The Science of Firearm Injury Prevention: Charting the Path Forward with Data and Innovation

Abstracts
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Session 2A: Safe Storage and Access Abstracts:

Safety, Firearms, and Children: Findings from the 2018 California Safety and Wellbeing Survey
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Statement of Purpose: To describe firearm ownership and storage practices in households with children and public perceptions of safety and interventions to reduce children’s risk of firearm injury.

Methods/Approach: Descriptive analyses of population weighted data from a repeated cross-sectional survey of California adults (n=2558), fielded online in 2018.

Results: Nearly one-quarter of gun-owning households in California include children (24.4%, 95% CI: 19.5-30.1). In one-third of those households (31.5%, 95% CI: 17.8-49.3), all guns are locked up and unloaded. In households with guns and children, 45.5% (95% CI: 28.6-63.4) own only handgun(s), compared to 28.1% (95% CI: 22.1-34.9) of those who do not live in homes with children. More gun owner respondents in homes with children own at least one firearm for protection against people compared to those in homes without children (respectively 77.3%, 95% CI: 60.7-88.3; 63.6%, 95% CI: 55.8-70.7). Nearly half (46.4%, 95% CI: 40.0-53.0) of respondents who live in homes with children and do not have a gun or have gotten rid of gun(s) are not currently owners at least in part because of concern for safety of children who live there.

More respondents with children in the home reported that having a gun in the home did/would make their home a “more dangerous” place to be (35.4%, 95% CI: 29.8-41.4) compared to those from homes without children (26.0%, 95% CI: 23.0-29.2).

Support for parents inquiring about the presence of unlocked guns in homes where their children play and for health professionals talking about firearm safety with those who live with children was high, including among firearm owners.

Conclusions: When children live in homes with firearms, safe storage is recommended. Parents or others in the home may perceive that children are at increased risk, and may be amenable to conversations with other parents or health care professionals or to other interventions that reduce children’s risk of harm.

Innovation & Significance to the Field: We provide recent, state-level estimates of firearm ownership, storage practices, opinions on injury prevention strategies in California homes where children live.
Store It Safe: Firearms Safety Program of the Ohio Chapter, American Academy of Pediatrics

Michael A. Gittelman, MD¹; Sarah A. Denny, MD²; Hayley Southworth, MS³; Melissa Wervey Arnold³

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Purpose: Ohio AAP established the Store It Safe (SIS) Program and Partnership in 2015. Compared to other countries, American children 9 times more likely to die of an accidental gun injury and 10 times more likely to die of a gun suicide.

Methods: Discussion around gun safety can be emotional and not productive between organizations and citizens. SIS focuses on increasing awareness of the risks of unsecured firearms in the home with a goal of standardizing the approach by all audiences. Agreement about messaging and programming by a multi-faceted team consisted of: distribution of gun boxes in pediatric offices; messaging for providers and families on safe storage of firearms; and public awareness campaigns through traditional and social media to raise awareness of SIS recommendations. Ohio AAP practices volunteered to participate. Families were surveyed at office visits and media hits were captured.

Results: More than 500 gun boxes were distributed in 10 pediatric practices in Ohio over 4 years. 95% of families surveyed had received guidance on firearm safety in practices, and 49% of families learned something new in that discussion. Families most prefer to receive firearms safety information from healthcare providers (48%). QI study of SIS for young children and expansion into teen suicide prevention began. Materials have been provided to 3,000 Ohio AAP members and partners.

Conclusion: A focused message on firearms safety can improve discussions between providers, patients and the public. Consistent messaging has the potential to instigate drastic behavior changes that could significantly reduce unintentional pediatric firearm injuries.

Innovation and Significance: SIS uniquely brings together organizations and individuals, with different viewpoints about firearms, to develop unified messaging, resources, and approaches to reduce unintentional gun injuries and deaths in children, and suicides by firearms in adolescents. Members include healthcare professionals, firearm experts, community organizations, and law enforcement.
The Effect of an EMR Prompt on Documentation of Firearm Screening in an Adolescent Primary Care Setting
Michael Soto, MPH¹, Eric J Sigel MD²

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Statement of Purpose: The purpose of this study is to examine whether changing the basic well child/adolescent template in the electronic medical record to include a question about the presence of firearms in the household increases HCP documentation of screening youth for access to firearms.

Methods/Approach: Data from chart review compared HCP documentation of evaluating firearm access before and after introducing a template change. A random sample of visits for routine care in an adolescent clinic were selected for the 6 months pre and 6 months’ post template change. The prompt was located in the subjective/social history section of the template, and read as: ‘Guns: Are there any guns/firearms in your home?’ The main outcome was chart documentation of youth firearm access. Independent t tests were used to determine differences between groups.

Results: A total of 250 charts were reviewed. There were no demographic differences for the patients between the pre and post groups, with 35% male, 18% white, 42% Hispanic, and 27% Black. Prior to the EMR change, HCPs documented screening for firearm access 25% of the time compared to 84% after the EMR change (p<.001). In terms of provider type, trainees documented firearm access screening 90% of the time compared to attending physicians at 73% (p=0.017).

Conclusion: These results show that documentation of provider screening for firearm access increases dramatically with a change to the EMR template.

Innovation and Significance to the Field: Little is known about what may contribute to HCPs addressing firearm safety during routine health care appointments. This study may be the first to show how altering HCP workflow can lead to an increased recognition of firearm access for youth. HCPs who are interested in addressing firearm safety, in accordance with national guidelines, can use the results from this study to enact change.
Adolescent and Parent Perception of Firearm Availability and Storage Practices
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\textbf{Statement of Purpose:} The purpose of this study was to determine to what degree adolescents and their parents agree on whether firearms 1) are present in the home, 2) how the firearms are stored, and 3) whether storage patterns impact how easy youth perceive it is to obtain a gun.

\textbf{Methods/Approach:} Youth and parents were recruited to participate in an RCT evaluating the effect of providing safe storage counseling on parental safe storage practices. Eligibility depended on whether the adolescent or parent endorsed firearm presence in the home. Adolescents 12-18 and one parent participated. Data obtained from baseline questionnaires included presence of firearms, how firearms were stored and youth perception of how easy it would be to obtain one of the guns. The Kappa statistic assessed agreement, and bivariate analysis to determine whether storage patterns were associated with ease of firearm access. The study was approved by the Colorado IRB.

