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Association Between Geospatial Access to Care and Firearm Injury Mortality in Philadelphia

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IMPORTANCE The burden of firearm violence in US cities continues to rise. The role of access to trauma center care as a trauma system measure with implications for firearm injury mortality has not been comprehensively evaluated.

OBJECTIVE To evaluate the association between geospatial access to care and firearm injury mortality in an urban trauma system.

DESIGN, SETTING, AND PARTICIPANTS Retrospective cohort study of all people 15 years and older shot due to interpersonal violence in Philadelphia, Pennsylvania, between January 1, 2015, and August 9, 2021.

EXPOSURES Geospatial access to care, defined as the predicted ground transport time to the nearest trauma center for each person shot, derived by geospatial network analysis.

MAIN OUTCOMES AND MEASURES Risk-adjusted mortality estimated using hierarchical logistic regression. The population attributable fraction was used to estimate the proportion of fatalities attributable to disparities in geospatial access to care.

RESULTS During the study period, 10 105 people (910 [9%] female and 9195 [91%] male; median [IQR] age, 26 [21-28] years; 8441 [84%] Black, 1596 [16%] White, and 68 other [<1%], including Asian and unknown, consolidated owing to small numbers) were shot due to interpersonal violence in Philadelphia. Of these, 1999 (20%) died. The median (IQR) predicted transport time was 5.6 (3.8-7.2) minutes. After risk adjustment, each additional minute of predicted ground transport time was associated with an increase in odds of mortality (odds ratio [OR], 1.03 per minute; 95% CI, 1.01-1.05). Calculation of the population attributable fraction using mortality rate ratios for incremental 1-minute increases in predicted ground transport time estimated that 23% of shooting fatalities could be attributed to differences in access to care, equivalent to 455 deaths over the study period.

CONCLUSIONS AND RELEVANCE These findings indicate that geospatial access to care may be an important trauma system measure, improvements to which may result in reduced deaths from gun violence in US cities.

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Supplemental content

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Firearm violence is a public health crisis in the US. More than 120 000 people are shot annually, and 34 000 die from their injuries.[1,2] Firearm injury due to interpersonal violence is a predominantly urban phenomenon.[1] The burden of people shot in US cities has continued to rise, even more so since the arrival of SARS-CoV-2 has stressed vulnerable communities.[3,4]

Patients who have sustained gunshot wounds frequently require urgent surgical intervention. In these patients, rapid transport to a trauma center and early operative management are important determinants of survival.[5,6] Systemwide policies that minimize prehospital delays and prioritize scoop-and-run practices to expedite access to care for those shot can save lives.[7,8] Conversely, delayed access to trauma center care is associated with worse mortality.[9,10] While previous studies have characterized geospatial access to trauma resources as a trauma system measure,[11-15] to our knowledge, the association of access to care with firearm injury mortality in an urban trauma system has not been comprehensively evaluated. As the epidemic of gun violence persists, quantifying the role of timely access to care may help to guide resource allocation with the goal of reducing deaths from firearm violence in US cities.

We hypothesized that delayed access to care is associated with worse survival for those shot due to gun violence, and that this association contributes to the observed rate of firearm homicide system wide. The objective of this study was to measure the association between geospatial access to trauma center care and mortality for those shot in Philadelphia, Pennsylvania, and to estimate the proportion of gun violence deaths that might be attributable to variable access to care.

Key Points

Question What is the association between geospatial access to trauma center care and firearm injury mortality in a mature urban trauma system?

Findings In this cohort study, among 10 105 people shot due to interpersonal violence in Philadelphia, Pennsylvania, from 2015 to 2021, longer predicted ground transport time was associated with an increase in risk-adjusted odds of death.

Meaning Geospatial access to care is an important trauma system measure in urban environments; the findings in this study suggest that improvements in access to care may reduce deaths from gun violence.

Methods

Study Design

This was a retrospective cohort study including people injured due to firearm violence in Philadelphia between January 1, 2015, and August 9, 2021. The study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guideline. The project was approved by the University of Pennsylvania Institutional Review Board, Philadelphia. All data were publicly available and deidentified; therefore informed consent was not required.

