

Current Burden of Gunshot Wound Injuries at Two Los Angeles County Level I Trauma Centers

Christopher P Foran, MD, Damon H Clark, MD, Reynold Henry, MD, Priti Lalchandani, MD, Dennis Y Kim, MD, FACS, Brant A Putnam, MD, FACS, Morgan Schellenberg, MD, Christianne J Lane, PhD, Kenji Inaba, MD, FACS, Demetrios G Demetriades, MD, PhD, FACS

- BACKGROUND:** Gunshot wound (GSW) injuries present a unique surgical challenge. This study explored the financial and clinical burdens of GSW patients across 2 Los Angeles County Level I trauma centers over the last 12 years, and compared them with other forms of interpersonal injury (OIPI).
- STUDY DESIGN:** This was a retrospective study of patients presenting as those with GSW and OIPI (defined as combined stab wound or blunt assault), between January 1, 2006 and March 30, 2018, at LAC+USC Medical Center (LAC+USC) and Harbor UCLA Medical Center (HUCLA). Demographic and clinical variables were assessed for GSW patients and compared with victims of OIPI.
- RESULTS:** There were 17,871 patients who met inclusion criteria. There was a significant difference in mortality for patients with GSW vs OIPI (11% vs 2%, $p < 0.001$). The odds ratio for GSW patients requiring operation was twice as high as those suffering OIPI (odds ratio [OR] 2.0, 95% CI 1.8 to 2.2). The odds ratio for GSW patients requiring ICU admission was 20% higher than that for OIPI patients (OR 1.23, 95% CI 1.11 to 1.36). Gunshot wound patients experienced a longer median length of stay vs OIPI patients (3 days vs 2 days, $p < 0.001$). The median hospital charge per admission for GSW was twice that of OIPI (GSW \$12,612 vs OIPI \$6,195; $p < 0.001$).
- CONCLUSIONS:** When compared with OIPI, GSW patients arrived more severely injured and required more operations, more ICU admissions, and longer hospital stays. Patients with GSW incurred significantly higher hospital charges and had a significantly higher mortality rate. Gunshot wound injury is a unique public health concern requiring comprehensive, nation-wide, contemporary study. (J Am Coll Surg 2019;229:141–149. © 2019 by the American College of Surgeons. Published by Elsevier Inc. All rights reserved.)

CME questions for this article available at <http://jacscme.facs.org>

Disclosure Information: Authors have nothing to disclose. Timothy J Eberlein, Editor-in-Chief, has nothing to disclose.

Presented at the Southern California Chapter of the American College of Surgeons Annual Scientific Meeting, Santa Barbara, CA, January 2019.

Received January 5, 2019; Revised February 25, 2019; Accepted February 26, 2019.

From the Division of Acute Care Surgery and Surgical Critical Care, Los Angeles County + University of Southern California Medical Center (LAC+USC), Los Angeles, CA (Foran, Clark, Henry, Schellenberg, Lane, Inaba, Demetriades) and the Division of Trauma/Acute Care Surgery/Surgical Critical Care, Harbor-University of California Los Angeles Medical Center (HUCLA), Torrance, CA (Lalchandani, Kim, Putnam).

Correspondence address: Damon H Clark, MD, 1520 San Pablo St, Los Angeles, CA 90033. email: Damon.clark@med.usc.edu

Gunshot wound (GSW) injury poses a unique surgical and public health challenge in the US. Additional research into this mechanism of traumatic injury is required to fully understand its scope and adequately implement informed prevention and intervention strategies.

In an effort to add to the academic discourse on gun violence in the US, the trauma divisions of the Los Angeles County + University of Southern California Medical Center (LAC+USC) and Harbor-UCLA Medical Center (HUCLA) have collaborated to better understand the clinical burden of GSW injuries in our communities. As high-volume level I trauma centers that frequently treat patients with GSW, it is incumbent on hospitals like ours to add to the knowledge base

Abbreviations and Acronyms

GSW	= gunshot wound
HPSA	= Health Professional Shortage Area
HUCLA	= Harbor University of California Los Angeles Medical Center
ISS	= Injury Severity Score
LAC +	= Los Angeles County + University of Southern California Medical Center
OIPI	= other forms of interpersonal injury
OR	= odds ratio

regarding GSW injury. Previous investigations have provided an excellent framework for publishing regional data on gun violence, and we have used these to help guide our investigation.¹⁻⁴

The purpose of this study was to define the clinical and financial burden of GSW trauma in our combined patient population over the last 12 years and compare these results with other forms of interpersonal injury (OIPI). We hypothesized that gun-related trauma will demonstrate a larger clinical and financial impact on patients and hospitals when compared with other forms of interpersonal violence.