\textbf{Results:} 51 youth parent dyads participated. For adolescents, mean age = 14.8, 71\% female, 41\% White, 41\% Hispanic, 14\% African American. There was substantial agreement as to the presence of any guns in the home, with Kappa=.71. Fifty-two \% of parents, and 54\% of adolescents revealed that not all guns in the home were stored safely, with moderate agreement (Kappa=.52). For the adolescents who stated it would be easy to get one of the guns (16\%), all of those parents reported unsafe storage practices while for the adolescents who stated they could not get any of the guns easily (63\%), 62\% of those parents reported the safest firearm storage ( P<.01).

\textbf{Conclusion:} There is strong agreement between youth and parent reporting of the presence of firearms. Importantly, there is an association between youth’s perception of how easy it would be to get a firearm and parental storage patterns.

\textbf{Innovation and Significance to the Field:} This study allowed for in depth analysis of both adolescent and parents perceived firearm storage patterns. Further, this confirms a strong association between parental firearm storage practices and adolescent’s perception of how easy it would be to access that gun, strengthening the importance of the message that safest firearm storage is critical to ensuring that adolescents do not have easy access to firearms.
Firearm Storage in Families with Teens Psychiatrically Hospitalized: A Descriptive Study
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**Purpose:** Ohio AAP established the Store It Safe (SIS) Program and Partnership in 2015. Compared to other countries, American children 9 times more likely to die of an accidental gun injury and 10 times more likely to die of a gun suicide.

**Methods:** Discussion around gun safety can be emotional and not productive between organizations and citizens. SIS focuses on increasing awareness of the risks of unsecured firearms in the home with a goal of standardizing the approach by all audiences. Agreement about messaging and programming by a multi-faceted team consisted of: distribution of gun boxes in pediatric offices; messaging for providers and families on safe storage of firearms; and public awareness campaigns through traditional and social media to raise awareness of SIS recommendations. Ohio AAP practices volunteered to participate. Families were surveyed at office visits and media hits were captured.

**Results:** More than 500 gun boxes were distributed in 10 pediatric practices in Ohio over 4 years. 95% of families surveyed had received guidance on firearm safety in practices, and 49% of families learned something new in that discussion. Families most prefer to receive firearms safety information from healthcare providers (48%). QI study of SIS for young children and expansion into teen suicide prevention began. Materials have been provided to 3,000 Ohio AAP members and partners.

**Conclusion:** A focused message on firearms safety can improve discussions between providers, patients and the public. Consistent messaging has the potential to instigate drastic behavior changes that could significantly reduce unintentional pediatric firearm injuries.

**Innovation and Significance:** SIS uniquely brings together organizations and individuals, with different viewpoints about firearms, to develop unified messaging, resources, and approaches to reduce unintentional gun injuries and deaths in children, and suicides by firearms in adolescents. Members include healthcare professionals, firearm experts, community organizations, and law enforcement.
Tailored Firearm Safety Education to Reduce Morbidity and Mortality in Rural Youth

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Statement of Purpose: Firearm related injuries are the second leading cause of death among youth in the US; in rural communities, the suicide rate, rate of firearm use in suicides, and rates of gun ownership are substantially higher than in suburban and urban regions, with differing cultural practices and beliefs about the role of firearms in community life.

Methods: In this two-phase project, a community-based participatory model was used to: 1) develop a culturally tailored firearm safety message for rural families and 2) conduct a pilot acceptability/feasibility study. This presentation focuses on mixed methods data collected during Phase 1 and a preview of the multi-component prevention strategy.

Results: Focus group participants (n=40; 60% male, 40% female) ranged in age from 15-72 (mean= 36.9, SD= 18.9); 90% reported a firearm present in their household. Participants provided qualitative and quantitative input on: a) safe storage message content, b) recommended messengers, and c) delivery mechanism as well as d) culture, e) reactions to existing safety materials and f) barriers to safe storage. When asked to rank order messenger credibility, top responses were Hunter Safety Instructor and Parent/Grandparent. Respondents prioritized community testimonials, information about available storage options, as well as how to use them as critical content to include in a firearm safety message.

Conclusions, Innovation, & Significance: Safe firearm storage practices have the potential to reduce firearm-related injury and death, but it is critical for public health messages to be culturally tailored and aligned with community norms and values. This project is designed to develop a universal pediatric safe storage message that can be implemented with rural families nationwide.
Developing a Universal Safe Firearm Storage Intervention for Rural Alaska Native Communities
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Purpose: The presentation will describe research informing a universal family-focused approach to reduce youth access to firearms, the top cause of serious and fatal intentional and unintentional injuries in Alaska Native (AN) youth,3,10,11 which represents a health disparity.2,8 Firearm injuries are more likely to occur in households with unlocked and loaded, ‘unsafely stored’ firearms1, and over 90% of the households in rural and remote Alaska stored at least 1 gun unlocked,9 which merits a universal approach focused on safe household gun storage.

Methods: Collaborating with community partners, 3 focus groups with AN community member (n=33) explored firearm beliefs, social roles and situational factors that influence home firearm storage practices. Qualitative thematic analysis identified norms and shared beliefs related to firearms, contextual and other factors influencing firearm storage practices of gun-owners and others within households. Results informed the cultural adaptation of the National Survey of Firearm-owning Parents and Youth Survey, the development of the Family Safety Net (FSN) intervention, which engages AN adult through rural primary care clinics to encourage safe home firearm storage, and outreach methods for involving community members and organizations through radio announcements, local newspapers, and flyers in churches, post offices, and hospitals.

Conclusion: It is important to understand the beliefs, situations and social roles that influence firearm storage practices within AN homes. The focus group findings set the stage to consider the prevalence of these determinants for different people (gun ownership, gender, age), and informs the cultural-specific intervention development. The presentation illustrates how participatory and exploratory research informs research and intervention development.

Innovation & Significance: Our approach extends long-term partnerships and builds on the strong family bonds of AN people and existing tribal healthcare to engage adults in known-effective simple interventions to increase home safety by limiting access to firearms in a family-centric, gun owning population.
Adaptation of the Safety Check Safe Firearm Storage Program using the ADAPT-ITT Framework

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Statement of Purpose: Safety Check is an evidence-based program that increases parent safe firearm storage behavior. To date, the program has not been widely implemented in pediatric primary care. This project sought to adapt Safety Check to increase its acceptability, appropriateness, and feasibility in pediatric primary care.

Methods: The ADAPT-ITT framework1 was used to guide iterative program adaptation. First, we adapted the program using the behavioral science literature and qualitative feedback from 70 stakeholders. Second, nine stakeholders were interviewed about the adapted program. Third, we crowdsourced feedback on the name and logo from 561 parents. Fourth, stakeholder feedback was incorporated into a second version of the adapted program. Fifth, quantitative acceptability ratings for the adapted program were collected from 54 gun-owning and 52 non-gun-owning parents.