Data Sources

Mapping Data

Data used for mapping and geospatial analyses were derived from multiple sources. A base map of Philadelphia county was obtained from OpenDataPhilly.[16] State-designated level 1 and 2 trauma centers in Philadelphia and surrounding counties were identified from the Pennsylvania Trauma System Foundation.[17] A network data set of US streets obtained from ESRI ArcGIS StreetMap Premium[18] was used for geospatial analyses of Philadelphia roads (eFigure in the Supplement).

Philadelphia Shooting Victims Data

Data for people injured due to gun violence were obtained from the Philadelphia Police Department's registry of shooting victims.[19] This data set includes individual-level data for all people shot as the result of interpersonal violence since 2015. Only shootings classified by police as criminal in nature were included; therefore, injuries resulting from self-harm were excluded. Variables captured include time and date, baseline demographic characteristics, documented wounds, indoor (vs outdoor) shooting location, and whether the injured person died. Geospatial coordinates were included, allowing for each shooting to be mapped. Race data were included in this study due to known race-based disparities in gun violence. Categories of race are presented in keeping with the manner they were recorded in police records. Asian and unknown race categories were consolidated as they represented 0.6% of the study population.

Study Population

All individuals 15 years and older who were shot as a result of interpersonal violence were included. Records for officer-involved shootings (n = 88) lacked location information and were therefore excluded.

Derivation of the Exposure: Geospatial Access to Trauma Center Care

The exposure was defined as the predicted ground transport time to the nearest trauma center. Shooting locations and trauma centers were mapped using ArcMap version 10.5 (ESRI ArcGIS). Network analysis was then performed to identify the nearest trauma center and calculate predicted transport time for each person shot. Network analysis uses road segment characteristics in a street network data set to determine geospatial relationships between points on the network. This technique has been previously demonstrated as a geospatial approach for the quantitative analysis of trauma center access.[12] The closest facilities solver in ArcMap Network Analyst was used to determine the route to nearest trauma center along public roads for each person shot. Predicted transport time was estimated by applying time as the impedance along each route with emergency vehicle selected as the travel mode. In this way, predicted transport time represented the fastest possible travel time to the nearest trauma center for each person shot—a measure of geospatial access to trauma care.

The status of trauma centers in Philadelphia changed during the study period (eTable 1 in the Supplement). Specifically, the Trauma Center at Penn moved from the Hospital of the University of Pennsylvania to Penn Presbyterian Medical Center at noon on February 4, 2015; Lankenau Medical Center opened as a level 2 trauma center on September 1, 2016; and Hahnemann University Hospital closed as a level 1 trauma center on June 29, 2019. To account for these changes in trauma center location, predicted transport times were calculated separately for each intervening time period.

Outcome

The outcome was firearm injury mortality. Mortality information was recorded for each person shot in the Philadelphia Police Department's registry. These data are updated with police homicide records and therefore account for changes to mortality status over time.

Potential Confounders

We considered several variables that might confound the measured association between predicted transport time and mortality. Baseline demographic characteristics (age, sex, and race), injury characteristics (anatomic location of gunshot wounds), and event characteristics (indoors vs outdoors shooting location, time of day, and season) were derived. Time of day was operationalized in 6-hour increments (midnight to 6 AM, 6AM to noon, noon to 6PM, and 6 PM to midnight). Season was operationalized as spring (March through May), summer (June through August), fall (September through November) and winter (December through February). The level of state trauma center designation (level 1 vs level 2) of the nearest trauma center was also considered.

Anatomic location of gunshot wounds was recorded for each person shot in the data set from police records. Because these data do not follow a standardized system for abstraction, wounds were grouped into broad anatomic categories: head, neck, torso, extremity, and multiple wounds. The derivation of these categories from available descriptors is provided in eTable 2 in the Supplement.

Age was the only variable missing in fewer than 1% of records (n = 58). Missing values were imputed using a multiple imputation technique.[20]

Statistical Analysis

Univariable comparison was made between characteristics of fatal and nonfatal shootings. Wilcoxon rank sum and χ^2 tests were used to compare median values and frequencies of categorical variables, respectively. The unadjusted probability of death after firearm injury was plotted as a function of increasing predicted transport time using locally estimated scatterplot smoothing.[21]

