regarding social distancing, masking, and elective surgery changed frequently over the first year of the pandemic, with up to 30 COVID-related executive orders between March and December of 2020, making it challenging to evaluate the effects of specific interventions on trauma patterns within this time period.

In an attempt to evaluate how rising COVID-19 case numbers affected trauma volume, we performed a limited analysis of the trauma registry for our peak COVID period of November 2020–February 2021. This revealed similar overall trauma volume despite a significant rise in our city's absolute number of COVID 19 cases and some of the highest mortality rates in the country. Out of these four months, December 2020 had the highest trauma volume even amidst the highest number of COVID 19 cases resulting in hospitalization and death. Penetrating volume remained stable at 11% compared to 12.5% from initiation period of state mandates. The median hospital length of stay, ICU length of stay, and ventilator days increased by 1 day compared to earlier in 2020. Discharges to long term care facilities and rehab/skilled nursing facilities also remained similar. This may be due in part to our location

on the border and our established referral patterns to facilities in two states.

5. Conclusions

The effects of governmental mandates requiring social distancing and quarantine are seen in trauma volumes and injury patterns in both the adult and pediatric trauma population. Though our results mirror some of those seen around the country and even the world, our institution did reveal some unique differences. We observed an initial decline in overall trauma numbers, but volume soon rose to pre pandemic numbers, and even surpassed in certain months. There was a rise in penetrating trauma and an increase in self-inflicted injury and suicide, but overall injury severity scores remained stable. Despite challenges with patient dispositions reported around the country, our patient discharges to needed facilities did not suffer. It is clear that the pandemic has left lasting effects on our system and in the world. Analyzing the overall effects of social distancing can lead to a better understanding for the development of preventive strategies, outreach in trauma centers, and overall preparedness in times of pandemic.