Results: Adaptations included removing screening for guns in the home, changing the program name, and adding a follow-up reminder. Major themes resulting from stakeholder feedback on the adaptations included the importance of considering context and the need to promote parent autonomy and privacy. The most preferred program name by parents was SAFE (Suicide and Accident prevention through Family Education) Firearm. Non-firearm-owning parents rated program acceptability higher than firearm owners (p=0.030), although ratings were high in both groups (M=4.45 and 4.23, respectively, on a 1-5 Likert scale).

Conclusions, Innovation, & Significance: Firearm-related injuries are the second leading cause of death among youth.2 Since most youth have contact with healthcare annually,3 primary care may be an optimal venue for decreasing youth firearm mortality by promoting safe firearm storage. The current study uniquely leverages an established adaptation framework to refine Safety Check in a way that integrates a high degree of stakeholder feedback to increase the likelihood that pediatric clinicians will deliver the program, that families will be open to engaging in it, and that rates of firearm injury and mortality will subsequently be reduced.

References:
The Role of Art & Design in Firearm Injury Prevention: A Review of Creative Works Shown in the US
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A literature review of artists’ and designers’ projects that address firearm injury prevention and impact. We treated creative projects as literature, conducted an online search, then collated a database of thirty-nine art and design works from four countries, created by diverse professional artists and designers. We identified four categories of work, some of which overlap.

Works in the first category, Social Engagement, purposes beyond aesthetic pleasure; respond to a firearms-related social issue; prompt visitors to engage with that issue; are often participatory, and involve people as the medium or material of the work. The second, Social Commentary, use rhetorical means to comment on issues in society; are often produced to implement or promote change by informing the general populace, and appeal to people's sense of justice. The third, collaborative work, reflects the high incidence of collaboration across the categories that may or may not include participation by communities. We made design the fourth category, as there were so few examples in contrast to a larger number of works defined as art. We had expected to find more design but there were not even many speculative designs (that prompt thinking rather than being utilitarian). The majority of works are socially engaged, produced in response to specific events, in specific communities. However, there is often not much data about associated workshops in the community.
The Distribution of Unintentional Firearm Deaths Among Youth and Young Adults in Illinois, by Race/Ethnicity, 2008-2018
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STATEMENT OF PURPOSE: To investigate the distribution of unintentional firearm deaths among youth and young adults in Illinois, and how these deaths vary by race/ethnicity.

METHODS/APPROACH: We used Illinois certified death certificate data to describe unintentional firearm deaths by person (age group, sex, race/ethnicity), place (urbanicity and region, at county level; place of death) and time (day of week fatal injury occurred). Decedents were included if: they were under age 25; location of death was Illinois; ICD-10 underlying cause of death code was firearm, unintentional (W32-W34); and year of death occurred 2008-2018. Demographic, temporal, location and circumstance variables were described using frequencies and percentages. Differences in age group, urbanicity, and region by race/ethnicity were assessed using Chi-square test.

RESULTS: We identified 53 decedents for inclusion in the analysis. Decedents were overwhelmingly male (>90%); the majority were aged 20-24 (39.6%), injured on a Friday/Saturday/Sunday (58.5%), died in northern Illinois (43.4%) and were pronounced at the scene (45.3%). Race/Ethnicity (NH White [43.4%] and NH Black [49.1%]) and urbanicity (suburban and rural, 43.4%) were nearly evenly or evenly distributed. Proportionately, NH Black decedents (versus NH White) were more likely to be aged 20-24 (77.8% vs. 22.2%, p<0.05) and suburban (71.4% vs. 28.6%, p<0.05). NH White decedents (vs NH Black) were more likely to be rural (63.6% vs. 36.4%, p<0.05).

CONCLUSION: Successful prevention programs for unintentional firearm deaths aimed youth and young adults need to consider the distribution of such deaths at a local level. In Illinois, significant variations in age and urbanicity exist among these deaths by race and ethnicity.

INNOVATION AND SIGNIFICANCE: This work informs unintentional firearm death prevention efforts for youth and young adults in Illinois, that local programs might be tailored accordingly for maximum impact.
A 5-Year Comparison of Pediatric Motor Vehicle and Firearm Injury Trends in The US
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Recent evidence from the Centers for Disease Control demonstrate that firearm injuries (FI) have reached a record high. This is juxtaposed against motor vehicle injuries (MVI) which have decreased. This studied compare national trends in pediatric MVI vs. FI for patients presenting to a collaborative network of pediatric hospitals over a 5-year period. A retrospective review of patients <19 presenting nationally to 34-member hospitals who contribute to the Pediatric Health Information System (PHIS) database from Jan. 1, 2013 to Dec. 31, 2017. PHIS was queried for patients who had billable diagnosis codes for either FI or MVI and analyzed using SAS and modeled separately. Trends were calculated using linear regression models with logged case counts as the dependent variable.

During the 5-year period, 89,145 visits occurred for MVI and 3,247 for FI. FI-related inpatient admissions increased on average 15% per year (p <0.05). ICU admissions noted a 13% (p <0.05) increase for FI vs. -5.3% (p=0.22) change for MVI. FI deaths increased by 21% (p=0.07) vs stable trend for MVI. Regional trends showed FI increased nationwide over the study period and are consistently higher in the South and Midwest.

Trends show an increasing number of injuries and deaths attributed to FI presenting to a large pediatric database of hospitals while similar increases in MVI are not seen. Motor vehicles are highly regulated in design, safety features and use. In contrast, firearms are much less regulated, less studied and safety designs are less mandated. These and other differences need further investigation in order to optimally study and effectively intervene on these alarming trends in pediatric related firearms deaths.
National Non-Fatal Gun Injury: Implications of Medical Record Use to Estimate Firearm Injury Incidence and Intent
Susan T. Parker, MPP, MS

1University of Michigan - School of Public Health - Doctoral Student

Statement of Purpose: Firearm injury research often uses medical records to examine gun injury incidence and intent, yet the quality of these data sources is largely unexamined. This research explores the accuracy of medical claims data to estimate gun injury incidence and distribution, highlighting both strengths and limitations.

Methods/Approach: The National Emergency Department Sample (NEDS) is compared to the National Electronic Injury Surveillance System (NEISS) to examine reporting of gun injury at the national level. While NEDS permits more granular estimates of gun injury, it is not subject to the same review of medical coding that NEISS undergoes. Gun injury incidence and intent are compared across sources.

