



Circumstances surrounding gun violence with youths in an urban setting☆☆☆

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ABSTRACT

Background: Our pediatric trauma center has noted an increase in the occurrence of gunshot wounds in children. We aimed to understand the circumstances surrounding these injuries in order to provide targeted injury prevention methodologies.

Methods: A retrospective review was performed on patients who presented with a gunshot wound to our Level I Pediatric Trauma Center and two neighboring Adult Trauma Centers between 2013 and 2017.

Results: Three hundred twenty-six patients (6 months to 18 years) were treated for gunshot wounds. Patients were African American (86%), Caucasian (9%), and other races (5%). Eight zip-codes were identified as high-risk, accounting for 52% of patients. Most injuries (86%) were from powder firearms. Known circumstances (n = 275) included drive-by shootings (47%), unlocked guns (19%), crime related (13%), altercation between adolescents (7%), cross-fire from adult altercation (6%), home invasion (6%), and suicide attempts (2%). There was a progressive increase of 50% over the last 4 years. The increase in incidence was predominantly from an increase in drive-by shootings; however, the incidence of injuries from unlocked guns has remained relatively constant per year. Mortality was 6%.

Conclusion: Identifying high-risk zones for drive-by shootings and other crimes is critical for developing system-focused interventions. Zip-code data stratified by age and circumstances, will allow for targeted community outreach on gun safety education, in an effort to reduce the incidence of injuries from unlocked guns.

Level of Evidence: Prognostic and Epidemiologic study, Level III.

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1. Background

Firearm-related injuries remain a significant public health concern, contributing to premature death and trauma in children. The American College of Surgeons issued a report in 2013, stating that firearm injuries were the second leading cause of death in their pediatric trauma centers [1]. Since this report, there have been over 17,000 children injured or killed by firearms in the United States [2]. Despite heightened public awareness, increasing fatalities from firearms represent a concerning trend across the nation [3].

According to the Federal Bureau of Investigation, violent crime was at a height of 1.93 million crimes in 1992 but then since reached a low of 1.15 million violent crimes in 2014. Violence has steadily increased

nationwide since 2014 with an estimated 1.25 million violent crimes occurring in 2017 [4]. The city of Detroit leads the nation as the most violent big city, having a 16% increase in all violent crimes in 2016 (13,705); this trend continued into 2017 (13,796) [5].

Non-fatal injuries have lasting devastating effects on children and their families. The Center for Disease Control and Prevention's (CDC) National Center for Injury Prevention and Control reported 47,234 non-fatal firearm assault injuries nationally between 2013 and 2016 among children 18 and younger [6]. The CDC ranked the city of Detroit 8th in pediatric (aged 10–19 years old) firearm homicides (32 per 100,000 people annually) [7]. In 2013 the Detroit Youth Violence Prevention Initiative surveyed 1311 students within the Detroit Public School Community District and found that 87% of children knew someone who had been disabled, wounded or killed by gun violence. Fifty-one percent reported witnessing a violent act as frequently as 4–7 times per week [8].

A study conducted by Fowler et al. examined data from 17 states over 10 years in order to understand fatal and nonfatal firearm injuries in children. They concluded that “understanding their nature and impact is a first step towards prevention” [9]. Choi et al. conducted an epidemiologic study in St. Louis that showed a constant rate of

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unintentional shootings despite their gun safety injury prevention efforts. The number of violent crimes (per 100,000 population) in St. Louis is similar to that of Detroit [10]. Our own institution reported an increasing incidence of pediatric firearm related injuries over a 10-year study period (2003–2012), proposing prevention programs focused during summer months [11].

Big cities with high crime rates are in great need of effective firearm prevention initiatives that aim to reduce both intentional and unintentional shootings. Within the city of Detroit, our trauma centers have noted a continued increase in firearm-related injuries among the pediatric population. We aimed to understand the circumstances surrounding these injuries in order to provide targeted injury prevention methodologies. This data can be used for the development of system-focused interventions in an effort to reduce the incidence of firearm-related injuries.

2. Methods

An institutional review board approved retrospective review was performed on all pediatric patients (0–18 years old) who presented with a gunshot wound to the Detroit Medical Center (DMC) hospital system between 2013 and 2017. The DMC includes Children's Hospital of Michigan (CHM), Sinai-Grace Hospital (SGH) and Detroit Receiving Hospital (DRH), with American College of Surgeons (ACS)-verified Level I pediatric, Level II adult, and Level I adult trauma centers, respectively.