METHODS

After Institutional Review Board approval, we performed a nearly 12-year (January 1, 2006 to March 30, 2018) retrospective study of patients presenting after GSW or OIPI. We defined OIPI as stab wound or blunt assault. Patients were identified from the electronic trauma databases of LAC+USC and HUCLA—2 urban, level I trauma centers under the Los Angeles County Department of Health Services. Data were combined for multicenter review. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Demographic and clinical variables collected were age, race, mechanism of injury, Injury Severity Score (ISS), admission disposition, mortality, hospital length of stay, insurance status, and total hospital charges. Regarding race, patients were grouped into the following categories based on their designation in the electronic database: White, non-Hispanic; Black; Asian; Filipino and Pacific Islander; Hispanic; and Other or Unknown. For analyses, all race categories < 5% of the sample were combined. The total number of wounds was not considered for any injury mechanism, only the presence or absence of injury. Self-inflicted wounds were included in the analysis and were not examined separately. For admission disposition, patients were organized into the following categories based

on the next phase of care from the emergency department: directly to the operating room, ICU (including pediatric ICU), interventional radiology, medical/surgical ward, stepdown unit, or post-hospital (discharged from the emergency department). Patients listed for 23-hour observation and as “special” were excluded from analysis. For the purposes of analysis, patients dispositioned directly to interventional radiology from the trauma bay were combined with the operating room patients, and step-down admissions were combined with medical/surgical ward patients. Patients with missing disposition data were excluded from this section of analysis.

Readmissions for complications due to GSW or OIPI were included in our analysis because these readmissions contributed to the overall burden of GSW or OIPI. Financial data were assessed by total hospital charges and calculated by each hospital based on Consolidated Business Office protocols. Charges were considered for each individual emergency department or inpatient admission. All other charges associated with outpatient follow-up or home care were not evaluated. Charges assigned per day were calculated from rates approved by the Los Angeles County Board of Supervisors, based on services required for each hospital visit. Insurance status of patients was provided by the electronic trauma databases and the Utilization Review Department of LAC+USC.

All variables were assessed for GSW patients and compared with those for patients with OIPI. Main outcomes measures included mortality, admission disposition, length of stay in days, hospital charges, and ISS. Frequencies of categorical variables for GSW and OIPI were reported as n (%); categorical outcomes were reported as medians and 99% CI of the median in order to adjust for some extreme outliers. Bivariate comparison between GSW and OIPI were made using chi-square tests for categorical variables and Mann-Whitney U tests for continuous variables using SPSS (v. 24). Multivariate models of the outcomes were performed using logistic regression for mortality and linear regression of log values for length of stay, charges, and ISS in order to satisfy normality criteria. A priori alpha of 0.01 was set to indicate statistical significance. Mapping software Tableau (v.2018.2.3) was used to create a heat-map of GSW injury patient admission by ZIP code of injury incident.

RESULTS

Of 26,996 injuries queried during the observation period, 17,871 were either GSW- or OIPI-related. In our study group, most patients were Hispanic (56%), followed by African-American (26%). While the median age overall was 30 years old (99% CI 30 to 31 years), the median age of GSW patients was several years less (median 25 years

old, 99% CI 25 to 26 years). Forty-four percent of patients were uninsured, 17% had commercial insurance, and 36% had some form of government-sponsored insurance (such as Medicare, Medicaid, Medi-Cal) (Table 1).

Patients with GSW had higher admission ISS than OIPI patients (median ISS for GSW = 8, 99% CI 8 to 9 vs median ISS for OIPI = 4, 99% CI 4 to 5, $p < 0.001$). There was a statistically significant difference in mortality for patients with GSW vs OIPI (11% vs 2%, $p < 0.001$), with a 6.2 times greater risk of dying in GSW patients than OIPI patients (99% CI, odds ratio [OR] 5.3 to 7.3, $p < 0.001$) (Table 2). Table 3 demonstrates the total number of GSW and OIPI injuries each year studied, with their associated mortality rates. The statistically significant difference in mortality rate between GSW and OIPI remained

consistent throughout the study period (Table 3, Fig. 1). The odds ratio for GSW patients requiring direct admission to the operating room was twice as high as that for OIPI patients (OR 2.0, 99% CI 1.8 to 2.2, $p < 0.001$). There was no significant improvement in GSW mortality over the study period. The odds ratio for GSW patients going to the ICU was 20% higher than for OIPI patients (OR 1.23, 99% CI 1.11 to 1.36, $p < 0.001$). Length of hospital stay ranged from 1 to 1,098 days.