Two analytic approaches were then used to meet the stated study objectives. First, a hierarchical logistic regression model was used to estimate the risk-adjusted association between geospatial access to care and mortality at the individual level. To account for neighborhood-level characteristics not captured by fixed effects, the model included a random intercept term to account for clustering of shootings within zip codes.[22,23] Potential confounders were evaluated for inclusion using a combination of the 10% change-in-estimate approach described by Mickey and Greenland[24] and significance in univariable comparisons. The final model included variables that changed the exposure point estimate by more than 10% or differed significantly between fatal and nonfatal shootings. Multicollinearity was ruled out using the variance inflation factor and tolerance statistic. Model calibration was ensured using the Hosmer-Lemeshow goodness-of-fit test and model discrimination is reported using the C statistic. A sensitivity analysis was performed limiting the study cohort to those with gunshot injuries most likely to be life threatening and time sensitive: truncal (neck or torso) or multiple gunshot wounds.

Second, we estimated the proportion of shooting fatalities that might be attributable to variable access to care using the population attributable fraction. The population attributable fraction is an epidemiologic measure, defined as the fraction of all cases (in this study, shooting fatalities) in a population that could be attributed to a specific exposure (in this study, geospatial access to care) assuming a causal association.[25] To accomplish this, concentric 1-minute service areas of increasing predicted transport time (≤1 minute to >15 minutes) were mapped. Case fatality rates were calculated for the populations of people shot within each service area. Mortality rate ratios were then estimated for each service area using a negative binomial model, with the fastest possible theoretical access to care (predicted transport time ≤1 minute) defined as the reference category. Mortality rate ratios were risk adjusted for the case mix within each category of access to care. The population attributable fraction was then calculated using the formula described by Rockhill et al[26] and Miettinen[27]:

$$\text{Population Attributable Fraction} = \sum_{i=0}^{k} Pc_i \left(1 - \frac{1}{MRR_i}\right) \times 100\%$$

where Pc_i was the proportion of all shooting deaths that occurred in the i^{th} service area of predicted ground transport time, and MRR_i was the adjusted mortality rate ratio in the i^{th} service area compared to the reference ($i = 0$; in this case, predicted transport time ≤1 minute). In this way, the number and proportion of shooting fatalities attributable to the association between variable access to care and mortality was estimated.

Mapping and geospatial analyses were performed using ArcMap version 10.5 (ESRI ArcGIS). Statistical analyses were performed using SAS statistical software version 9.4 (SAS Institute). Threshold for statistical significance was set to $P < .05$.

Results

During the study, period 10 105 people 15 years and older were shot in Philadelphia (910 [9%] female and 9195 [91%] male; median [IQR] age, 26 [21-28] years; 8441 [84%] Black, 1596 [16%] White, and 68 other [<1%], including Asian and unknown). Shootings occurred with greatest frequency during summer months (June through August; n = 3132 [31%]) and between the hours of 6 PM and midnight (n = 4244 [42%]). Most shootings occurred outdoors (n = 9599 [95%]). The median (IQR) predicted ground transport time was 5.6 (3.8-7.2) minutes. A total of 1999 individuals who were shot (20%) died.

Table 1 compares characteristics between fatal and nonfatal shootings. Head, torso, and multiple wounds were associated with fatality, as were indoor shootings and those that occurred during winter months. **Figure 1** shows the plot of unadjusted probability of death as a function of increasing predicted transport time. Longer predicted ground transport time was associated with higher probability of mortality in a near linear fashion.

Hierarchical Model for Shooting Fatality

Results of the multivariable logistic regression model for mortality are shown in **Table 2**. Model discrimination was excellent (C statistic, 0.81). Head, torso, and multiple wounds were independently associated with mortality, as were indoor and winter shootings. Extremity gunshot wounds were strongly associated with survival. After risk adjustment, predicted transport time to the nearest trauma center was significantly associated with shooting fatality. Specifically, each additional minute of predicted transport time was associated with a 3% increase in odds of death (odds ratio [OR], 1.03 per minute; 95% CI, 1.01-1.05).