Results: NEDS and NEISS both generate similar gun injury estimates prior to NEISS sampling issues commencing in 2015. However, NEDS -- and by extension the state emergency department databases it samples -- undercounts violent injury intent by 20% and over counts unintentional injury by 134%. This distributional difference could result in undercounting of U.S. gun violence to the detriment of public health resource allocation.

Conclusion: Medical records can serve to replace the lack of national shooting databases for aggregate estimates of gun injury but require caution when using intent or more granular state estimates. Further research into state emergency department limitations and barriers to data quality should be examined.

Innovation / Significance to the field: One of the most promising but understudied sources of gun injury data is medical claims which span the universe of hospital care. While promising, this data may be limited in the accuracy of measuring important outcomes such as injury by intent.
Firearm Morbidity and Related Mortality Among Youth in Florida for Years 2006-2018
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Statement of the Problem: Florida suffers from high rates of lethal and non-lethal firearm injuries. However, little is known about the extent of firearm injury among adolescents. This research characterized prevalence, patterns, costs, and correlates of adolescents’ (10-19 years old) firearm morbidity, including cases resulting in death, from 2006 to 2018 in Florida.

Methods/Approach: This study followed a descriptive analysis using data from the Florida Agency for Health Care Administration (AHCA) emergency department (ED) visits and inpatient episodes (non-fatal firearm injuries). Direct medical costs were calculated for firearm injuries. The variables in the AHCA database, in conjunction with hospital specific cost/charge ratios, permit analysis of the direct medical costs associated with non-lethal firearms injuries, while the insurance status and source shows the distribution of this burden among the public and private sectors of the economy.

Results: The data revealed over 18,000 ED (N=13,183) and inpatient (N=5,036) firearm related episodes from 2006-2018, indicating an annual average in excess of 1,000 injuries among the study population. Victims were mostly male (80%), black (53%), non-Hispanic (88%), and resided in a major metropolitan area (88%). The median age was 17 years. Medicaid was the primary payer for over half (52%) while 20% were uninsured. Over 700 (4%) died of their injuries after arriving at the hospital. Total estimated direct patient care cost, in 2018 dollars, amounted to $180 million. Firearm injuries claimed 35,382 inpatient bed days during the period.

Conclusion: This research shows the excess economic and healthcare burden of firearm injuries in poor and young African American males in Florida.

Innovation & Significance to the Field: This analysis of injuries and resulting deaths has not been previously done. Future studies incorporating geocoding and modeling will guide targeted interventions/policy that focus on costliest events, regions, and equity issues related to these injuries.
Evaluating the Accuracy of External Cause of Injury Codes in Describing Firearm Injury Hospital Visits
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Statement of Purpose: No accurate reporting system currently exists to quantify nonfatal firearm injuries in the United States, and CDC estimates are becoming increasingly unreliable. External cause of injury codes (e-codes) are used to report the mechanism, intent, and circumstances of GSWs. Public health datasets rely upon the quality of e-codes for accurate surveillance, but we hypothesize that these inputs are inaccurate.

Methods: All GSWs at a single urban trauma center were reviewed for 2017. For each GSW, the corresponding medical chart was reviewed for the (1) Trauma H&P (2) ED H&P (3) Social Work Notes (4) Discharge Summaries. Each was reviewed for reporting of perpetrator, weapon and intent of injury. Kappa statistic assessed agreement between the observed GSW e-codes and review of the medical charts.

Results: 376 GSWs were included, with 53 (13.8%) absent codes. For the remaining 323, agreement was found in 184 (57.0%) between billing and medical chart data. The kappa statistic was 0.196 (p <.001). There was 84.2% agreement in assaults, but only 32.6% agreement in the undetermined/unintentional category. 100% agreement was found in rare intent categories. Weapon e-codes were reported for 21 cases (6.5%). Place of occurrence e-codes were reported for 312 of 323 GSWs (96.6%), but 215 (66.6%) were non-specific. There were no perpetrator e-codes other than 3 incidents of self-harm (0.9%). The most common source of discordance is the overuse of assault codes without chart evidence of assault.

Conclusion: At a single center, 13.8% of all GSWs are not reported, representing an underreporting of firearm injury, in general. In the case that firearm injury is reported to public health datasets, the descriptive external cause code is inaccurate in 15.8% of assaults and 67.4% of unintentional or undetermined injuries.

Innovation and Significance: There may be many assumptions directing coding of assaults when intent is actually undetermined. Requiring accurate e-codes for reimbursement may improve the quality of public health data.
Mechanism of Injury and Odds of Admission to the Adult vs Pediatric Intensive Care Unit among Pediatric Trauma Patients in California, 2005-2020

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Background/Statement of Purpose: Firearm-related injury is the third-leading cause of death in children 1-17 years of age, and the second-leading cause of injury-related death. However, deaths capture only a fraction of the human toll of gun violence. In California, for every 90 deaths due to firearms among children, there are approximately 200 hospitalizations and 160 emergency department visits for non-fatal firearm assault. While research demonstrates systemic and sociodemographic inequities in pre-hospital determinants of violence and in post-discharge outcomes following violent injury, few studies have examined disparities in hospital care for violently injured youth. This is despite research in related areas on the “adultification” of youth of color and the socially constructed, often racialized, tendency to equate injury from certain types of violence, particularly community gun violence, with personal shortcomings, criminality, and blame; the extent to which assumptions like these might influence the care and treatment received by violently injured young people is unknown.

Methods/Approach: We use trauma registry data from a Level I adult and pediatric trauma center in the inland Northern California region for January 2005-February 2020 to explore the relationship between mechanism of injury and placement in the adult vs pediatric intensive care unit (ICU) among trauma patients 13-17 years of age.

Results: Compared to pediatric patients admitted for motor vehicle crash injuries, violently injured pediatric patients had significantly higher odds of being placed in the adult vs pediatric ICU: 4.7 times greater odds among stabbing victims (95% CI: 2.8-7.8), 3.7 times greater odds among gunshot victims (95% CI: 2.7-5.2), and 1.9 times greater odds among victims of blunt assault (95% CI: 1.3-2.7).

Conclusion, Innovation & Significance to the Field: Because the adult ICU may lack appropriate pediatric equipment, staff training, and support personnel (e.g. child life specialists), disparities in adult vs pediatric ICU bed placement may have important implications for healing and recovery among violently injured pediatric patients.
**Session 4A: Suicide, Homicide and Weapon Carriage**

**Abstracts:**

**Pediatric Firearm Deaths: Who, Where, and How?**

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**STATEMENT OF PURPOSE:** Understanding circumstances surrounding the 3,000 firearm deaths among United States (U.S.) youth each year may help prevent firearm-related fatalities.