Patients with GSW stayed in the hospital approximately 1 day more than patients with OIPI (GSW median 3 days vs 2 days for OIPI, $p < 0.001$) (Table 2). The total hospital charge for GSW patients was \$351,378,882. The median hospital total charge per admission for GSW was twice that of OIPI (median

Table 1. Demographics, Disposition, and Mortality of Gunshot Wound and Other Forms of Interpersonal Injury Patients

Variable	Total		OIPI		GSW		p Value*
	n	%	n	%	n	%	
Site							<0.001
LAC+USC	12,381	69	9,311	79	3,070	51	
HUCLA	5,490	31	2,518	21	2,972	49	
Race [†]							<0.001
Asian	473	3	383	4	90	2	
African American/black	4,407	26	2,335	21	2,072	35	
Filipino/Pacific Islander	78	1	33	<1	45	1	
Caucasian	2,112	13	1,683	15	429	7	
Hispanic	9,497	56	6,277	57	3,220	54	
Native American	8	0	6	<1	2	<1	
Other	351	2	238	2	113	2	
Type of insurance							<0.001
Commercial	2,979	17	1,820	16	1,159	19	
Government subsidized	6,199	36	3,977	35	2,222	37	
Unknown [‡]	490	3	260	2	230	4	
None	7,549	44	5,172	46	2,377	40	
Mortality							<0.001
Lived	16,099	95	10,792	98	5,307	89	
Died	905	5	223	2	682	11	
Disposition from ED [§]							<0.001
ICU	1712	10	1,039	10	673	12	
Interventional radiology	28	0	15	<1	13	<1	
Operating room	2,952	18	1,516	14	1,436	24	
Ward	5,582	33	3,885	36	1,697	29	
Step down	439	3	197	2	2,42	4	
Discharge from ED	6,066	36	4,252	39	1,814	31	

p Values are for unadjusted analyses. Comparisons of categorical variables were made with chi-square.

*Statistically significant.

[†]Race comparison combined all categories with <5%.

[‡]Removed from statistical analyses.

[§]Disposition combined interventional radiology with operating room, and ward with step down for analyses.

ED, emergency department; GSW, gunshot wound; HUCLA, Harbor-University of California Los Angeles Medical Center; LAC+USC, Los Angeles County + University of Southern California Medical Center; OIPI, other forms of interpersonal injury.

Table 2. Length of Stay and Charges of Gunshot Wound and Other Forms of Interpersonal Injury Patients

Variable	Total		OIPI		GSW		p Value*
	Median	99% CI	Median	99% CI	Median	99% CI	
Age, y	30	30–31	33	33–34	25	25–26	<0.001
Hospital length of stay, d	2	2–3	2	2–3	3	3–4	<0.001
Hospital charge, \$	9,277	7,875–9,553	6,195	6,195–7,298	12,612	12,569–15,620	<0.001
Injury Severity Score	4	4–5	4	4–5	8	8–9	<0.001

Values of p are for unadjusted analyses. Comparisons of categorical variables were made with chi-square. Comparisons of medians were made using Mann-Whitney U test.

*Statistically significant.

GSW, gunshot wound; OIPI, other forms of interpersonal injury.

GSW, \$12,612 [99% CI \$12,569 to \$15,620] vs median OIPI, \$6,195 [99%CI \$6,195 to \$7,298]; $p < 0.001$ (Table 2). A multivariate analysis was performed. Controlling for site, race, insurance status, and year did not change the effects of GSW on our primary outcomes.

The ZIP codes of injury incidents were collected for GSW patients with available data ($n = 2,599$) from the respective hospital's trauma database and depicted in a heat map of Los Angeles County (Fig. 2). These ZIP codes were cross-referenced with publicly available data published by the Centers for Medicare and Medicaid Services (CMS) to determine income level and qualification for designation as a Health Professional Shortage Area (HPSA).⁵ The 10-injury incident ZIP codes providing the highest volume of GSW patients were all found to be designated as "low income," and 70% were also determined to be HPSAs (Table 4). Overall, combining both GSW and OIPI patients, only 27% of the sample ($n = 7,205$) had both home and injury ZIP codes available. Of these patients, 43% ($n = 3,118$) had the same home and injury ZIP codes.

DISCUSSION

The US has the highest rate of homicides due to firearms among developed countries,⁶ with more than 38,000 deaths and 85,000 nonfatal injuries annually.⁷ The GSW patients in our patient population were significantly more likely to require operations, ICU admissions, or die from their injury when compared with OIPI patients. The significantly higher ICU and OR admissions undoubtedly contributed to the higher hospital charges and length of stay seen in our GSW patients when compared with patients of OIPI.