References

- WHO Director-General's opening remarks at the media briefing on COVID-19 11 March 2020. <https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19-11-march-2020>. Accessed June 30, 2021.
- Holshue ML, DeBolt C, Lindquist S, et al. Washington state 2019-nCoV case investigation team. First case of 2019 novel coronavirus in the United States. *N Engl J Med*. 2020 Mar 5;382(10):929–936. <https://doi.org/10.1056/NEJMoa2001191>. Epub 2020 Jan 31. PMID: 32004427; PMCID: PMC7092802.
- The county of El Paso Texas.work Safe, stay home order No. 16. <https://www.epc.oumy.com/admin/stayhomeworksafe.htm>. Accessed June 29, 2021.
- National archives and records administration. <https://www.federalregister.gov/documents/2020/03/24/2020-06253/notification-of-temporary-travel-restrictions-applicable-to-land-ports-of-entry-and-ferries-service>, 7/1/21.
- United States Department of Transportation. Bureau of transportation statistics. Border crossing/entry data. <https://www.bts.gov/browse-statistical-products-and-data/border-crossing-data/border-crossingentry-data>. Accessed January 7, 2021.
- Staunton P, Gibbons JP, Keogh P, Curtin P, Cashman JP, O'Byrne JM. Regional trauma patterns during the COVID-19 pandemic. *Surgeon*. April 2021;19:2. <https://doi.org/10.1016/j.surge.2020.08.003>.
- Olding J, Zisman S, Olding C, Fan K. Penetrating trauma during a global pandemic: changing patterns in interpersonal violence, self-harm, and domestic violence in the Covid-19 outbreak. *Surgeon*. February 2021;19:1. <https://doi.org/10.1016/j.surge.2020.07.004>.
- Jacob S, Mwagiru D, Thakur I, Moghadam A, Oh T, Hsu J. Impact of societal restrictions and lockdown on trauma admissions during the COVID-19 pandemic: a single-centre cross-sectional observational study. *ANZ J Surg*. 2020 Nov;90(11):2227–2231. <https://doi.org/10.1111/ans.16307>. Epub 2020 Sep 29. PMID: 32894624.
- Ghafil C, Matsushima K, Ding L, Henry R, Inaba K. Trends in trauma admissions during the COVID-19 pandemic in Los Angeles county, California. *JAMA Netw Open*. 2021;4(2), e211320. <https://doi.org/10.1001/jamanetworkopen.2021.1320>.
- Hatchimonji JS, Swendiman RA, Seamon MJ, Nance ML. Trauma does not quarantine: violence during the COVID-19 pandemic. *Ann Surg*. 2020;272(2):e53–e54. <https://doi.org/10.1097/SLA.0000000000003996>.
- Leichtle SW, Rodas EB, Procter L, Bennett J, Schrader R, Aboutanos MB. The influence of a statewide "Stay-at-Home" order on trauma volume and patterns at a level 1 trauma center in the United States. *Injury*. 2020;51(11):2437–2441. <https://doi.org/10.1016/j.injury.2020.08.014>.
- Druzin H. Gun sales Skyrocket in March on pandemic fears [Internet] *Guns & America*; April 1, 2020. Available from <https://gunsandamerica.org/story/20/04/01/gun-sales-skyrocket-in-march-on-pandemic-fears/>.
- Cohen JS, Donnelly K, Patel SJ, et al. Firearms injuries involving young children in the United States during the COVID-19 pandemic [published online ahead of print, 2021 apr 13] *Pediatrics*. 2021, e2020042697. <https://doi.org/10.1542/peds.2020.042697>.
- Sanford EL, Zagory J, Blackwell JM, Szmuk P, Ryan M, Ambardekar A. Chagnes in pediatric trauma during COVID-19 stay-at-home epoch at a tertiary pediatric hospital. *J Pediatr Surg*. May 2021;918–922 [Dallas].
- Kovler ML, Ziegfeld S, Ryan LM, et al. Increased proportion of physical child abuse injuries at a level I pediatric trauma center during the Covid-19 pandemic. *Child Abuse Negl*. 2021;116(Pt 2):104756. <https://doi.org/10.1016/j.chiabu.2020.104756>.
- Sidpra J, Abomeli D, Hameed B, Baker J, Mankad K. Rise in the incidence of abusive head trauma during the COVID-19 pandemic. *Arch Dis Child*. 2021;106, e14.
- Green P. Risks to children and young people during covid-19 pandemic. *BMJ*. 2020; 369. <https://doi.org/10.1136/bmj.m1669>. m1669.
- Berg GM, Wyse RJ, Morse JL, et al. Decreased adult trauma admission volumes and changing injury patterns during the COVID-19 pandemic at 85 trauma centers in a multistate healthcare system. *Trauma Surg Acute Care Open*. 2021;6(1), e000642. <https://doi.org/10.1136/tsaco-2020-000642>. Published 2021 Feb 11.
- Pelzl CE, Salottolo K, Banton K, et al. COVID-19 and trauma: how social distancing orders altered the patient population using trauma services during the 2020 pandemic. *Trauma Surg Acute Care Open*. 2021;6(1), e000645. <https://doi.org/10.1136/tsaco-2020-000645>. Published 2021 Feb 17.
- Public health and data analytics. <https://www.elpasocountyhealth.org/covid19data-dashboard>, 6/30/21.
- Chodos M, Sarani B, Sparks A, et al. Impact of COVID-19 pandemic on injury prevalence and pattern in the Washington, DC metropolitan region: a multicenter study by the American College of surgeons committee on trauma, Washington, DC. *Trauma Surg Acute Care Open*. 2021;6(1), e000659. <https://doi.org/10.1136/tsaco-2020-000659>. Published 2021 Jan 19.
- Bleyer A, Siegel SE, Thomas Jr CR. Increasing rate of unintentional firearm deaths in youngest Americans: firearm prevalence and covid-19 pandemic implication. *J Natl Med Assoc*. 2021;113(3):265–277. <https://doi.org/10.1016/j.jnma.2020.12.005>.
- Kellermann AL, Simes G, Rivara FP, Lee RK, Banton JG. Injuries and deaths due to firearms in the home. *J Trauma*. 1998 Aug;45(2):263–267. <https://doi.org/10.1097/00005373-199808000-00010>. PMID: 9715182.
- McGraw C, Jarvis S, Carrick M, et al. Examining trends in gun violence injuries before and during the COVID-19 pandemic across six trauma centers. *Trauma Surg Acute Care Open*. 2022;7(1), e000801. <https://doi.org/10.1136/tsaco-2021-000801>. Published 2022 Jan 10.
- Pino EC, Gebo E, Dugan E, Jay J. Trends in violent penetrating injuries during the first year of the COVID-19 pandemic. *JAMA Netw Open*. 2022;5(2), e2145708. <https://doi.org/10.1001/jamanetworkopen.2021.45708>. Published 2022 Feb 1.
- Rowhani-Rahbar A, Simonetti JA, Rivara FP. Effectiveness of interventions to promote Safe firearm storage. *Epidemiol Rev*. 2016;38(1):111–124. <https://doi.org/10.1093/epirev/mxv>.
- Gunnell D, Appleby L, Arensman E, et al. Suicide risk and prevention during the COVID-19 pandemic. *Lancet Psychiatr*. 2020;7(6):468–471. [https://doi.org/10.1016/S2215-0366\(20\)30171-1](https://doi.org/10.1016/S2215-0366(20)30171-1).
- McGraw C, Salottolo K, Carrick M, et al. Patterns of alcohol and drug utilization in trauma patients during the COVID-19 pandemic at six trauma centers. *Inj Epidemiol*. 2021;8:24. <https://doi.org/10.1186/s40621-021-00322-0>.
- Marroquín B, Vine V, Morgan R. Mental health during the COVID-19 pandemic: effects of stay-at-home policies, social distancing behavior, and social resources. *Psychiatr Res*. 2020;293, 113419. <https://doi.org/10.1016/j.psychres.2020.113419>.