**METHODS/APPROACH:** U.S. firearm fatalities from the National Violent Death Reporting System (NVDRS) from 2005-2017 were categorized by intent (homicide, suicide, unintentional [self-inflicted or inflicted by other]) and by age (<1, 1-9, 10-14, 15-19 years). Descriptive statistics and chi-square tests included cases with available data.

**RESULTS:** There were 11,120 firearm deaths among youth ages 0-19 years, including 6,230 homicides (56%), 4,193 suicides (38%), and 697 unintentional deaths (6%). Of unintentional deaths, 249 (36%) were self-inflicted. The death occurred in the victim's home for 19% of homicides, 68% of suicides, and 48% of unintentional deaths. It occurred with a parent/family member's firearm in 18% of homicides, 67% of suicides, and 55% of unintentional deaths. Firearms were more commonly stored not locked and loaded than locked and unloaded (homicide 79% vs. <10%, p<0.001, suicide, 36% vs 19%, p<0.001, and unintentional 84% vs. <7%, p<0.001). For homicides, the shooter was the parent for 17 children age <1 (63%), 195 children 1-9 (66%), 92 children 10-14 (35%), and 70 children 15-19 (3%) years old. For non-self-inflicted unintentional deaths, the shooter was a parent/family member for 60 children age 1-9 (81%), 47 children 10-14 (51%), and 36 children 15-19 (22%) years old.

**CONCLUSION:** Pediatric firearm suicide and unintentional deaths often occur in the child’s home with a family member’s gun. Firearms were not stored in the safest manner (i.e., locked and unloaded) in the majority of cases. Encouraging firearm safety and proper firearm storage, potentially through parental education, may reduce pediatric firearm fatalities.

**INNOVATION & SIGNIFICANCE TO THE FIELD:** This is the largest study describing circumstances surrounding firearm violence and describes firearm storage status, which is one of the cornerstones of safe firearm legislation.
Adolescent Firearm Suicide Risk Patterns: A Latent Class Analysis using Surveillance Data from the U.S. National Violent Death Reporting System, 2007-2017

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Statement of Purpose: Suicide is a leading cause of death among U.S. adolescents, and firearms are the means in approximately 40% of adolescent suicides. Research has identified risk patterns in youth suicide attempts, but no studies have examined firearm suicides specifically. Study objectives were to: examine risk patterns (i.e., classes) among adolescent firearm suicides; and identify factors associated with class membership.

Methods: Data were from the U.S. National Violent Death Reporting System (NVDRS), 2007-2017. Latent class analyses (LCAs) were conducted separately for firearm and non-firearm suicides among adolescent suicide decedents 10-17 years. Associations with class membership were examined using multinomial logistic regression. Risk factors in the LCAs were: mental health (MH) problem, suicidality, intimate partner problems, other relationship problems, school problems, legal problems, alcohol use, and other substance use.

Results: Most firearm suicides (n=2,139) were among males (86%); 78% were non-Latinx White (NLW). The firearm suicide LCA identified three patterns: “Low problems” (50.3% of suicides), “High MH problems” (34.7%), and “High school problems” (15.1%). Males compared to females (AOR=0.69, 95% CI: 0.53, 0.89) and non-Latinx Black compared to NLW adolescents (AOR=0.53, 95% CI: 0.36, 0.79) had lower odds of being in the “High MH problems” pattern compared to the “Low problems” pattern. A post-hoc analysis compared patterns of firearm and non-firearm suicides. The non-firearm suicide LCA identified four patterns, which also included a “Low problems” pattern, but it had lower membership (33.9%) relative to the firearms group.

Conclusion: Membership was largest in the pattern with a low probability of exhibiting common risk factors. This is consistent with research on adult firearm suicides indicating firearm compared with non-firearm suicide decedents are less likely to have discussed suicide.

Innovation & Significance to the Field: This is the first LCA among adolescent firearm suicides. Findings emphasize the importance of safe storage practices for parents of adolescents, even in the absence of a crisis or warning.
Identifying Best Practices in Firearms Means Restriction for Youth Suicide Prevention
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Statement of Purpose. Suicide is the second leading cause of death among youth. Over the past decade, almost half of all youth suicides involved firearms. Access to a firearm triples individual risk of death by suicide. Likewise, restricting lethal means for suicide prevention is one of the most effective prevention strategies. Yet, deploying means restriction interventions across settings and situations remains a challenge, specifically for mental health providers in rural areas where firearms are often accessible. The presentation will describe the state of suicide prevention training required for social workers across the United States, and will focus specifically on the importance of training mental health providers on assessment and intervention in firearm-related suicide risk.

Approach. A review of the literature reveals the inadequacy of training for suicide prevention in general, and specifically in the knowledge and skills needed to initiate and facilitate firearm means restriction interventions in ‘imminent risk’ and less acute situations. Our presentation will describe the content and depth of current training, and identify key gaps in understanding and navigating firearm assessment and intervention in firearm-related suicide encounters.

Results. The presentation will identify potential determinants of effective mental health provider assessment and intervention in reducing firearm-related suicide risk.

Conclusion. Suicide risk assessment and intervention are consistently challenging in practice, and little is known about best practices for firearm-related suicide risk. The preliminary identification of gaps and training area needs will inform future mental health provider trainings on firearm means restriction.

Significance to the Field. The primary goal of this work is to describe current training practices for firearm-related suicide encounters and identify key gaps in assessment and intervention. A secondary goal is to apply these findings to inform trainings for mental health provider assessment and intervention in firearm-related suicide risk. In addition, many determinants of effective intervention in firearm-related suicide risk may also generalize to other contexts in which rates of firearm-related injury are high, including child safety and intimate partner violence.
Suicide by Firearm Among Youth and Young Adults in the State of Illinois, by Urbanicity and Region, 2008-2018
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STATEMENT OF PURPOSE: To investigate whether the proportion of suicide deaths by firearm among youth and young adults varies by urbanicity in Illinois, and whether region impacts variation by urbanicity.

METHODS/APPROACH: We used Illinois certified death certificate data for all decedents under age 25 in which the location of death was Illinois, manner of death was suicide, and years of death 2008-2018. Means/Method was dichotomized into firearm (versus non-firearm). All 102 Illinois counties were categorized by urbanicity (Large central metro [1], Large fringe metro [2], Medium metro [3], Small metro [4], Micropolitan [5], NonCore [6]) and region (North [1], Central [2], and South [3]).