Several articles reiterate the clinical burden of gun violence on clinicians and hospitals.^{2,4,8-10} Works by Sise and colleagues,¹¹ Gross and associates,² and Wintemute and coworkers,¹² found that there has been little to no change in firearm-related mortality over time, despite general improvements in trauma care. Our data echoed these findings, with no significant improvement in GSW mortality over time (Table 3, Fig. 1).

Our financial analysis showed that the median hospital charges for hospitalization of a GSW patient were more

Table 3. Injuries and Mortalities per Year

Year	Total			Other form of interpersonal injury			Gunshot wound			p Value*
	Injury, n	Mortality, n	Mortality rate, n	Total, n	Mortality, n	Mortality rate, %	Total, n	Mortality, n	Mortality rate, %	
2006	306	22	7	164	5	3	142	17	11	<0.01
2007	1,198	61	5	812	24	3	386	37	9	<0.01
2008	1,121	65	6	767	20	3	354	45	11	<0.01
2009	1,204	60	5	892	26	3	312	34	10	<0.01
2010	1,191	52	4	872	23	3	319	29	8	<0.01
2011	1,171	46	4	854	26	3	317	20	6	0.02
2012	1,497	83	5	967	16	2	530	67	11	<0.01
2013	1,632	114	7	1,062	10	1	570	104	15	<0.01
2014	1,656	92	5	1,128	18	2	528	74	12	<0.01
2015	1,773	94	5	1,169	14	1	604	80	12	<0.01
2016	1,815	113	6	1,142	22	2	673	91	12	<0.01
2017	1,425	91	6	915	18	2	510	73	13	<0.01
2018 [†]	110	12	10	48	1	2	62	11	15	0.03

*Value of p refers to difference in mortality rates between gunshot wound and other forms of interpersonal injury.

[†]2018 data collected through March 30, 2018.

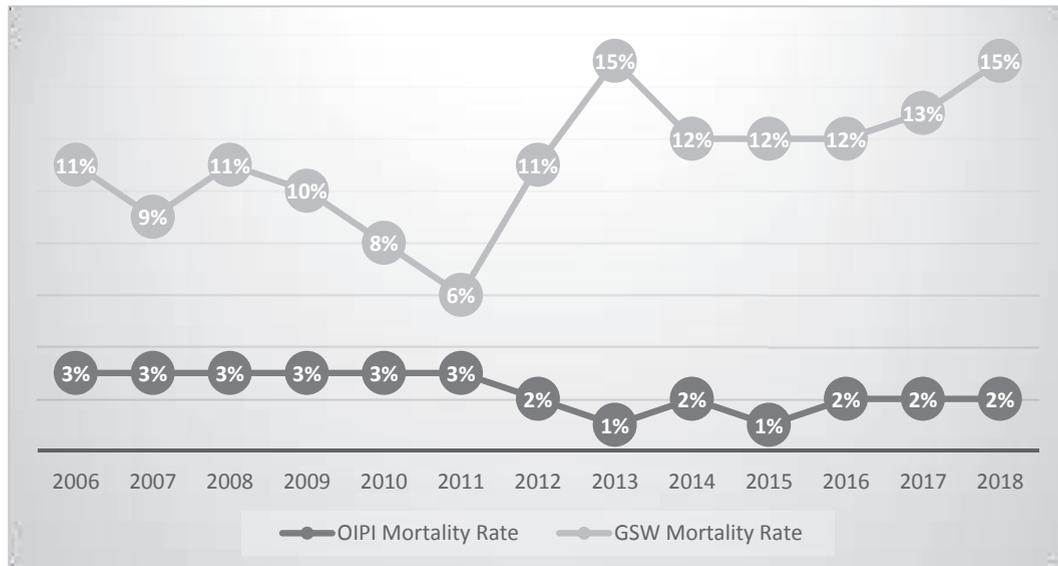


Figure 1. The mortality rate over time for gunshot wound (GSW) victims vs those with other forms of interpersonal injury (OIPI).

than twice those for patients with OIPI, per patient admission. Previous studies have calculated the financial burden of GSW injuries in the US. In 2014, Lee and coauthors¹³ projected that the overall societal cost of firearm injury in the US was approximately \$174 billion in a single year. Miller and Cohen¹⁴ demonstrated, in a meta-analysis, that the costs of gun violence extended beyond the hospital, with increased use of prehospital care, remedial mental health care requirements, skilled nursing, and outpatient physical and occupational therapy needs in GSW survivors. In a profound disparity, GSW survivors' cost on average \$154,000 per survivor compared with only \$12,000 per stab wound survivor. This disparity in cost mirrors our own disparity in inpatient hospital charges between GSW and OIPI patients.

