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# Under fire: gun violence is not just an urban problem



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### ABSTRACT

**Background:** Gun violence continues to be a source of trauma patient morbidity and mortality annually in the United States. We sought to characterize gun violence in the combined suburban and rural county of Lancaster, PA, and compare it with gun violence results obtained in urban areas.

**Materials and methods:** All gunshot wound (GSW) admissions from January 2000–December 2013 were queried from trauma registry. Patients sustaining ball bearing/ball bullet (BB) or pellet gun injury were excluded. Data collected included mortality, injury severity score (ISS), number of GSW per patient, and cost data. Linear trend tests assessed the change in mortality, patients with three or more GSWs, and patients with an ISS  $\geq 15$  and ISS  $\geq 25$  over the study period. Statistical significance was defined as  $P < 0.05$ .

**Results:** A total of 478 patients met our inclusion criteria. Linear trend tests revealed no significant changes in percent mortality ( $P = 0.973$ ), percent of patients with three or more GSWs ( $P = 0.692$ ), percent of patients with an ISS  $\geq 15$  ( $P = 0.545$ ), and percent of patients with an ISS  $\geq 25$  ( $P = 0.343$ ) over the 14-y study period. No significant change in cost per case was observed over the study period ( $P = 0.246$ ); however, percent reimbursement significantly increased ( $P = 0.012$ ).

**Conclusions:** In the relatively affluent suburban and rural community of Lancaster, PA, there is a low-level pattern of gunshot violence and subsequent mortality that has not changed over time. This continuing pattern of gunshot violence speaks to the need for development of innovative preventative measures, as well as continuing efforts against gunshot violence by health care and law-enforcement personnel in suburban and urban centers alike.

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## 1. Introduction

The injuries and fatalities inflicted on the American population by firearms continue to be a major public health problem. Close to parity with motor vehicle accidents, firearms are the third

leading cause of fatality in the country [1]. Since the turn of the 21st century, firearm-related fatality rates have become endemic, with the approximate 10.4 fatalities per 100,000 citizens [1] accounting for 17.3% of all injury deaths [2]. Despite the magnitude of this issue, relatively little data exist regarding

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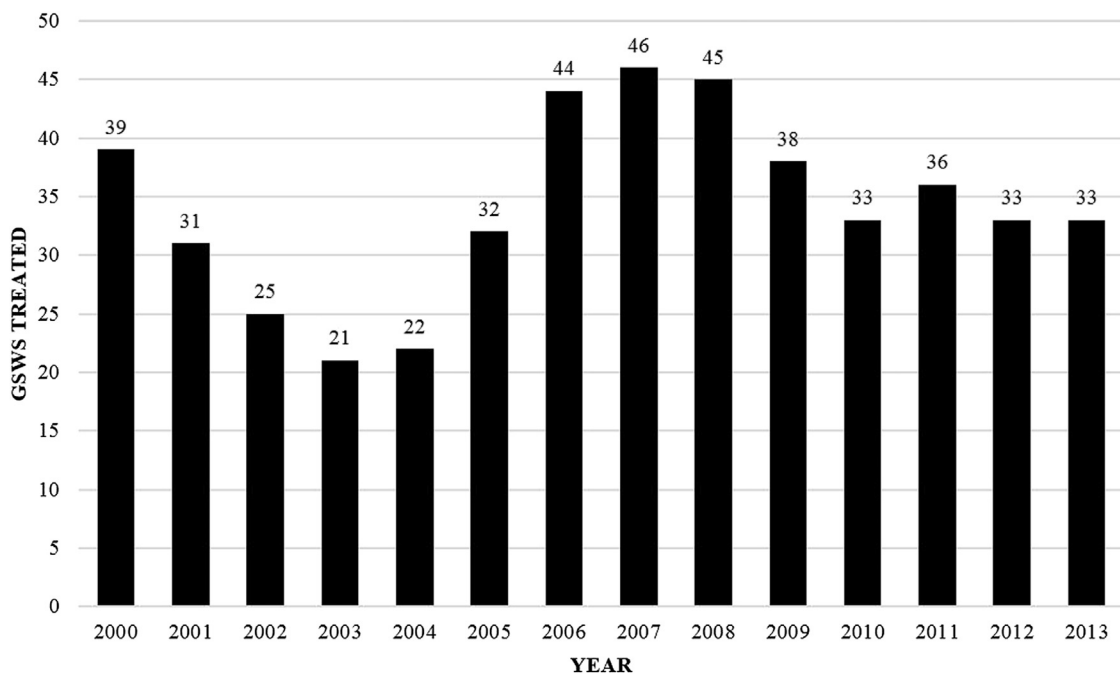
incidence rates, mortality trends, and prevention strategies to address this concern. In fact, just this year, the American College of Physicians declared the nation's gun violence endemic a public health issue, specifically citing the need for more research [3]. Because of funding issues, however, data remain scarce [4]. Furthermore, much of the current firearm data describe state and nationwide trends, or only details incident rates from predominantly urban population centers. Gun violence in semirural or rural population centers remains grossly understudied, despite there being a marked heterogeneity in rates of firearm injury and death across states [2].