RESULTS: We identified 1,939 suicide decedents for inclusion in the dataset. Proportion of suicide deaths due to firearm varied significantly by urbanicity and region in Illinois; the proportion of firearm suicide deaths was negatively associated with urbanicity (linear trend p<0.001) and regionality (north to south, linear trend p<0.001). While urbanicity and region are significantly associated, when urbanicity is stratified by region, significant variations in the proportion of firearm deaths by urbanicity remain: Large fringe metro counties in the North region (28.6% firearm [vs. 33.0% non-firearm]); Small metro counties in the North (57.1% firearm [vs. 24.0% non-firearm]) and South (64.1% firearm [vs.42.4% non-firearm]); and NonCore counties (100% firearm [vs. 23.9% non-firearm]).

CONCLUSION: There are significant variations in the proportion of suicide deaths among youth due to firearm by urbanicity in the state of Illinois, irrespective of region. This suggests that region is either an effect modifier on urbanicity and/or there is interaction between the two.

INNOVATION AND SIGNIFICANCE: This work informs suicide prevention efforts for youth and young adults by identifying where the proportion of suicide deaths by firearm are the highest and lowest in the state of Illinois, allowing local efforts to be tailored accordingly.
Type of Guns used in Suicides: A Focus on Rurality
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Statement of Purpose: The Pew Research Center reports that 46% of rural residents report owning a gun, compared with 19% of urban residents. Rural youth are more likely to live in a household with at least one gun. Although guns as a means of suicide is well documented, less is known about weapon type. This analysis examined suicide by means and type of weapon, and compared suicide by long guns and handguns in a largely rural state.

Methods: We examined cases from the 2016-2018 Iowa Violent Death Reporting System and the National VDRS for 2016-2017. We examined the frequency of guns as a means of suicide. Logistic regression was used to identify factors related to long barreled gun suicides, including rurality, age, gender, and suicide circumstances.

Results: Nationally, 70.5% of gun suicides were by handgun; 11.3% by shotgun; and, 8.5% by rifle. In Iowa, 65.4% of firearm suicides were by handgun; 21.3% by shotgun; and, 11.6% by rifle. Youth under 25 years of age were the most likely age group to use a long gun (OR = 2.52; 95% CI 1.49 – 4.26 compared with 25-44 year olds). Suicides in isolated (OR = 2.02 95%CI: 1.28-3.19) and small rural areas (OR = 2.12 95%CI: 1.33-3.40) were more likely to involve a long gun. Victims who personally owned the gun used for the suicide were more than two times more likely to use a long gun (OR = 2.34 95%CI: 1.18-4.62) than a handgun.

Conclusion: The use of long guns was common in youth suicides, and long gun use was more common in rural than urban areas.

Innovation: Current policies and practices have rural gaps. For example, lethal means counseling has been concentrated in trauma centers, which are largely urban. When offered, these programs encourage safe storage or removal of firearms from the home. Long guns present challenges for safe storage because gun safes of adequate size for long guns are expensive, and trigger or cable locks, the inexpensive option for long gun storage safety, can be easily compromised.
An Examination into the Covariates Surrounding Children and Teen Firearm Homicide Victimization
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Statement of Purpose & Innovation and Significance to the Field: Scholars have found that firearm-related deaths are the second leading cause of death overall among U.S. children and teens between ages 1 and 19, surpassing the number of deaths from other diseases (Fowler et al., 2017; Schmidt et al., 2019). Despite this, recent scoping reviews by Cunningham, Carter and Zimmerman (2019) and Schmidt and colleagues (2019) have highlighted the limited knowledge in the field surrounding the impact of risk factors for firearm homicide victimization for children and teens at the situational- and community-level. Those that have conducted research on children and teen firearm violence have focused mainly on individual-level risk factors and largely ignored situational and community-level factors, such as the impact of the presence of domestic violence and other interpersonal conflict within the home (Schmidt et al., 2019). Moreover, researchers who have examined risk factors and correlates for firearm homicide has yet to include gun laws as a covariate of firearm homicide in conjunction with individual, situational, and other structural factors. Given the clear need to remedy these gaps in our understanding of firearm homicide, in my dissertation, I seek to examine what the correlates are for children and teen firearm victimization and how these two age groups differ. Children and teen victims will be examined in the context of risk factors at the micro-, situational, and macro-level. I will examine two research questions for this presentation: What are the covariates of firearm homicide for children and teens? How do the covariates of firearm homicide differ for children and teens?

Method/Approach: This study will utilize logistic regression and other strategies to analyze nation-wide data from the Center for Disease Control and Prevention’s National Violent Death Reporting System. This data will also be merged with state-level firearm data from Boston University School of Public Health’s State Firearm Laws database and U.S. Census data. This data will be computed into the longitudinal panel model with time nested within a larger structure that examines child and teen homicide rates within states. Covariates that will be examined in this dissertation will be three levels: the individual-level (e.g. drug use, alcohol use, mental health problems, etc.); social situational-level (e.g. domestic violence in home, interpersonal conflict, presence of firearms within the home, etc.); and at the community-level (e.g. socioeconomic status, percentage black, percentage of female-headed households, gun laws, etc.). The novel measure of gun laws as a covariate will be created using the restrictiveness scale that will be modeled off the Gifford Center’s Annual Gun Law Scorecard.

Results and Conclusion: Data is still being cleaned and models are still being run.
Bullying Victimization, Weapon Carrying, and Firearm Carrying Among A Sample of Adolescent Students
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Statement of Purpose: Much of the existing research on adolescent firearm carriage lacks a theoretical framework. Relatedly, few studies have examined weapon carrying as a behavioral response to strain experienced at school. Given the theoretical applicability of general strain theory to account for delinquent responses to victimization, associations between bullying victimization and firearm and non-firearm weapon carrying were investigated.

Methods: The study includes data from the 2009-2010 Health Behavior in School-aged Children U.S. survey. 7th-10th grade students (n=8,856) self-administered survey questions assessing sociodemographic information, health-related behaviors, social support, school experiences, and weapon carrying. Binomial and multinomial logistic regression analyses were conducted.

Results: 12.0% (n=1064) of respondents reported carrying a weapon in the past 30 days (including 2.4% (n=215) who reported carrying a firearm). In addition to being more likely male (AOR=10.21) and more affluent (AOR=1.09) than those who did not report weapon carriage, recent firearm carriers reported having more weapon-carrying friends (AOR=17.35) and low social support (AOR=1.54). Among weapon carriers, firearm carriers were more likely male (AOR=2.31) and reported having more weapon-carrying friends (AOR=1.55) than those who recently carried other weapons. In the multinomial model examining carrying frequency, age, male sex, weapon-carrying friends, and affluence were positively associated with frequent firearm carriage. Urban district and Hispanic ethnicity were negatively associated with frequent firearm carriage.