Further work by Spitzer and colleagues¹⁵ demonstrated that the majority of the financial burden for these injuries falls on uninsured patients or patients with government-funded insurance. Consistent with Spitzer's findings, roughly 77% of the GSW patients in our study were either uninsured or were participating in government-subsidized insurance programs. Research has shown that nonprofit hospitals must absorb more than two-thirds of the cost of uninsured patient care.¹⁶ With this in mind, it is reasonable to intuit that a substantial portion of the hospital charges for GSW patients in our study were supported to some degree by tax dollars.

Our work demonstrated that the black and Hispanic populations of Los Angeles County presenting to LAC+USC and HUCLA bear approximately 90% of the burden of GSW injuries. This percentage must be taken in the context

of the overall demographics of Los Angeles County. Los Angeles County is 48.6% Hispanic or Latino, 9.0% black, and 26.2% non-Hispanic white.¹⁷ Most of these patients are younger than 30 years old. These findings are echoed by Livingston and associates¹¹ work from Newark, NJ, showing that 95% of GSW patients were either black or Hispanic, with a median age of 27 years old. Livingston's work also found that census tracts with high-incidence clustering of GSW victimization had greater proportions of residents living below poverty, with lower median household incomes. Similarly, when assessing the 10 ZIP codes with the highest incidence of GSW victimization from our patient population, 100% of these ZIP codes were deemed "low-income" by the Centers for Medicare and Medicaid Services, while 70% were also considered HPSAs. Further supporting our findings, multiple additional studies, both local and national in scope, have shown that minority populations, particularly black and Hispanic, bear the brunt of GSW victimization in the US.^{10,18,19}

Sossenheimer and colleagues²⁰ provided a thorough discussion of the concept of "structural violence," defined as the ways in which social arrangements, such as government, economics, or religion, put certain populations in harm's way over others. Examples of structural violence cited in the piece include lower life expectancy for poorer communities; higher rates of trauma center closures for communities of poor, uninsured minorities; poorer surgical outcomes and less postoperative care for uninsured patients; and poorer outcomes for minority trauma patients. Most importantly, lower socioeconomic status, homelessness, race, and lack of insurance predict a higher risk for

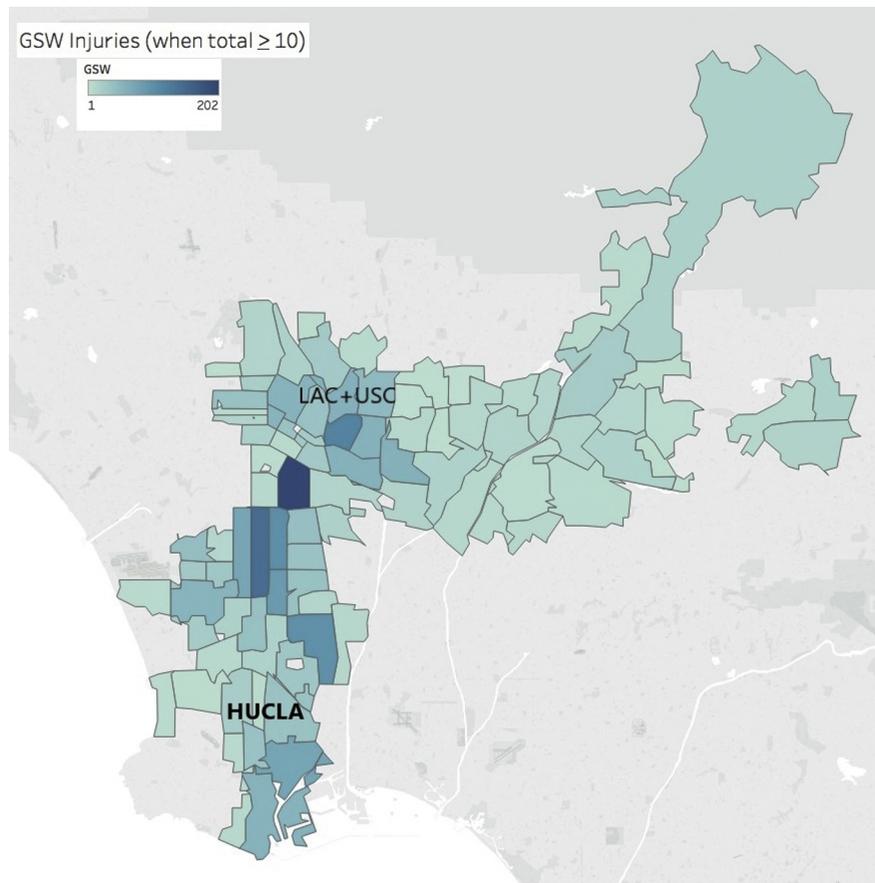


Figure 2. A color-coded heat map of injury incident ZIP codes for gunshot wound (GSW) patients. The darker blue color represents higher volumes of GSW incidents. HUCLA, Harbor-University of California Los Angeles Medical Center; LAC+USC, Los Angeles County + University of Southern California Medical Center.