There were 480 patients identified through our trauma database. Of these patients, 154 were excluded; 8 patients were unidentifiable with unknown age, 17 patients were later identified to be over 18 years old, 39 patients did not sustain a penetrating injury (blunt trauma or witness to gun-related circumstance), and the remaining patients did not have data available regarding the circumstances of their injury.

The study population was divided into three age categories: 0–7 years (infants and young children), 8–14 years (older children and preadolescents) and 15–18 years (adolescents). Variables examined included age, race, gender, zip-code, type of firearm, circumstances surrounding the firearm-related injury, location of shooting, shooter and mortality. Data were analyzed by using SPSS version 24 (IBM, Armonk, New York) and descriptive statistics. A Spearman's correlation was used to assess the relationship between age categories and circumstances. The assumptions for these tests were verified prior to analysis. Statistical significance was determined at $p = 0.01$ level.

3. Results

In this 5-year period, 326 patients were treated for gunshot wounds. The average age was 14 years old, ranging from 6 months to 18 years old; 35 (11%) were infants and young children (6 months to 7 years old), 80 (24%) were older children and preadolescents (8–14 years old), and 211 (65%) were adolescents (15–18 years old). Males were most commonly injured (80%). Patients were African American (86%), Caucasian (9%), and other races (5%). Most injuries occurred from powder firearms (86%). Known circumstances ($n = 275$) included drive-by shootings (47%), unlocked guns (19%), crime related (13%), altercation between adolescents (7%), cross-fire from adult altercation (6%), home invasion (6%), and suicide attempts (2%). Most injuries were sustained from an unknown shooter (72%) followed by self-inflicted (11%), another child (10%), known adult (6%), and a sibling (1%). Of the known locations ($n = 297$), the shooting occurred in the car (30%), own home (29%), while walking in the neighborhood (18%), public places (9%), recreational areas and schools (7%), and other's home (7%). Mortality was 6%.

There was a progressive increase the incidence of gunshot injuries by 50% over the last 4 years. In 2013 there were 68 incidents, followed by a decrease in 2014 and 2015 with 43 and 48 incidents, respectively. In 2016, we saw a 67% increase of gunshot wound patients with 80 incidents; there were 88 in 2017. The increase during 2016 and 2017 was predominantly from an increase in drive-by shootings. We also noted that the number of injuries from unlocked guns increased from 5 cases in 2016 to 18 cases in 2017 (Fig. 1).

There was a statistically significant association between age categories and circumstances surrounding gunshot injuries ($r_s(326) = -0.152, p = 0.006$). Among all age groups, drive-by shootings were the most prevalent. The next most common circumstances surrounding infants and young children were unlocked guns (14%) and cross-fire from adult altercations (11%); unlocked guns (26%) and home invasions (11%) for older children and preadolescents; unreported circumstances (20%) and crime-related (16%) for adolescents (Table 1). Of the 51 circumstances reported as unknown, 43 of the children were in the adolescent category (84%).

Of the 326 patients included in this study, 110 were treated at CHM (34%), 160 at SGH (49%), and 56 at DRH (17%). Of the patients treated at CHM, 27 were 0–7 years old (24%), 59 were 8–14 years old (54%), and 24 were 15–18 years old (22%). Of the patients treated at SGH, 7 were 0–7 years old (4%), 9 were 8–14 years old (12%), and 134 were 15–18 years old (84%). Of the patients treated at DRH, 1 was 0–7 years

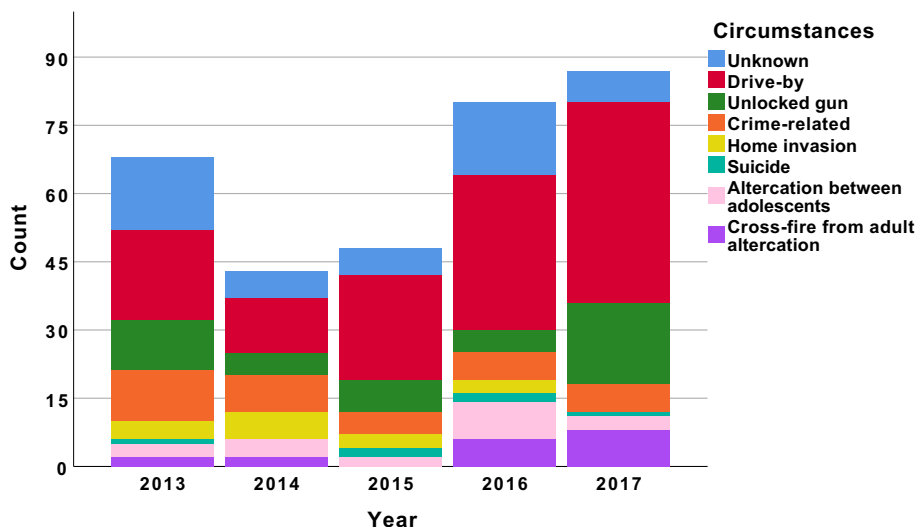


Fig. 1. Incidence of firearm-related injuries per year by circumstances.