Conclusions: Peer weapon-carrying is a significant correlate of firearm and non-firearm weapon carrying. Although bullying victimization was consistently associated with non-firearm weapon carrying (and weapon carrying overall), no associations were found with firearm carriage. Future strain research should examine other school-based strains and conditioning effects of strain on weapon carrying.

Innovation/Significance: In addition to applying a theoretical framework to weapon carrying and analyzing associations with frequency-specific measures of firearm carrying, the present analysis adds to the limited research examining differences between firearm and non-firearm weapon carrying.
4B: Risk & Protective, COVID-19 Findings, Novel Approaches to Firearm Research Abstracts:

Risk and Protective Factors for Gun Carriage Among Predominantly African American Adolescents in Urban High-Burden Communities.
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Statement of Purpose: This study examined individual- and peer-level risk and protective factors for handgun carriage among a predominantly African American sample of adolescents in urban high-burden communities.

Methods/Approach: We conducted secondary data analysis on a cross-sectional sample of 265 adolescents (Mage = 14.3 years; 57% female; 96% African American) in three urban communities consisting primarily of subsidized housing. Measures assessed handgun carriage and hypothesized risk (i.e., handgun access, gang involvement, involvement with the law, friends’ handgun carriage) and protective factors (i.e., positive future orientation, constructive use of time, friends’ prosocial behavior, developmental assets in the personal and social contexts). Covariates included age, sex, community, and exposure to community violence via violent victimization. We conducted moderation analyses using the PROCESS macro for SPSS.

Results: Positive outlook ($\chi^2 (1) = 11.44, p < .001$) and developmental assets in the personal ($\chi^2 (1) = 8.49, p = .004$) and social contexts ($\chi^2 (1) = 10.41, p = .001$) buffered against the risk of friends’ handgun carriage on adolescents’ own handgun carriage. Further, constructive use of time diminished the effects of gang involvement ($\chi^2 (1) = 4.69, p = .030$) and involvement with the law ($\chi^2 (1) = 3.98, p = .046$) and adolescents’ handgun carriage. We did not find evidence of protective effects for any constructs on the relation between handgun access on handgun carriage.

Conclusion: Gun violence prevention efforts should consider bolstering high-risk adolescents’ future orientation, constructive use of time, and other developmental assets to reduce rates of adolescent gun carriage within urban high-burden communities.

Innovation & Significance to the field: This study addresses gaps in the existing literature by identifying risk factors beyond the individual level and examining dynamics between risk and protective factors for adolescent handgun carriage.
Risk Factors and Survival Disparity in Firearm Violence Against Females: A National Multicenter Analysis
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Statement of Purpose: The increased risk of firearm violence against females in the setting of Intimate Partner Violence (IPV) is well described. However, IPV is not the only cause of firearm violence against females. This study examined trends, demographics and circumstances surrounding female gunshot wound (GSW) victims.

Methods: Five geographically diverse Level 1 trauma centers each obtained GSW victims from the hospital trauma registry (2012-2016). Chart review examined the history and physical, social work notes and discharge summaries to abstract demographics, outcomes and narrative circumstances related to the shooting. Descriptive statistics were performed on the abstracted data elements utilizing SPSS, using males from the same center for comparators of mortality and overall injury.

Results: There were 732 female GSW victims during 2012-2016 compared to 6,558 male victims. An increasing trend in female GSWs over the period was consistent with an upward trend in total GSWs from 1,376 in 2012 to 1,668 2016, however, the female percentage of total GSWs remained static at 10.0%. GSW intent was classified as either assault (49.6%), undetermined (36.5%), unintentional (8.2%), self-harm (5.5%) or legal intervention (0.3%). Although 26.1% of female GSW incidents occurred inside or around the home, only 5.3% were presumed to be IPV related.

Conclusion: The circumstances surrounding firearm injury and death in women are different than men. The incidence of firearm injury in women has risen over a recent 5 year period, but parallels an overall rise in firearm injury in the locations studied.

Innovation and Significance: Nearly a quarter of all women who are shot who arrive to the hospital are shot at their home, but reported intimate partner violence is low, representing either a high prehospital mortality for IPV related GSW or poor screening and reporting. The majority of women GSWs are non-IPV assaults, indicating the need to include women as participants in urban violence intervention strategies.
Violence, Firearms, and COVID-19: Findings from the 2020 California Safety and Wellbeing Survey (CSaWS)
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Statement of Purpose: To examine the intersection of firearm ownership, violence, and the coronavirus pandemic, with an emphasis on households with children.

Methods/Approach: Descriptive analyses of population weighted data from a repeated cross-sectional survey of California adults (N~2800), fielded online in June/July 2020.

Results: Results will include the percentage of respondents who viewed gun violence as a “big” problem in America and in their neighborhood, those who indicated they were “somewhat” or “very worried” about violence happening to them, and those who believed having guns in their home and in all their neighbors’ homes would make their neighborhoods “safer” places to be, before/during the coronavirus pandemic. Results will highlight the proportion of respondents who reported ever buying a gun out of concern about violence and those who reported buying a gun, buying ammunition, and/or changing their firearm storage practices in response to the coronavirus pandemic. We will also report the percentage who believed a child could access a gun in their home without their knowledge. We will estimate the number and percentage of people who live with someone at risk of intentionally hurting themselves or others and the proportion of at-risk individuals (<20 years) with firearm access. All analyses will be stratified by households with and without children.

Conclusion, Innovation & Significance to the Field: We present real-time data on the near-term effects of the coronavirus pandemic on individual perceptions and behaviors related to firearm ownership and violence exposure, highlighting households with children. Recent media has reported increased firearm sales fueled by coronavirus; when coupled with stay-at-home orders and socioeconomic stressors, risk of firearm injury and death may be especially high. A deeper understanding of these relationships can inform early intervention efforts and encourage more comprehensive research and prevention in the future.
Youth Firearm Assault in Philadelphia during the COVID-19 Shutdown
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Purpose: To describe the impact of the COVID-19 shutdown on firearm assaults of youth in Philadelphia.

Approach: We used publicly available data from the Philadelphia Police Department to identify victims of firearm assault from 1/1/2015 through 8/11/2020. Victims were classified as youth (<21 years old) or adult. We compared incidents occurring in the first 150 days of the Pennsylvania statewide COVID prevention measures (March 15-August 11, 2020) to incidents in the preceding 150 days (October 17, 2019-March 14, 2020) and to corresponding periods in 2019. Victim gender, race, ethnicity, and mortality were tabulated. Comparisons between time periods used chi-squared tests.