violent injury recidivism. The shared demographics and socioeconomic makeup of our patient population with populations cited in Sossenheimer's work beg further, more nuanced investigation into the structural violence

helping to feed patients into the LAC+USC and HUCLA trauma systems.

There are multiple limitations to this study, the first being its retrospective design with data acquisition from 2

Table 4. Top 10 Home ZIP Codes for Gunshot Wound Patients and Characteristics

Zip Code	GSW	OIPI	Total	Low-income status*	HPSA*
90011	202	285	487	Yes	Yes
90044	145	91	236	Yes	Yes
90033	117	199	316	Yes	No
90003	102	68	170	Yes	Yes
90220	99	20	119	Yes	No
90061	88	44	132	Yes	Yes
90744	74	56	130	Yes	No
90047	72	20	92	Yes	Yes
90031	58	104	162	Yes	Yes
90022	57	82	139	Yes	Yes

*Determined by the Centers for Medicare & Medicaid Services (CMS).

GSW, gunshot wound; HPSA, Health Professional Shortage Area; OIPI, other forms of interpersonal injury.

separate databases. This inevitably leads to missing data points for a number of patients. Furthermore, we were unable to accurately estimate the burden of missed injuries that were not recorded in the trauma registries. A weakness of the financial burden assessment includes assessing hospital charges rather than hospital cost, which may be a more accurate measure of the actual financial burden to the hospital and society. At this time, the Los Angeles County Department of Health Services does not have a standardized cost-accounting system by which we can easily track hospital costs. A charge-to-cost ratio would help us better understand the final dollar amount required to care for these patients. There is no reason to assume, however, that the significant difference in hospital charges between GSW and OIPI patients would not appear similarly in a hospital cost analysis. We believe the disparity in charges between care of GSW patients and OIPI patients is a more important point to make in this work than the final dollar amount of cost.

Another limitation of this study is its focus on an almost exclusively young, urban, minority population. This is likely due to the geographic location and associated demographics of both hospitals studied. The overall implications and applicability of our data must still be taken within the context of the specific demographic studied. It should be noted, however, that GSW injuries in the US transcend demographic boundaries. Nationally, the proportion of firearm suicide to firearm homicide is approximately 2:1. Older, white, non-Hispanic men are at the greatest risk of firearm suicide.²¹ Additionally, research has shown that the rate of youth gun homicide in most urban counties in the US nearly equals the rate of youth gun suicide in rural counties.²² These facts speak to the ubiquity of GSW injury as a salient mechanism of traumatic injury across all geographic and demographic delineations.

We did not perform an independent analysis of self-inflicted vs interpersonal injuries in this study, which may be seen as a shortcoming. However, this research has been performed previously at our institution, LAC+USC, by Bukur and colleagues.²³ They found that over an 11-year period, 1.6% of trauma admissions were due to self-inflicted injury. Of those injuries, roughly 10% (72 of 753) were due to self-inflicted GSW. Self-inflicted GSW carried with it a nearly 110-fold increased risk of death compared with self-inflicted stab wound.

The urgency of recognizing and addressing firearm-related suicide in the US cannot be overstated. The rate of suicide for both adults and youths has risen sharply in recent years,²⁴ and access to firearms has been shown to increase the risk of completed suicide.²⁵ Nationally, 51% of all suicides involve a firearm²⁶ and 63% of all firearm-related deaths are suicides.²⁷ Suicide is a particularly

worrisome problem in young populations; it is the second leading cause of death for 12 to 25 year olds and the third leading cause of death for 26 to 34 year olds.²⁸

The research team deliberately did not perform an analysis of the changes in the sheer volume of GSW injuries presenting to our 2 hospitals (Table 3). Factors that may lead to fluctuations in GSW injury volume, such as changes to surrounding hospitals' trauma care capabilities or dynamic catchment areas over time, prevent us from making an informed statement on the current state of gun violence in all of Los Angeles County, based on the experience of LAC+USC and HUCLA alone.