Table 1
Circumstances surrounding firearm-related injuries per age category.

	Unknown	Drive-by	Unlocked gun	Crime	Home invasion	Suicide	Altercation between adolescents	Cross-fire from adult altercation
Infants and young children	3 (9%)	19 (54%)	5 (14%)	0 (0%)	1 (3%)	0 (0%)	3 (9%)	4 (11%)
Older children and preadolescents	5 (6%)	27 (34%)	21 (26%)	3 (4%)	9 (11%)	3 (4%)	7 (9%)	5 (6%)
Adolescents	43 (20%)	87 (41%)	20 (10%)	33 (16%)	6 (3%)	3 (1%)	10 (5%)	9 (4%)

old (2%), 2 were 8–14 years old (3%), and 53 were 15–18 years old (95%).

A heat map was created using incidence rate for each zip-code (Fig. 2). There are 57 zip-codes in the city of Detroit; patients were seen at our centers from 46 of these. Eight zip-codes were identified as high-risk (accounting for 52% of patients). These regions were stratified by circumstances surrounding gunshot injuries (Fig. 3).

4. Discussion

According to the AAP, the rise in juvenile violent crime is related to the increased availability and use of handguns [12]. In 2016 and 2017, our trauma department identified a two-thirds increase in pediatric firearm-related injuries in our city. This aligns with national trends. We sought to understand the circumstances surrounding these injuries in order to develop prevention initiatives within our community. In order to gain a more accurate representation of the youths in our

urban city, we collaborated with the adult trauma centers in our hospital system as they also treat the adolescent patients.

Adolescent patients (15–18 years old) represented 65% of our patient population. Most of these firearm injuries were treated at the adult trauma centers (89%). The most common reported causes of injury for these patients were drive-by shootings, unknown circumstances and crime-related. Oftentimes adolescents refused to report the circumstances surrounding their injury (20%). This lack of information makes it difficult to study circumstances surrounding the most at-risk adolescent population.

Firearm-related injuries as a result of an unlocked gun most commonly occurred in older children and pre-adolescents (8–14 years). This is consistent with the literature upon review of childhood firearm-related injuries across the United States [9]. During our 5-year study period, the number of injuries as a result of an unlocked gun has remained relatively constant, until 2017 when the occurrence has almost quadrupled (5–18). This is a preventable circumstance that can