Results: During the first 150 days of the COVID-19 shutdown, 197 of the approximately 415,000 youth residing in Philadelphia were shot compared to 125 in the prior 150 days (p = 0.0001) or compared to 123 from March 15-August 11, 2019 (p<0.0001). Youth made up 21.8% of victims, stable from other periods (p=0.50). During the COVID-19 shutdown, 93% of youth victims were Black compared to 86% in other periods (p=0.04) and 11.2 vs. 9.1% were female (p=0.35). 10% of youth shootings were fatal in these five months compared to 14% in other months (p=0.11).

Conclusion: There were 58% more youth shot during the first five months of the COVID-19 shutdown in Philadelphia compared to the months or year prior. Youth maintained a constant representation among overall shooting victims. Firearm assaults continued to disproportionately affect Black men and boys.

Significance: Although prevention measures including stay at home orders might be expected to reduce conflict that can lead to firearm assaults, youth shootings increased in the first five months of the COVID-19 shut down. Shutdown-associated reductions in social support, positive neighborhood activity, and economic opportunity, along with increase in stressors, such as schools closing, may contribute to these dynamics.
Gun Availability and Violence: An Examination of Legal and Illegal Firearm Access in American Cities
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Statement of Purpose: Despite the United States’ exceptional rate of assaultive firearm homicide, it remains uncertain how firearm availability across communities influences rates of gun homicide. This study examines how the availability of guns via legal purchases through federally licensed firearm dealers (FFLs) versus broad access to illegal guns impacts community homicide risk.

Methods: We combine data from a number of federal (FBI, ATF, U.S. Census), media (The Trace), and academic (Boston University School of Public Health) sources to generate a novel dataset of approximately 250 American cities for the years 2010-2015. We first conduct descriptive analyses to examine longitudinal trends in different types of gun availability over time. Following this, we leverage fixed-effects regression models to assess the influence of legal and illegal firearm availability on homicide rates year-over-year, controlling for pertinent city- and state-level covariates.

Results: Preliminary results suggest that illegal firearm availability has increased over time whereas legal availability through FFLs has remained relatively stable. Illegal firearm availability, measured as the rate of recovered stolen guns, increases the risk of firearm homicide. Legal availability through FFLs is not significantly associated with homicide. State gun laws are found to significantly reduce the risk of firearm homicide.

Conclusion: Greater illegal firearm availability in cities heightens rates of firearm homicide. Supply-side violence interventions that focus on reducing access to illegal guns and interrupting illicit markets may assist in reducing firearm homicide rates. Stronger gun laws to suppress legal-to-illegal firearm pipelines may also prove effective.

Innovation and Significance: This is the first national study to examine the influence of both illegal and legal firearm access on homicide rates in a large selection of American cities. The results highlight the potential for supply-side gun violence interventions to reduce youth access to firearms and the utility of aggregating disparate data sources in future gun violence research.
Can Synthetic Controls Improve Causal Inference in Interrupted Time Series Evaluations and Advance the Science of Firearm Research?

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Statement of Purpose: Interrupted time series (ITS) designs are a valuable quasi-experimental approach for evaluating population-level interventions, such as laws regulating firearm access and use. But history bias – confounding by unexpected events occurring at the same time of the intervention – threatens the validity of this design and limits causal inference. Synthetic control methodology (SCM), a popular data-driven technique for deriving a control series from a pool of unexposed populations, is increasingly recommended. In this paper, we evaluate if and when SCM can strengthen ITS.

Approach: First, we summarize the main observational study designs used in evaluative research, highlighting their respective uses, strengths, biases, and design extensions. Second, we outline when the use of synthetic controls can strengthen ITS studies and when their combined use may be problematic. Third, we provide recommendations for using synthetic controls in ITS and, using a real-world example evaluating the impacts of self-defense laws on firearm homicides, we illustrate the potential pitfalls of using a data-driven approach to identify a suitable control series. Finally, we emphasize the importance of theoretical approaches for informing study design and argue that SCM is not always well-suited for generating a counterfactual that minimizes critical threats to ITS studies.

Innovation & Significance to the field: Methodological advances in SCM brings new opportunities to conduct rigorous evaluations and innovative the science of firearm research. However, SCM should not be viewed as a panacea as incorporating synthetic controls in ITS studies may not always nullify important threats to validity nor improve causal inference.
Agent-based Modeling of Childhood Firearm Mortality
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Statement of Purpose: Firearm policies and public health approaches, such as urban greening, address different, but potentially interacting, aspects of firearm violence epidemiology. Finding the most cost-effective strategies for lowering firearm violence requires properly exploiting this synergy. The overall goal of this project is to develop an agent based model (ABM) of interpersonal firearm violence in a city mirroring Flint, MI, and use it to estimate the joint effects of urban greening and firearm policies on firearm injuries. In this presentation, we focus on the comparative effectiveness of different greening strategies.

Methods/Approach: We developed an ABM of interpersonal violence guided by Routine Activities Theory in a city mirroring Flint, MI. Agent location and characteristics (e.g., demographics, mental health, substance use history, firearm ownership) were specified from using the most proximal data available. We obtained Flint-specific data on property conditions, alcohol outlet locations, and violence incident locations through the U-M Youth Violence Prevention Center. Routine Activities Theory guided the occurrence of violence incidents, with individual victimization and perpetration risks determined by covariates, and the opportunity level of a location based on property condition and violence history in the area. We calibrated the model to mirror the spatial and temporal distribution of violence incidents observed in the crime data, and used the calibrated model to compare three greening counterfactuals.

Results: Under a universal greening program, there was a roughly linear dose-response relationship between greening intensity and firearm incident reduction, and if the property score of every pixel were improved by 50%, we estimate a reduction of 34% (95%CI: 31%-37%) in firearm violence. Greening only the bottom decile of properties resulted in an 18% reduction (95%CI: 16%-20%) in firearm violence, and greening places with an incident in the prior year (~3% of the city) reduced firearm violence by 11% (95%CI: 9%-13%).

Conclusion: Firearm violence in Flint can be reasonably modeled using an ABM. When resources are fixed, greening areas with a history of firearm violence is most efficient.

Innovation and Significance: ABMs are well-suited to evaluate scenarios that are infeasible to test in practice, and are underutilized in firearm violence research. Such approaches may be useful for prospectively comparing different strategies, and determining optimally cost-effective strategies, in a way that is not possible with real data.