Results of the sensitivity analysis in which the patient cohort was limited to truncal or multiple gunshot wounds

Table 1. Comparison of Characteristics Between Fatal and Nonfatal Shootings

Parameter	No. (%) Fatal (n = 1999)	No. (%) Nonfatal (n = 8106)	*P* value
Baseline characteristics			
Age, median (IQR), y	28 (22-35)	26 (21-33)	<.001
Female	154 (7.7)	740 (9.1)	.045
Male	1845 (92.3)	7366 (90.9)	
Race[a]	1675 (83.8)	6766 (83.5)	
Black	1675 (83.8)	6766 (83.5)	.62
White	308 (15.4)	1288 (15.9)	
Other[b]	16 (0.8)	52 (0.6)	
Injury characteristics			
Head wound	779 (39.0)	586 (7.2)	<.001
Neck wound	29 (1.5)	99 (1.2)	.41
Torso wound	474 (23.7)	1568 (19.3)	<.001
Extremity wound	45 (2.3)	3725 (46.0)	<.001
Multiple wounds	948 (47.4)	2257 (27.8)	<.001
Event characteristics			
Indoor shooting	199 (10.0)	331 (4.1)	<.001
Time of day			
Midnight to 6 AM	473 (23.7)	1807 (22.3)	.03
6 AM to noon	270 (13.5)	997 (12.3)	
Noon to 6 PM	482 (24.1)	1867 (23.0)	
6 PM to midnight	774 (38.7)	3435 (42.4)	
Season			
Spring (Mar-May)	495 (24.8)	1986 (24.5)	<.001
Summer (Jun-Aug)	569 (28.4)	2583 (31.9)	
Fall (Sept-Nov)	465 (23.2)	1955 (24.1)	
Winter (Dec-Feb)	470 (23.5)	1582 (19.5)	
Level of nearest trauma center			
Level 1 (vs level 2)	1856 (92.9)	7597 (93.7)	.15
Access to nearest trauma center			
Predicted transport time, median (IQR), min	5.7 (4.0-7.4)	5.5 (3.8-7.2)	.002

[a] Race data were included in this study due to known race-based disparities in gun violence. Categories of race are presented in keeping with the manner they were recorded in police records.

[b] Other included Asian and unknown, consolidated because they represented 0.6% of the study population.

(n = 4970) are shown in eTable 3 in the Supplement. The risk-adjusted association between access to care and mortality was no different among this cohort (OR, 1.03 per minute; 95% CI, 1.01-1.05).

Contribution of Variable Access to Care to Shooting Fatalities

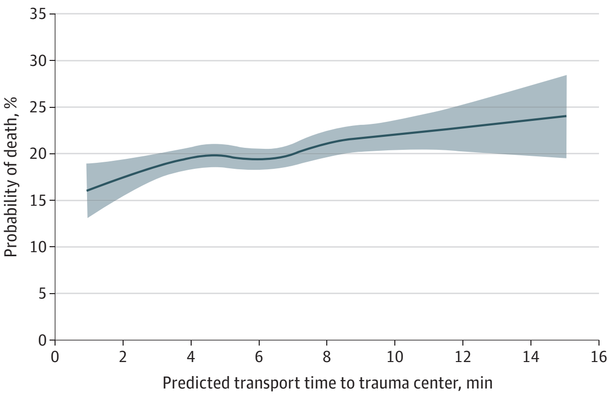
The population attributable fraction was calculated to estimate the proportion of shooting fatalities that could be attributable to variable access to care. Concentric 1-minute service areas of increasing predicted transport time are mapped in **Figure 2**. The case fatality rate for people shot increased from 13% (29 of 232 shootings) in the service area with quickest potential access to care (predicted transport time ≤1 minute) to 29% (7 of 24 shootings) in the service area with most delayed access to care (predicted transport time >15 minutes). Risk-adjusted mortality rate ratios estimated for shootings at increasing ranges of predicted ground transport time are shown in eTable 4 in the Supplement. The resulting population attributable fraction was 23%, equivalent to an estimated 455 fatalities during the study period.

Discussion

In this retrospective cohort study of people shot in Philadelphia, geospatial access to trauma care was significantly associated with survival. Specifically, each additional minute of predicted ground transport time to the nearest trauma center was associated with increased odds of mortality. An estimated 23% of observed fatalities could be attributed to this association owing to differences in access to care across the population of people shot.

These data provide new evidence that the variable nature of access to trauma center care matters in the struggle to reduce deaths from gun violence. Previous studies have evaluated the association of access to care with deaths from firearm injury. Crandall et al[10] found that people shot more than

Figure 1. Unadjusted Association Between Increasing Predicted Transport Time to Nearest Trauma Center and Probability of Death for Individuals Shot



Shading indicates 95% CIs.