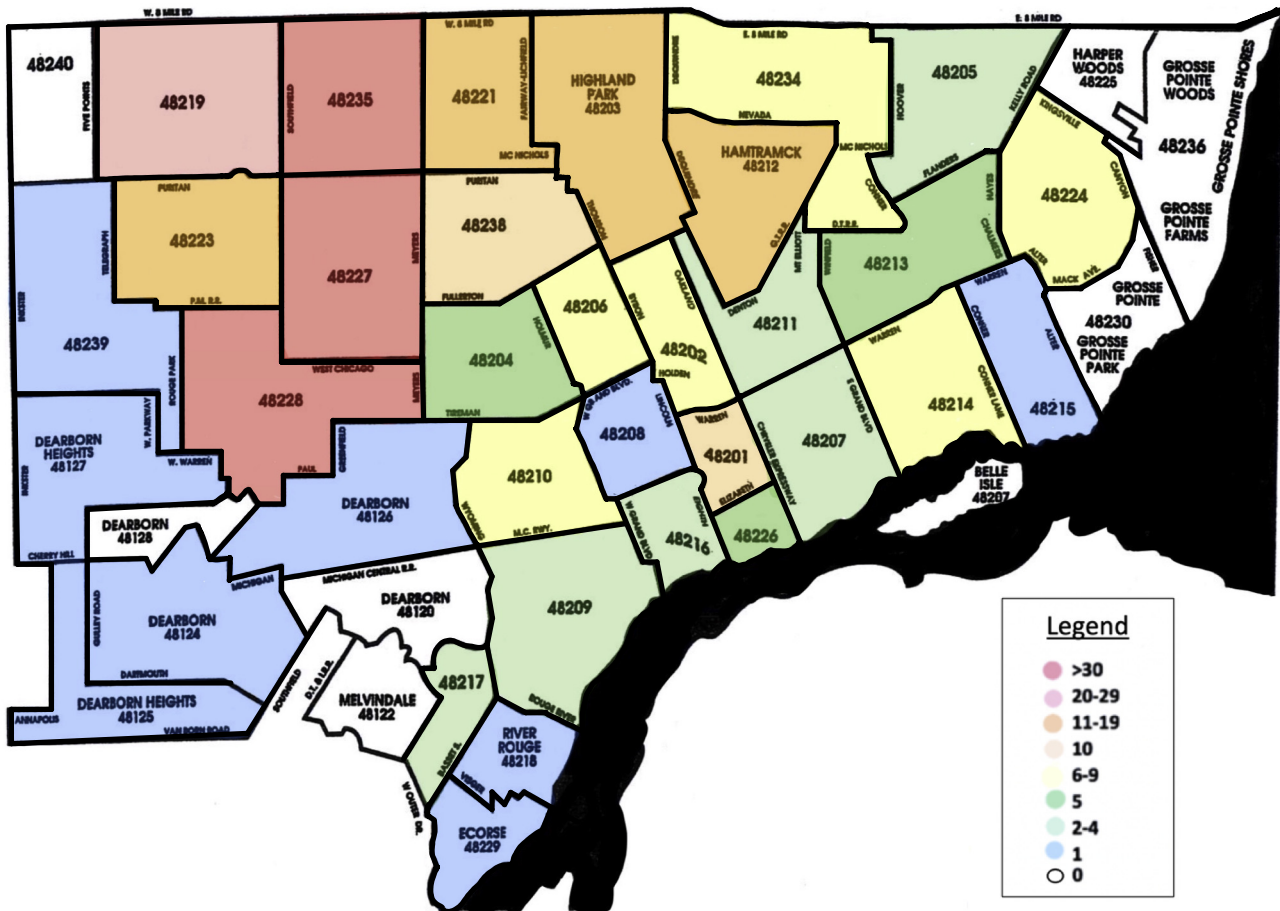


Fig. 2. Heat map of incidence of firearm-related injuries per zip-code.

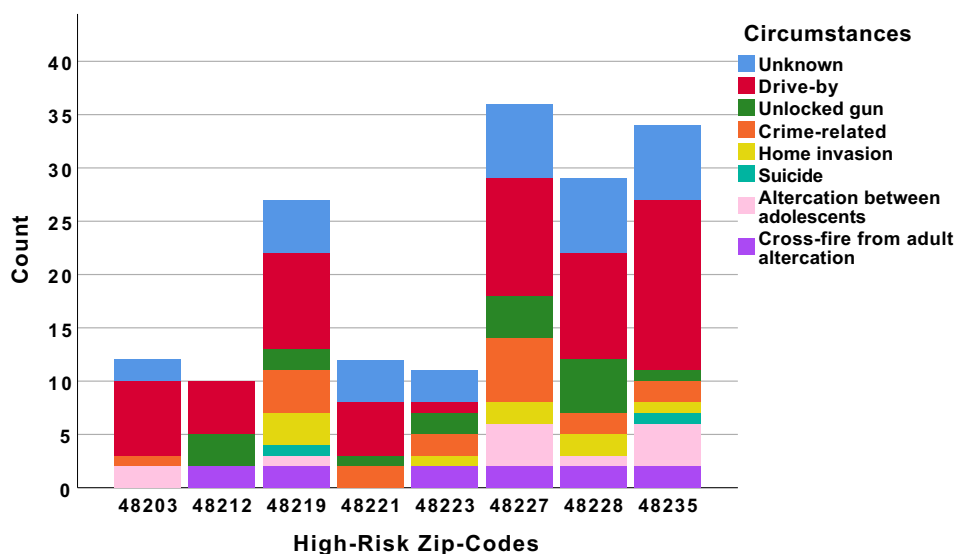


Fig. 3. Incidence of firearm-related injuries per zip code by circumstances.

be directly influenced by an injury prevention initiative and resources, such as gun-locks or education on safe gun storage.

Infants and young children represented the smallest population of youth in our study. Aside from drive-by shootings, they are most commonly injured by firearms because of an unlocked gun or from being in the cross-fire as a result of an adult altercation.

The most recent position statement of the American Pediatric Surgical Association affirms high priority on reducing gun-related injuries through research, education, outreach, prevention, and advocacy [2]. Analysis of the circumstances surrounding the firearm-related injuries stratified by year, age and zip-code each provide an important aspect of our data-driven targeted injury prevention initiative. Moreover, this data can supplement the local programs and aid the police department by directing their resources more efficiently. Circumstance data arranged by year allows us to identify where the change in incidence is specifically coming from (intentional or unintentional injuries). Circumstance data arranged by age allows us to have a target audience when out in the community with resources (grade school or high school). Circumstance data arranged by zip-codes allows us to identify which regions are in need of specific resources. High-risk zip-codes will be the main objective of our injury prevention initiative.