Finally, the scope of this study does not extend to the roots of GSW injury or the long-term societal costs associated with GSW victimization. The authors of this work have consciously made this a statement of the problem of GSW violence in our catchment areas, rather than a dedicated exploration of causes or solutions. This constitutes a first step in our commitment to holistically examining the public health problem of gun violence in Los Angeles County. The natural and intended next steps in our academic pursuit include investigating the coalescence of race, economics, geography, legislation, regulation, politics, and health care infrastructure at the root of interpersonal violence incidence, outcomes, and recurrence. To this end, the authors are using these data to help inform hospital-based violence intervention and prevention initiatives within our respective catchment areas, such as Stop the Bleed training at local high schools, education on violent injury outcomes and violence prevention to local high-risk youths by our trauma surgeons, a laser tattoo removal program for former gang members within our catchment area, and augmentation of inpatient violence intervention programs for youth injured by interpersonal violence. By partnering with nonprofit community organizations such as Southern California Crossroads, our institutions have steadily improved our collective ability to both identify patients who are victims of interpersonal violence and ensure that victim advocacy efforts continue to gain momentum. Early identification and enrollment of patients into intensive case management services has been critical in our efforts to assist those affected by interpersonal violence with safe housing and relocation, employment, assistance with coverage of funeral costs, and improved access to state-funded compensation programs. Our geographic analysis helps provide target zones for these community outreach programs.

It is important to frame this work within the context of a growing volume of recent literature devoted to examining gun violence in the US as a public health issue rather than a political one. The American College of Surgeons Firearm Strategy Team (FAST) Workgroup has recently

published The Chicago Consensus I: a list of evidence-based recommendations on gun regulation, safety, research, and education. Gun-owning surgeons also considered to be experts in the field of trauma were deliberately recruited to collaborate on the consensus.²⁹ Stewart and colleagues²⁶ recently published work seeking to “provide a constructive path forward to reducing violent injury and death based on an effective and durable public health approach,” while acknowledging the need for all sides of the political argument to work in concert to find solutions rather than proceed as adversaries. Further papers by Resnick and colleagues,³⁰ Kalesan and associates,³¹ and Lee and coworkers³² have laid the groundwork for contemporary research into effective gun regulation.

CONCLUSIONS

The experience of LAC+USC and HUCLA with GSW patients over nearly 12 years clearly demonstrated that when compared with all other forms of interpersonal injury, GSW patients arrived younger and more severely injured. Gunshot wound patients more frequently required operations, ICU admissions, and longer hospital stays, and they incurred significantly higher hospital charges and had a significantly higher mortality rate compared with patients with OIPI. The burden of these injuries appears to be falling on a predominantly black and Hispanic population in low-income ZIP codes. As more contemporary studies are completed, we are confident that a new, comprehensive, modern understanding of GSW violence is manifesting, as we collectively seek to solve this unique public health issue.

Author Contributions

Study conception and design: Foran, Clark, Henry, Lalchandani, Kim, Putnam, Schellenberg, Lane, Inaba, Demetriades

Acquisition of data: Foran, Clark, Henry, Lalchandani, Kim, Putnam, Schellenberg, Lane, Inaba, Demetriades

Analysis and interpretation of data: Foran, Clark, Henry, Lalchandani, Kim, Putnam, Schellenberg, Lane, Inaba, Demetriades

Drafting of manuscript: Foran, Clark, Henry, Lalchandani, Kim, Putnam, Schellenberg, Lane, Inaba, Demetriades

Critical revision: Foran, Clark, Henry, Lalchandani, Kim, Putnam, Schellenberg, Lane, Inaba, Demetriades