Table 2. Multivariable Model for Shooting Fatality

Parameter	Odds of fatality (95% CI)
Access to nearest trauma center	
Predicted transport time (per 1-min increase)	1.03 (1.01-1.05)
Baseline characteristics	
Age (per 1-y increase)	1.01 (1.01-1.02)
Female sex (vs male)	0.82 (0.66-1.02)
Injury characteristics	
Head wound	5.10 (4.21-6.19)
Torso wound	1.34 (1.05-1.70)
Extremity wound	0.05 (0.04-0.08)
Multiple wounds	1.45 (1.18-1.79)
Event characteristics	
Indoor shooting	2.03 (1.62-2.54)
Time of day	
Midnight to 6 AM	1.15 (0.99-1.33)
6 AM to noon	1.10 (0.92-1.32)
Noon to 6 PM	1.07 (0.93-1.24)
6 PM to midnight	1 [Reference]
Season	
Summer (Jun-Aug)	1 [Reference]
Fall (Sept-Nov)	1.14 (0.98-1.33)
Winter (Dec-Feb)	1.25 (1.07-1.47)
Spring (Mar-May)	1.11 (0.96-1.30)

5 miles from trauma centers in Chicago, Illinois, in so-called trauma deserts, were more likely to die. Crandall et al[9] later found that closure of an urban level 1 trauma center in Los Angeles, California, was followed by a rise in shooting fatalities in the surrounding catchment. Drawbacks to these studies were that they considered only straight-line distance as a dichotomized measure of access or the catchment area of a single hospital. In contrast, we evaluated the full spectrum of access to care as a continuous measure for all people shot using network analysis, a geospatial technique validated for quantifying access within trauma systems.[12] Our findings therefore provide evidence that system-level interventions to improve access to definitive trauma care may result in a tangible reduction in firearm injury mortality.

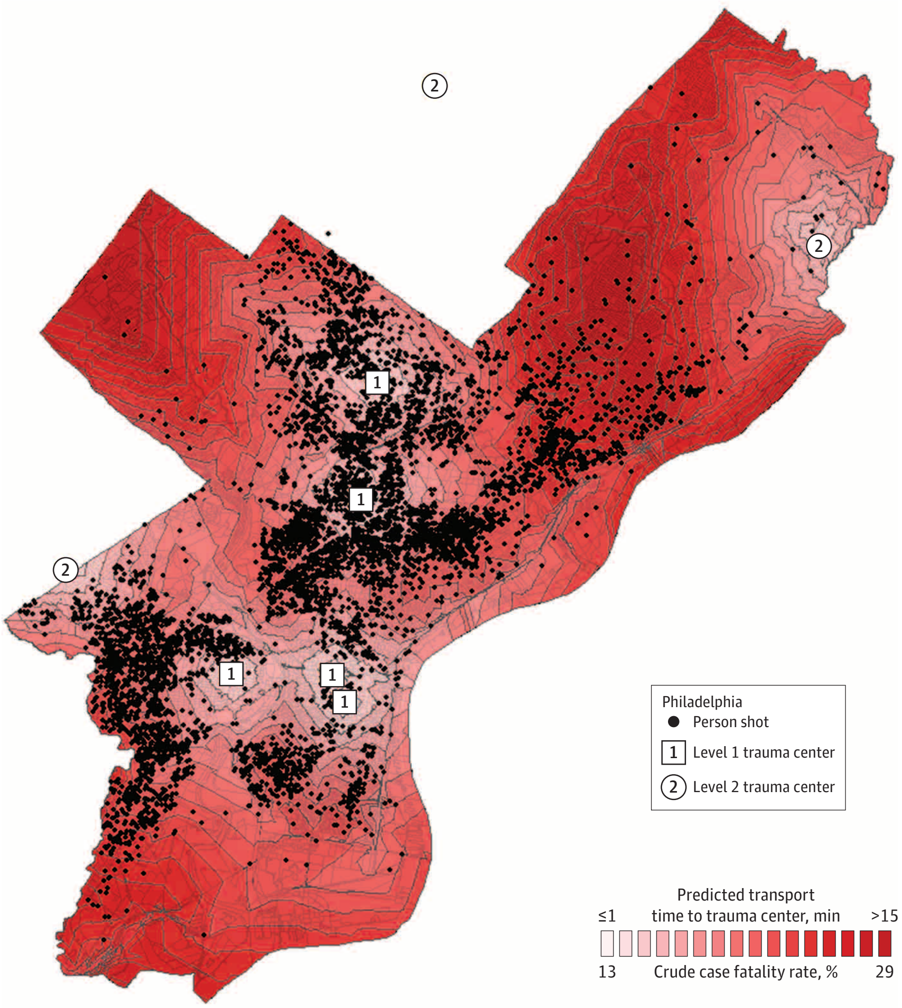
We used the population attributable fraction to provide a meaningful estimate of the net contribution of the association between access to care and mortality to observed fatalities citywide. This analysis was important to account for variation in the geospatial distribution of shootings relative to trauma centers. For example, if the observed association were relatively minor, the contribution of disparities in access to care to observed fatalities would be small. Similarly, if few shootings occurred in neighborhoods with greater delays in access, this association would translate to few deaths. Rather, we estimated that 23% of fatalities were attributable to differences in access to trauma center care. It is important to note that this calculation assumes a causal relationship, which cannot be interpreted from this observational study. Furthermore, the estimate may be subject to residual confounding due to unmeasured factors. However, within these limitations, the findings suggest that local policy makers should consider investing in improved trauma center access as a systems approach to reducing deaths from gun violence in US cities.