The present aim of this investigation was to address this understudied population segment by evaluating levels of firearm violence across a 14-y period in the combined rural and/or suburban county of Lancaster, PA. Although not known for excessive rates of firearm injury, conducting an investigation in this diverse region could provide a more accurate representation of the gun violence endemic in the nonurban portions of the country not known to have gun violence-prone populations. Lancaster County is a scenic, semirural region in Southeastern Pennsylvania with an estimated population of 529,600 [5]. The county is predominantly ethnically white and relatively affluent [5]. It includes the city of Lancaster itself and surrounding townships. It is primarily serviced by Lancaster General Health, a mature Pennsylvania Trauma System Foundation-accredited level II trauma center with an annual admission rate of >2300 per year, with penetrating trauma accounting for approximately 5% of admitted injuries. As the vast majority of traumatically injured Lancaster County citizens are seen at this facility, we had an opportunity to track the incidence and severity of firearm injury across time (both interpersonal and self-inflicted) so as to help shed light on the full spectrum of gun violence. It was hypothesized that a significant change in mortality would be observed over the 14-y study period; however, because of

recent conflicting findings, the researchers were unsure whether an increase or decrease would be observed.

## 2. Materials and methods

After review and approval by the Institutional Review Board of Lancaster General Health, the trauma registry of the Pennsylvania Trauma Systems Foundation (Digital Innovation, Forest Hill, MD) was retrospectively queried for all gunshot wound (GSW) injury admissions from January 2000–December 2013 to the only Pennsylvania-accredited level II trauma center in Lancaster County. The population of interest included patients sustaining both interpersonal and self-inflicted (intentional or unintentional) GSWs. Law enforcement-inflicted GSWs were included in this investigation; however, patients presenting with ball bearing/ball bullet (BB) or pellet GSW injuries were excluded. Collected variables included age, race, gender, abbreviated injury scale (AIS) body region(s) injured, number of GSWs, injury severity score (ISS), hospital length of stay (LOS), intensive care unit LOS (ICU LOS), vent days, and mortality. Number of wound data was collected using the following criteria: (1) "Through-and-through" GSWs in which a clear missile tract from entrance to exit wound was present were defined as one GSW. (2) Presentations in which connections between wounds could not be definitively made were counted as separate GSWs. (3) Patients sustaining shotgun injury were excluded from number of wound analysis. Two or more patients presenting with GSWs in a 15-min period of time were defined as a cluster. Cost data were obtained using net charges for the population, and net costs were calculated using cost-charge modifiers to annualize the data over the 14-y study period. To further assess the underlying characteristics of the trauma center, and provide a control comparison group of another trauma category with which to compare the GSW analysis, the



**Fig. 1** – Number of GSW injuries treated per year over the study period. Mean, 34 GSWs per year (range, 21–46 GSWs per year).

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