Using this data, our trauma department has implemented several prevention efforts in the community. Beginning with community events in high-risk zip-codes, we discuss safe gun storage practices, pass out gun locks, and teach emergency response techniques to reduce bleeding as a result of a gunshot wound. Our injury prevention education is specific for age groups, with the message for young children differing from the message for adolescents (never to touch a gun and consequences of gun misuse, respectively). The trauma department has shared this data with the Detroit Police Department in hopes to further collaborate and develop a system-focused strategy to combat crime-related circumstances. This data will also provide support for existing violence prevention groups in its efforts to expand to the west-side of the city which based on the data, is also plagued by gun violence.

This larger series adds to the literature a data-driven picture of the ongoing pediatric gun violence problem. There were a few limitations to this study. Data collection was completed at only 3 of the 5 ACS verified trauma centers in the city of Detroit. Our centers are located in the central and west side of the city, whereas the other two are located in the central and east side of the city. The areas identified as high-risk zip-codes are on the west side of the city, alluding to disproportionate incidence rates in our study. Our data is also limited as we were unable to

capture patients who were dead on arrival or on the scene from police and coroner records. The actual incidence and mortality rates in our city may be higher than our institution can report.

Unfortunately, Detroit is a city with a reputation for violence, with its children and adolescents at risk. Our data-driven injury prevention initiative aims to reduce gun-related injuries in a large, crime-ridden metropolitan city. Identifying high-risk zones for drive-by shootings and other crimes is critical for developing system-focused interventions, alongside the police department and local programs. Circumstantial data stratified by age and zip-codes will allow for targeted community outreach on gun safety education. With our targeted injury prevention initiative, we aim to reduce the occurrence of crime-related gun violence and unintentional shootings.

References

- [1] Nance ML, Krummel Tm Fau - Oldham KT, Oldham KT. Firearm injuries and children: a policy statement of the American Pediatric Surgical Association. 2013 (1879–1190 (Electronic)).
- [2] Petty JK, Henry MC, Nance ML, et al. Firearm injuries and children: position statement of the American pediatric surgical association. *J Pediatr Surg* 2019;144:e20183058.
- [3] Lee LK, Mannix R. Increasing fatality rates from preventable deaths in teenagers and young adults. *JAMA* 2018;320(6):543–4.
- [4] U.S.: Reported violent crime 1990–2017 | Timeline. (n.d.). Retrieved from <https://www.statista.com/statistics/191129/reported-violent-crime-in-the-us-since-1990/>
- [5] Federal Bureau of Investigation. Uniform Crime Reports. Available at: <https://ucr.fbi.gov/crime-in-the-u.s/2016/crime-in-the-u.s.-2016/topic-pages/offenses-known-to-law-enforcement>.
- [6] Centers for Disease Control and Prevention: non-fatal injury data, other assault firearm gunshot nonfatal injuries 2013–2016. Injury Prevention and control: data & statistics website. <https://webappa.cdc.gov/sasweb/ncipc/nfrates.html>. Updated July 10, 2018
- [7] Centers for Disease Control and Prevention. Violence-related firearm deaths among residents of metropolitan areas and cities—United States, 2006–2007. *JAMA* 2011; 306(5):482–4.
- [8] Detroit Youth Violence Prevention Initiative: Progress Report. 2012–2013. http://detroitk12.org/content/wpcontent/uploads/2014/10/DYVP_BookFinal_Condensed.pdf (1–20 (Electronic)).
- [9] Fowler KA, Dahlberg LL, Haileyesus T, Gutierrez C, Bacon S. Childhood Firearm Injuries in the United States. 2017(1098–4275 (Electronic)).
- [10] Choi PM, Hong C Fau - Bansal S, Bansal S Fau - Lumba-Brown A, Lumba-Brown A Fau - Fitzpatrick CM, Fitzpatrick Cm Fau - Keller MS, Keller MS. Firearm injuries in the pediatric population: A tale of one city. 2015(2163–0763 (Electronic)).
- [11] Veenstra M, Patel V, Donoghue L, Langenburg S. Trends in pediatric firearm-related injuries over the past 10 years at an urban pediatric hospital. 2015(1531–5037 (Electronic)).
- [12] Commerce GD. Efforts by the American Academy of Pediatrics to prevent and reduce violence and its effects on children and adolescent. *Bull N Y Acad Med* 1996;73(2): 398–410.