Improved access to trauma care can be achieved in urban environments through various interventions, each with benefits and drawbacks. Police transport is one potential means. Since police are often first to arrive at the scene of a shooting, police transport results in quicker arrival at definitive care (so-called scoop-and-run) and fewer prehospital delays (so-called stay-and-play).[7,28,29] The Philadelphia Police Department has practiced this under a directive with increasing frequency such that in 2018 nearly 80% of patients treated for gunshot wounds arrived by police transport.[30,31] While implementing such a policy is challenging, police transport is associated with lower risk-adjusted mortality[32] and anecdotal perceptions from patients, police, and trauma clinicians are that the practice saves lives.[33]

Another approach to improving access to care is to prioritize early notification. The response of police and emergency medical services to shootings is variable across an urban built environment. Use of acoustic sensor technology (eg, ShotSpotter) has been shown to hasten activation of emergency services and reduce both response and total prehospital times for patients transported by police or ambulance.[34]

Complementary to interventions that emphasize the prehospital system, optimizing the location of trauma resources represents another target for system-level improvement. Geospatial analysis provides a powerful means to identify discrepancies between injury locations and trauma center distribution.[11-15] Bringing trauma care to shooting hotspots with poor access could shorten transport times and provide opportunities for rescuing people with time-sensitive injuries. This might take the form of building trauma capabilities at non-trauma hospitals or military treatment facilities.[35] Taken together, each urban trauma system must be evaluated uniquely to determine where shortfalls exist and which approaches to improving access to care will yield the greatest population benefit.

Figure 2. Map Showing Concentric 1-Minute Service Areas of Increasing Predicted Ground Transport Time to Nearest Trauma Center for Individuals Shot in Philadelphia



The case fatality rate of shootings increased from 13% in the service area of shortest predicted transport time (≤1 minute) to 29% in the service area of longest predicted transport time (>15 minutes).

Limitations

This study has several limitations. Perhaps most important is the potential for unmeasured confounding. Specifically, real-world data pertaining to prehospital times, mode of transport, injury diagnoses, destination hospital, or in-hospital course were not available. However, not all unmeasured variables are confounders. Confounding would occur only if these factors differed systematically across the spectrum of access to care. We have no evidence that such systematic differences in prehospital care or injury severity exist within the confined geographic area of urban Philadelphia. Furthermore, by accounting for clustering of shootings within zip codes in our hierarchical model, neighborhood-level differences in mortality risk due to unmeasured confounding would be further minimized. Therefore, it is unlikely that the observed association between access to care and mortality is due to confounding.

Second, the study exposure—predicted ground transport time to the nearest trauma center—is a geospatial measure that represents the fastest possible access to care. We are unable to know how close the system came to achieving this estimate for each person shot. However, while prehospital times and transport mode will vary, the geospatial estimate of access to care is likely a valid analog that is proportional to the real-world scenario.

Third, locations of death were not available for analysis. Therefore, the proportion of fatalities that occurred in the prehospital environment is unknown. While the opportunity to evaluate prehospital mortality would lend construct validity to our findings, there is no statistical or biological rationale for excluding these cases. On the contrary, prehospital deaths represent a natural extreme of delayed access to care in individuals with time-sensitive injuries and should be included in analyses such as ours that seek to make probabilistic estimates of mortality risk.