REFERENCES

- Livingston DH, Lavery RF, Lopreiato MC. Unrelenting violence: An analysis of 6,322 gunshot wound patients at a Level I trauma center. *J Trauma Acute Care Surg* 2014;76:2–11.
- Gross BW, Cook AD, Rinehart CD. An epidemiologic overview of 13 years of firearm hospitalizations in Pennsylvania. *J Surg Res* 2017;210:188–195.
- Morrison C, Gross B, Horst M. Under fire: gun violence is not just an urban problem. *J Surg Res* 2015;199:190–196.
- Moore DC, Yoneda ZT, Powell M. Gunshot victims at a major level I trauma center: a study of 343,866 emergency department visits. *J Emerg Med* 2013;44:585–591.
- Centers for Medicare & Medicaid Services. Database of HPSA and low-income ZIP codes for issuers subject to the alternate ECP standard for the purposes of QHP certification. Available at: <https://data.cms.gov/Marketplace-Qualified-Health-Plan-QHP-/Database-of-HPSA-and-Low-Income-ZIP-Codes-for-Issu/8wk5-pp5m>. Accessed November 10, 2018.
- Grinshteyn E, Hemenway D. Violent death rates: the US compared with other high-income OECD countries, 2010. *Am J Med* 2016;129:266–273.
- AAST Statement on Firearm Injury. *J Trauma Acute Care Surg* 2018;85:426.
- Demario VM, Sikorski RA, Efron DT. Blood utilization and mortality in victims of gun violence. *Transfusion* 2018;58:2326–2334.
- Agarwal S. Trends and burden of firearm-related Hospitalizations in the United States across 2001–2011. *Am J Med* 2015;128:484–492.
- Cook A, Osler T, Hosmer D. Gunshot wounds resulting in hospitalization in the United States: 2004–2013. *Injury* 2017;48:621–627.
- Sise RG, Calvo RY, Spain DA. The epidemiology of trauma-related mortality in the United States from 2002 to 2010. *J Trauma Acute Care Surg* 2014;76:913–920.
- Wintemute GJ. The epidemiology of firearm violence in the twenty-first century United States. *Ann Rev Pub Health* 2015;36:5–19.
- Lee J, Quraishi SA, Bhatnagar S. The economic cost of firearm-related injuries in the United States from 2006 to 2010. *Surgery* 2014;155:894–898.
- Miller TR, Cohen MA. Costs of gunshot and cut/stab wounds in the United States, with some Canadian comparisons. *Accid Anal Prev* 1997;29:329–341.
- Spitzer SA, Staudenmayer KL, Tennakoon L. Costs and financial burden of initial hospitalizations for firearm injuries in the United States, 2006–2014. *Am J Pub Health* 2017;107:770–774.
- Garthwaite C, Gross T, Notowidigdo M. Hospitals as insurers of last resort. *Amer Econ J: Applied Economics* 2018;10:1–39.
- QuickFacts Los Angeles County, California. Available at: www.census.gov/quickfacts/losangelescountycalifornia. Accessed February 17, 2019.
- Walker GN, McLone S, Mason M, Sheehan K. Rates of firearm homicide in Chicago by region, age, sex, and race/ethnicity, 2005–2010. *J Trauma Acute Care Surg* 2016;81:S48–S53.
- Fowler KA, Dahlberg LL, Haileyesus T, Annett JL. Firearm injuries in the United States. *Prev Med* 2015;79:5–14.
- Sossenheimer PH, Andersen MJ, Clermont MH, et al. Structural violence and trauma outcomes: an ethical framework for practical solutions. *J Am Coll Surg* 2018;227:537–542.
- Centers for Disease Control and Prevention. Injury Prevention & Control Data and Statistics (WISQARS). Available at: <https://www.cdc.gov/injury/wisqars/index.html>. Accessed November 10, 2018.

22. Dodson NA. Adolescent gun violence prevention: what we know, and what we can do to keep young people safe. *Curr Opin Pediatr* 2016;28:441–446.
23. Bukur M, Inaba K, Barmparas G. Self-inflicted penetrating injuries at a level I trauma center. *Injury* 2011;42:474–477.
24. Centers for Disease Control and Prevention. Suicide rising across the US. Available at: <https://www.cdc.gov/vitalsigns/suicide>. Accessed February 18, 2019.
25. Anglemyer A, Horvath T, Rutherford G. The accessibility of firearms and risk for suicide and homicide victimization among household members: a systematic review and meta-analysis. *Ann Intern Med* 2014;160:101–110.
26. Stewart RM, Kuhls DA, Rotondo MF. Freedom with responsibility: a consensus strategy for preventing injury, death, and disability from firearm violence. *J Am Coll Surg* 2018;227:281–283.
27. Alban RF, Nuño M, Ko A. Weaker gun state laws are associated with higher rates of suicide secondary to firearms. *J Surg Res* 2018;221:135–142.
28. Thompson MP, Swartout K. Epidemiology of suicide attempts among youth transitioning to adulthood. *J Youth Adolesc* 2018;47:807–817.
29. Talley CL, Campbell BT, Jenkins DH. Recommendations from the American College of Surgeons Committee on Traumas Firearm Strategy Team (FAST) Workgroup: Chicago Consensus I. *J Am Coll Surg* 2019;228:198–206.
30. Resnick S, Smith RN, Beard JH. Firearm deaths in America: can we learn from 462,000 lives lost? *Ann Surg* 2017;266:432–440.
31. Kalesan B, Mobily ME, Keiser O. Firearm legislation and firearm mortality in the USA. *Lancet* 2016;387:1847–1855.
32. Lee LK, Fleegler EW, Farrell C, et al. Firearm laws and firearm homicides: A systematic review. *JAMA Intern Med* 2017;177:106–119.