Fourth, while we included all people shot in our primary analysis, not all injuries are time sensitive. Therefore, the results of this analysis may not be generalizable to all patients. For example, gunshot wounds to the head are more likely to be fatal irrespective of timely access to care. For this reason, we performed a sensitivity analysis limited to individuals with penetrating truncal injuries or multiple gunshot wounds (excluding head wounds). The results were unchanged. Furthermore, the C statistic for our multivariable models exceeded 0.8, indicating excellent accuracy in predicting mortality irrespective of differing patterns of injury.

Fifth, the generalizability of our results to other cities is uncertain. Nearly 80% of individuals shot in Philadelphia are transported by police and the geographic density of trauma centers is high. Given that these system characteristics should reflect fast access to definitive care, our findings are more notable. This association is likely to be even more pronounced in urban trauma systems where characteristics are less favorable for quick access to care.

Conclusions

In this retrospective cohort study of individuals shot in a mature urban trauma system, each additional minute of predicted ground transport time to the nearest trauma center was associated with increased mortality. This association was estimated to contribute to 23% of fatalities owing to differences in access to care. These findings indicate that geospatial access to care may represent an important trauma system measure, improvements to which may result in reduced deaths from gun violence in US cities.

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Concept and design: Byrne, Kaufman, Scantling, Tam, Raza, Cannon, Reilly, Seamon.
Acquisition, analysis, or interpretation of data: Byrne, Scantling, Martin, Raza, Schwab, Seamon.
Drafting of the manuscript: Byrne, Scantling, Raza.
Critical revision of the manuscript for important intellectual content: All authors.
Statistical analysis: Byrne, Scantling, Tam, Raza.
Administrative, technical, or material support: Byrne, Raza.
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Invited Commentary

Firearm Injury—When Minutes Really Matter in the Field

Joshua B. Brown, MD, MSc

Trauma is a time-sensitive condition. Nowhere is this more apparent than firearm violence, an epidemic occurring in our communities every day. These patients frequently need rapid operative intervention to stop life-threatening hemorrhage and shock. This has led to a scoop-and-run approach for prehospital care to minimize time to reach a trauma center.

Byrne and colleagues[1] examine the association between geospatial access to trauma care and firearm-injury mortality in Philadelphia, Pennsylvania. The authors measure geospatial access as transport time from the incident location to the nearest trauma center. They use a geographic information system to calculate driving time along road networks accounting for traffic, a more robust approach than the "as the crow flies" straight-line distance.[2] Rather than medical records or trauma registry data, the authors used the Philadelphia Police Department's Shooting Victim Database. As expected from this group, a robust statistical approach was used. The authors[1] showed each minute of transport time was associated with an increase in mortality, with 23% of firearm fatalities attributed to transport times longer than 1 minute.

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There are a few caveats to consider when interpreting these findings. As a trade-off of using the law-enforcement database, they lack clinical data for robust risk adjustment. For instance, while the authors[1] adjust for gunshot wound body region, there is wide variation among potential injuries from a truncal wound, ranging between graze wounds to devastating major vascular injuries. This lack of granularity may represent unmeasured confounding. Their data did not include the timing of deaths. Thus, some patients may have died later, obscuring the true association between transport time and mortality. Transport time is a measure of geographic access; however, scene times may vary considerably, impacting actual time to an operating room and ultimately outcome. This especially may depend on transport by emergency medical services or police in Philadelphia, but was not recorded. Additionally, the population attributable fraction assumes all deaths were preventable, which may not be true.[3]

The real question is how to improve access. Using geographic information system approaches seen here can help target and optimize trauma system resource distribution. While a trauma center on every corner is not feasible, Chicago has shown us evaluation of system needs with directed resource additions can improve access.[4] Lastly, further reducing transport time may not be realistic, and creative solutions to bring the trauma center to the patient through advanced field care may be necessary.[5]

This article provides a novel perspective on urban firearm injuries. Despite limitations, the authors' results[1] corroborate those from other studies,[6,7] and confirm that timely access to care is critical in these patients. This should push trauma leaders to examine their own systems with data-driven approaches and think outside the box for cross-disciplinary solutions to save lives within their communities.

ARTICLE INFORMATION

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